



## UMass Amherst Climate Action Plan

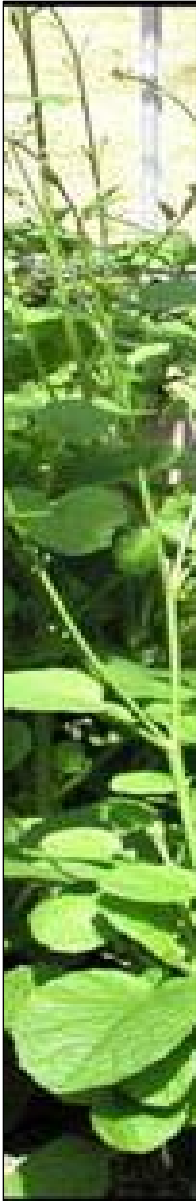
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**CLIMATE ACTION PLAN**  
**UNIVERSITY OF MASSACHUSETTS AMHERST**



COMPILED BY THE  
**E**NVIRONMENTAL **P**ERFORMANCE **A**DVISORY **C**OMMITTEE  
JANUARY 2010

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The following letter was sent to the Campus Community via email on January 14, 2010



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January 14, 2010

To the Campus Community:

In the past few years, concerns of global climate change and its effects on our planet have become increasingly numerous and urgent. In response the American College and University Presidents' Climate Commitment (ACUPCC) was established to address global climate change by garnering institutional commitments to neutralize greenhouse gas emissions and by accelerating the research and educational efforts of higher education to equip society to re-stabilize the earth's climate. In 2007, University of Massachusetts President Jack Wilson committed the entire UMass system to work together to fulfill this commitment.

Today, I am happy to present the campus' Climate Action Plan - electronically at <http://www.umass.edu/green> or for review at the DuBois Library's Reserves Desk. Compiled by the Environmental Performance Advisory Committee (EPAC), the Climate Action Plan describes initiatives that we have already undertaken to combat global climate change and how the campus community will work together to fulfill the goal of the ACUPCC as we move toward a more sustainable future. Even though carbon neutrality is a lofty goal, especially for an institution our size, we are dedicated to developing innovative ideas and technologies that will help us achieve this goal.

I would like to express my grateful appreciation to the many people who dedicated a great deal of time not only to produce the Climate Action Plan, but also to create the synergy necessary to vigorously address issues of campus sustainability. The Climate Action Plan was compiled through the collaborative effort of over 100 students, faculty and staff, it reflects ideas that stretch across a broad spectrum of the campus community. The Plan is a testament to what can be accomplished when we work together.

Sincerely,

A handwritten signature in black ink, appearing to read "Robert C. Holub".

Robert C. Holub  
Chancellor

## 1. Acknowledgements

We would like to thank the following people for their assistance in providing information used in crafting each section of the University of Massachusetts Amherst Climate Action Plan and their participation on the Environmental Performance Advisory Committee (EPAC). This report would not have been possible without their assistance.

### **Environmental Performance Advisory Committee**

- Alexandra Adler, Vice Chair, Student Government Association Environmental Committee
- Glenn Barrington, Assistant Manager, Transit Services
- Jim Cahill, Director, Facilities Planning
- Scott Civjan, Associate Professor, Civil and Environmental Engineering
- Pat Daly, Director, Physical Plant and EPAC Chairman
- Rachel Dutton, Chair, Student Government Association Environmental Committee
- Nell Finnigan, Manager, UMA Eco-Rep Program
- Steve Goodwin, Dean, College of Natural Sciences
- Susanne Hale, Plant, Soil and Insect Sciences Master's Candidate
- Amber Hewett, Student Sustainability Coordinator
- Susan Personette, Director, Campus Planning
- Craig Ruberti, Manager, Environmental Health and Safety
- Steve Schreiber, Director and Professor, Architecture and Design
- Josh Stoffel, Sustainability Coordinator
- Ken Toong, Executive Director, Food Services
- Sharon Tracey, Associate Director, The Environmental Institute
- Loren Walker, Associate Director, Research Liaison and Development

### **With valued assistance from:**

- Joyce Hatch, Vice Chancellor, Administration and Finance
- Juanita Holler, Associate Vice Chancellor, Administration and Finance
- Ruth Yanka, Director, Administration and Finance Budget and Operations
- Bruce Parkin, Assistant Director, Physical Plant (Retired)
- The many members of the campus community who voluntarily served on the eight EPAC subcommittees that were created to help craft the UMA Climate Action Plan.

### **Primary Authors and Editors**

Josh Stoffel and Bruce Parkin

## 2. Executive Summary

The University of Massachusetts Amherst (UMA) recognizes that global climate change and other environmental challenges have become defining issues of our time. UMA continuously pursues research and education with a goal of providing a sustainable and climate neutral environment. We provide our students with groundbreaking courses and educational opportunities, our faculty with state-of-the-art research and development facilities and funding, and continually strive to reach out to other campuses and communities to develop collaborative solutions to sustainability issues. By discussing and examining the newest technologies, the latest environmental controversies, and potential solutions to the world's environmental issues we are determined to achieve the goals set out in the American College & University Presidents Climate Commitment (ACUPCC). In the classroom, through participation in experiential learning opportunities, and with an environmentally conscience staff, UMA actively pursues the tenants set forth in this Climate Action Plan (CAP).

The UMA Climate Action Plan establishes a timeline and specific strategies to become climate neutral by 2050. In order to develop a comprehensive plan, the UMA Environmental Performance Advisory Committee (EPAC) created eight subcommittees to investigate and report on 1) campus emissions; 2) energy conservation; 3) green building; 4) transportation; 5) renewable energy; 6) food; 7) sequestration and offsets; and 8) education, outreach, and research. Each subcommittee analyzed existing programs and recommended new strategies to meet the ACUPCC goals on the UMA campus. Complicated issues require exhaustive research, coordination and dissemination of the research findings, and ultimately, a document that integrates information and recommendations into action. The UMA CAP provides such a plan around these eight areas of action as described below.

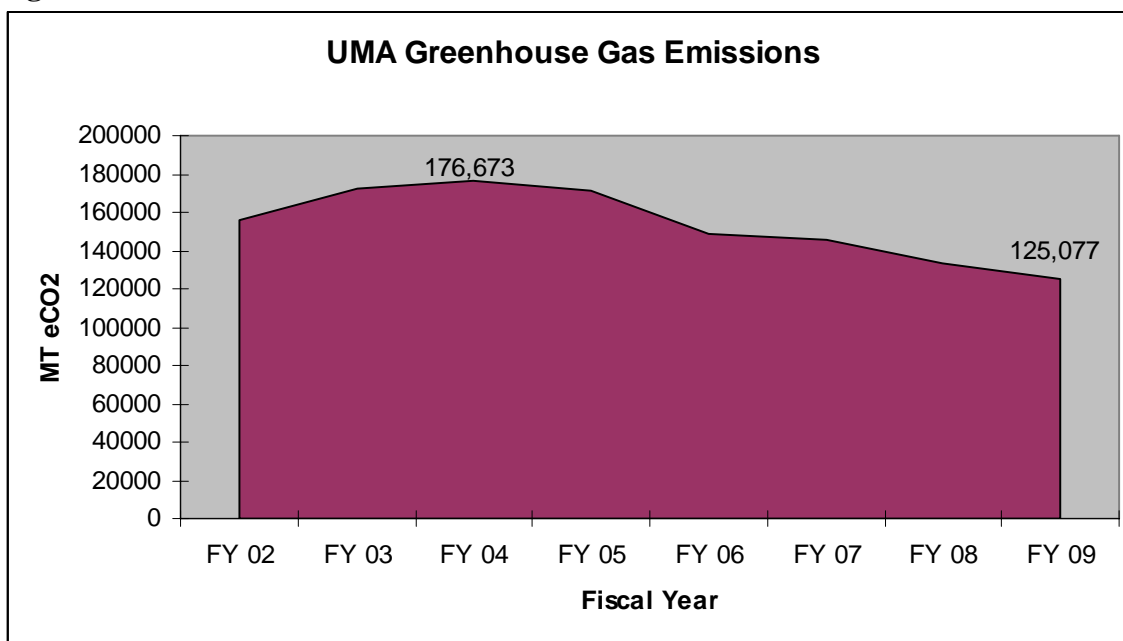
**Campus Emissions:** The University of Massachusetts Amherst currently utilizes the Clean Air Cool Plant (CACP) Carbon Calculator to calculate its carbon footprint. UMA first began efforts to track its carbon footprint in FY 2002. This effort fell under the requirements of Executive Order No. 438 which established the Massachusetts State Sustainability Program and was overseen by the Massachusetts Executive Office of Energy and Environmental Affairs (EOEEA). As a signatory to the 2001 New England Governors and Eastern Canadian Premiers Climate Change Action Plan, the state conducted a baseline assessment of its carbon footprint in FY 2002. The University began using CACP's carbon calculator in 2004 to track campus emissions internally. The data used to calculate UMA's carbon footprint is derived from a variety of sources. The Utilities' Department provides all of the fuel data associated with campus heating and cooling needs and electricity consumption. Efforts are underway to work with both the Rideshare Program and Controller's Office to collect data that can be used to calculate emissions associated with commuting and travel, respectively.

Once the data is collected and reconciled, it is entered into the CACP. The carbon calculator determines the emission numbers (in their respective units) for carbon dioxide,

nitrous oxide, and methane (and the CO<sub>2</sub> equivalents). The program uses standard emission factors specific to each fuel source.

UMA's carbon footprint for Fiscal Year 2009 was 125,077 metric tons of carbon dioxide equivalent (MT eCO<sub>2</sub>) compared to a high of 176,673 MT eCO<sub>2</sub>. See Chart 3.1 below for a profile of the campus' emissions. This significant drop in GHG emissions is due to the implementation of a number of energy conservation measures across campus and more recently through the construction of a new \$133-million Central Heating Plant (CHP). The new facility will ultimately be responsible for providing all of the campus' heating needs and up to 80% of its electricity needs. Compared to the old facility that operated on a fuel mix of coal, natural gas, #2 fuel oil, and papercubes, the new facility is much cleaner and efficient and relies solely on natural gas and ultra-low sulfur diesel. The state-of-the-art facility, dedicated in 2009, is one of the cleanest-burning plants in the nation. It generates both electricity and steam and could be expanded with new equipment to burn biofuels. The Central Heating Plant is part of an effort that has helped UMA reduce greenhouse gas emissions by 30 percent.

**Figure 3. 1**



**Energy Conservation:** UMA has put significant investment towards improving the condition and reliability of its buildings and utilities infrastructure.

In 2004, the campus developed a \$42 million performance contract with Johnson Controls Inc.(JCI) which guaranteed that the campus would reduce its utilities costs by \$6.5 million per year. The project covered the entire 10 million square feet of campus space. The campus reduced its steam use by 24 percent, electric use by 9 percent and water use by 43 percent. Given the success of this cost-reduction project, the Vice Chancellor for Administration and Finance implemented an in-house performance contracting program in

which the Physical Plant Division may propose energy-reduction projects that have a simple payback of up to seven years in utilities savings.

In late October each year, an infrared flyover is conducted to determine the location of hot spots in steam lines, electrical connections and roof leakages and capital requests are developed based on the data from the flyover.

The following chart (Figure 4.1), produced by Sightlines LLC for UMA, shows the electric and fossil fuel use for the UMA campus from 2002 to 2008. UMA has adopted 2004 as a baseline year since it was the start of the JCI ESCO contract which significantly altered the statistical regression that had been used to project utilities usage. As can be seen in the Figure 4.1 UMA has been steadily reducing its overall utilities use on a unit basis.

**Figure 4.1 Utilities Use 2002 – 2008**

	2002	2003	2004	2005	2006	2007	2008
Electric BTU/GSF (BTU/GSF)	37,419	38,624	39,437	38,508	39,539	36,427	36,007
Fossil BTU/GSF (BTU/GSF)	148,646	165,025	162,254	178,254	121,861	127,191	121,434
Total BTU/GSF (BTU/GSF)	186,065	203,649	201,690	216,762	161,400	163,618	157,441
Total KWH/GSF (kWh/GSF)	10.96	11.31	11.55	11.28	11.58	10.67	10.55

Based on the regression analysis using actual data from 2002 through 2009, if the UMA continues at its current pace, the campus will become carbon neutral in 2031. However, at this time the UMA is committing to become carbon neutral by 2050. We will continue to aggressively pursue energy reduction projects, renewable energy projects, and behavior modification efforts. We will also seek other creative ways to reduce the carbon footprint of the UMA campus. For a list of identified potential projects, see section 4.1.3. – Mitigating Strategies.

**Green Building:** Significant construction of new campus facilities in the recent past with several others in the design phase has added over 750,000 square feet of new space as well as 864 new beds to Undergraduate Housing. This new construction effort differs from previous campus development in that each project seeks to employ “green building” or high-performance design characteristics. Although the campus has not sought a LEED certification for any of these buildings, the LEED rating system has served as the guiding principles for design decisions in an attempt to incorporate as many green building characteristics as possible. For more detail on the green characteristics of the new facilities, see Section 5.2.

The 2007 Massachusetts State Executive Order No. 484 states “All new construction and major renovations, effective immediately, must meet the Mass. LEED Plus green building standard established by the Commonwealth of Massachusetts Sustainable Design Roundtable.” To that end, all new buildings include LEED Accredited Professionals and Commissioning agents in the design and construction process.

Implementation of strict LEED Gold or Platinum Standards and Energy Performance Targets will help minimize the amount of energy each new building requires through high performance design and ease UMA management of carbon emissions while growing as a campus. Incorporate metering, controls, day-lighting, PV and solar thermal, and other efficient technologies during the initial design and construction will be simpler and ,more cost effective than retrofitting in the future .

**Transportation:** UMA already had an extensive public transportation service at the time of the signing of the Presidents Climate Commitment. The service provides faculty, staff, and students an opportunity to commute to and from campus on one of the most environmentally friendly operations available. The Pioneer Valley Transit Authority (PVTa) buses are operated by UMA Transit Services, a student run department located on the UMA campus. A fleet of 35 buses provides public bus service throughout the entire Five College community. Yearly ridership on the UMA Transit Services buses resulted in over 2.8 million passenger trips in FY2009. This public transit option will continue to aid the campus in reducing its commuter-related greenhouse gas emissions.



UMA Transit Services also operates several other transportation services on campus including Field Trip Services, Special Transportation Services (wheelchair lift equipped van service), and Meet & Greet Services. A new garage houses the Regional

Traveler Information Center (RTIC), a state of the art intelligent transportation system serving the entire Pioneer Valley through the MassTraveler.com. The RTIC provides commuters the opportunity to view traffic on-line using live video from cameras located along major routes in the area.

UMA has developed several alternative Commuter Options Programs (COP) in the recent past, including the Rideshare program, the Occasional Parker Program, the Clean Vehicle Permit Program, and the Bike Commuter Program. For more information on these programs see Section 7.2. Partially due to the high price of gasoline, but also because of the numerous options and incentives of the UMA COP, there was an increase in the number of non-single occupancy vehicle (SOV) commuting to campus. The UMA Commuter Options Program continues to grow each year. We continue to strive towards reducing the number of single occupancy vehicles commuting to UMA.

The UMA Fleet supports the institution’s academic, research, administrative and student activity missions. The fleet is comprised of vehicles which provide for efficiency in operations and the safe transportation of personnel and equipment. Vehicles are used for a variety of operations including building and grounds maintenance, mail delivery, mass transportation of students and employees, crime prevention and detection, and for official University business travel within and outside the State of Massachusetts. The University Fleet includes approximately 355 vehicles (not including Physical Plant vehicles). In addition to rigorous performance specifications, the University fleet must comply with federal and state fleet requirements such as the Energy Policy Act of 1992 and 2005, requiring that 75 percent of “covered” University fleet purchases (non-emergency vehicles weighing less than 8,500 pounds) be alternative fuel vehicles. UMA is committed to purchasing the most appropriate vehicles within this requirement and striving to judiciously use the remaining 25 percent of covered vehicles, while balancing department needs and limited budgets.

**Renewable Energy:** As the flagship campus of the state university system, it is fitting for UMA to play a leadership role in the development of renewable energy throughout Massachusetts. Heat and power generation from renewable sources at suitable locations across campus will be required to achieve long-term Climate Action Plan goals.

The Commonwealth of Massachusetts has set ambitious goals for reducing the environmental impact of state agencies. Executive Order 484 states, “All Commonwealth agencies as a whole and, to the greatest extent feasible individually, shall... Procure 15% of agency annual electricity consumption from renewable sources by 2012 and 30% by 2020.”<sup>1</sup> UMA is capable of meeting these goals. Moreover, the campus is well equipped to make the most of renewable energy systems by incorporating their installation, maintenance, and monitoring into research, education, and outreach programs.

However, the use of renewable energy on campus currently accounts for a small fraction of total energy consumption: two building-top photovoltaic arrays supply a total of 8.5 KW and diesel vehicles in the campus fleet run on B20, a blend of 80 percent conventional diesel fuel and 20 percent biodiesel, which amounts to 8000 gallons of biodiesel annually. The UMA CAP recommends dramatically increasing renewable energy production on campus.

Three overarching recommendations to increase the percentage of campus power and fuel generated from renewable sources are:

- 1) Set goals for renewable energy on campus
- 2) Conduct renewable energy generation site assessment studies
- 3) Continuously assess potential renewable energy projects

More specifically, the campus renewable energy deployment strategy should:

- Include a comprehensive series of studies assessing the capacity for renewable energy generation on campus/university property;

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<sup>1</sup> Executive Order No. 484 “Leading by Example – Clean Energy and Efficient Buildings”  
<http://www.mass.gov/Agov3/docs/Executive%20Orders/Leading%20by%20Example%20EO.pdf>

- Embrace opportunities to install renewable generation capacity during new construction and renovations;
- Officially align campus goals for reducing greenhouse gas emissions and generating renewable power with the goals set for all the Commonwealth's public agencies as outlined in Executive Order 484<sup>1</sup>;
- Make the best use of all available financing options for procurement and installation of renewable power systems;
- Consider options for the use of renewable fuels in the central co-generation plant where all campus heat and nearly three quarters of all electricity used on campus is generated; and
- Continuously monitor and evaluate new and emerging renewable energy technologies and systems for their potential use on campus.

Details of UMA CAP renewable energy goals, studies and proposed projects can be found in Section 7.3.

**Food:** Founded in 1863 as a land grant agricultural college, UMA was originally named Massachusetts Agriculture College. Economic times, as well as pressing environmental issues, force us to rethink our current model of living and, in some respects, revert to how our food was once produced and distributed in earlier times. Our goal is to achieve carbon neutrality for UMA in all food-related areas while feeding and educating our community about sustainable food issues.

For the UMA food system to become truly carbon neutral, the amount of local food must continue to increase. One strategy to do this is to cultivate segments of the UMA campus. Current successful examples include a small-scale herb garden at Worcester Dining Common and vegetable production / fruit production at UMA Gardenshare. We must think creatively about how to grow food on campus and bring it directly to the student's plates. An easy first step is to plant herb gardens outside of the three remaining dining commons. Long-term planning would include low-maintenance, aesthetically pleasing and noticeable fruit trees planted adjacent to the four dining commons. Knowledgeable faculty should be included in selecting these sustainable species. The trees can be maintained by UMA classes (newly approved Permaculture Design and Edible Forest Gardens) and independent studies.

Food can also be grown indoors, using UMA greenhouses and hoop houses, to provide fresh vegetables to the dining commons throughout the four seasons. A whole systems approach should be undertaken where composting, passive solar design and thermal mass keep the structure heated at little to no cost throughout the year.

UMA students and faculty have been implementing environmentally conscious food initiatives on campus for decades. These initiatives revolved mainly around the Reduce, Reuse and Recycle mentality. - Housing & Dining Services (HDS) strongly encourages the use of reusable containers whenever possible. Plastic bags are no longer in use in any dining operation and students are encouraged to bring a reusable carrying bag (e.g. a Chico Bag) for items from the grab-n-go locations and convenience stores. Likewise, students are

also encouraged to bring their own water bottle and/or travel mug for beverages from the dining centers and grab-n-go locations.

Dining Services purchases food items from several local vendors for use in all the dining centers and continues to identify further expansion of its array of affordable, fresh, local ingredients. A total of 12% of food is currently from local (New England) industries including 25% of produce from local farmers. Additionally, Piazanos, one of the grab-n-go locations on campus, strives to serve fare consisting of 100 percent natural, 80 percent organic, and 10 percent local ingredients.

Waste management practices and purchasing decisions in the Dining Services are aimed toward sustainability. Through composting of all wet garbage, use of biodegradable cups, trays, and bags, by eliminating the use of trays (which encourage food waste), and using only green certified cleaning products, Dining Services strives to reduce their carbon footprint on campus. In addition, a Sustainability Internship has been developed to assist with their food program.

The UMA Hotel, part of the same department as Dining Services, utilizes recycling and other environmentally friendly procedures. The water from the Air Conditioner in the upstairs office is used to irrigate flowers outside the entrance of the Hotel. Eco-friendly products are used for cleaning hotel guest rooms. Guest(s) have an option to reuse towels and sheets to cut down on washing, thus reducing the washing of sheets and towels in guest rooms. Ozone is used in the laundering process. Various appliances in the Hotel Guest rooms are left unplugged until the guest plugs them in. The heat and Air Conditioner system is turned off when the hotel room is unoccupied and Ozone is used in laundry washing. The Hotel purchases breakfast items and locally grown fruit from the UMA Bakery shop and locally owned bakeries. The majority of Hotel confirmations are sent out via email. The Hotel staff recycles used paper, turning it into scrap paper.

The Student Government Association, the UMA Center for Agriculture, and the College of Natural Sciences have all developed programs to help UMA achieve the goal of carbon neutrality by 2050. For more detailed information on these programs, see Section 8.2.

**Offsets and Sequestration:** UMA's approach to carbon offsets will be to avoid them if at all possible. Rather, we would prefer to funnel scarce resources to on-campus emissions reduction projects. Our ongoing strategy will be to generate revenue through the sale of Renewable Energy Credits (RECs) from on-campus renewable energy and energy efficiency projects and to use this revenue to fund additional green projects. These funds would be set aside and dedicated to future carbon reduction projects on campus. We will develop carbon negative forms of energy such as biochar to sequester carbon and offset any unavoidable "in-house" emissions. We will investigate forest management and agricultural practices that have been shown to sequester carbon and apply these practices to campus land (forests, farms, orchards, and landscaping). UMA is not currently buying carbon

offsets or sequestering carbon. Although UMass owns forested land, none of this forest can be counted toward sequestration according to the ACUPCC definition of “additionally.”<sup>2</sup>

Biochar is a form of charcoal produced by heating biomass in the absence of oxygen through a process called pyrolysis. UMass will conduct a feasibility study for installing a pyrolysis system, either at the Central Heating Plant (CHP) or elsewhere on campus. The biofuel produced would be used in the campus state-of-the-art co-generation CHP (perhaps co-fired with biomass in a planned biomass boiler) and the biochar would be used for carbon sequestration and soil enhancement on University farms, orchards, forest, and landscaping operations.

UMA will investigate forest management and agricultural practices that have been shown to sequester carbon and apply these practices to campus land (forests, farms, orchards, and landscaping).

**Education, Outreach, and Research:** UMA’s commitment to education in environmentally sustainable issues is woven throughout the fabric of the University, addressing lifestyle choices, providing curriculum options and developing future leaders. Outreach involves a wide range of programs geared toward 1) bringing external information to the campus community; 2) disseminating information beyond campus; and 3) integrating information throughout the UMA community.

Experiential learning describes activities in which significant sustainability-related experience occurs outside the formal classroom environment. This includes participation in student organizations and student-run businesses that are focused on environmental issues. The UMA Eco-Rep program is a student-facilitated environmental education program which strives to create an environmentally literate student population. By promoting environmentally responsible behavior in the UMA residence halls, residential students are encouraged to reduce their individual impact on the environment. UMA’s Eco-Rep Program is the largest of its kind in the country. Its extensive student leadership structures trains dozens (?) of peer educators each semester to be effective environmental stewards in their residential halls. The SGA Environmental Committee is another experiential program. In collaboration with UMA administration, staff, and students, and the Student Government Association, the Environmental Committee implements environmentally sustainable initiatives in all aspects of campus life. Their goal is to focus campus-wide efforts to create policies that contribute to sustainability and are financially efficient practices which minimizes UMA’s ecological footprint. The UMA Student Chapter of Engineers Without Borders organizes ongoing summer projects in Kenya and Brazil. Working with local populations in rural areas, students examine drinking water quality and then develop a reliable, clean, and sustainable water supply and wastewater disposal for the villages. Net Impact is a diverse community of UMA graduate students dedicated to using the power of business to make a positive net social, environmental, and economic impact. Programs and

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<sup>2</sup> The American College and University Presidents’ Climate Commitment (ACUPCC) document “Investing in Carbon Offsets: Guidelines for ACUPCC Institutions” states that “project reductions must be ‘in addition to’ reductions that would have occurred without the offset project or the incentives provided by offset credits.” (American College and University Presidents’ Climate Commitment, November 2008 v1.0.)

endeavors such as the Student Farming Enterprise, Earthfoods, People's Market, and Living Routes help create additional learning environments for sustainability at UMA.

Formal curriculum related to sustainability is offered through a wide range of programs and Departments across campus, including courses in the Colleges/Schools of Engineering, Humanities and Fine Arts, Natural Sciences, Social and Behavioral Sciences, Public Health and Health Sciences and Management, and the Stockbridge School of Agriculture. This breadth of courses and programs allows students the opportunity to enhance their education with a solid understanding of contemporary environmental issues, regardless of their major or academic focus.

A concerted campaign to expand sponsored research in clean energy and sustainability on campus is underway. In September 2009 the Vice Chancellor for Research and Engagement announced a goal of doubling sponsored research on campus by 2015. Clean energy and sustainability research has been cited as a major pillar of this growth strategy. In pursuit of this goal, faculty-led projects and programs in clean energy and sustainability will see even greater support from the central campus administration.

To learn about the many courses, initiatives, and programs, please see Section 10.2.

**Financing:** Implementing greenhouse gas emissions reduction strategies requires large amounts of upfront capital investments even when it is understood that these strategies will ultimately reduce overall expenses through the energy saving incurred by completed projects. These upfront capital investments are extremely challenging for UMA as it faces extensive budget cuts across the campus. However, UMA is dedicated to reducing its greenhouse gas emissions through a variety of financial strategies.

The most significant source of funding available to UMA is the E+ Program. The E+ Program is a funding mechanism that was established based on the successful ESCO that UMA initiated with Johnson Control Inc. in 2003. The ESCO utilized state legislation that allows for a group of energy conservation and reduction projects to be funded by the university's operating budget as long as the entire group of projects has an overall simple payback of seven years or less.

A study to identify other energy conservation projects was initiated and it revealed that there were still many projects that could be funded through this mechanism. With this finding, the E+ Program was created and still exists to this day, utilizing the same simple payback system as the original ESCO. As more energy conservation projects are completed through the E+ Program, the savings that is incurred by the university is realized in a reduction of the campus utilities budget. This means that every time a project is completed, the savings that is associated with each project is deducted from the campus utilities budget, which means that this money will not have to come out of the university's operating budget the following year.

Since the completion of the original ESCO in 2006, UMA has created and funded three more groups of energy conservation projects. The university will continue to utilize this

mechanism to fund more energy conservation projects in the future, with a goal of submitting a group of energy conservation projects to be funded each fiscal year through the E+ Program.

Currently, the E+ Program selects energy conservation projects based solely on simple payback that each individual project has. The calculation for simple payback is merely the capital cost of a project divided by the annual savings that will be incurred after the completion of the project.

However, UMA is working on expanding the E+ Program so that the estimated cost per metric ton of CO<sub>2</sub> equivalent avoided for each project will also be considered when choosing projects for future incorporation into the program.

The sustainability funds that UMA has set aside also finances two student internships that give the most dedicated and capable students opportunities to gain first hand experience of developing campus sustainability with the Sustainability Coordinator.

Please see Section 11.2 and 11.3 for more details on current and proposed funding opportunities.

### **3. Greenhouse Gas Emissions at the University of Massachusetts, Amherst**

#### **3.1. Introduction**

The University of Massachusetts, Amherst (UMA) currently utilizes the Clean Air Cool Plant (CACP) Carbon Calculator to calculate its carbon footprint. UMA first began efforts to track its carbon footprint in FY 2002 with the assistance of the state. This effort fell under the requirements of Executive Order No. 438 which established the



Massachusetts State Sustainability Program and was overseen by the Massachusetts Executive Office of Energy and Environmental Affairs (EOEEA). As a signatory to the 2001 New England Governors and Eastern Canadian Premiers Climate Change Action Plan, the state conducted a baseline assessment of its carbon footprint in FY 2002. This included all state agencies, state colleges, and universities, and state authorities (e.g., MA Turnpike Authority). For consistency and ease of tracking, the state collected fuel data only from purchasing records and vendor reports through the Operations Services Division. UMA has worked with EOEEA to submit and reconcile its data on an annual basis since FY 2002.

UMA has seen a significant drop in its GHG emissions due to the implementation of a number of energy conservation measures across campus and more recently through the construction of a new Combined Heat and Power facility. The new facility will ultimately be responsible for providing all of the campus' heating needs and up to 80% of its electricity needs. Compared to the old facility which operated on a fuel mix of coal, natural gas, #2 fuel oil, and papercubes, the new facility is much cleaner and efficient and relies solely on natural gas and ultra-low sulfur diesel.

Clean Air Cool Planet Carbon Calculator - The data used to calculate UMA's carbon footprint is derived from a variety of sources. The Utilities' Department provides all of the fuel data associated with campus heating and cooling needs and electricity consumption. The University began using CACP's carbon calculator in 2004 to track campus emissions internally. The CACP calculator follows a three-step process including: data collection, greenhouse gas emission calculations and analysis, and summary results. CACP is a Microsoft Excel-based emissions calculator that takes information provided and converts the data into equivalent greenhouse gas emissions. The spreadsheets that make up CACP are based on information offered by the Intergovernmental Panel on Climate Change (IPCC), as well as on the methodologies and calculators of the GHG Protocol. Efforts are underway to work with both the Rideshare Program and Controller's Office to collect data that can be used to calculate emissions associated with commuting and travel, respectively.

### **3.2. Campus Data**

Prior to the ACUPCC Commitment, UMA annually submitted emission data to the state for the following fuel sources: coal, electricity, natural gas, #2 fuel oil, gasoline, propane, diesel, biodiesel and paper cubes. Prior to engaging in the State Sustainability Program, UMA tracked this information from the Operational Services Division. UMA recognized there were discrepancies regarding this data. For example, the coal tonnage was based on purchase records and not on use. UMA had tracked its emissions based on fuel consumed. UMA worked with the state to ensure that the data used was based on consumption and not procurement.

The fuel data is compiled for a combination of invoices and meter readings. Once the data is collected and reconciled, it is entered into the CACP. The carbon calculator calculates the emission numbers (in their respective units) for carbon dioxide, nitrous oxide, and methane (and the CO<sub>2</sub> equivalents). The program uses standard emission factors specific to each fuel source.

Emissions by Scope - The GHG Protocol defines three "scopes" for GHG accounting and reporting. The purpose of these scopes is to help categorize the varying emissions as direct or indirect emission sources and to ensure fair comparisons of the respective emissions.

*Scope 1* emissions refer to direct GHG emissions from sources owned or controlled by the University; this may include on-campus stationary combustion of fossil fuels, mobile combustion of fossil fuels by University-owned vehicles, and those emissions that result from intentional or unintentional releases of GHGs. *Scope 2* emissions are those indirect

emissions generated during the production of electricity that will be consumed by the University. *Scope 3* emissions refer to all other indirect emissions; the emissions that are a result of the University’s activities, but occur from sources not owned or controlled by the University. **Figure 3.1** lists the UMA emission source and the source of the data. **Figure 3.2** below categorizes UMA emission sources by scope.

**Figure 3.1 UMA Emission Data Sources**

<b>Emission Source</b>	<b>Data Sources</b>
Coal+	Plant Daily Engineer’s Log
Electricity Purchased*	Western MA Electric Invoices
Electricity Generated	CHP Facility Meters
Natural Gas*	Berkshire Gas Invoices (reconciled against CHP Facility Meters)
#2 Fuel Oil*	CHP Facility Meters
Paper Cubes+	Plant Daily Engineer’s Log
Propane	Utility Invoices
Gasoline	Fuel Throughput
Diesel**	Fuel Throughput
Air Travel***	Controller’s Office
Vehicle Rental***	Controller’s Office
Commuting***	UMA Rideshare Program
Animal Husbandry	Various Academic Depts.

Key:

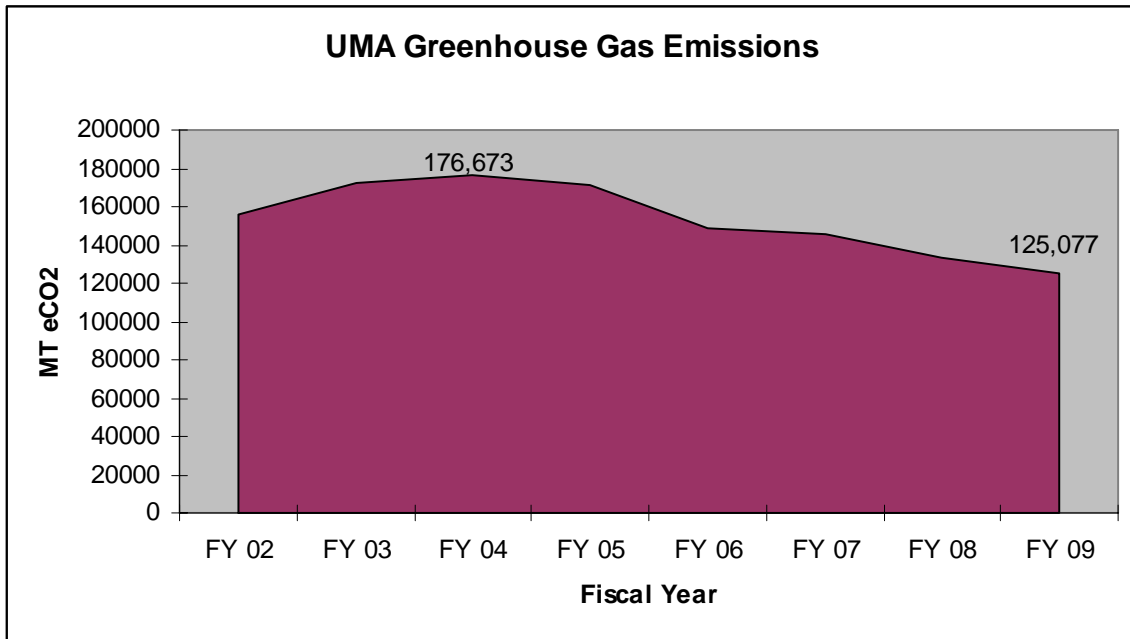
- +Fuel no longer used
- \* Includes Ware, Waltham, and Belchertown (invoices)
- \*\* Includes PVTA Fuel
- \*\*\* Commuting and Travel related emissions are currently not included in UMA’s carbon footprint.

**Figure 3.2 UMA Emissions by Scope**

<b>Scope I Emission Sources</b>
Coal
Paper Cubes
Natural Gas
Oil #2
Gasoline
Diesel/Biodiesel
Propane
Animal Husbandry
<b>Scope II Emission Sources</b>
Purchased Electricity
<b>Scope III Emission Sources</b>
Electricity Line Loss
Faculty & Staff Commute
Faculty & Staff Air Travel

UMA’s carbon footprint for Fiscal Year 2009 was 125,077 MT eCO<sup>2</sup> compared to a high of 176,673 MT eCO<sup>2</sup>. See **Figure 3.3** next page for a profile of the campus’ emissions.

**Figure 3.3**

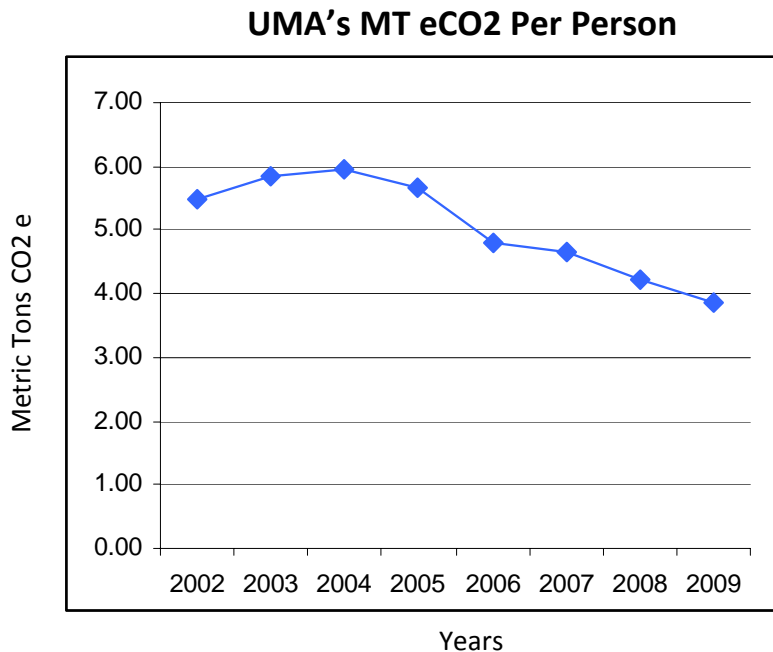


**Figure 3.4** below depicts the change in UMA’s greenhouse gas emissions, student enrollment, faculty and staff totals and total square footage of buildings on campus since 2002. Most notably is how the MT eCO2 per person on campus has decreased so greatly since 2004 - from a high of 5.95 to our current low of 3.86 - even though the campus population has steadily grown since then. **Figure 3.5** on the next page graphs this decline.

**Figure 3.4 UMA Metric Tons CO2e per Person 2002- 2009**

	2002	2003	2004	2005	2006	2007	2008	2009
<b>MT eCO2</b>	155,536	171,868	176,673	171,784	148,290	145,958	133,845	125,077
<b>Student Enrollment</b>	23,332	24,312	24,646	25,093	25,593	25,873	26,360	27,016
<b>Total Faculty and Staff</b>	5,030	5,069	5,042	5,267	5,322	5,363	5,413	5,381
<b>Total Square Footage</b>	9,866,000	9,905,030	9,986,334	9,986,334	9,983,000	9,977,279	10,363,997	10,677,667
<b>MT eCO2 Per Person</b>	5.48	5.85	5.95	5.66	4.80	4.67	4.21	3.86
<b>MT eCO2 Per Square Foot</b>	0.0158	0.0174	0.0177	0.0172	0.0149	0.0146	0.0129	0.0117

Figure 3.5



## 4. Energy Conservation

### 4.1. Infrastructure

#### 4.1.1. Introduction

The University of Massachusetts Amherst (UMA) has invested significant effort into improving the condition and reliability of its utilities infrastructure. The campus has replaced the two main electrical substations and much of the electrical distribution systems. It also has moved the campus-owned electric distribution system completely underground to protect it from weather-related failures. Several miles of deteriorated steam lines have been replaced throughout the campus. In late October each year, an infrared flyover is conducted to determine the location of hot spots in steam lines, electrical connections and roof leakages and capital requests are developed based on the data from the flyover.

In 2004, the campus issued a Request for Bids for energy service contractors (ESCO) and developed a \$42 million performance contract with Johnson Controls Inc. (JCI)- a contract which guaranteed that the campus would reduce its utilities costs by \$6.5 million per year. The project covered the entire 10 million square feet of campus space. The campus reduced its steam use by 24 percent, electric use by 9 percent and water use by 43 percent. Given the success of this cost-reduction project, the Vice Chancellor for Administration and Finance implemented an in-house program in which the Physical Plant Division may propose energy-reduction projects that have a simple payback of up to seven years in utilities savings.

Focusing on a green campus is propelling UMA as a leader in environmental conservation. UMA models best practices in environmental sustainability with

conservation projects across its 1,400-acre campus – a natural extension for a public university that’s gaining attention with leading-edge research in renewable energy. The new \$133-million Central Heating Plant exemplifies these efforts. The state-of-the-art facility, dedicated in 2009, is one of the cleanest-burning plants in the nation. It generates both electricity and steam, relies on natural gas and oil for fuel, and could be expanded with new equipment to burn biofuels. The Central Heating Plant is part of an effort that has helped UMA reduce greenhouse gas emissions by 30 percent, significantly shrinking the campus’s carbon footprint. By using treated wastewater from the town of Amherst, it also will conserve 65 million gallons of clean drinking water annually. The campus has replaced incandescent lights with compact florescent light bulbs and recycles nearly 60 percent of its solid waste. Dining Services supports sustainability by buying about 20 percent of its produce from local growers. The campus achieved the state’s first green certification of its kind for cleaning operations that, among other benefits, reduce hazardous chemicals. And new campus building projects are designed to meet the silver level of Leadership in Energy and Environmental Design (LEED) standards. With such projects, the UMA is getting greener all the time.

#### 4.1.2. Baseline

The following chart produced by Sightlines LLC for UMA shows the electric and fossil fuel use for the UMA campus from 2002 to 2008. UMA has adopted 2004 as a baseline year since it was the start of the JCI ESCO contract which significantly altered the statistical regression that had been used to project utilities usage. As can be seen in the Figure 4.1 UMA has been steadily reducing its overall utilities use on a unit basis.

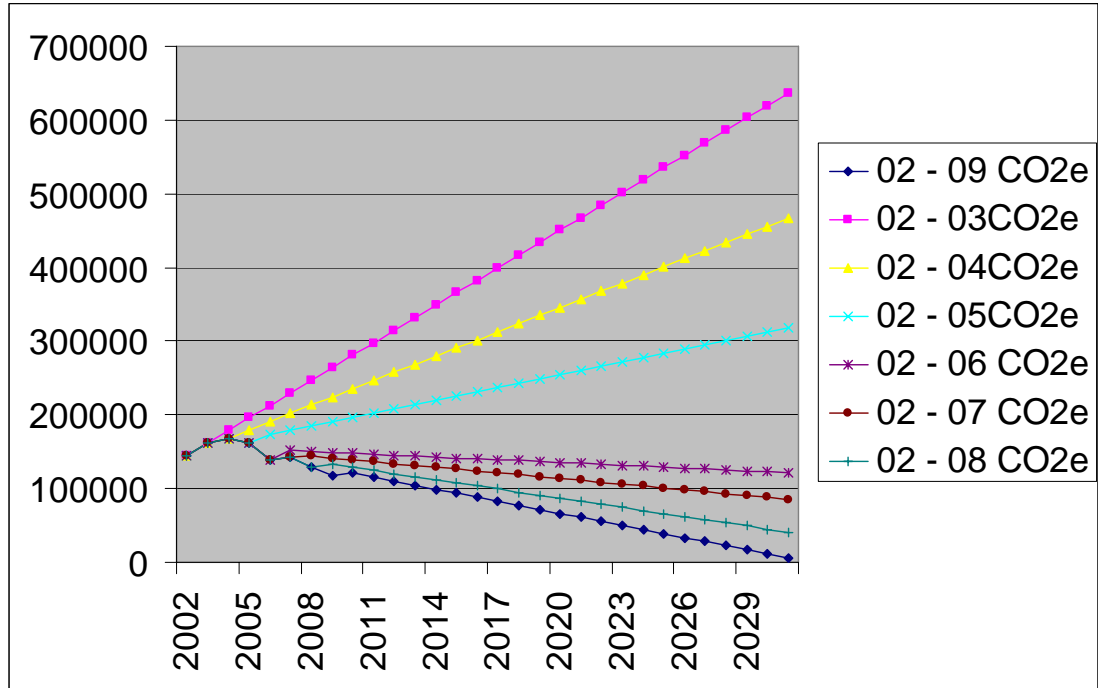
**FIGURE 4.1 Utilities Use 2002 – 2008**

	2002	2003	2004	2005	2006	2007	2008
Electric BTU/GSF (BTU/GSF)	37,419	38,624	39,437	38,508	39,539	36,427	36,007
Fossil BTU/GSF (BTU/GSF)	148,646	165,025	162,254	178,254	121,861	127,191	121,434
Total BTU/GSF (BTU/GSF)	186,065	203,649	201,690	216,762	161,400	163,618	157,441
Total KWH/GSF (kWh/GSF)	10.96	11.31	11.55	11.28	11.58	10.67	10.55

Figure 4.2 below is a regression analysis projecting CO<sub>2</sub>e based on the actual emissions from UMA in previous years. The line labeled 02-03 CO<sub>2</sub>e takes actual data from 2002 and 2003 and plots a future regression line, the next line takes actual data from 2002 through 2004 and re-plots a regression line, 2002-2005 plots a new regression line and so on through 2009. As can be seen from the chart, as UMA continued to reduce its energy usage and change the primary fuels used to heat and cool the campus, the slope of the future CO<sub>2</sub>e line continues to decline. Based on the regression analysis using actual data from 2002 through 2009, if the UMA continues at its current pace, we should become carbon neutral in 2031;

however at this time the UMA is committing to become carbon neutral by 2050. We will continue to aggressively pursue energy reduction projects, renewable energy projects, behavior modification efforts and seek other creative ways to reduce the carbon footprint of the UMA campus.

**Figure 4.2 Regression Analysis**



### 4.1.3. Mitigation Strategies

Campus Outreach - In an effort to encourage participation from the campus community and to make the campus community aware of the EPAC and its efforts, UMA contracted with a third party (JCI) to develop, present and report on two sustainability sessions. These sessions were conducted in early October and each session was attended by a cross section of the campus community. Vice chancellors, deans, managers, faculty, staff and students were part of both sessions and the results of the effort were collected and collated by JCI and compared to other universities that had participated in similar sessions. The results of that effort are presented in Figures 4.3 through 4.6. These charts specifically depict what the participants of the sustainability sessions found important in terms of sustainability on campus and how satisfied they were with the current state of these specified efforts. The participants thoughts are depicted by the solid lines with the blue lines depicting their thoughts of importance of specified projects and the red line depicts their satisfaction with the current efforts around these projects and ideas. The second part to these charts is the two dashed lines on each chart. These lines represent a benchmark of the average responses to these same projects and ideas at other institutions of higher education. This benchmarking allows the UMA to determine where they stand in comparison to our peers. The charts show that, by and large the UMA campus community places more importance on the specified issues of sustainability than people at other higher education institutions.

Figure 4.3

# Needs Analysis (Environmental Stewardship)

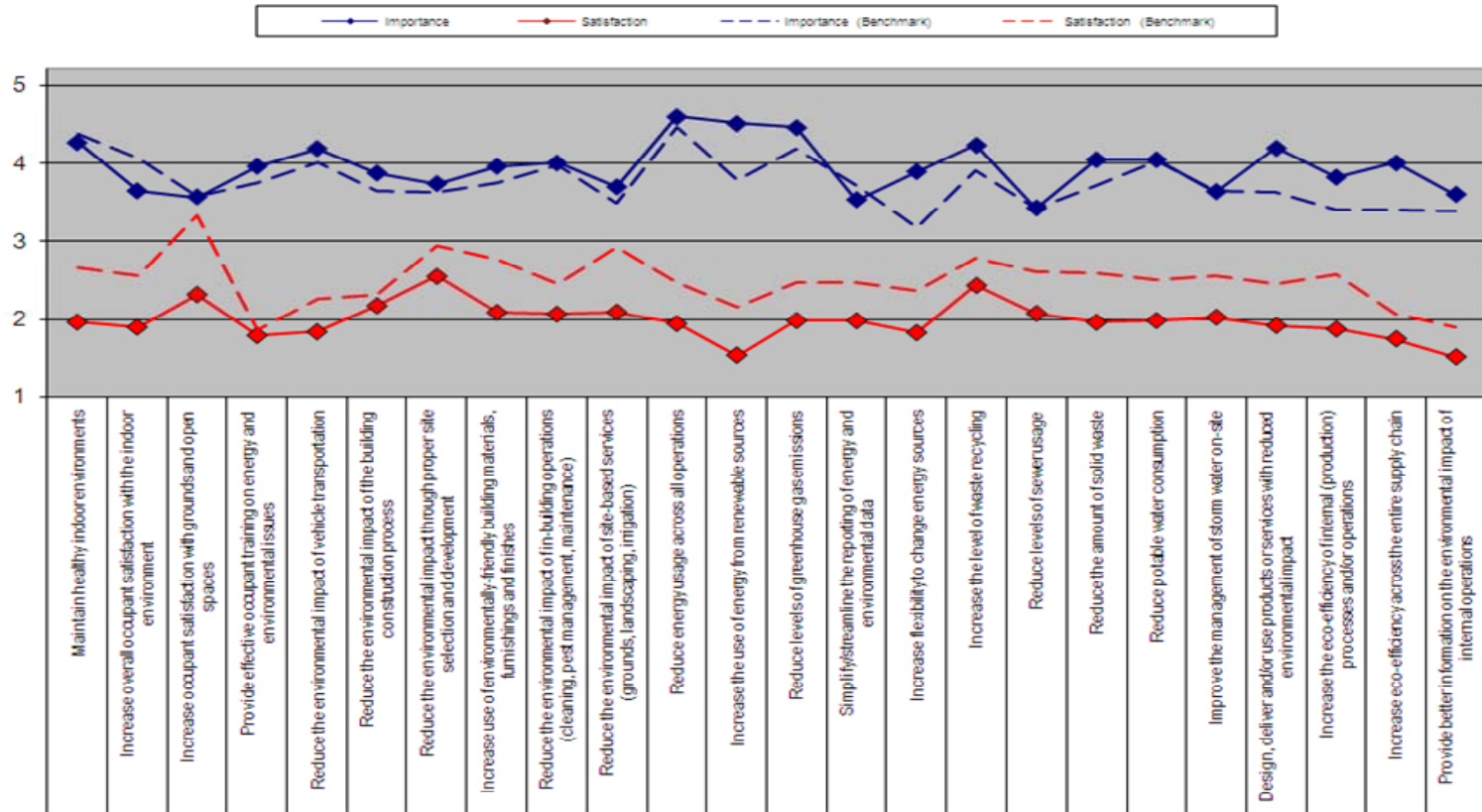


Figure 4.4

# Needs Analysis (Social Responsibility, Economic Prosperity)

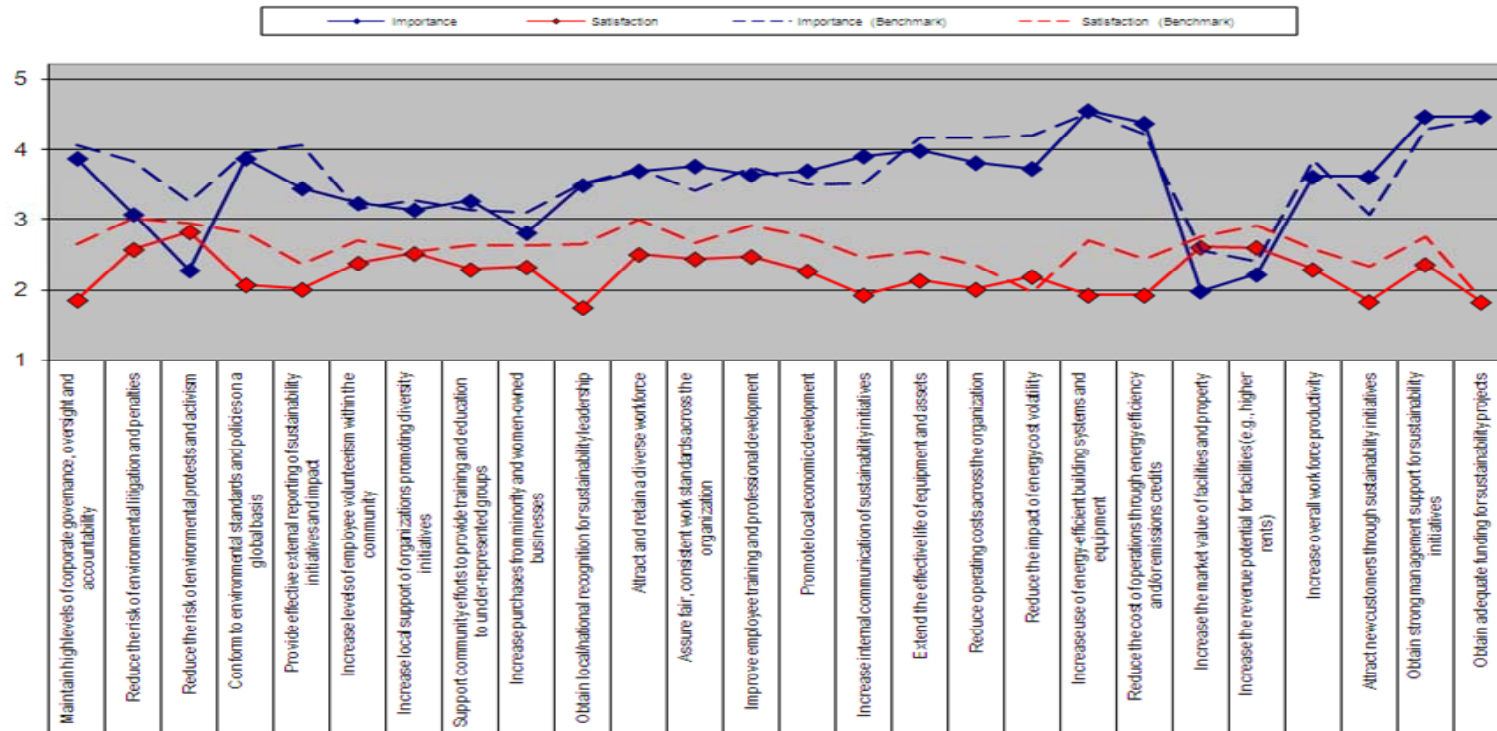


Figure 4.5

# Practices Analysis

## (Environmental Design/Operational Efficiency)

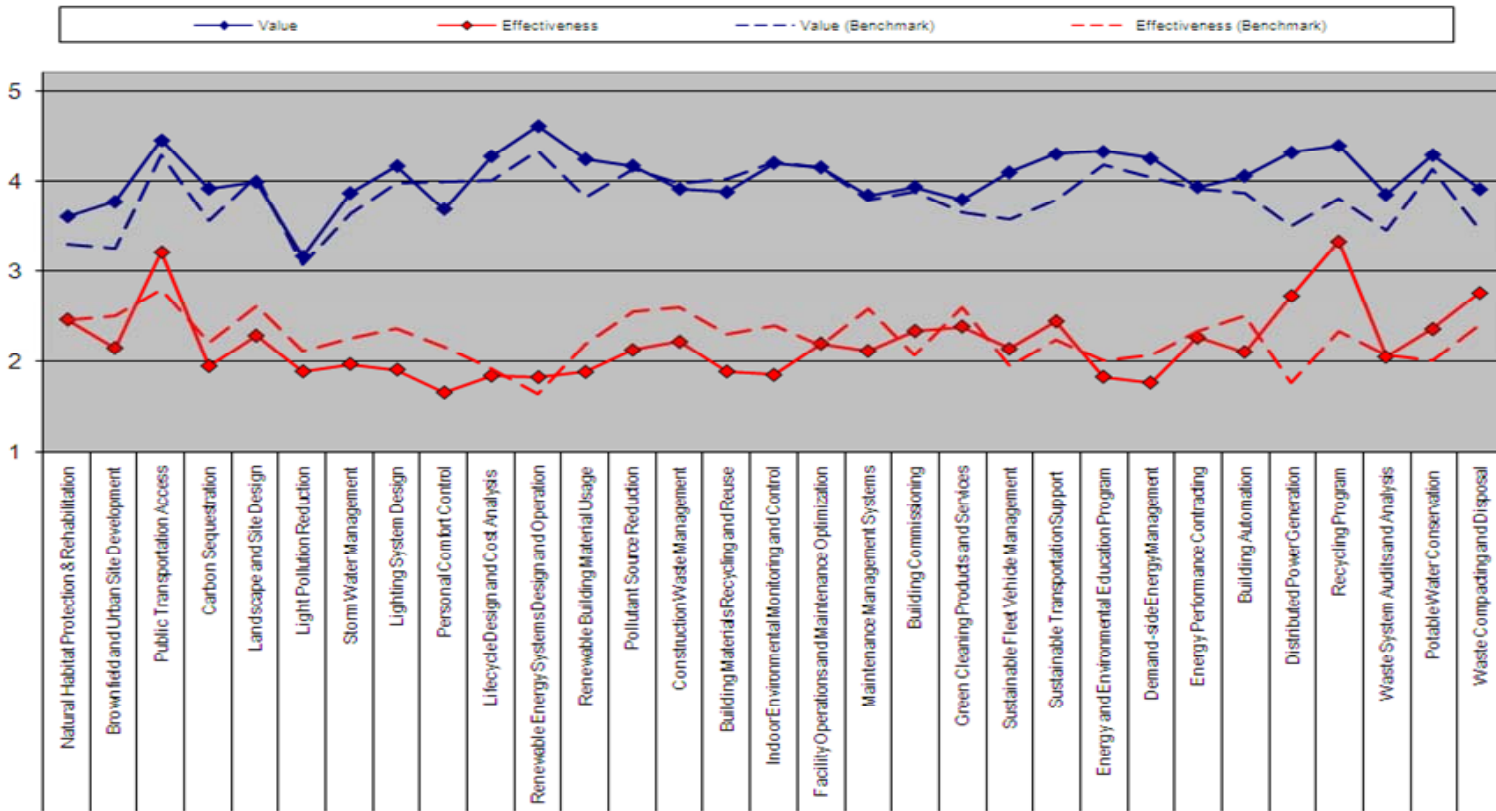
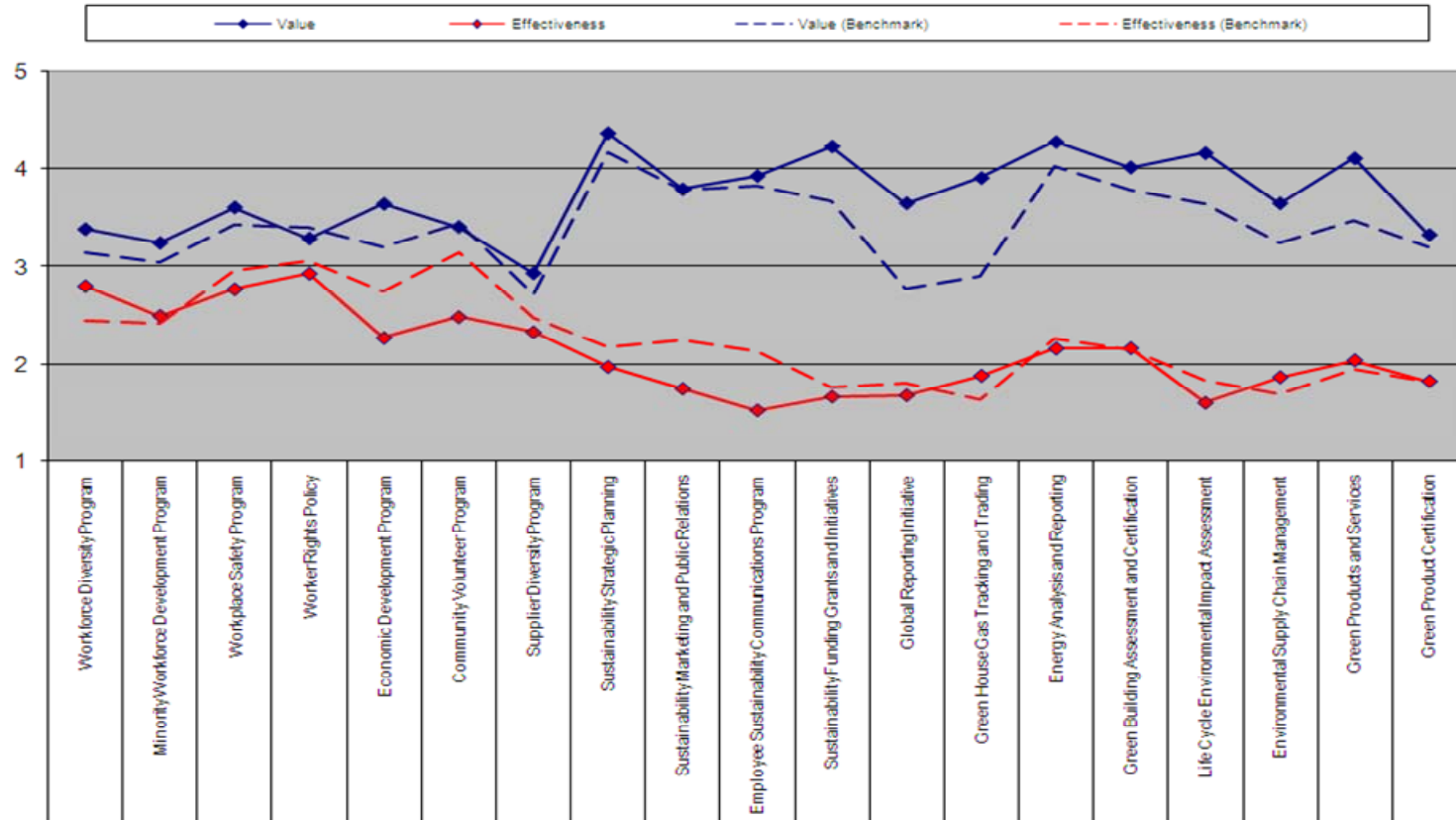


Figure 4.6

# Practices Analysis

## (Social Development, Management)



As stated earlier the UMA continues to build on the 2004 ESCO project with its own E+ program. Some potential projects to help UMA attain the ACUPCC goals include:

- Complete Bio-mass boiler study
- Obtain grant and install bio-diesel processor in Central Heating Plant (CHP)
- Install 2 megawatt 600/200 psi steam turbines in CHP
- Replace steamlines:
  - Lincoln Apts
  - Sylvan
  - Tobin
  - Dike line
- Continue annual IR flyover and develop projects based on report.
- Develop continuous/ retro-commissioning plan for all facilities.
- Install occupancy sensors in all classrooms for lighting.
- Install occupancy sensors in corridors for lighting.
- Investigate installation of advanced energy panels over single glazed windows.
- Install fume hood occupancy sensors in Conte PRC and Elab II.
- Lower fluorescent light bulb standards from 30 w to 25 w.
- Move in-vessel composter to Hadley Farm and begin composting on site
- Install high efficiency electric chiller in Hamden DC
- Install high efficiency electric and steam absorption chiller in the Campus Center
- Install new absorption chiller in Whitmore
- Install building automation controls in the Student Union.

## **4.2. Behavioral Energy Conservation**

### **4.2.1. Introduction**

The University of Massachusetts Amherst (UMA) is dedicated to conserving energy for the betterment of the global environment. One way that the UMA shows its commitment to energy conservation is through its numerous educational programs with the solitary goal of helping the campus community understand the impacts they have on the environment and how they can reduce their impact. One of the largest ways that the university community can help reduce the UMA's impact on the environment is to conserve energy and resources wherever possible. Not only does this make sense environmentally, but it is also a solid economic strategy during the current economic times. The UMA continues to expand these current programs and has many more in development.

### **4.2.2. Current Programs**

- **The UMA Eco-Rep Program –**  
The UMA Eco-Rep Program is a peer-to-peer, student-facilitated environmental education program comprised of 68 students that strive to create an environmentally

literate student population, help residential students reduce their individual impact on the environment that strives to create an environmentally literate student population, helping residential students reduce their individual impact on the environment UMA's Eco-Rep Program is one of the largest in the country and has one of the most extensive student leadership structures designed to give some of the many student interested in environment issues on campus a chance to learn how to be effective peer educators and environmental stewards. The UMA Eco-Rep Program is coordinated by the Sustainability Coordinator and facilitated by a student leadership team managed by a student Program Manager.

One of the primary focuses of the UMA Eco-Rep Program is to educate students about simple behavioral changes that they can make to reduce the amount of energy and resources they use. Topics covered by the UMA Eco-Rep Program range from reducing Phantom Loads to proper recycling of all recyclable materials. Since its inception in the fall of 2008, the UMA Eco-Rep Program has been extremely well received by the student body and recently celebrated its highest enrollment of 68 Eco-Reps during the Fall 2009 semester.

- **Energy Dashboard Program –**

In the Spring 2010 semester, UMA will be launching an Energy Dashboard Program in four residence halls on campus. Energy dashboards are devices that display how much electricity, water, steam and other utilities a specific building is consuming in real-time. The UMA will be piloting this program in selected residence halls to see if these devices will help educate and motivate students to consume less energy and fewer resources. The UMA Eco-Rep Program will be utilizing the energy dashboards throughout the semester as part of their education events. If the Energy Dashboard Program proves to be effective in educating students about energy conservation and motivates them to reduce their consumption, then the UMA will investigate the opportunity of installing more dashboards across campus.

- **New Students Orientation Sessions**

During the summer of 2010, the Sustainability Coordinator will be holding Sustainability Sessions at each of the different New Students Orientation sessions. These sessions will cover the many great programs that are currently underway at the university and how the UMA is dedicated to becoming a more sustainable institution. The sessions will also provide an opportunity for students to ask questions about what the university is doing in terms of sustainability and will give the Sustainability Coordinator a chance promote the many programs that the students can get involved with once they officially arrive on campus. Ultimately, these Sustainability Sessions will act as the first step of educating students about energy conservation and its importance, especially to the university.

- **Waste Reduction Programs**

UMA has two well-established and highly effective waste reduction programs currently in operation. The first is the recycling program that was established on

campus back in the 1970s. Recycling containers are located prolifically across campus and are heavily utilized. Presently, the university has a recycling rate of roughly 56%, which means that 56% of all the waste we create as a campus is recycled. The UMA is proud of this accomplishment but still acknowledges that there is room for improvement.

The other well established waste reduction program is the food waste composting program that exists in all of the Dining Commons and has begun to spread to some of the campus eateries. At these locations, compost is collected from both the preparatory staff in the kitchens and from the customers. This ensures that the maximum amount of compost is collected from these sites. When the compost has been collected, it is shipped only a few miles north of campus to a local farm where it is officially composted and is then used as fertilizer.

- **Campus Involvement**

Though the UMA has many programs that work to educate the campus community about energy conservation and prompt behavior changes that will reduce the university's overall resource consumption, it has also reached out to the campus community for their ideas on how to conserve energy. The UMA achieved this by holding Sustainability Navigation Sessions that were facilitated by Johnson Controls Inc. People from every part of the campus community were invited to these Sessions to help the university brainstorm innovative ideas as to how we could be conserving energy and reducing our negative environmental impacts on the whole. Not only were excellent ideas discussed at these Sessions, but it was also an effective way to involve the campus community in issues of campus sustainability.

#### **4.2.3. Future Programs and Goals**

- **Green Office Program**

Due to the overwhelming success of the UMA Eco-Rep Program, the university has begun to investigate how to transfer this success to a staff and faculty environmental education program. Specifically, the university has begun to develop a Green Office Program that will integrate many of UMA's campus sustainability initiatives, including transportation, recycling, and energy. The program will also have large environmental and financial impacts with very little time commitment on the part of the participating staff, faculty or offices.

The Green Office Program will give interested staff, faculty or entire offices the opportunity to learn more about how they can be more environmentally sustainable. A large portion of this effort will focus on energy conservation in the workplace. The UMA is investigating possible structures, coordination and incentives for this program and plans to launch a pilot version in the spring of 2010 with the New Students Orientation office signed up to be the first Green Office at the UMA.

- **UMA Eco-Rep Program**

With almost two full years in operation completed, the UMA Eco-Rep Program is the most effective and well-received sustainability program on campus. The amount of students interested in being involved in the Program grows every semester as does the calls from students to expand the Program to more of the residence halls on campus. Currently, the Program is only operation in half of the residence halls on campus. Due to its popularity, the UMA will begin to investigate the possibility of expanding the Eco-Rep Program to the remaining residence halls on campus and family housing complexes.

To accomplish such an expansion, the UMA will investigate the possibility of funding a graduate student assistantship to coordinate the Eco-Rep Program. Currently, the Sustainability Coordinator organizes and facilitates the Program; however, has the Program and other sustainability initiatives expand on campus, another person will need to be hired to coordinate such a massive program. Also, the UMA will begin to investigate the possibility of creating one or two more paid student Program Manager positions to help facilitate the expansion of the Program. Currently, there is one student who is paid ten hours a week to help the Sustainability Coordinator facilitate the Program.

- **Developing Staff Trainings**

One initiative that the UMA feels could offer a great benefit to reducing energy and resource consumption on campus is the development of staff trainings focused on energy conservation and waste reduction. The university is currently investigating the possibility of integrating such a training into the new staff orientation, as well as incorporating energy conservation into a training that current employees must take on a yearly basis. The UMA believes that educating new and existing staff about energy conservation could yield a large reduction in energy consumption.

- **Waste Reduction Programs**

As discussed above, the UMA has excellent recycling and composting programs on campus. However, the university recognizes that there is still room for improvement in both of these areas and thus are hiring two student interns starting in the Spring 2010 semester to work on increasing the effectiveness of these two programs. One student will be the Energy Programs Intern and the other will be the Waste and Recycling Intern; both of who will work for the Sustainability Coordinator. The UMA will determine the effectiveness of these new internship positions that will offer credits to the students and if they are proven to be effective, the university will investigate paying these student interns.

## 5. Green Building

### 5.1. Introduction

The University of Massachusetts, Amherst (UMA) has recently completed the construction of several new campus facilities with a total value of over \$420M. Several others are in the design phase. This construction program has added over 750,000 square feet of new space as well as 864 new beds in the Undergraduate Housing. This new construction effort differs from previous campus development in that each project seeks to employ “green building” or high-performance design characteristics. Although the campus has not sought a LEED certification for any of these buildings, we have used the LEED rating system as the guiding principles for design decisions in an attempt to incorporate as many green building characteristics as possible.



The 2007 Massachusetts State Executive Order No. 438 states “All new construction and major renovations, effective immediately, must meet the Mass. LEED Plus green building standard established by the Commonwealth of Massachusetts Sustainable Design Roundtable.” To that end, all of the new buildings include LEED Accredited Professionals and Commissioning agents in the design and construction process. Not every site is ideal and not every design is best suited for the ultimate Green building. However, we recognize what we can achieve and endeavor to incorporate the most beneficial green characteristics into each project within the parameters of the project budget and public process.

The following pages provide a summary of the “green building” or high-performance design characteristics employed in our new buildings.

### 5.2. Current Projects

- **Central Heating Plant (CHP)**

The UMA CHP represents a model in economic, technical, architectural, operational, and environmental planning. The new \$120M, 45,000 square foot CHP employs advanced energy generation and pollution control technologies. Replacing an older heating plant on campus, the new, combined heat and power



plant produces nearly twice as much energy, while emitting up to 7 times less green house gas emissions than the old plant. It is one of the cleanest burning facilities of its size and kind in the nation. The CHP provides all of the steam and nearly all of the electric power required for a campus of 26,000 students, 250 buildings with 10 million square feet of heated space. The CHP became operational in the summer of 2008.

The CHP will achieve optimum efficiency with a combination of advanced technologies:

- A 10 megawatt, jet engine derivative, combustion turbine generator;
- A heat recovery steam generator that turns the 900-degree exhaust heat from the combustion turbine into 125,000 pounds of steam per hour;
- Three auxiliary boilers each rated for 125,000 pounds of steam per hour, to augment CHP district steam capacity;
- Both high and low pressure steam turbines using the steam produced for district heating to co-produce an additional 6.5 megawatts of electric power (combined cycle technology).

There are many distinct, green design features incorporated into the Central Heating Plant:

- the design of the power process systems to extract over 90% of the potential energy from each pound of fuel consumed (compared to an efficiency of around 35% achieved by large, electric utility power plants),
- A large eave overhangs all sides of the building, this “big roof” concept helps in terms of shading and reduction of summer heat load,
- The building design reduces openings on the north side as a way to mitigate heat loss,
- An expansive, south facing glass curtain wall incorporates as much natural day lighting as possible deep into the building to mitigate the requirement for artificial lighting. The curtain wall includes fritted glass to increase light while reducing heat gain.
- A clear story runs the full length of the east and west sides to provide natural day lighting. Openings in the roof overhang allow for light to penetrate through the clear story deep into the building.
- The heat recovery boilers and large, auxiliary boilers are equipped with both *selective catalytic reduction* and *oxidation catalyst* technologies that reduce the emissions of green house gases, specifically nitrous oxide and carbon monoxide.
- The efficient fuel cycles and combustion of low sulfur transportation grade fuel oil and natural gas significantly lowers the emissions of green house gases when compared to the old UMA heating plant.
- An effluent treatment facility that recycles up to 200,000 gallons of municipal wastewater effluent from the Amherst Wastewater Treatment Plant to meet daily boiler makeup water demand, eliminating the need to use the town’s public drinking water supply for steam generation. This also saves the campus approximately \$250,000/year in operating costs.

- **Integrated Sciences Building (ISB)**

The new \$102M ISB provides new office and laboratory space for teaching and research. The building has over 175,000 gross square feet of new space, housing Chemistry teaching labs, upper-division Life Sciences labs, research lab space and laboratory support facilities, an integrated Chemistry/Life Science computer resource center, a teaching development lab, a 300-seat auditorium equipped with scientific demonstration facilities and active-learning technology, an 85-seat classroom, upper-division discussion/computer rooms, distance learning capability, and faculty and staff office space.

Green Characteristics of the ISB include:

- Terra cotta bagettes were installed on the south façade of the atrium to allow for solar heating during the winter and for solar protection in the summer.
- Operable windows were installed on the south façade of the atrium. When outside air temperature is 65-75F, the atrium windows begin to automatically open and the dampers on the smoke exhaust fans open for “natural” circulation. When the space temperature sensor in the atrium registers more than 90F a sequence of additional opening or windows & dampers starts and the smoke exhaust fans start operation to bring the temperature back down (75F target – obviously dependent on outside air temperature).
- Rain water from roof area and from the underground foundation drainage system is piped to an underground 20,000 gallon storage tank. The collected water is then pumped to the chiller plant cooling towers and used to supplement the make-up water that is lost to evaporation.
- Effluent water from the Town of Amherst water treatment plant is pumped to the cooling towers. This effluent water is then used to supplement the make-up water that is lost to evaporation.
- During the winter heating season excess return air from the classroom wing is ducted to provide heated air in the mechanical penthouse and to preheat the incoming air serving the lab areas.
- An enthalpy heat recovery wheel was installed in each of the (4) air handling units serving the lab areas to remove latent heat in the summer and add moisture and sensible heat to the supply air during the winter. Heat wheel recovers 50% more heat and moisture than the previously proposed glycol loop.



- Use of an “intensive roof garden” over the chiller plant and an “extensive roof garden” over the loading dock. The intensive roof garden consists of soil depths greater than 6” and less than 42” with a variety of plants including small trees and shrubs. The extensive roof garden consists of soil depths no greater than 6” with plant materials restricted to withstand harsh growing conditions.
- Use of (2) high efficiency water cooled electric centrifugal chillers and (1) steam absorption chiller in the regional chiller plant. The installation of both electric and steam chillers will help the University to “balance” steam and electric consumption and maximize the operating efficiency of the next Central Heating Plan. The electric chillers utilize VFD controls to operate more efficiently at partial loads.
- Use of variable frequency drives (VFD’s) on the cooling tower fan motors and oversize the cooling towers to provide more surface area and thereby require less airflow and fan energy to maintain the condenser water set point.
- Use of plate and frame heat exchanger to provide chilled water for winter cooling loads without operating the electric centrifugal chillers.
- Use of hot water radiant perimeter ceiling panels in labs and offices to provide perimeter heating while maintaining minimal airflow in unoccupied areas.
- Use of low flow fume hoods in the teaching labs, 60 CFM instead of the standard 100 CFM fume hoods, to reduce heating, cooling and fan energy consumption. 100 CFM fume hoods are used at dispensing and waste hoods and on the research floor. The savings in fan size for the building is approx. 30,000 CFM
- To reduce air flow and energy consumption lower the fume hoods fan speed at night and during the summer while still maintaining negative pressure in the hood and lab areas
- To reduce air flow and energy consumption in the laboratories during unoccupied periods (6 PM - 7 AM) reduce ventilation to 4 air changes/hour.
- Use of CO2 sensors to modulate outdoor air dampers and control the amount of outdoor ventilation air being supplied to the 300-seat auditorium and 85 seat classrooms.
- Use of thermally broken, low emissivity, insulating glass in the curtain wall and window units to reduce both heating and cooling energy losses.
- To reduce the lighting watts for the same perceived light output, install in the office and lab areas, pendant mounted direct/indirect lighting fixtures in lieu of standard recessed parabolic fixtures.
- Reduction in lighting energy consumption, install in the laboratory areas, offices, and other spaces, motion detectors sensors that will turn on and off the lighting fixtures.
- Reduction in lighting energy consumption, install in corridors, atrium and other circulation areas computer controlled lighting that will turn on and off the lights at preset time intervals.
- Provide bicycle racks and changing shower facilities within the building
- Use of rubber flooring in the lab areas and use partially recycled content vinyl and ceramic floor tiles in the circulation areas of the building

- Utilize bamboo (sustainable) wood on the lab casework, wood doors and wood trim.
- Recycled 100% of the steel and concrete resulting from the demolition of Marshall Annex

- **Studio Arts Building**

The new \$25M Studio Arts Building provides 50,000 gross square feet of instructional studios as well as individual faculty and student studios. The instructional studios accommodates several studio art functions including printmaking, sculpture, painting and ceramics.

Green Characteristics of the Studio Arts Building are:

- Reused existing pavers in front of Hills. Reuse of the pavers reduced the amount of material that would need to be trucked to a landfill site, and reduced the amount of raw materials required to produce additional bricks and transport them to the site.
- The users of the building utilize the EH&S Reuse and Exchange program to recycle and reuse various chemicals, and keep them in very small quantities in the building. This is a substantial enhancement to the greenness of the Art Program. It reduces the cost of operation, as EH&S provides the chemicals for free to participating UMA units.
- The landscaping of the project features low-maintenance, drought-resistant plant materials.
- Storm water from hard surfaces such as pavement and roofs is collected on the site and retained in an underground 3,000 gal. tank to regulate the flow of storm water into the campus drain system, reducing the chance of overflow at the Pond. This in turn helps to mitigate the need for ever-larger storm water collection systems and waste water treatment facilities.
- The building's mechanical and electrical systems are constantly monitored and managed by the campus Energy Management System, providing real time information that includes alarms when systems are not functioning properly and when energy is being used unnecessarily.
- The building employs occupancy and CO2 sensors to regulate the amount of ventilation air sent to specific spaces, and to automatically turn off lights when rooms are unoccupied.



- Toilet room fixtures feature hands-free faucets and flush valves, and utilize low gallon per flush toilets and urinals.
- Almost every room is equipped with an exterior window to allow daylighting when practical.
- South-facing windows are equipped with louvered sunshading devices that allow winter sun energy to be brought into the building, but shade the building from summer heat.
- Operable (opening) windows are provided throughout the building to allow natural ventilation to be used when weather permits, and to offer an alternate way to evacuate fumes.
- The building houses many functions that produce various fumes dusts and waste heat during programmed activities. The building is equipped with special exhaust and 100% Outside Air ventilation systems to protect the occupants from exposure to these byproducts of the work. Typically, these types of systems waste a tremendous amount of energy, so to combat those losses, the exhaust air is sent through an Energy Recovery Unit (ERU) to recapture the energy that would normally be lost in the ventilation process.
- The use of walk-off mats at building entrances reduces the amount of dirt, dust and pollens brought into the building.
- Except for the building entrances, the building has hard polished concrete floors which will not collect dust, dirt and pollen, is easy to maintain with no use of solvent-based cleaning solutions, and does not emit any harmful gasses.
- Concrete used in the building uses fly ash, a recycled byproduct of coal and oil combustion in place of some Portland cement. The use of fly ash improves concrete workability, and reduces the amount of water required in the concrete mix.

- **School of Nursing - Skinner Renovation**

The \$18.8 renovation for the School of Nursing includes a total renovation of the existing 38,000 square foot building and a new 12,000 square foot addition. This project provides 50,000 gross square feet of modern office, classrooms and laboratories for Nursing instruction.

Green Characteristics of the School of Nursing - Skinner Renovation include:

- Re-use of a previously developed site.
- Community Connectivity – Site lies within ½ mile of a residential zone of average density of 10 units per acre and within ½ mile of 10 basic services. Pedestrian access is provided.
- Public transportation access.
- Open space exceeds building footprint.
- Reduced impervious cover on the site.
- In conjunction with adjacent Integrated Science Building, no increase in storm water run-off.

- Building re-use – Maintained more than 95% of existing building structure, exterior walls and roof.

- Asbestos removal.
- Non-Roof heat island effect is minimized with the use of shade trees on 50% of the site, and the use of concrete pavement with a high Solar Reflectance Index.

- Heat island effect-roof: Low-slope roofs – white membrane; Steep-sloped roofs – Solar Reflectance Index of 29.

- VAV air handlers with full air-side economizer.

- Variable speed drives for AHU fans and heating pumps.

- Perimeter fin-tube heat that allows the central air systems to be turned off when building is unoccupied overnight.

- Low-velocity duct system to reduce central fan horsepower.

- CO2 sensors in assembly rooms to minimize unnecessary use of outside air for ventilation.

- Lighting controls, including occupancy sensors in private offices and dual-level switching in classrooms.

- Low-water-use plumbing fixtures.

- Carpeting has IAQ (Indoor Air Quality) Green label.

- Construction waste management reduction plan.

- Environmental tobacco smoke control.

- Low-emitting composite wood products, no urea formaldehyde content.

- Low VOC-emitting sealants and adhesives.

- Low VOC-emitting paints and coatings.

- Storage and collection of recyclables.

- Indoor chemical and pollutant source control.

- Entryway foot cleaning systems (floor grates).

- Daylight and views in 90% of regularly occupied areas of the building.

- LEED accredited professionals on project team



- **Undergraduate Housing**

The new Undergraduate Housing opened in the Fall of 2006 and provides an additional 864 student beds in four new structures totaling 325,000 square feet.

The new student housing provides apartment style living quarters that includes 4

single occupancy bedrooms, two baths, a kitchen and living room in each apartment unit.

Green Characteristics of the new Undergraduate Housing include:

- 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.
- 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.

- **Recreation Center**

The new \$50M Recreation Center's provides 120,000 gross square feet of square feet of recreation space including weight and fitness, three court gym, multipurpose rooms, a juice bar and lounge, locker room facilities and administrative offices.

Green Characteristics of the Recreation Center include:

- Use of light colored roof membrane to reduce the heat load.
- Use of sensor activated sinks, toilets, and urinals to conserve water.
- Use of energy efficient lighting including motion/occupancy sensors to save electricity.
- An energy management system that can program and ramp down the mechanical units during low occupancy periods and achieve minimum ventilation values.
- Use of solar shading devices on the exterior of the building to reduce summer solar heat gain.
- Use of fritted glazing to reduce the southern solar exposure thru the glass.
- No CFC-based refrigerants in the HVAC&R systems that may contribute to ozone depletion.
- A waste management plan to recycle and/or salvage 50% of non-hazardous construction and demolition components.
- Goal of extracting 10% of the processed materials for the project from regional sources within 500 miles.
- Implementing an Indoor Air Quality Management Plan in the pre-occupancy and construction phase to protect stored and absorptive materials.
- On the interior of the building, only adhesives and sealants that comply with Green Seal Standard for VOC's.
- Carpeting and rug backing will comply with the VOC limit of 50g/L set by the Green Label Plus Program.
- Recycling programs of product material and packaging during the construction



### 5.3. Mitigating Strategies

- **Maximize Space Utilization to Minimize New Construction**

The greenest building is the one that already exists. Each new building adds to the campus carbon footprint unless it is a zero-energy building or it replaces a building that used more energy. UMass should pursue strategies for addressing poor space utilization, including making better use of existing buildings over the summer, and aggressive scheduling of classes.

- **Enhanced Sub-Metering and Performance Benchmarking**

Building-level metering (electricity, gas, chilled water, and steam) is not now in place throughout UMass, making it difficult to benchmark energy use and effectively recommend and prioritize conservation measures on a programmatic basis.

- **Retro-commissioning and Energy Audits**

Retro-commissioning of buildings will ensure that all building systems are maintained to high performance standards. Retro-commissioning entails testing the performance of building systems in comparison to the designed standard and making operational adjustments to correct any system imperfections.

- **Increased Building Automation: Smart Buildings**

Building Automation Systems (BAS) and other controls can be used to manage HVAC systems, lighting, plug-in equipment (e.g., computers), and other systems, by cycling down or turning off equipment not in use.

- **Building Retrofits and Upgrades**

UMass will prioritize the upgrading building equipment, HVAC systems, boilers and pumps, lighting, and building envelopes.

- **Integrate Energy Considerations into Space Planning**

Space planning is critical to the successful operation of a university, and energy use should be considered in the initial design, annual scheduling, and daily assignment of space. Classroom and office space may have highly variable occupancy rates (e.g. summer break vs. mid-semester), while research facilities may be mission-critical and constantly in operation.

- **LEED Gold or Platinum Standards and Energy Performance Targets**

Each new building constructed on campus adds to UMA's carbon footprint and to future utility costs. Minimizing the amount of energy each new building requires through high performance design will help UMA manage carbon emissions while growing as a campus. It will often be easier and cheaper to incorporate metering, controls, day-lighting, PV and solar thermal, and other efficient technologies during the initial design and construction than via future retrofit.

- **Adopt Architecture 2030 Challenge**

UMA will investigate adopting the Architecture 2030 challenge, which requires all new buildings to be carbon neutral by 2030.

- **Green Building Design Committee Policy** for new building construction and major renovations – UMA should adopt the following statement as policy:

“The University of Massachusetts, Amherst, will promote through facility design, construction and operation, the conservation, protection, improvement and sustainability of the environment by:

- Maximize existing building utilization before constructing new facilities- Build small, if at all
- Implement sustainable building principles in all new and existing buildings; develop sustainable design guidelines utilizing LEED-NC as the core standard with further specific Commonwealth and UMass performance standards.
- Optimize site selection to preserve green space and protect the surrounding environment
- Use energy as efficiently as possible and maximize the use of renewable energy
- Use water as efficiently as possible to control consumption and minimize discharge and run-off
- Minimize impact of construction materials by using green and locally available products
- Promote the well being of building occupants by designing for a healthy indoor environment
- Select green design strategies that address regionally important environmental impacts
- Utilize life cycle cost analysis in making building design decisions
- Commission all new construction and re-commission all older buildings
- Establish collaborative teaching and research projects, involving students, faculty and staff, to explore strategies for the efficient operation of existing buildings and the sustainable design for new construction
- Establish a new building budget process to ensure project budgets are realistic and adequate for meeting functional needs as well as implementing energy efficient green building designs.”

- **Rain Garden projects** sit in a shallow depression that holds tiers of plants adept at filtering out toxins and regulating the flow of water. Plants and soil chosen to fill rain garden act as natural filters and regulators, allowing the water to slowly seep into the ground and make its way naturally and cleanly to the nearest watershed.

- Max Cohen, a senior student in a class on Contemporary Urbanism, is working on a yearlong project involving rain gardens. He is currently in the researching stage. He hopes to put his plan into action during the spring 2010 semester. Cohen and his advisor, Professor of Landscape Architecture Jack Ahern, believe a rain garden will not only enhance the university’s aesthetics but boost its research on the subject and inspire students to get involved.

- Amanda Kukle and her partners are creating a rain gardens proposal for their Sociology of Climate Change class. The group is determining the data needed to make rain garden installation at various points on campus feasible. All students involved support the placement of an information sign at the border of the rain garden to harness its full educational potential.
- The University is planning to break ground on a new sciences laboratory building in March, and currently intends to include an extensive rain garden on the street-facing lawn
- Professor Frank Slegers of Landscape Architecture is determining which endemic plants are the most effective at phytoremediation. He is looking at rain gardens in other locations around the world, comparing aesthetics and efficiency. His aim is to figure out how to incorporate trees and beautiful flowers into the gardens that will slow the absorption of water and filter out contaminants such as lead, cadmium, copper and nickel.
- Construction on a rain garden at the Southwest Concourse will begin in Spring 2010. The design will consist of forests at the north and south ends of the concourse, a field for collection of stormwater, and a channel to send the water into wetlands, where plants will filter and slow the water. The plan will include local-growing, low-maintenance plants that will maintain aesthetic integrity through all seasons. The rain garden Concourse should be completed by the end of fall semester 2010.
- **Green Roof projects** function similarly to Rain gardens. Plants are grown on the rooftops of buildings to regulate the flow of water to the ground and into drains. The roofs are either intensive (usable for broad purposes) or extensive (solely for rain and stormwater). Not only do they assist in stormwater management, they provide insulation and protect roofs from the harmful effects of ultraviolet light.

The newly constructed Integrated Sciences Building is home to two green roofs – one extensive over the loading dock and one intensive over the chiller plant.

A new UMass Police Department building is currently under construction. Following the guidelines of the newest LEED document, this could include rain gardens and green roofs, costs allowing.

The Hampden Dining Commons could support a green roof and the weight of such a structure

- **Other Stormwater Treatment Initiatives**
  - Near the Studio Arts Building parking lot, deep underground, sits a Vortex stormwater filter system. Water flows from the lot into the ground and into a cylindrical chamber through a manhole. The chamber swirls the water causing sediments to sink out to the bottom of the system. The water then continues into the regular stormwater flow. This method does not reduce the effect of stormwater on peak flows of rivers, but it does reduce contaminants making their way into the watersheds.

- Construction will begin on a parking lot between Boyden and the new recreational center in summer 2010. With the parking lot, a stormwater detention and retention structure will be built underground to mediate the high flow of water. Chambers under the lot will capture the water and allow it to slowly seep into the ground, effectively reducing the quick flow.
- A few years ago, Facilities installed roof drains near the Old Chapel in the center of the UMA Campus to help cool rain water coming off the hot roof in the summer. If hot water flowed directly into the campus pond, depleted oxygen levels and the heat would affect the marine life. To allay the problem, roof water flows into an underground chamber full of cooler water. The waters mix, cool and then move into the pond.
- During a heavy rainstorm, a swath of land across the street from Boyden along Massachusetts Avenue intentionally floods, which forces rain water to sink more slowly into the ground and ultimately into the watershed. Rain water spreads out along the patch of land and the grass does some slight remediation of toxins. Peak flow is diverted and some contaminants are filtered out.
- The UMA Massachusetts Water Resources Research Center is proposing to work with academic and administrative departments across campus on the UMass Stormwater 2099 project. This project would integrate research and education to develop tools for the design of infrastructure and implement and monitor stormwater improvement projects across campus to reduce runoff and NPS pollution. The Center would utilize these projects to showcase stormwater sustainability on campus and to educate (through workshops, continuing education programs, and on-line materials) regional town officials, planning boards, developers, land owners and others on the efficacy of such projects for minimizing runoff and reducing NPS pollution by increasing local recharge.

## 5.4. Future Goals

- **Continuous commissioning** signifies commissioning as a continuous process that starts at the time building is in design stage (or for the existing building, starting from the point of redesign or retrofit) and ends when the building is decommissioned, without gaps in this timeline.
- **Establish a dedicated Center for Energy Sustainability (CES)**, with adequate funding that would cover professional staff and with the clear mandate to implement proposed goals. The new Center should fully interface with designated departments and should design sustainability programs which will involve faculty and students and would provide funding for this activity. Their contribution would be invaluable, so their time and effort should be adequately covered and funding for research assistantships for students working for these faculty on campus sustainable energy issues should be provided. Both faculty and students would report to the CES, with progress and accomplishments measured by the metrics developed as a part of CES organization and implementation. CES would also be responsible for managing financial aspect of the activities related to

energy sustainability, coordinating between facilities planning, physical plant and various academic departments.

- **Funding for the CES** would need to be substantial in order to accomplish stated goals. This funding can come from a revolving loan, established by the state legislature. The initial tranche of the loan would be provided as a onetime payment by the state. Future funding would be provided from the savings generated by implementing comprehensive energy efficiency measures and installation of renewable energy facilities. Metrics would need to be clearly established, so that the revolving loan fund gets replenished on a yearly basis and is based on the savings achieved. Assuming linear progress toward the CAP goals between the years 2030 and 2050, and provided that the current spending for the energy on campus is approximately \$38 million, in the first 20 years the projected savings would be \$210 million in present dollars. The second 20 year period would provide savings of \$590 million in present day dollars, for a total of \$800 million. Future savings (beyond 2050) start to accumulate at the rate of \$38 million (present day dollars) per year. With this level of savings, it is realistic to expect that the revolving loan in the amount of \$100 million be established and then replenished as the savings accumulate. The amount of CO<sub>2</sub> and NO<sub>x</sub> reduction as well as reduced dependence on the imported oil and gas would be equivalent and would substantially contribute to the State's goal of becoming carbon neutral and minimization of the dependence on the imported fossil fuels.

## 6. Transportation

### 6.1. Introduction

The University of Massachusetts/Amherst (UMA) already had an extensive public transportation service upon signing the Presidents Climate Commitment. The service provides faculty, staff, and students an ideal opportunity to commute to and from campus on one of the most environmentally friendly resources available. The Pioneer Valley Transit Authority (PVTA) buses are operated by UMA Transit Services, a student run department located on the UMA campus. The fleet of 35 buses provides public bus service throughout the entire Five College community. Yearly ridership on the UMA Transit Services buses



resulted in over 2.8 million passenger trips in FY2009. This public transit option will continue to aid the campus in reducing its commuter-related greenhouse gas emissions.

While fuel for the PVRTA buses is purchased by the PVRTA, UMA Transit Services also operates several other transportation services on campus, purchasing fuel through the physical plant. These services include Field Trip Services, Special Transportation Services (wheelchair lift equipped van service), and Meet & Greet Services. A new garage houses the Regional Traveler Information Center (RTIC), a state of the art intelligent transportation system serving the entire Pioneer Valley through the MassTraveler.com website. The RTIC provides commuters the opportunity to view traffic on-line using live video from cameras located along major routes in the area. The goal is to allow those who use it to seek the best travel alternatives in the area and avoid sitting in traffic as a result.

In addition to the vehicles operated by Transit Services, UMA has many other departments that own and operate vehicles on campus. Those vehicles comprise the University Fleet as described below in section 6.2.6.

## 6.2. Current Programs

UMA has developed several alternative Commuter Options Programs (COP) in the recent past, including the Rideshare program, the Occasional Parker Program, the Clean Vehicle Permit Program, and the Bike Commuter Program. This past year saw further increase in the number of non-single occupancy vehicle (SOV) commuting partially due to the higher price of gasoline, but also because of the numerous options and incentives offered through the UMA COP. The UMA Commuter Options Program continues to grow and is gaining momentum each year. The Commuter Options Program will continue to strive towards reducing the number of single occupancy vehicles commuting to UMA.

- **The Rideshare Program** was launched in September of 1999. The program has since grown into a full fledged Transportation Demand Management program, offering UMA employees and commuting students numerous alternatives to single occupancy vehicle commuting. The Rideshare Program is only one component of the UMA COP. A full time Program Coordinator administers the program. The Rideshare Program offers an on-line carpool matching service and an incentive program that includes discounted UMA carpool-parking permit, preferential parking spaces, a guaranteed ride home, and free one day parking passes. These incentives have boosted the carpool numbers every year since the program's inception. In 2009 the UMA carpool rate was 10%.
- **Occasional Parker Program.** This COP program offers University students and employees a pay-as-you-drive alternative to the yearly parking permit. The Program offers discounted daily parking passes limited to 60 days per year. This forces the driver to consider how they commute to UMA on a daily basis. UMA Parking Services sold approximately 700 Occasional Parker permits for the 08-09 permit year.

- **Clean Vehicle Permit.** Also part of COP, this program offers alternative parking permits for 'clean' (high mileage hybrid, electric, cng, lpg) vehicles. This discount is intended to encourage the use of clean vehicles and reward those already doing their part to reduce the environmental impact of the automobile. UMA received an award for this program from the Patriot Chapter of the Association for Commuter Transportation. There are 50 clean vehicle permits for the 07-08 permit year.
- **Bike Commuter Program.** Established in 2002 as part of COP, the goal is to encourage commuting by bicycle to the University. While the program lacks specific incentives, it does act to encourage a discourse among bike commuters and is a clearinghouse of information on such pertinent bike commute topics as lockers and showers, bike storage, and bike routes. The UMA Bike Commuter Program has boosted our bike commuter numbers to approximately 5% commuting by bike to campus.
- **The UMA COP Coordinator** has been a major organizer of the annual Bike to Work Week, which promoted sustainable (long term) bicycle commuting throughout the Pioneer Valley. During the event, UMA hosts a free bike commuter's breakfast and a forum to discuss ways to encourage and facilitate bicycle commuting at UMA. UMA has been involved in this event for seven years running and attendance/participation has increased each year.
- The University is committed to **encouraging bicycle commuting** through the expansion and proliferation of racks and access to lockers/showers. A campus wide bicycle committee has been working on a bicycle and pedestrian campus master plan. Much progress has been made on promoting the bicycle as an efficient and safe mode of transportation. For example, the rail trail bike path connector was completed in 2001. The connector now serves as an important link between the University and the extremely popular Norwottuck Rail Trail. The trail is also a very popular pedestrian route. Our walking rate is 5% of the commuters getting here on foot, the same as by bicycle. UMA Transit's Rack-N-Roll Program also makes it possible to bring bikes on the bus by utilizing bike racks on the front of the UMA bus fleet.
- The UMA COP launched a **vanpool program** in 2006. We made arrangements with Mass Rides to act as a joint facilitator in forming vanpools to UMA. Unfortunately, we only fielded a limited number of interested callers. However, we will continue to promote vanpools at UMA and hope for its future success.
- **Chemical Inventory Program-** UMA 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:

- **Reduction of shipments of chemicals** coming to campus due to deliveries at numerous laboratories across campus. The reduction of shipments greatly reduced the number of trucks coming onto campus for chemical deliveries. They now also only deliver to one center location, which has helped reduce truck traffic on campus. This has the obvious benefit of reducing the amount of greenhouse gases releases by the campus receiving shipments of chemicals for research and other uses.
- **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.
- **University Fleet** - The UMA Fleet supports the institution's academic, research, administrative and student activity missions. The fleet is comprised of vehicles which provide for efficiency in operations and the safe transportation of personnel and equipment. Vehicles are used for a variety of operations including building and grounds maintenance, mail delivery, mass transportation of students and employees, crime prevention and detection, and for official University business travel within and outside the State of Massachusetts. The University Fleet includes approximately 355 vehicles (not including Physical Plant vehicles). In August 2009 Transportation Services hired a Transportation Specialists to consolidate the University fleet, establish a vehicle maintenance program, and create more effective control for the use of University vehicles by departments on campus. As part of that process, the Vehicle Review Board (VRB) was established. The VRB is responsible for reviewing proposed vehicle purchases, advising University departments on allowable vehicle specifications, and approving final requisitions for purchase. Transportation Services acts as a gateway/pass-thru for all things related to vehicle use on campus.

Because of the need to securely transport personnel, tools and equipment in order to maintain University infrastructure, a large percentage of University vehicles are trucks and vans (e.g., to support facilities personnel, mail delivery, etc.) Given campus traffic and the relatively compact nature of the campus geography, the vast majority of campus service vehicles are driven short distances at low speeds,

resulting in a low average fuel economy that does not improve substantially as older vehicles are replaced.

- **Energy Policy Act Requirements** - In addition to rigorous performance specifications, the University fleet must comply with federal and state fleet requirements such as the Energy Policy Act of 1992 and 2005, requiring that 75 percent of “covered” University fleet purchases (non-emergency vehicles weighing less than 8,500 pounds) be alternative fuel vehicles. UMA is committed to purchasing the most appropriate vehicles within this requirement and striving to be innovative with the remaining 25 percent of covered vehicles, while balancing department needs and limited budgets. Greater federal flexibility would allow the University to experiment with new technologies which currently must compete with priority institutional purchases that are not alternatively fueled. As an example, the University currently cannot buy hybrid electric vehicles under the Act, despite the fact that these vehicles perform well under the stop and go driving conditions present on campus.

### 6.3. Mitigation Strategies

UMA has adopted a number of strategies for reducing campus transportation-related emissions. Some of these strategies can be affected through University actions, while others need to be addressed by society as a whole. Choosing among these strategies (or a mix of strategies) should be guided by the impact on emission reductions as well as concerns about the overall development of the University’s physical infrastructure, aesthetics, quality of life, and other business considerations.

- **Diverse Lower Carbon Strategies**  
Lower carbon commuting strategies include greater use of available public transportation. Options need to be convenient, safe, reliable, and uncrowded. This can be achieved through existing schedule and route enhancements, carpools, van pools, walking, and biking. It also includes greater utilization of low carbon vehicles such as hybrid electric and electric vehicles. Fortunately, many of these programs currently exist or are in development.
- **More on- and near-campus housing development** for undergraduate and graduate students should be planned. These developments must provide easy access to campus via UMA Transit Services, walking, and biking. They would also contribute to the vibrancy of the near campus community.
- Other developments over which the University has more limited influence include advancements in vehicle fuel economy, increases in fuel prices (which may encourage lower carbon commuting options), and broader societal changes that will stimulate carpooling and mode switching. UMA should investigate the possibility of joining forces with other ACUPCC campuses to initiate a nation-wide RFP for affordable zero-emission vehicles (ZEV) for campus and community use. With over 650 campuses now committed to climate neutrality, ACUPCC schools constitute a

weighty economic force, which could be leveraged effectively to encourage and speed the availability and affordability of energy-efficient vehicles for the nation.

- **Reduced Vehicles on Campus**

Reducing the number of cars on campus will lessen the congestion on campus, which may encourage even greater numbers of people to walk or commute by bicycle. There will be less demand for parking, reducing the number of parking lots or even garages needed. This would free up land for other purposes such as recreation areas.

The following strategies can also help reduce the number of vehicles on campus:

- Increased use of UMA Transit  
Through a prominent marketing campaign, including educating employees and [all] students about public transportation options, public transportation usage would increase. Increasing the number and frequency of transit routes and “Park & Ride” options would lower transportation costs and reduce transportation-related emissions. Reduced traffic, lower commuter costs and an enhanced quality of life would result.
- Increase use of carpooling  
Enhance and improve the Rideshare program (6.2.1 above)
- Increase use of vanpools  
Commuter use of vanpools would increase through employee-financed vanpools or student run shuttles from Park & Ride satellite lots and preferred parking.
- Increase use of bicycles (6.2.4 above)  
Actively provide information about bicycling (routes, bike racks on buses, shower facilities, etc.). The development of incentives and improving the infrastructure would assist in improving the percentage of bicycle usage on campus. Also, expansion of the existing Bike Trail to major off-campus housing would facilitate bicycle usage.
- Support faculty and staff telecommuting  
The UMA is currently developing a policy that will outline acceptable situations in which university employees will be allowed to telecommute with proper approval from their supervisor.

- **Promote Virtual meetings**

UMA needs to increase availability and use of existing virtual meeting facilities. Development of a website request form where those needing support can request use of the technology and be matched with existing on-campus resources would facilitate the development of this strategy. This action would increase employee productivity by reducing travel time.

- **Vehicle Procurement through Vehicle Review Board (VRB)**

This policy requires that all requests for purchasing motorized vehicles benefit from VRB research on low emission vehicles. Campus purchasers will be educated about low emission options.

- **Improve landscaping practices** in order to reduce mowing, leaf blowing, etc. Assess landscaping practices to determine how to reduce their carbon intensiveness. Could include maintaining taller grass or different plantings altogether such as perennial grasses, shrubs, etc.
- **Improve fuel efficiency of fleet**
  - Through hybrid technology and alternative fuels.
  - Ideal campus vehicles (economical, low emissions, durable workhorse trucks) do not readily exist. UMA is actively researching, test driving, and judiciously purchasing trial vehicles.
  - To further underscore the importance of fuel efficiency and reducing the University's carbon footprint, this plan recommends adding the following language to campus fleet policies: "Vehicle purchase requests must take into consideration the most economical, most fuel efficient, and lowest emission vehicles available in a particular model year that meet the operational needs and policy requirements of UMA Amherst. In addition, the institution must consider safety issues, federal warnings, and commercial driver's license requirements when selecting vehicles." Previous policy language did not include discussion of fuel efficiency and low emission vehicles.
- **Bike Share Program** - The development of a Bike Share Program offers several potential benefits. Providing the university community with access to a fleet of bicycles, encourages reduced reliance on personal vehicles, ultimately reducing congestion, air pollution, and parking demand on campus. With the involvement of the established Bike Co-op, the program can be entirely student-run.

#### 6.4. Tracking Progress

Measuring the carbon footprint of transportation at UMA is a challenge. The University does not have accurate survey data about campus commuter behavior. Until UMA develops better data regarding commuter frequency and vehicle usage to more accurately estimate the commuter footprint, the EPAC Committee recommends using commuter parking permits as a means to track progress. Unfortunately, this metric is imperfect and relies on a number of assumptions about commuter frequency and the average fuel economy of commuter vehicles. Specifically, the total number of issued commuter permits does not directly correlate to the amount of greenhouse gas emissions associated with commuting. In addition, not all commuters use parking permits, driving to campus and parking at meters or using daily passes. These emissions are not included in the campus greenhouse gas inventory.

Nonetheless, using the number of issued commuter parking permits as a method of measuring progress is the most viable near-term strategy as the data is readily available and currently used to estimate commuter related emissions. Giving up one's commuter parking permit and the associated convenience signals a willingness to change one's behavior and try lower carbon modes. Thus, the milestones established

by UMA are based on reducing commuter parking permits which are converted into an emission reduction target.

**Tracking Strategies -**

Parking Services, interested campus units, and the Sustainability Coordinator will work to develop, promote, manage, and track the progress of the sustainable transportation strategies outlined in 6.3 “Mitigating Strategies” above. They will develop, monitor, and evaluate data collection mechanisms regarding parking permit holder data used in the calculation of greenhouse gas emissions such as: the type of vehicle driven to campus, miles traveled to campus, and the number of days per week and number of weeks per year that a commuter travels to campus. Ultimately, the commuter behavior information gathered from all commuter parking permit holders (students as well as faculty and staff) will help ensure more accurate calculation of commuter-related emissions and a better means of gauging the effectiveness of the University’s green commuting options. The process to gather this data from faculty and staff should begin as soon as possible and an on-line process should be created for commuters when they apply for a parking permit. Diligent monitoring of the data collected will be required to ensure that parking permit reductions correspond to desired campus emission reductions.

**7. Renewable Energy**

**7.1. Introduction**

As the flagship campus of the state university system, it is fitting for UMass Amherst (UMA) to also play a leadership role in the development of renewable energy throughout Massachusetts. Heat and power generation from renewable sources at suitable locations across campus will be required to achieve long-term Climate Action Plan goals.

The Commonwealth of Massachusetts has set ambitious goals for reducing the environmental impact of state agencies. Executive Order 484 states, “All Commonwealth agencies as a whole and, to the greatest extent feasible individually, shall... Procure [or produce] 15% of agency annual



electricity consumption from renewable sources by 2012 and 30% by 2020.”<sup>3</sup> UMA is capable of meeting these goals. Moreover, the campus is well equipped to make the most of renewable energy systems by incorporating their installation, maintenance, and monitoring into research, education, and outreach programs.

However, the use of renewable energy on campus currently accounts for a small fraction of total energy consumption: two building-top photovoltaic arrays supply a total of 8.5 KW and diesel vehicles in the campus fleet run on B20, a blend of 80 percent conventional diesel fuel and 20 percent biodiesel, which amounts to 8000 gallons of biodiesel annually.

A strategy to increase the percentage of campus power generated from renewable sources should:

- Include a comprehensive series of studies assessing the capacity for renewable energy generation on campus/university property;
- Make every effort to avoid lost opportunities to install renewable generation capacity during new construction and renovations;
- Officially align campus goals for reducing greenhouse gas emissions and generating renewable power with the goals set for all the Commonwealth’s public agencies as outlined in Executive Order 484<sup>1</sup>;
- Make the best use of all available financing options for procurement and installation of renewable power systems;
- Consider options for the use of renewable fuels in the central co-generation plant where all campus heat and nearly three quarters of all electricity used on campus is generated; and
- Continuously monitor and evaluate new and emerging renewable energy technologies and systems for their potential use on campus.

## 7.2. Baseline Data

From July 1 2008 to July 1 2009, the electricity consumption (i.e. building use) at UMA was 122,000,000 KWh (416,264,000,000 BTU). Of that total, approximately 70 percent of electricity is produced on campus by the Central Heating Plant (CHP). During this same period, campus steam production was 931,000,000 lbs. (1,095,294,117,647 BTU) generated using 341,600,000,000 BTU of fuel (natural gas and heating oil). One hundred percent of central campus heat is supplied by steam produced at the CHP. Total fuel consumption was 1,884,468 gallons of oil and 13,605,160 therms of natural gas.

The use of renewable power and fuel on campus accounts for only a very small fraction of total consumption. Two building-top photovoltaic arrays with 8.5 KW capacity supply a total of 7300 kWh per year. Diesel vehicles in the campus fleet run on B20, a blend of 80 percent conventional diesel fuel and 20 percent biodiesel, or approximately 8000 gallons of biodiesel annually.

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<sup>3</sup> Executive Order No. 484 “Leading by Example – Clean Energy and Efficient Buildings”  
<http://www.mass.gov/Agov3/docs/Executive%20Orders/Leading%20by%20Example%20EO.pdf>

Preliminary solar radiation studies suggest that there is ample space for multiple megawatts of solar power generation on campus. Using a Digital Elevation Model (DEM) of the UMA campus, the area sun radiation for year 2009 with monthly intervals was computed with the *Solar Analyst tool* (from ESRI Spatial Analyst). Total sun radiation estimation can be improved by applying more precise modeling parameters. A more precise analysis of campus solar site potential is recommended as a follow-on to this preliminary study.

### 7.3. Future Goals, Studies, and Projects

Three overarching recommendations for renewable energy deployment on campus are to 1) Set goals for renewable energy on campus; 2) Conduct renewable energy generation site assessment studies; and 3) Continuously assess potential renewable energy projects.

Goals:

- Generate 15 percent of electricity from renewable sources by 2012 and 30 percent by 2020. The campus currently purchases approximately 30 percent of the total electricity consumed during a given year. Eliminating the need to purchase grid-tied electricity by meeting this demand through renewable power generation on campus is an ambitious, but attainable, near-term goal and also aligns UMA with Executive Order 484. One way the UMA will attempt to achieve this goal is having energy companies who bid for the university's next contract for purchased power submit two bids. One bid with 15% renewable energy included and one without. This will allow the UMA to see how much the 15% renewable energy will cost and if it is financially feasible to purchase.
- Pilot the use of advanced renewable fuels in the central co-generation plant by 2015. Expand use of renewable fuels to 30 percent by 2020.
- Produce enough biodiesel from waste vegetable oil to fuel all diesel fleet vehicles with B20 fuel by 2020.
- Develop a basis for benchmarking and reporting on renewable energy power generation goals.
- Provide technical support for executive decision makers to evaluate renewable energy investments and demonstrate progress on renewable energy goals.

Studies:

- Analyze opportunities for PV installation on existing buildings as part of roof replacement and as part of façade renovations where shading devices on southern and western walls provide multiple benefits
- Work with the Massachusetts Division of Capital Asset Management (DCAM) to develop standards for solar ready roofs and best practices when applied to existing buildings

- Analyze opportunities for PV installation at “dual-use” sites, such as parking structures and grazing pastures.
- Develop a tool, similar to Solar Boston<sup>4</sup> for campus planners and contractors to evaluate the solar potential of campus buildings
- Analyze opportunities for central (i.e. CHP) or distributed energy generation through burning waste.
- Continue to collect wind data at the Mt. Lincoln radio tower. After a full year of data is collected (by the Fall of 2010), the site will be assessed for its wind energy generation potential. A study will then be undertaken to ascertain if and how a wind energy project there could be developed in such a way that it will provide a direct benefit to the campus as well as to the Commonwealth.
- Review capacity for solar thermal heating/hot water at Mullins Center, as per original design specifications.

#### **Potential Projects -**

Using our renewable energy goals as a guide, the campus should develop and prioritize a list of potential projects. Criteria for renewable project selection may include: 1) Energy savings-to-cost ratio; 2) Carbon offset amount (price/ton CO<sub>2</sub> reduced); 3) Site availability and readiness; 4) Time to deployment; 5) Fit with “E+” energy efficiency measures budgeting approach (i.e. combine simple payback of renewable energy systems with other faster payback energy projects); and 6) Opportunities to decrease the net cost to the campus through external grants (i.e. sponsored research).

Of the possible financing mechanisms that could be used to fund proposed projects, a matching grant program would be desirable. A competitive internal grant program requiring a 1-to-1 match from an off-campus entity could help incentivize faculty and staff proposals for renewable energy projects on campus and provide the added benefit of building meaningful research and educational partnerships with companies, agencies and organizations. Among the renewable energy projects proposed to date are:

- 1MW solar installation in Taylor Field. Dual purpose application: PV electricity and livestock grazing pasture.
- Highly efficient production of biodiesel via a campus-based waste oil-to-biodiesel production facility. An estimate 21,000 gallons of waste oil can be collected annually from Five Colleges campuses.
- Assess the wind resource on Mt. Tom for potential wind turbine installation on university property there.
- Increase the size of the central co-generation plant and feed it renewable fuels, preferably an advanced biofuel with high conversion efficiency. Converting some

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<sup>4</sup> <http://www.cityofboston.gov/climate/solar.asp>

of the fuel usage in the CHP to renewable fuels would dramatically lower the overall campus carbon footprint.

- Develop renewable energy demonstration projects that both generate power and provide an educational/training benefit for the campus community.
- Human renewable energy. Exercise bikes and treadmills as power producers for the Recreation Center.
- Investigate the potential of having UMA be a Western Mass Electric Company solar site.
- Convert building rubbish into electricity.<sup>5</sup>
- Seasonal snow storage for cooling applications. See example from Sundsvall, Sweden where a large-scale snow cooling plant provides for comfort cooling for a hospital.
- Off-peak ice banking for cooling applications. An IceBank system prepares ice at night, when electricity is cheaper and it is cooler. The stored energy can be consumed by running air conditioning during the daytime.
- Human waste to energy. Technology developed by Ameresco, Inc., a Massachusetts-based energy services company, converts the methane from human biosolids into natural gas.
- Piezoelectric atrium floor in the Student Union. Piezoelectric substances, like some ceramics, also generate electrical energy from mechanical strain but without the need for voltage to be applied. In a high-traffic area, a piezoelectric floor can generate substantial electricity.
- Work in tandem with Education, Research and Outreach to raise awareness about renewable energy on campus. Annual workshops/seminar series.

While the above projects have been proposed, the feasibility of each still needs to be determined.

## 7.4. Tracking Progress

One clear measure of progress is whether the campus can meet or exceed the percent-renewable-generation goals set by Governor Patrick in Executive Order 484 - 15 percent renewables by 2012 and 30 percent by 2020.

Among the quantifiable measures of energy consumption and renewable generation that can be tracked are:

- Renewable electricity generation as a percentage of total electricity consumption on campus;

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<sup>5</sup> See, for example, the Massachusetts-based company IST Energy that has developed GEM™. A Waste-To-Energy Conversion (WEC) solution that integrates into customer waste processing streams, mitigates the negative impact associated with waste disposal, and directs clean renewable energy back into customer power grids. <http://www.istenergy.com>

- Renewable transportation fuel use as a percentage of total fuel consumption by the campus fleet;
- Renewable heating fuel used as a percentage of the total fuel used to power the central co-generation plant;
- Total KWh/BTU generated from renewable sources; and
- The number of buildings in which integrated renewable power systems are installed.

Use of renewable power systems as a component of research, educational, and outreach programming will also yield important measurable benefits, including:

- Dollars of research grants awarded in connection with campus renewable energy systems, and
- Hours of course work conducted in connection with campus renewable energy systems.

Progress can also be tracked as a function of how our renewable energy portfolio, and concomitant research and education activities, compare with those of our peer institutions around the country.

Finally, it is important to preserve institutional knowledge relative to the procurement, installation, maintenance, and research/educational/outreach use of renewable energy systems. This institutional knowledge will help guide decision making in the future.

## 8. Food

### 8.1. Introduction

Founded in 1863 as a land grant agricultural college, University of Massachusetts Amherst (UMA) was originally known as Massachusetts Agriculture College. Economic times, as well as pressing environmental issues, are now forcing us to rethink our current model of living and, in some respects, revert to how our food was once produced and distributed. Our goal is to achieve carbon neutrality for UMA in all food-related areas while feeding and educating our community about sustainable food issues. "The mission of UMA Dining Services is to contribute to the campus life experience by providing a variety of healthy and flavorful meals featuring local, regional



and world cuisine in a sustainable and environmentally conscious manner", Ken Toong, Director of UMA Dining Services.

For the UMA food system to become truly carbon neutral, the amount of local food must continue to increase. One way to do this is to cultivate segments of the UMA campus. There are already successful examples of this happening on a small-scale with an herb garden at Worcester Dining Common and vegetable production / fruit production at UMA Gardenshare. We must think creatively about how to grow food on campus and bring it directly to the student's dinner plates. An easy first step is to plant herb gardens outside of the three remaining dining commons. Thinking long-term, there could be fruit trees planted adjacent to the four dining commons. Many fruit trees are low maintenance, aesthetically pleasing and noticeable from the sustainability standpoint.

Selecting the right species is essential and knowledgeable faculty should be included in the decision making. Maintenance can be done by UMA classes (newly approved Permaculture Design and Edible Forest Gardens) as well as through students taking independent study credits.

There could also be food grown indoors, using UMA greenhouses and hoop houses, to provide fresh vegetables to the dining commons even during the cold winter months. A whole systems approach should be undertaken where composting, passive solar design and thermal mass can keep the structure heated at little to no cost throughout the year.

## **8.2. Baseline Data – Current Initiatives**

UMA students and faculty have been implementing environmentally conscious food initiatives on campus for decades. These initiatives revolved mainly around the Reduce, Reuse and Recycle mentality. Some of our current and existing initiatives are listed below:

- **UMA Dining Services initiatives include**
  - Chico Bags, Water Bottles, and Travel Mugs - Housing & Dining Services (HDS) strongly encourages the use of reusable containers whenever possible. Plastic bags are no longer in use in any dining operation and students are encouraged to bring a reusable carrying bag (e.g. a Chico Bag) for items from the grab-n-go locations and convenience stores. Likewise, students are also encouraged to bring their own water bottle and/or travel mug for beverages from the dining centers and grab-n-go locations.
  - Buying natural, organic, and local - Dining Services purchases food items from several local vendors for use in all the dining centers and continues to identify further expansion of its array of affordable, fresh, local ingredients. A total of 12% of food is currently from local (New England) industries including 25% of produce from local farmers. Additionally, Piazanos, one of the grab-n-go locations on campus, strives to serve fare consisting of 100 percent natural, 80 percent organic, and 10 percent local ingredients.

Local food includes: tomatoes, cucumbers, peppers, brussels sprouts, green beans, potatoes, onions, zucchini, summer squash, bean sprouts, spinach, corn, carrots, pickles, turnip, cabbage, apples, asparagus, pears, apples, fresh eggs, strawberries, eggplant, acorn squash, honey, maple syrup, ice cream jam, goat cheese, free range turkey, brown eggs, milk and ice cream.

Two percent of the food is organic and all seafood is sustainable, in compliance with Seafood Watch, a program designed to raise consumer awareness about the importance of buying seafood from sustainable sources. We also work the Alaska Seafood Marketing Institute for help in providing materials and speakers to educate our customers about the value of sustainable seafood.

- Vegetarian and Vegan Offerings - Dining centers offer at least one vegetarian and/or vegan hot main entree item at every breakfast, lunch and dinner. This is in addition to the many vegan and vegetarian items available at the deli bar, salad bar, pizza station, pasta bar and beverage lines and all grab-n-go locations. Over 15 world cuisines are often daily at UMass Dining locations and many of them are vegetable based. Recently we implemented an initiative to double the consumption of vegetables and fruit on campus.
- Special Events – Emphasis has been made to making events such as Global Jam, Building Communities, Snack Bites, and certain orientation meals “zero-waste.” This consists of reducing waste in preparation of an event, providing recycling and composting receptacles/pick-up at the event, and using compostable flatware and utensils for service.
- Waste and Reduction - We compost all wet garbage in all dining commons. All Dining Services locations are now trayless. Biodegradable bags are used in all C-Stores and Grab’n’Go stations. We purchased and distributed 14,000 stainless steel water bottles for all students on the meal plan. We are selling hot/cold travel mugs at cost. These measures contributed to the elimination of paper cups in the dining commons.
- Cleaning products - We use OS1 Certified Green Cleaning Program in all locations including the dining commons, retail locations, Campus Center food services, University Club, and the Campus Center Hotel.
- Energy - We turn off all kitchen equipment when it is not being used, installed pop up toasters to replace conveyor toasters. All refrigeration equipment is monitored for peak efficiency. We recently purchased to energy efficient dishwashers to reduce both electricity and water usage. We recently installed a high speed roll up door at the Campus Center Receiving dock to conserve heat in the winter and air conditioning in the summer. We turn off the lights in all areas when they are not being used. All of these measures resulted in an annual savings of 15%, close to half a million dollars..

Sustainability - We have inserted a clause in all of our bids that allows us to purchase up to 25% locally. Sustainability is playing a greater role in purchasing decisions and the awarding of bids. The new Prime Vendor is located 26 miles from campus compared to 75 miles for the old Prime Vendor. We also have expanded the role of the purchasing manager to include the responsibility of sustainability officer for the department.

- **The UMA Hotel** is taking the following steps towards a more sustainable environment -
  - Recycling bins are located at the Front Desk for guest use. There is access to numerous recycling bins on the 1<sup>st</sup> and 2<sup>nd</sup> concourses. Items recycled include cans, bottles, paper (white, newspaper), and cardboard. The water from the Air Conditioner in the upstairs office is used to water the flowers outside the entrance of the Hotel
  - Green Chemicals - Chemicals that are used to clean the hotel guest room bathrooms, counter tops, windows and mirrors are eco-friendly.
  - Saving of Water - We encourage our guests to reuse sheets and towels to conserve water.
  - Saving of Electricity - Various appliances in the Hotel Guest rooms are left unplugged until the guest plugs them in. The heat and Air Conditioner system is turned off when the hotel room is unoccupied and Ozone is used in laundry washing
  - Local Businesses - The Hotel purchases breakfast items from the UMA Bakery shop and locally owned bakeries and also purchases fruit from local farms
  - Paper Reduction - The majority of Hotel confirmations are sent out by email, fewer are printed out and mailed.
- **Sustainable Food Education** (also see Sec. 10 – Education, Outreach, and Research)  
UMA Dining regularly invites guest speakers to talk about sustainability related topics such as sustainable seafood, fair trade coffee, and the importance of the use of local products. We bring in guest chefs to train our staff in the use of local products for menu planning and weekly specials.
  - UMA Dining - UMA Dining maintains a website devoted to sustainability and updates it regularly to showcase new initiatives and highlight results.
  - Herb garden at Worcester DC - UMA Dining planted a herb garden at Worcester DC during the spring of 2009. We consulted with the Plant and Soil Sciences Department to determine which herbs would bring the most success. Herbs from this garden are used in meal preparation at Worcester Dining Commons.

- Stealth Health nutritional program - Dining Services implemented a Stealth Health Dining Program featuring healthier flavor-driven options without labeling them . Efforts include reducing sodium, offering small portions, and whole grain items, and eliminating trans fats, and implementing a Small Plate, Big Flavor program. We also doubled the consumption of fruits and vegetables on the menu.
- **College of Natural Sciences** brings together 15 departments and is a resource for research, education and outreach related to food and sustainable agriculture. Sustainability programs and initiatives include:
  - UMA Center for Agriculture brings together agricultural programs from Stockbridge School of Agriculture, UMass Extension, and the Massachusetts Agricultural Experiment Station all in the new College of Natural Sciences. The purpose of the Center for Agriculture is to serve as a portal through which individuals, industries, and agencies can connect with scientists and educators for agricultural research and information related to sustainable food production, food security, food safety, and environmental integrity.
  - UMA Farms - The farms operated by the College of Natural Sciences serve the research and education needs of faculty in the agricultural sciences. They cover the broad agricultural commodities found in Massachusetts and New England and are supported by State, Federal appropriated funds and grants and grants from the private sector. Agronomic crops, vegetables, turfgrass and livestock production occur at the UMass farms in Deerfield, livestock and equine in Hadley, fruit in Belchertown, and cranberry in East Wareham. The farms are a resource for student run farming activities and supply food for the dining services on campus.
  - Gardenshare – one credit student facilitated gardening course and Registered Student Organization.
  - UMA Student Farming Enterprise – Practicum that farms organic fields in South Deerfield, MA. Grows food for Earthfoods and UMass Dining Services.
- The mission of **the SGA Environmental Committee on Food & Waste** is to increase the amount of REAL (Local, Seasonal, Organic) FOOD in the UMA community. They offer many educational sessions on sustainability including:
  - Outreach and Education, e.g.,UMass Cooking Classes (UMaCCs) & EcoReps trainings
  - Building and coordinating UMass Gardens and Farms (starting with Franklin DC: Franklin Garden Project)
  - Creating Green Food Websites - SGAEC Food & Waste Website
  - Building a Strong Slow Food Five College Chapter - Slow Food Five Colleges
  - Real Food in the Pioneer Valley Film to be presented at Terra Madre 2010
  - Film Screening of Food Inc. with Director, Robert Kenner
  - Composting in Dorms
  - Eating and Enjoying REAL FOOD in Community

- **Earthfoods** - Their mission is to provide lacto-ovo vegetarian food at an inexpensive price to the UMass community. They purchase local food and food from the Student Farming Enterprise.
- **Just Food Now** – is a Blog/website dedicated to increasing awareness and consumption of good, clean and fair food.

### 8.3. Mitigating Strategies/Future Goals

The UMA Dining Services espouses the following strategies to move toward a more sustainable environment -

- Use reusable bags for grab-n-go (100% by Fall 2010)
- Another herb garden at Berkshire Dining Commons (by Spring 2010)
- An organic vegetable garden at Franklin Dining Commons (50% by Spring 2011)
- Purchase more from the UMA Student Farming Enterprise (starting Summer 2010)
- Implement a biodegradable program for flatware, bowls and utensils at retail operations (Fall 2010)
- More special events to promote ‘zero waste’ (2 per year starting Spring 2010)
- Purchase more local organic products (goal of 5% by Fall 2010)
- Achieve LEED certification for the Worcester Dining Commons renovation (2015)
- Install purified water coolers in all Dining Commons and grab-n-go locations (Fall 2010)
- More staff training and student outreach/education on sustainability issues (Spring 2010)
- Get involved in sustainability events and organization (Spring 2010)
- Reduce/Eliminate bottled water everywhere (2015)
- Improve composting in retail locations such as Pita Pit (Spring 2010)
- Discounted beverages for people w/reusable mugs (Spring 2010)
- Energy efficient dishwashers (ongoing)

The Farm UMass program has a goal of growing all of our own food, starting with seasonal goods. From there they intend to move into storage crops and season extension, grass fed animals and free-range eggs, and altered menus. The program hopes to re-integrate farming into the curriculum through offering a gardening program at orientation. This is a practical addition as a GenEd requirement, a practical addition to agricultural major, and create a major in small farm management.

## 9. Offsets and Sequestration

### 9.1. Introduction

UMA's approach to carbon offsets will be to avoid them if at all possible. Instead, we intend to funnel scarce resources to on-campus emissions reduction projects. Our ongoing goal will be to generate revenue through the sale of Renewable Energy Credits (RECs) from on-campus renewable energy and energy efficiency projects and to use this revenue to fund additional green projects. We will develop carbon negative forms of energy such as biochar (described below) to sequester carbon and offset any unavoidable emissions “in-house”. This will benefit the campus by providing educational and research opportunities while keeping University dollars on campus where they are sorely needed. We will investigate forest management and agricultural practices that have been shown to sequester carbon and apply these practices to campus land (forests, farms, orchards, and landscaping).

### 9.2. Baseline Data

UMA is not currently buying carbon offsets or sequestering carbon. Although UMass owns forested land, none of this forest can be counted toward sequestration according to the ACUPCC definition of “additionally.”<sup>6</sup>



#### **Renewable Energy Credits (RECs) Revenue:**

As a strategy for funding carbon reduction projects in an increasingly constricted budget environment, our ongoing strategy is to generate revenue through the sale of Renewable Energy Credits (RECs) from on-campus renewable energy. These funds will be set aside and dedicated to future energy conservation and carbon reduction projects on campus.

### 9.3. Future Goals

- **Biochar:**

Biochar is a form of charcoal produced by heating biomass in the absence of oxygen through a process called pyrolysis. Using forest, agricultural, and yard wastes, pyrolysis yields both bioenergy (in the form of syngas or bio-oil) and biochar. When buried in agricultural and forest soil, biochar has been found to be stable for hundreds to thousands of years, thus providing a permanent and affordable method of carbon sequestration. It has also been shown to enhance soil fertility and crop production and to prevent leaching of fertilizers and pesticides into ground water and waterways, thereby protecting water quality.

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<sup>6</sup> The American College and University Presidents' Climate Commitment (ACUPCC) document “Investing in Carbon Offsets: Guidelines for ACUPCC Institutions” states that “project reductions must be ‘in addition to’ reductions that would have occurred without the offset project or the incentives provided by offset credits.” (American College and University Presidents' Climate Commitment, November 2008 v1.0.)

UMA will investigate the possibility of conducting a feasibility study for the installation a pyrolysis system, either at the Central Heating Plant (CHP) or elsewhere on campus. The biofuel produced would be used in the campus state-of-the-art co-generation CHP (perhaps co-fired with biomass in a planned biomass boiler) and the biochar would be used for carbon sequestration and soil enhancement on University farms, orchards, forest, and landscaping operations. A small pilot system of 1-to 2-tons per hour could potentially offset 5,000 – 10,000 tons of CO<sub>2</sub> per year while generating bioenergy for on-campus use. The UMA had a Biomass Feasibility Study completed by an outside firm in December of 2009. This study did include the feasibility of using gasification at UMA and could be used as a jumping point for the inclusion of a pyrolysis system at UMA.

Using the pyrolysis system as a living laboratory, an interdisciplinary research team will investigate a range of topics including agricultural field testing of biochar, forest application, pyrolysis production of biofuels, and climate implications. As a first step, UMA recently held the Northeast Biochar Symposium and Biochar Technology Demonstration, which was attended by nearly 300 people, including representatives from Massachusetts State agencies (DEP, DAR, EOEEA), the USDA, and US House of Representatives.

- **Sequestration through forest and agricultural management:**  
UMA will investigate forest management and agricultural practices that have been shown to sequester carbon and apply these practices to campus land (forests, farms, orchards, and landscaping). For example, perennial agriculture has been found to sequester as much as 1000 times more carbon in the soil as annual agriculture.<sup>7</sup> We recommend that UMA pursue a research focus in agroforestry and permaculture, both of which use perennial and tree crops for food production, and to investigate applying these practices on University farms, forests, and landscapes.

#### 9.4. Tracking Progress

Guidelines for tracking biochar for sequestration are being developed by the United Nations as part of the current round of international climate talks. UMA would comply with these guidelines. Biochar is fairly simple and straightforward to measure and track, unlike many other forms of sequestration such as afforestation (tree-planting) or geological storage of CO<sub>2</sub> from power plant flue gases. Assuming that care is given to incorporate it into the soil to prevent loss from erosion or wind, biochar has been found to last in the soil for hundreds to thousands of years, providing safe, long-term carbon sequestration.

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<sup>7</sup> Glover, JD (2007) Future Farming: A Return to Roots? *Scientific American* 297, 82 – 89.

## 10. EDUCATION, OUTREACH and RESEARCH

### 10.1. Introduction

UMA is a vibrant community of faculty, students and staff that recognizes global climate change and other environmental concerns as the defining issues of our time. UMA continuously pursues research and learning with a goal of providing a sustainable environment.

As the flagship campus of the state university system, UMA has a special commitment to the Commonwealth of Massachusetts. As stated in a 2007 memorandum of understanding signed by University President Jack Wilson and Executive Office of Energy and Environmental Affairs (EOEEA) Secretary Ian Bowles, "...the University and EOEEA have the shared goal of increasing their cooperation in meeting the clean energy needs of the citizens of the Commonwealth through research, education and public service..." Through these activities, and by modeling the use of renewable energy technologies, energy efficient systems, and sustainable practices on campus, UMA is helping to foster a culture of environmental sustainability and promote clean energy-driven economic development throughout Massachusetts.

Students have access to groundbreaking courses and educational opportunities which explore cutting-edge technologies, current environmental controversies and potential solutions to the world's environmental issues. The following sections describe existing activities, future goals and implementation strategies to reach these goals.

### 10.2. Current Education and Outreach Activities

At UMA the commitment to education in environmentally sustainable issues extends throughout the fabric of the University, addressing lifestyle choices, providing curriculum options and developing the leaders of the future. Outreach involves a wide range of programs geared towards 1) bringing external information to the campus community; 2) disseminating information



beyond campus; and 3) integrating information throughout the UMA community. The following sections will highlight these actions through current activities and a plan for organized development of these important activities in the future.

- **Experiential Learning** describes activities on campus where significant education related to sustainability takes place outside the classroom environment. This includes student organizations and student-run businesses that are focused on environmental issues. The following are example programs that exist at UMA.
- **The UMA Eco-Rep Program** is a student-facilitated environmental education program that strives to create an environmentally literate student population, helping residential students reduce their individual impact on the environment. UMA's Eco-Rep Program is the largest program of its kind in the country and has one of the most extensive student leadership structures. Students participating in Eco-Rep are trained as effective peer educators and environmental stewards.
- **Student Government Association (SGA) Environment Committee** collaborates with UMA administration, staff, and students in order to implement environmentally sustainable initiatives in all realms of campus life. Their goal is to focus campus-wide efforts to create policies that contribute to sustainability and are financially efficient practices, minimizing the ecological footprint we generate for the benefit of future generations.
- **Engineers Without Borders** - the UMA Student Chapter of Engineers Without Borders organizes summer projects in Kenya and Brazil. Working with local populations in rural areas, students help develop a reliable, clean, and sustainable water supply and wastewater disposal for the villages.
- **Net Impact** is a diverse community of UMA graduate students dedicated to using the power of business to make a positive net social, environmental, and economic impact.
- **Student Farming Enterprise** - Students grow organic crops at the UMA Research Farm and bring to market for the UMA campus community.
- **Earthfoods Café** is a not-for-profit, student-run vegetarian collective founded in 1976 by a group of students concerned with the lack of economical, healthy food on campus. Their mission is to provide ovo-lacto vegetarian food at an inexpensive price to the campus community. Simultaneously, Earthfoods provides a cooperative learning environment for students who are seeking experience in restaurant management.
- For over 35 years, **the People's Market** has been a student-run collective that provides the UMA campus with conscientiously purchased natural foods. People's Market is a living classroom in business management, the food industry, and collective leadership.
- **Living Routes'** mission is to create opportunities to live and learn within human-scale communities that are consciously striving to live well and lightly. UMA students can study abroad in numerous locations from India to Australia and receive a

full semester worth of course credits for the sustainability focused studies that they complete while aboard through Living Routes.

- **Community Service Learning** Courses are offered through the Commonwealth Honors College and other individual Departments, developing community-based research projects and experiences while partnering with various community organizations. Several of these projects are specifically geared towards sustainable issues.

### 10.2.1. Classroom Curriculum

Formal curriculum related to sustainability is offered through a wide range of programs and Departments across campus. Such a breadth of courses and programs gives our students the opportunity to enhance their education with a solid understanding of contemporary environmental issues, regardless of their major or academic focus.

In addition, through the University Without Walls program students can develop their own curriculum in a cross disciplinary fashion. As part of the 5-College Consortium students can take courses at Smith College, Hampshire College, Mount Holyoke College and Amherst College to broaden their academic program. Many courses related to environmental sustainability are available through this consortium, but are out of the scope of this report.

The following sections address how UMA is improving the system to aid students pursuing sustainable coursework, as well as a list of programs focusing on sustainability.

- **Awareness of existing classes and degree programs**  
As a large University, UMA has a challenge in assisting students in identifying sustainability classes that are outside of their major. SPIRE, the web based course database and student administration program allows students to sort courses by discipline and obtain up-to-date course descriptions. New web pages have recently been developed to flag courses with a sustainability focus. These courses are listed by discipline and include links to their SPIRE information. An active outreach program to disseminate this information will take place in the next year.
- **Tracking of Sustainability Related Classes**  
To effectively provide information on courses with sustainability content, UMA has recently flagged such course . The College of Engineering took an additional step by asking each faculty member to verify courses in which there was significant coverage or awareness of sustainability issues. These new designations will be completed in Fall 2010.

- **Encourage Development of New Curriculum**  
Expanding the sustainability curriculum is a high priority. In the past year a Chancellor’s initiative for 1<sup>st</sup> year seminar programs to broaden the curriculum resulted in courses such as “Sociology of Climate Change”. An ongoing program of faculty teaching grants has also been tapped for development of relevant courses. Over the past five years entire programs have been developed which have a strong focus on sustainability. Examples include: 1) a Professional Masters in Green Building (Building and Construction Technology); 2) formation of an accredited Masters in Architecture which has a strong focus on sustainable design and a Master of Science in Design in Historic Preservation (Architecture and Design); 3) a new concentration in Sustainable Food and Farming (Plant, Soil and Insect Sciences); 4) a Bachelors Degree Program in Sustainable Entrepreneurship (University Without Walls); 5) a Green IT Technology Certificate Program is being developed through a Commonwealth Information Technology Initiative grant, 6) a proposal for a Master’s Degree program in Sustainability that would be trans-disciplinary, utilizing courses from each of the individual schools and colleges on campus; and 7) a proposal for a 5-College Sustainability Certificate (the 5-College consortium).

## 10.2.2. Continuing Education and Professional Development

The UMA Continuing and Professional Education department has developed a set of courses focused around sustainability, including a Sustainable Entrepreneurship course. Many of these programs and courses are related to classroom curricula, but extended to the greater community as continuing education opportunities. Specific examples are outlined below:

- **Continuing Education:**
  - **Online Green Building Professional Development Series** - Courses include Sustainable Building and LEED Certification, Energy Efficient Housing, The Built Environment, Green Building and Indoor Environmental Quality, Sustainable Sites for Green Building.
  - **Geothermal Heat Pump Installation and Design: Concept to Completion** - An intensive 2-day workshop designed to teach how to effectively and efficiently design and install geothermal heat pumps that meet state regulations and Massachusetts homeowner and business needs.
  - **Sustainable Food and Farming Series** - Courses designed to help the hobbyist or start-up farmer learn how to: Grow food organically and sustainably, reap the rewards of perennial vegetable production, start a Community Supported Agriculture (CSA) business, develop a small farm business plan, begin a maple syrup business, raise animals and start an animal products business.
  - **Sustainable Building LEED Platinum Tours and Lectures** - An intensive one-day workshop, which incorporates tours of LEED Platinum Certified National Grid Headquarters and LEED Platinum Certified Artist for Humanity building.

- UMA Extension is part of the national Cooperative Extension System partners with other organizations to offer research and educational opportunities through workshops, conferences, distance education, training events, consultations, and applied research. The Extension Agriculture and Landscape Program works with agricultural producers, the green industry, governments, and citizens on issues of an environmentally sustainable, economically viable food system. The Extension Natural Resources and Environmental Conservation Program brings together scientists, natural resource professionals, conservationists, and educators to provide educational programs focused on natural resource conservation. The Extension Nutrition Education Program works with low-income families, parenting teens, children and elderly at high risk of poverty, and professionals in agencies serving high need populations to improve health and nutritional status.
  - Massachusetts Water Resources Research Center (MWRRC)  
Located in The Environmental Institute, the MWRRC has a strong outreach component and works with volunteers across the state to monitoring water bodies for acid rain and stormwater management (water quality monitoring)– compiling lists of rain garden/stormwater projects and soliciting proposal ideas.
  - Library Resources  
Specific resources for sustainability include subject guides for Sustainability and Local Food. These online resources highlight Library databases which access local food/sustainability-related information.

### **10.2.3. Campus and Community Engagement**

Through such things as newsletters, the Eco-Rep program, and the Building Recycling Coordinator program, UMA reaches out to the community regarding sustainability issues. An active UMA Listserv networks individuals seeking to discuss ways to support and advance sustainability at UMA. Programs like Habitat for Humanity and river cleanups are done by student chapters of groups in various Schools and Colleges across campus.

- **Connecticut River Targeted Watershed Initiative Virtual Tour**  
The Massachusetts Water Resources Research Center (WRRC) and Center for Educational Software Development (CESD) have collaborated to create a Virtual Tour (VT) website for the EPA funded Connecticut River Targeted Watershed Initiative.
- **The Pioneer Valley Sustainability Network** was created through a 3-year EPA-funded project led by The Environmental Institute, MIE, and the Pioneer Valley Planning Commission to develop sustainability metrics for the region. Project outputs will include: 1) a sustainability network and associated web page; 2) sustainability metrics and associated maps representing the current values of the metrics; 3) an integrated assessment model of the impacts of electricity generation

alternatives on a number of attributes as defined by the metrics; and 4) a web-based interactive decision tool.

- **The 2010 UMA Extension Green Directory** is a comprehensive 37 page guide to educational resources for Massachusetts Agriculture and Landscape industry professionals.

#### 10.2.4. **Current/ Ongoing Conferences/Lectures**

There are a wealth of annual conferences, symposia and lecture series offerings at UMA that address some aspect of sustainability, are interdisciplinary and are open to the public. Examples include:

##### **Annual Conferences**

- Annual International Conference on Soils, Sediments, Water, and Energy
- Annual Mass Water Resources Research Center Conference
- Annual Clean Energy Connections Conference
- EPA/UMAEnviro Conference Series - 2010 to address Green and Sustainable Remediation
- Mass. Statewide Undergraduate Research Conference – Commonwealth College/UMA host
- Annual CO-OP Power June Energy Conference – UMA hosts site
- STEM Summits
- Mass Envirothon

##### **Lectures Series** (interdisciplinary and open to the public)

- TEI Environmental Lecture Series, The Environmental Institute
- Feng Lecture Series, Civil and Environmental Engineering
- INFORM Seminar Series, School of Management
- Environmental Activism Workshop for Students
- Community Art and Environment Projects
- K-12 Educational Partnerships
- Double Bill on Thursdays Feb. 25, March 11, March 25, April 15 , April 29
- Designing the Built Environment at UMA - Environmental Seminar Series
- Greening The Valley

#### 10.2.5. **Current Research Activities**

As a Research 1 Extensive University, the commitment to research at UMA is fundamental to our mission. Total research expenditures exceed \$125 million, with many centers, individual research projects and campus initiatives at the forefront of the research frontiers. Systemwide UMA research in clean energy was over \$18 million in 2006, an increase of 170% from 1998, with over 80% of research dollars for projects at UMA. Advancing renewable energy sources, improving energy efficiency, developing sustainable products, impacting human behavior and tracking environmental impacts

through a multitude of trans-disciplinary, collaborative projects, as well as individual research activities are all major on-going research efforts. Much of the research being done is through existing research centers and institutes, though a wide array of individual projects are also pushing for a more sustainable future.

- **Research Centers and Institutes**

- **Political Economy Research Institute**

Reports produced by the UMA Political Economy Research Institute show that the U.S. can create millions of jobs by investing in a rapid green economic recovery program, which will strengthen the economy, increase energy independence, and fight global warming.

- **Fueling the Future Center for Chemical Innovation**

The Center's goal is to improve the function and efficiency of today's fuel cells and lead the way toward meeting the worldwide technological challenge of developing this sustainable, domestic source of energy.

- **Energy Frontiers Research Center (Polymer Materials for Harvesting Solar Energy)**

The EFRC focuses on basic research in the area of polymer-based solar energy harvesting and conversion. The Center is one of just sixteen nationwide that to be funded through the American Recovery and Reinvestment Act of 2009.

- **The Institute for Massachusetts Biofuels Research**

The development of alternative, renewable fuel sources to reduce or replace our dependence on fossil fuels has emerged as a paramount challenge for maintaining the economic security of the United States.

- **Climate Systems Research Center**

The Climate System Research Center is a research facility UMA. Their research is focused on the climate system, climatic variability and global change issues, from contemporary climate variations, their causes and consequences, to paleo-climatic and paleo-environmental changes.

- **Center for Energy Efficiency and Renewable Energy (CEERE)**

CEERE provides technological and economic solutions to environmental problems resulting from energy production, industrial, manufacturing, and commercial activities, and land use practices.

- **Wind Energy Center**

The Wind Energy Center is a unique program that has distinguished UMA as the national leader in wind energy education, academic research, and service to government and industry for 34 years.

○ **Geobacter Project**

*Geobacter* species have the ability to transfer electrons onto the surface of electrodes, which makes it possible to design novel microbial fuel cells which can efficiently convert waste organic matter and renewable biomass to electricity. UMA is home to the world's leading *Geobacter* research center.

○ **The Environmental Institute**

The Environmental Institute encourages and supports collaborations across colleges and disciplines in environmental research and education through conferences, workshops, lecture series and other events and as connector to the environment on campus.

○ **Virtual Center for Supernetworks**

The mission of the Virtual Center for Supernetworks is to foster the study and application of supernetworks and to serve as a resource to academia, industry, and government on networks ranging from transportation, supply chains, telecommunication, and electric power networks.

○ **Green Building Research Group**

Green Building is a world-wide movement to create cleaner and more energy efficient buildings.

○ **Massachusetts Pesticide Analysis Laboratory**

The Massachusetts Pesticide Analysis Laboratory (MPAL) provides analytical services and scientific expertise for the regulation and enforcement of pesticide use in Massachusetts.

○ **Plant Tissue Testing Laboratory**

Services offered include a wide variety of soil tests, plant tissue testing, water testing, fertilizer testing, compost testing, and soilless greenhouse media testing.

○ **UMA Extension Plant Diagnostic Laboratory**

The Plant Diagnostic Laboratory evaluates plant samples and can call upon each other's expertise to make fast and accurate diagnoses.

○ **UMA Crops and Animal Research and Education Center (CAREC)**

This UMA farm is located in western Massachusetts in the central Connecticut River Valley where the soils and weather are representative of agriculture in New England. Currently there are nearly 150 acres of flat prime river bottom land adjacent to the Connecticut River, and more than 150 acres of hillside pasture and woodland. The land base offers a unique opportunity for research in pasture based, mixed farming systems With a focus on Community Supported Agriculture, implementation of Green Energy and Sustainable crops.

- **Center for Public Policy and Administration (CPPA)**  
The CPPA is the hub of interdisciplinary public policy research, teaching, and engagement at UMA. Within this center are graduate students pursuing research related to climate change issues. The Public Engagement Project (PEP) was established in 2008 as a collaboration between CPPA, the Center for Research on Families, the Sociology Department, SADRI, and the Psychology Department. Through panels, workshops, and mutual mentoring, PEP supports and trains UMA faculty members who want their research to make a difference in the world.
- **Center for Sustainable Design (Pending)**  
UMA is exploring the creation of a Center for Sustainable Design in Springfield. The center will be affiliated with the Architecture+Design Program, the Department of Landscape Architecture and Regional Planning, and the Building and Construction Technology Program. The Center will address architectural, urban and regional problems related to the natural and built environment, and will provide design expertise, technical assistance, and applied research to assist New England's communities.

#### **10.2.6. Support Structure for Future Research**

A concerted campaign to grow sponsored research in clean energy and sustainability on campus is underway. In September 2009 the Vice Chancellor for Research and Engagement announced a goal of doubling sponsored research on campus by 2015. Clean energy and sustainability research has been cited as a major pillar of this growth strategy. In pursuit of this goal, faculty-led projects and programs in clean energy and sustainability will see even greater support from the central campus administration.

Research development efforts are coordinated among relevant administrative units including: Research Affairs; Commercial Ventures and Intellectual Property, Research Liaison & Development, Government Affairs; The Environmental Institute, University Development; and University Relations. Senior faculty advisors and faculty working groups provide direction and leadership for campus research. Industry advisory boards provide a valuable market-oriented perspective. Such on-campus coordination and communication with off-campus partners in industry is necessary to expand the campus research portfolio and rapidly transition new knowledge and technologies related to clean energy and sustainability from the university into the marketplace where it can have an impact on society.

### **10.3. FUTURE GOALS**

To continue the development of learning opportunities and implementation of new technologies and concepts into Education and Outreach activities, the following should be implemented at UMA:

### **10.3.1. Visibility**

One thing that the UMA could do to build on achievements already accomplished at the university would be to promote, disseminate information about, and coordinate similar projects happening across campus. The UMA community, regional stakeholders and general public needs to be aware of current activities and future plans. Toward this end UMA needs to:

- Expand the Sustainability Coordinator's position and create an Office of Sustainability to coordinate, sustain and expand UMA wide efforts.
- Expand current presence in web, print and media outlets to quickly disseminate Teaching, Outreach and Research activities to those not directly involved.
- Be recognized as a leader in progressive Sustainability Activities in Teaching, Outreach and Research

### **10.3.2. Programming**

The UMA Education and Outreach programs are currently very vibrant, but would greatly benefit from coordination across campus. To this end the following plans are reliant on Visibility Goals. UMA needs to:

- Become the regional clearinghouse for education and outreach activities
- Become nationally recognized as a leader in program development and content related to sustainability
- Attract top students and organizations to our sustainability programs, both academic and extracurricular
- Develop high level partnerships in Education and Outreach

### **10.3.3. Research Targets**

UMA has been steadily improving in this area for many years, and future goals should be to not only continue to increase the quality and quantity of research, but also to improve the visibility of UMA activities. The UMA organizational structure has been recently revised to include the Vice Chancellor Office for Research and Engagement, specifically to focus on new initiatives. The Clean Energy for the Commonwealth Report to the UMA Clean Energy Working Group (2008) recommended that UMA pursue state-of-the-art facilities and instrumentation, seed and matching grants for development of research and education projects and provide faculty talent recruitment and retention funds. It is through the implementation of these recommendations that research be expanded in the coming years.

Furthering these goals, UMA needs to:

- Become a national leader in targeted areas of expertise

- Increase sustainability related research to 30% of total research funding.
- Set up method to track research related to sustainability
- Develop new partnerships with off-campus researchers and funding agencies

## **10.4. Mitigating Strategies**

### **10.4.1. Visibility**

Increasing the visibility of UMA's sustainability effort is essential to continued movement towards the goals and objectives set forth in this Climate Action Plan. In this regard UMA needs to:

- Expand the Sustainability Coordinator's position and create an Office of Sustainability— this office should be the central hub of all related activities in which UMA is involved. Expanded responsibilities should include coordination, dissemination, marketing, tracking and evaluation of activities related to sustainability. Its placement within the university structure should reflect the fact that sustainability is a part of both the operations and academics on campus.
- Continue development of the interactive Green Portal web presence at [www.umass.edu/green](http://www.umass.edu/green)
- Increase coordination efforts across disciplines and throughout 5 Colleges
- Develop fact sheets/brochures and ensure dissemination at Visitor Center, Campus Center, Hotel and Conference Services, Mullins center, etc.
- Enter the interdisciplinary Solar Decathlon in 2012

### **10.4.2. Programming**

The UMA sustainability effort needs to become second nature for the campus community. In order for this to occur, UMA should strive to achieve the following:

- Coordinate efforts in education and outreach throughout the 5-Colleges and region
- Complete course tracking program as an integrated part of course scheduling
- Institute faculty workshops to promote development of new educational materials
- Evaluate existing and new programs to measure effectiveness
- Utilize Foundations as an untapped resource for supporting Education and Outreach programs

- Increase number of Degree and Certificate programs related to sustainability offered through UMA (Master's, Bachelor's, Certificates)

### **10.4.3. Research Targets**

The following goals and objectives [milestones and specific targets] for research projects need to be established and tracked in order to make the sustainability effort second nature to the UMA community:

- Establish internal funding specifically for seed research projects in sustainability related topics through the Vice Chancellor for Research and Engagement
- Institute a policy of utilizing a portion of indirect costs resulting from sustainable research projects to promote research developments in related topics
- Develop facilities to meet the specific needs of research in topics related to sustainability
- Establish UMA-Chaired academic positions in sustainability
- Initiate a program to formally track research that is specifically focused on topics of sustainability
- Track Intellectual Property Disclosures founded in sustainability related research

## **11. Financing**

### **11.1. Introduction**

Implementing greenhouse gas emissions reduction strategies requires large amounts of upfront capital investments even when it is understood that these strategies will ultimately reduce overall expenses through the energy saving incurred by completed projects. These upfront capital investments are extremely challenging for UMA as it faces extensive budget cuts across the campus. However, UMA is dedicated to reducing its greenhouse gas emissions through a variety of financial strategies.

### **11.2. Current Funding Program**

- **The E+ Program**

The most significant source of funding that UMA has to effectively implement some of the strategies discussed throughout this plan is the E+ Program. The E+ Program is a funding mechanism that was established based on the successful ESCO that the university initiated with Johnson Control Inc. in 2003. The ESCO utilized state legislation that allows for a group of energy conservation and reduction projects to be funded through a short term borrowing and repaid by the university's operating budget as long as the entire group of projects has an overall simple payback of seven years or less.

Johnson Controls Inc. identified a group of 47 different energy conservation projects that had a total cost of \$42.7 million dollars, but had a 6.8-year simple payback that would yield roughly \$6.3 million dollars of saving each year. The ESCO was successfully completed in 2006 and the campus continues to incur the saving from this project. With the success of the ESCO project, Joyce Hatch, Vice Chancellor for Administration and Finance, decided that if there were more projects that could be completed through the same funding mechanism, that the university should establish a formal program to continue such efforts.



A study to identify other energy conservation projects revealed that there were still many projects that could be funded through a simple payback methodology. The E+ Program, where the campus loans the upfront costs of the project and utilizes savings in the utilities budget to pay back the loan, was created. Under the E+Program, UMA has created and funded three more groups of energy conservation projects. The university will continue to utilize this mechanism to fund more energy conservation projects in the future, with a goal of submitting a group of energy conservation projects to be funded each fiscal year through the E+ Program.

- **Expanding the E+ Program**

Currently, the E+ Program selects energy conservation projects based solely on the simple payback of each individual project. The calculation for simple payback is merely the capital cost of a project divided by the annual savings that will be incurred after the completion of the project (*Payback in years = Capital Cost / Annual Savings*)

However, UMA is working on expanding the E+ Program so that the estimated cost per metric ton of CO<sub>2</sub> equivalent avoided for each project will also be considered when choosing projects for future incorporation into the program.

$$\$/MTCO_2e = \frac{(Total\ NPV)}{(Total\ Years\ of\ Project)} \times \frac{1}{Annual\ MTCO_2e\ Avoided}$$

$$Total\ NPV = (Capital\ Cost) + (Annual\ Saving) \times \frac{(1 + r)^n - 1}{r(1 + r)^n}$$

where *r* = discount rate and *n* = total years of project

The annual greenhouse reduction potential of each energy conservation project is calculated by multiplying the amount of energy avoided annually (electricity, natural gas or other fossil fuels) by its emissions factor of combustion.

- **Sustainability Funds**

In addition to the E+ Program, UMA has dedicated funds purely for sustainability projects and programs on campus. The largest program that is supported by these funds in the UMass Amherst Eco-Rep Program, which is a peer-to-peer, student-facilitated environmental education program that strives to create an environmentally literate student population, helping residential students reduce their individual impact on the environment. UMA's Eco-Rep Program is the largest in the country and is the center of student involvement around issues of campus sustainability.

The sustainability funds that UMA has set aside also finances two student internships that give the most dedicated and capable students opportunities to gain first hand experience of developing campus sustainability with the Sustainability Coordinator. Due to the fact that the students are a driving force behind the advancement of campus sustainability, these two internships also allow the student body's enthusiasm to help the university as a whole take necessary steps toward a more sustainable future.

### **11.3. Additional Funding Opportunities**

- **UMA Revolving Green Fund**

One of the funding mechanisms that is currently being investigated is the potential for a Revolving Green Fund to be established. A Revolving Green Fund is an account established that would be used for subsidizing energy conservation and reduction projects that has too long to be economically feasible. The idea is that when money is used from the Green Fund to subsidize a project or group of projects that the borrowed money would be paid back via the cost savings from the project plus interest. This allows for projects with longer paybacks to be completed while providing a structure for the Green Fund to continue to grow in size.

Recently, the Class of 2010 decided that their class gift was going to be a donation to help start a UMA Revolving Green Fund. In conjunction with the Class of 2010's efforts, the SGA Environmental Committee will be initiating a ballot question during the Spring 2010 student government elections that will be to create a "Green Fee". A Green Fee is a small fee that students could pay each semester that would enter into the UMA Revolving Green Fund to help support energy conservation projects.

Student leaders and the UMA have begun to investigate how such a Revolving Green Fund could function on campus and will determine the possibility of having such a funding mechanism on campus in the near future. As part of this discussion, the idea of whether some of the energy saving that is occurred from future E+ Program projects could be channeled into the Revolving Green Fund.

As the UMA Revolving Green Fund grows, it could begin to fund projects that would have no payback but that would still benefit campus sustainability, such as student internships, student/faculty projects, etc.

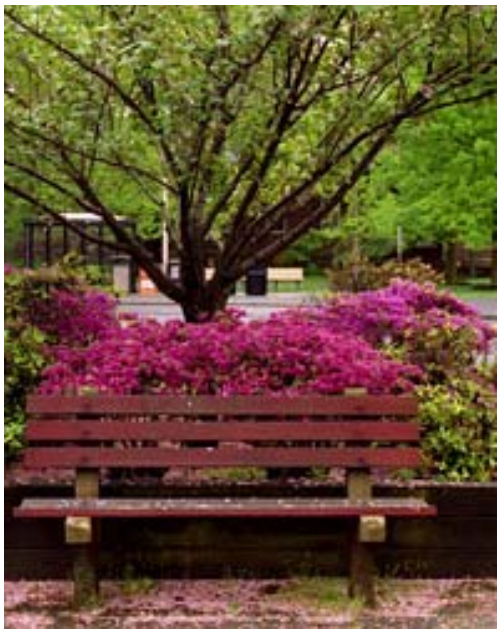
- **Position Expansions**

Another area that the UMA is investigating as possible expansion of funding for campus sustainability efforts is the expansion of the current Sustainability Coordinator position from a part-time graduate student position to a full-time staff position and the creation of more student internship opportunities. The expansion of the Sustainability Coordinator position is being investigated because of the great need for a staff position to exist that could coordinate all of the UMA's sustainability efforts as well as to work with the growing amount of student interest around such matters.

The investigation of creating more student internship opportunities has begun with determining if a student internship could be created that would focus on grant researching and writing with the aim to bring grant money campus sustainability projects. The other goal of this position would be that it becomes self-supported by the grants that are received through this intern's efforts. From there, the UMA will investigate the possibility of creating other student sustainability internship opportunities with focuses on energy conservation, waste reduction, communication, advertising, etc.

- **Renewable Energy Credits**

The new cogeneration Central Heating Plant that recently came online on the UMA campus in 2008 gains renewable energy credits (RECs) for the UMA. These RECs can be sold to other organizations that wish to offset their greenhouse gas emissions. The UMA is currently investigating the possibility of taking the profit from the sale of the RECs and using them to fund energy conservation projects on campus or to support campus sustainability programs such as the Eco-Rep Program.



***Final Thoughts*** - The UMA Climate Action Plan was crafted by the University community as a guiding document to help move the campus toward a more sustainable future. The plan will be continuously updated as the campus makes further reductions to its greenhouse gas emission. The latest version of the UMA Climate Action Plan can always be located at [www.umass.edu/green](http://www.umass.edu/green). With the formation of the UMA Climate Action Plan, the campus made great strides in becoming a leader in the area of environmental sustainability. EPAC, and the 100s of other UMA community members who contributed to this effort, are excited by the prospect of keeping the momentum going to enhance the campus' commitment to reduce its greenhouse gas emissions for a more sustainable future.

If you have any further questions or comments about the UMA Climate Action Plan, please contact our Sustainability Coordinator, Josh Stoffel, at [jstoffel@admin.umass.edu](mailto:jstoffel@admin.umass.edu).



DEVAL L. PATRICK  
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By His Excellency

DEVAL L. PATRICK  
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EXECUTIVE ORDER NO. 484

2007 APR 18 PM 2:49  
OFFICE OF THE SECRETARY OF STATE

**LEADING BY EXAMPLE—CLEAN ENERGY  
AND EFFICIENT BUILDINGS**

WHEREAS, buildings are significant users of energy, water and natural resources, consuming 39% of U.S. energy, 70% of U.S. electricity, 12% of U.S. potable water, and 40% of raw materials globally;

WHEREAS, the Commonwealth of Massachusetts manages over 64 million square feet of buildings at hundreds of facilities, which annually consume over 1 billion kilowatt hours of electricity, 22 million gallons of heating oil, and 46 million therms of natural gas;

WHEREAS, such energy consumption results in greenhouse gas emissions totaling more than 1.1 million tons per year, equivalent to the emissions generated by more than 200,000 cars driven for one year;

WHEREAS, environmental and health issues related to energy consumption, such as global climate change, regional mercury contamination, and urban asthma rates are critical issues that need to be addressed immediately and comprehensively;

WHEREAS, state government has an obligation to lead by example and demonstrate that large entities such as state colleges and universities, prisons, hospitals and others can make significant progress in reducing their environmental impacts, thereby providing a model for businesses and private citizens;



WHEREAS, by setting clean energy targets and developing clean energy practices, state agencies can play an important role in the development and support of new and local technologies, fostering innovation and benefiting the Massachusetts economy;

WHEREAS, leading-by-example programs can not only reduce environmental and health impacts but can also lead to significant cost savings;

WHEREAS, the Commonwealth is already committed to environmental protection and resource conservation through a variety of regional and state commitments, including, but not limited to, the Clean State Initiative, the Massachusetts Beyond 2000 Solid Waste Master Plan, the New England Governors/Eastern Canadian Premiers 2001 Climate Change Action Plan, the Commonwealth's Climate Protection Plan, the Toxics Use Reduction Reform Act of 2006, the Massachusetts Zero Mercury Strategy, and the Mass. LEED Plus green building standards for state construction;

WHEREAS, all the clean energy and environmental efforts under way within state government operations should be coordinated to ensure that programs are developed and implemented as effectively and efficiently as possible;

WHEREAS, this Administration intends to send a clear message to all state agencies that practicing what we preach is a priority and that agencies should integrate clean energy, environmental protection, and resource conservation programs, policies and procedures into all appropriate aspects of governing;

NOW, THEREFORE, I, Deval L. Patrick, Governor of the Commonwealth of Massachusetts, by virtue of the authority vested in me by the Constitution, Part 2, c. 2, § 1, Art. I, order as follows:

I affirm that state agencies shall prioritize practices and programs that address resource use at state facilities, including a reduction in energy

consumption derived from fossil fuels and emissions associated with such consumption.

Furthermore, I direct the Executive Offices of Energy and Environmental Affairs (EOEEA) and Administration and Finance (A&F) to establish and direct a **Leading by Example Program** (the Program), the purpose of which shall be to oversee and coordinate efforts at state agencies, including all UMass campuses and all state and community colleges, to reduce their environmental impact. Such efforts shall include, but not be limited to, the provisions of this Order to promote energy conservation and clean energy practices, as well as waste reduction and recycling, environmentally preferable procurement, toxics use reduction, water conservation, sustainable transportation, open space and natural resource protection, and improved compliance practices.

The Secretaries of EOEEA and A&F or their designees shall co-chair the **Leading by Example Council** (Council), which shall consist of members from each of the Commonwealth Executive Offices, with specific additional membership to be determined by the co-chairs. The purposes of the Council shall be to provide advice and feedback to the Program to facilitate the implementation of key initiatives that will result in reduced environmental impacts at state agencies. The Council shall coordinate efforts with all agencies, who shall appoint program coordinators to act as liaisons between the Council and agency staff and support Program efforts.

Furthermore, the Program shall direct all efforts across state government to track and measure progress toward clean energy and environmental goals, develop long-term programs at state facilities to identify and implement cost-effective initiatives that will result in environmental improvement, and offer educational and training efforts necessary to carry out the provisions of this Order and other related directives. Agencies shall provide all necessary support to the Council and Program and agency staff shall serve, as appropriate, on the Council or other internal committees as requested by the Secretaries of EOEEA and A&F. Agencies shall also provide all requested data related to facility operations and energy use at least annually or on an alternative schedule determined by the Council.

## **I. Energy Targets for Agency Buildings**

All Commonwealth agencies as a whole and, to the greatest extent feasible individually, shall meet the following targets:

1. Reduce greenhouse gas emissions that result from state government operations by 25% by Fiscal Year 2012, 40% by 2020 and 80% by 2050. In calculating emissions, agencies shall use Fiscal Year 2002 as the baseline, and emissions reductions shall be measured on an absolute basis and not adjusted for facility expansion, load growth, or weather.
2. Reduce overall energy consumption at state owned and leased (at which the state pays directly for energy) buildings by 20% by Fiscal Year 2012 and 35% by 2020. Such reductions shall be based on a Fiscal Year 2004 baseline and measured on a BTU per square foot basis.
3. Procure 15% of agency annual electricity consumption from renewable sources by 2012 and 30% by 2020. This mandate may be achieved through procurement of renewable energy supply, purchase of renewable energy certificates (RECs) in accordance with EOEEA guidance and/or through the production of on-site renewable power. Only renewable sources that qualify for the Massachusetts Renewable Portfolio Standard (RPS) shall be eligible. Alternative compliance payments under 225 CMR 14.08 shall not be required under this Order.
4. Utilize bio heat products with a minimum blend of 3% bio based materials for all heating applications that use #2 fuel starting with the winter of 2007-2008, and 10% bio heat blend by 2012.
5. All new construction and major renovations, effective immediately, must meet the Mass. LEED Plus green building standard established by the Commonwealth of Massachusetts Sustainable Design Roundtable.
6. Reduce potable water use, as compared to 2006, by 10% by 2012 and 15% by 2020.

Where appropriate, EOEEA, A&F and the Council shall establish alternative baselines and guidelines for meeting the above targets.

## **II. Clean Energy Committee**

A Clean Energy Committee, to be chaired by Secretary of the Executive Office of Energy and Environmental Affairs and the Commissioner of the Division of Capital Asset Management (DCAM), or their designees, shall be established to facilitate implementation of this Order and to assist agencies in their efforts to meet the targets and requirements herein. The Committee shall consist of representatives of the Division of Energy Resources (DOER), the Operational Services Division (OSD), and other agencies as determined by the chairs. The Committee shall meet regularly and shall communicate with agencies through designated Program Coordinators, who shall be responsible for disseminating all applicable information from the Committee to agency staff, coordinating agency energy activities, and tracking and reporting all requested energy consumption data to the Committee and Council.

The Committee shall, by February 1st of each year, submit to the Governor an annual report on the results of energy conservation actions taken by agencies during the prior fiscal year, the environmental and economic impacts of such actions, and recommendations for future energy reductions. The Committee shall also solicit advice on energy reduction goals from experts outside of state government, including, but not limited to, federal agencies, other states, and not-for-profit organizations. The Committee shall also consider and propose longer-term energy conservation strategies for state government and submit such proposals to the Governor.

## **III. Energy Measures and Strategies**

To meet the above targets, agencies may utilize a variety of energy conservation, energy efficiency and renewable energy strategies, including but not limited to:

- Comprehensive on-site energy efficiency programs
- Installation of energy efficient HVAC equipment
- Fuel switching
- Purchase of energy efficient products

- Increased energy conservation by employees
- Installation of on-site renewable energy and combined heat and power systems
- Procurement of renewable energy
- Use of bio-based and other alternative fuels
- Purchase of Renewable Energy Certificates

To meet the goals of this Order, all agencies shall adopt, where applicable, specific measures including but not limited to:

### **Energy Conservation**

- Develop and disseminate an agency-wide policy that encourages employees to reduce energy use by turning off lights in rooms when not in use, shutting down computers when leaving work, minimizing use of personal appliances, and other actions that will lead to a reduction in energy consumption and costs.
- Run dishwashers and laundry equipment only when fully loaded.
- Set thermostats 2 degrees lower than usual during the winter and 2 degrees higher than usual during the summer.
- Reduce lighting in common areas without compromising safety.
- Minimize energy use at facilities during non-work hours.

### **Energy Efficient Products**

I direct the Environmentally Preferable Products (EPP) Program of OSD to continue to make energy efficient products available on statewide contracts that meet the needs of state agencies and the requirements of this Order. Agencies shall also adopt, where applicable, specific energy efficiency measures including but not limited to the following:

- Use only efficient lights such as compact fluorescent lamps, LED lighting, or other similar products. Until further notice, agencies shall be prohibited from purchasing incandescent lights unless absolutely necessary to meet a specific and unique agency need.
- Install LED and/or photoluminescent exit signs to replace those with incandescent or fluorescent lighting wherever cost effective.
- Install programmable thermostats.

- Install motion sensors or timing devices in rooms that are used only intermittently, such as conference rooms, bathrooms, etc.
- Procure only computers, monitors, copiers, printers, and other office equipment that are EnergyStar qualified, enable all EnergyStar features upon installation, and establish policies and procedures to ensure that such equipment continues to operate efficiently during its life.

### **Energy Efficiency Programs**

I direct the Division of Capital Asset Management, in collaboration with EOEEA, to maximize the number and scope of energy efficiency efforts at state facilities. DCAM and EOEEA shall, in consultation with A&F, identify and recommend appropriate changes to construction laws and financing mechanisms necessary to ensure that the following goals are achieved by the end of Fiscal Year 2012:

- Comprehensive, large-scale energy efficiency projects at all appropriate facilities over 100,000 square feet.
- Implementation of energy efficiency programs such as installation of new equipment, agency coordinated performance contracts, and lighting retrofits at all facilities where the cost of such programs is less than \$1 million.
- Completion of smaller energy efficiency projects at all appropriate smaller state facilities where the cost of such projects is less than \$100,000, and electric and gas utility incentive programs cover a significant portion of the project cost.

Furthermore, DCAM and EOEEA shall coordinate efforts to ensure that:

- All renovation and new construction projects identify and utilize all available utility rebates.
- All applicable buildings over 50,000 square feet undergo a “retro-commissioning” process to identify and implement low-cost and no-cost energy and water conservation measures with short payback periods.
- Changes to building processes, funding mechanisms and regulations that are necessary to meet the goals of this Order are developed and implemented.

In addition, DCAM is directed to ensure that site selection for leased space considers energy performance.

### **Energy Training and Maintenance**

DCAM's Office of Facilities Maintenance shall, in coordination with agencies:

- Develop and implement a facility maintenance program and schedule for lighting and HVAC systems, including but not limited to, lubricating, balancing, aligning, vacuuming, cleaning, and checking seals, to ensure optimum efficiency.
- Ensure that all appropriate staff receive regular training on proper facility management and maintenance practices.

## **IV. Renewable Energy**

To achieve the renewable energy goals of this Order and obtain 15% of agency electricity from renewable resources by 2012 and 30% by 2020, agencies shall make every effort to power their facilities with clean, renewable energy resources (e.g. wind, solar PV, solar thermal, biomass, landfill gas, anaerobic digestion) that are RPS eligible. Such efforts may include the installation of on-site distributed generation, the purchase of renewable power from energy suppliers, and/or the use of Renewable Energy Certificates (RECs) in compliance with the REC guidance established by EOEEA.

EOEEA, DCAM, OSD and DOER shall continue to assist agencies in meeting these goals through bundled clean electricity contracts, technical and financial assistance, project management and policy initiatives. These entities shall continue to monitor and evaluate options for increasing the renewable energy portfolio of state government's electricity use.

## **V. Biofuels**

To achieve the 3% bioheat goal of this Order, agencies shall commence the purchase of this fuel as of October 1, 2007 for all facilities that use #2 heating oil, or as soon as available through statewide contracts. To facilitate agency use of this fuel, EOEEA and OSD shall conduct informational and training sessions prior to October 1, 2007 to address any

questions and report on the result of the bioheat pilot conducted during the winter of 2006-2007. Additionally, OSD is hereby directed to establish a heating fuel contract that specifies biofuel for oil heating products specified by this Order.

Furthermore, I direct EOEEA and OSD to work with cities and towns to inform them of this new policy and encourage them to utilize bioheat. Pending availability, performance and cost, EOEEA and OSD shall review annually the use of bioheat and develop recommendations for increasing the bioheat goals in this Order to a minimum of 10% by 2012.

## **VI. Building Design and Construction**

DCAM and all agencies involved in the construction and renovation of state facilities shall ensure that all new construction and major renovation projects are energy and water efficient, conserve the use of resources, and provide healthy and productive spaces for employees, clients, and visitors.

To achieve these goals, I endorse the recommendations of the Commonwealth of Massachusetts Sustainable Design Roundtable (Roundtable), which require all new construction at state agencies and significant renovation projects over 20,000 square feet to meet a Mass. LEED Plus building standard. For projects smaller than 20,000 square feet, all projects shall at least meet the minimum energy performance standards established by the Roundtable.

The Mass. LEED Plus standard includes:

- Certification by the U.S. Green Building Council Leadership in Energy and Environmental Design (LEED) program for all new construction and major renovation projects over 20,000 square feet;
- Energy Performance 20% better than the Massachusetts Energy Code;
- Independent 3rd party commissioning;
- Reduction of outdoor water consumption by 50% and indoor water consumption by 20% relative to standard baseline projections; and
- Conformance with at least 1 of 4 identified smart growth criteria.

The Mass. LEED Plus standard shall apply to all projects overseen by DCAM and any other executive agency, as well as those that are built for use by state agencies on state land. In addition, EOEEA shall coordinate efforts to incorporate the Mass. LEED Plus standard into all non-executive branch agencies involved in construction. EOEEA and DCAM shall report each year on progress made with regard to integration of this standard into state building projects.

Furthermore, whenever DCAM requires the construction of a new building to be leased by DCAM, DCAM shall establish and incorporate energy performance criteria consistent with the energy goals of this Order.

Additionally, I direct EOEEA and DCAM to support education and training programs for agency personnel and periodically consult with design and construction practitioners to review progress in meeting green building standards, develop strategies to improve communication of the benefits of green buildings, and identify new opportunities for expanded green building efforts.

## **VII. Distributed Generation**

In order to facilitate the installation of on-site renewable energy and Combined Heat and Power projects, within 6 months of the date of this Order, the DOER shall provide an analysis of the barriers to distributed generation that impede the successful completion of such projects at state facilities and, through collaboration with DCAM, OSD, and the Comptroller's office, shall develop recommendations on addressing identified barriers.

## **VIII. Forward Capacity Market**

In order to take advantage of the new ISO-New England Forward Capacity Market (FCM) Program, including the Demand Response Program, which allocate payments for new electric generation capacity, and measurable reductions in electricity use, agencies shall identify and submit all applicable projects for inclusion in the FCM program. DCAM shall coordinate this effort and, in collaboration with EOEEA and OSD, establish the necessary vehicles to facilitate agency participation in this program as well as ensure that payments received are allocated to agencies for additional energy reduction activities. DCAM may elect to

allocate portions of FCM payments in order to manage this program as well as other related energy efforts.

## **IX. Energy Tracking**

The EOEEA is hereby charged with development and implementation of an Energy Information System (EIS) that shall facilitate the tracking of agency energy use and prioritization of energy efficiency programs and projects at state facilities. Such a system will allow facilities to compare building energy consumption and rate energy performance of Commonwealth buildings. DOER and DCAM shall collaborate in the development of the EIS and shall work to ensure that DCAM information systems, such as CAMIS, are effectively linked with any new energy tracking systems. EOEEA and DCAM shall annually track all energy use at state facilities to determine compliance with the goals of this Order and, as appropriate, share this data with other state agencies to further the purposes of this Order.

The development of the EIS shall not eliminate the need for agencies to track other energy and water use and submit annual data to EOEEA as directed by the Council.

## **X. Water Conservation**

Agencies shall make every effort to reduce overall water use and increase water use efficiency to the maximum extent possible. Toward this end, all state agencies shall reduce water use through the following indoor and outdoor measures:

### **Indoor Water Consumption**

- Conduct periodic water audits and system-wide leak detection programs.
- Work toward metering all significant water uses.
- Strictly apply plumbing codes, and actively promote waterless plumbing fixtures, where appropriate.
- Replace and retrofit older water consuming equipment, such as toilets, faucets and showerheads, with modern, more efficient devices as quickly as possible.

- Implementation of energy efficiency programs such as installation of new equipment, agency coordinated performance contracts, and lighting retrofits at all facilities where the cost of such programs is less than \$1 million.

### **Outdoor Water Consumption**

- Minimize, and wherever possible eliminate, use of potable water and groundwater for outdoor watering purposes, street cleaning, and building washing.
- Lower watering frequency.
- Improve watering efficiency by watering lawns and plants only when necessary through use of moisture sensors and/or drip irrigation techniques.
- Incorporate Low Impact Development (LID) techniques wherever possible, including use of natural landscaping, permeable pavement, and native and drought resistant vegetation to prevent run-off and ensure rainwater infiltration into the groundwater.
- When procuring services for lawn and landscape maintenance, require contractors to minimize water use wherever possible through incorporation of the above techniques.

## **XI. Technology**

Agencies are hereby directed to analyze and consider use of innovative technologies wherever possible, either on a pilot- or long-term basis, when such technologies can demonstrate environmental and fiscal benefits. Where possible, and to the extent permitted by law, agencies shall work to identify technologies developed and/or manufactured in Massachusetts.

## **XII. Financing**

In order to facilitate the above efforts, EOEEA and A&F shall, within 6 months of the effective date of this Order, submit to me recommendations concerning financing options that will result in energy and water improvements at state facilities without requiring significant infusion of state funding.

### **XIII. Resources and Commitment**

All agencies shall provide the necessary resources and commitment to meet the goals of this Order.

### **XIV. Effective Date**

This Order shall take effect immediately and shall continue in effect until amended, superseded, or revoked by subsequent Executive Order. This Order shall supersede Executive Order No. 438 and all provisions contained in Administration Bulletin #11 and #12.



Given at the Executive Chamber in Boston this 16<sup>th</sup> day of April in the year of our Lord two thousand and seven, and of the Independence of the United States of America two hundred and thirty-one.

A handwritten signature in black ink, appearing to read "Deval L. Patrick".

DEVAL L. PATRICK, GOVERNOR  
Commonwealth of Massachusetts

A handwritten signature in black ink, appearing to read "William Francis Galvin".

William Francis Galvin  
Secretary of the Commonwealth

**GOD SAVE THE COMMONWEALTH OF MASSACHUSETTS**

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