Annual Sustainability Report

A report of the University of Massachusetts

September 2016

University of Massachusetts

Amherst • Boston • Dartmouth • Lowell • Medical School • UMassOnline

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Section 1: Executive Summary & University Efforts

The University of Massachusetts (UMass), which includes five campuses in Amherst, Boston, Dartmouth, Lowell and the Medical School in Worcester, has made a collective commitment to be "good steward of resources" including not only fiscal resources but also a commitment to be environmentally responsible. Each of the University's campuses conducts a wide variety of sustainable programs and services, many of which are unique to its campus population but all of which serve to make UMass as a whole better stewards of our environmental resources. The efforts and achievements of each of the campuses demonstrates the strong responsibility felt by members of the University community to our role as stewards of environmental resources. The report that follows represents the programs and achievements of our campuses during fiscal year 2016. For prior year reports on campus sustainability efforts please refer to our website: www.umassp.edu/budget-office/sustainability

LEARN LIVE LEAD Sustainable UMASS

UMass Amherst is a sustainability leader serving as a model for communities across the country. Students learn about sustainability through courses, majors, programs, co-curricular activities, and research. The campus is a culture of sustainability and lives sustainably through efficient practices in food, energy, and waste. UMass Amherst continues to be on the forefront of research and innovation. It is a community of changemakers honored for leadership. Learn, Live, and Lead It. Sustainable UMass!

UMass Boston has a historically strong commitment to environmental sustainability. The campus' sustainability program, UMBe Green, encompasses four areas in working towards sustainability campus wide and beyond: Recycling, Sustainability, Education and Practice and collaborates with departments campus-wide to make sustainability a part of the daily experience and support the vision and mission of UMass Boston.

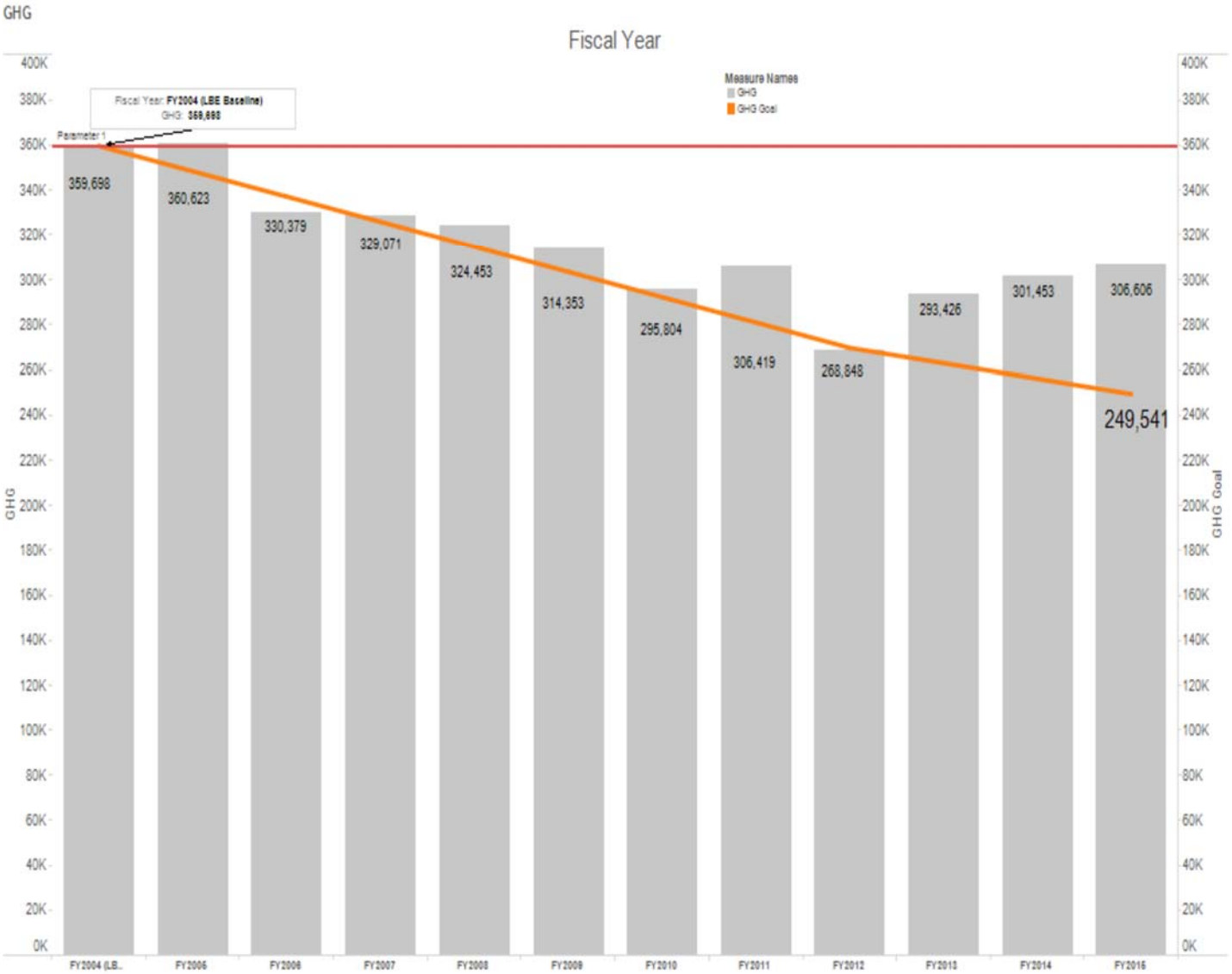
UMass Dartmouth is committed to the principles of sustainability through a network of staff, students, faculty and administrators passionate about the cause of reducing energy and natural resource demands. The University is on a path of adaptation to the needs of energy conservation, clean energy sources, food security, local and national economic resiliency and dissemination of sustainability knowledge to its students and our global citizenry.

UMass Lowell is committed to climate neutrality as an institution, and as a leader in sustainable education, research and innovation. The University's first Office of Sustainability began operations in 2015 and along with the Climate Action Plan Steering Committee serves as the primary managing bodies for sustainability initiatives on campus. Our commitment to sustainability serves as a means to attract the best talent and engage the entire campus community to help our students become leaders in a changing world.

The Medical School is committed to sustainability throughout its campus operations, as well as by encouraging sustainable practices among its students, faculty and staff. As programs in research, education, public service and clinical care expand, the community is working cooperatively on a multi-layered program to reduce energy consumption, reduce greenhouse gas emissions, and expand recycling and other measures that collectively will limit the campus' carbon footprint.

Executive Summary

In 2007, the University President and all five campus Chancellors signed the American College & University Presidents' Climate Commitment (ACUPCC). In so doing, the University committed to developing a plan for achieving carbon neutrality, taking concrete initial steps in order to achieve this goal, and publishing progress reports. As of FY2015, the University has succeeded in reducing its carbon emissions by 14.76% when compared to *the Leading By Example* baseline. Strategic investments in energy efficiency, recycling, building improvements and others have the campuses on course to meet their goals.



During that same year, then Governor Deval L. Patrick filed Executive Order 484 which established aggressive targets for state agencies including reducing greenhouse gas emissions. It requires state agencies to reach targets through obtaining electricity from clean sources and reducing potable water use. State universities are a key component of the state's efforts to reduce energy use and greenhouse gas emissions as stewards of over 25 million square feet of property across the entire Commonwealth.

In October 2009, Governor Patrick signed Executive Order 515 known as the Environmental Purchasing Policy. As part of the Commonwealth's overall goals of conserving natural resources, reducing waste, protecting public health and the environment, and promoting the use of clean technologies, recycled materials, and less toxic products, this policy committed to reducing State Agency impact on the environment and enhancing public health by procuring Environmentally Preferable Products and services (EPPs) whenever such products and services are readily available.

Since taking office in January of 2015, Governor Charlie Baker has also indicated his commitment to energy and sustainability efforts with a focus on diversification of the Commonwealth's energy sources. The Governor's administration has been actively developing policy proposals and advocating for alternative sources of energy. Prior to the end of the session, the Legislature approved and the Governor signed an energy diversification law implementing requirements for utilities to enter into long-term commitments for off-shore wind and hydroelectric power. The new law also creates opportunities to finance energy improvements for commercial properties, addresses improvements to renewable power storage; and prioritizes gas leak identification and remediation. While the law does not directly impact the University energy portfolio, the legislation aligns with the University's goal of reducing carbon emissions and increasing renewable energy consumption. Under the legislation, the Department of Energy Resources is authorized to establish a carbon reduction research center at UMass Lowell. The center would be created to advance the Commonwealth's carbon reduction targets and foster diverse research initiatives. The University welcomes the opportunity to leverage the accomplishments and work already in progress across the system in order to further advance the Commonwealth's carbon reduction goals.

In an effort to do our part, the University through each campus has dedicated staff focused on environmental responsibility. The UMass Sustainability Committee, comprised of the campus Sustainability/Energy Mangers and President's Office Budget Staff has been meeting regularly to discuss Sustainability/Energy Management topics ranging from clean energy and efficiency, to the reduction of greenhouse gas emissions as well as: waste reduction and recycling, water conservation, green buildings, alternative fuels, and efficient transportation. The group uses this collaboration to determine other areas where the University can work together to be more sustainable and determines areas where collaboration will create a more sustainable University.

One area where the Sustainability Group has been successful is in its partnership with the University's Procurement Council. In 2014, the Sustainability Committee partnered with the Procurement Council to determine areas where the University can employ procurement practices that will help to support the University's sustainability mission. It was determined that although some campuses currently strive to follow green guidelines, each are employing different standards and are experiencing varying levels of success. As a mechanism to launch a more cohesive and measurable effort in the procurement area, the group decided to work on specific commodities that would have significant impact. While several campuses currently utilize 30% recycled paper, it was agreed that a system-wide effort would improve compliance, and that immediate steps should be taken to formalize the recycled paper program at a system level.

As a result in FY16, Office Max was able to report that 42% of total spend on paper was on some level of recycled paper. In addition, the group continues to discuss standards that exist through the Sustainability Tracking, Assessment & Rating System (STARS) which may guide our procurement practices in the future. The collaboration is just beginning in the hope that these two groups can share ideas and best practices and work together to develop programs that support the University's sustainability goals.

Based on peer best practices, the Sustainability Council endeavored to craft a Board of Trustees policy on sustainability. The goal of such a policy is to reaffirm the University's commitment to the central tenets of the ACUPCC, bolster efforts around climate resilience, demonstrate sustainability as an institutional priority, and set the road map for achieving climate neutrality. Many colleges, universities, and systems have adopted similar policies and research to date have utilized the experience of others that have been successful to explore best practices. The Sustainability Directors and President's Office have been researching best practices, sustainability trends, and current reporting requirements in order to make informed decisions about what policy ideas should be adopted. The Sustainability Council has drafted a policy which has been reviewed by key campus stakeholders in order to incorporate multiple perspectives in this comprehensive document. The Sustainability Council is prepared to present the draft policy to the Board for feedback and consideration for approval during Winter 2016.

The first step in our process was research. In order to begin drafting, it was imperative to understand what other colleges and universities sustainability policies looked like and comprehend what was being included in those guiding documents. The Sustainability Council divided up a list of institutions who have adopted sustainability polices that are tracked by the Association for the Advancement of Sustainability in Higher Education (AASHE). The committee reviewed these policies to gain an understanding of how institutions choose to structure polices and what types of topics were generally, or specifically, covered. The research into these policies provided the group with some excellent examples to begin to build a framework for a UMass policy.

	Reduce GHG Emissions/carbon neutrality	Climate Resilience	Green Building Standards	Reduce Energy consumption	Renewable and clean energy sources	Sustainable Transportation	Recycling and Waste Management	Environmentally Preferable Purchasing	Sustainable Food Service	Sustainable Water System	Academic Programming & Community Engagement	Accountability Metrics
University of California	x	x	x	x	x	x	x	x	x	x		x
University of Kentucky	x			x	x			x			x	x
University of North Carolina - Chapel Hill	x			x	x	x	x				x	x
University of Texas	x		x	x			x				x	x
University of Minnesota - Twin Cities	x		x	x		x	x	x			x	x
Executive Orders 484/515	x		x	x	x	x		x		x		x
AASHE/STARS	x	x	x	x	x	x	x	x	x	x	x	x
ACUPCC	x	x	x	x	x	x					x	x

Utilizing the research conducted helped shape the format of the draft policy and hone discussions about the important areas contained in the document. The policy is organized by guiding principles outlining the major areas of focus that impact sustainability on campuses. It is important to note that the guiding principles in the draft policy are reflective of the sections outlined in this report for each campus to provide updates on efforts underway. Specific goals, which tackle specific issues, are then outlined under each principle in the draft policy. The Administrative Standards section was developed to address each goal with more specific information and determine how it would be evaluated over time. The development of the standards was achieved by answering six vital questions which centers on the importance of the goal, defines the goal, outlines progress achieved, etc. Further the standards have incorporated metrics for each goal to be evaluated on moving forward. We have included metrics that the campuses are currently collecting data for reporting to ACUPCC and/or STARS. To begin with, these metrics are fluid in nature in order to allow for the development of better refined data-points which can be utilized to manage the progress towards a goal. One key aspect of the policy document, which is the first priority, is for each campus to conduct and establish a sustainability strategic plan. The goal of this plan is to establish more precise information around the energy needs of each campus and seeks to align the needs of the campus in every aspect of sustainability with other strategic initiatives.

As previously noted, the Council is seeking Board of Trustee approval for the policy in the coming months. As part of the consideration of the policy and a desire to include trustees in the review process, the draft policy has been provided in a form which allows Board members to comment, make recommendations, and seek additional information prior to the formal consideration of the policy.

In addition to the efforts of the Sustainability group, the Strategic Energy Committee, which was created to leverage system-wide volume for energy procurements, share and implement best practices and develop standard metrics to measure building efficiency and implement energy reduction strategies. This effort culminated in contracting multiple Solar Net Metering projects which reduces the cost of power to our campuses and eventually the region. In addition, this initiative is projected to save millions for the University and created internships at several companies to support the UMass student experience.

UMass entered into 17 separate solar net excess generation contracts with 10 different solar developers totaling 48 MW (DC) of new solar capacity in Massachusetts. As of the end of FY15 13 of the 17 projects are operational, totaling 40 MW (DC). When all of these projects are fully operational they are expected to generate roughly 57 million kWh over the first 12 months and roughly 1.085 billion kWh over the first 20 years of their life. These solar projects supported by the University of Massachusetts will help the Massachusetts electric grid avoid[1] a total of 27,390 metric tons of CO2 in the first full year the solar installations are operational. Over the 20 year NEGC commitment, this will amount to a total of 522,553 metric tons of CO2 offset through projects supported by UMass.

The 27,390 metric tons equate to about 9% [2] of the 306,606[3] metric tons of GHG emissions created by the University of Massachusetts system for the FY2015 time frame.

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[1] As discussed previously the solar developers keep the REC's and thus the environmental attributes that can be publicly claimed. UMass through their participation helped to facilitate the creation and financing of these projects and were integral in these projects coming to fruition.

[2] The 9% is used only as a reference point for comparison. UMass can't claim these reductions from their GHG inventory.

[3] GHG values are based on the FY15 scope 1 & 2 emissions associated with building energy consumption (non-weather normalized).

The chart below provides more detailed information regarding the solar projects described in the previous section. It highlights the project by campus and the location of the generation facility. Additionally it shows the system capacity and the projected savings associated with each project. Those highlighted in yellow are active projects already online while the green are projects slated to be constructed and brought online in the near future.

Campus	Developer	Project Name	Expected Online Date	System Capacity (MW-DC)	System Location	Discount off Credit Value	Projected Savings 1st 12 Months [5]	Projected Savings 20 Years [6]
Lowell	Mass Midstate Solar 1, LLC [1]	Warren A	Active	5.60	Warren	37.50%	$340,000	$7,931,000
Lowell	Hubbardston Solar, LLC [2]	Hubbardston	Active	2.50	Hubbardston	35.00%	$130,000	$2,961,000
Lowell	Nexamp	Westford	Active	1.50	Westford	10% - 14%	$23,000	$660,000
Lowell	Mass Midstate Solar 3, LLC [1]	Warren C	Active	4.20	Warren	37.50%	$255,000	$5,950,000
Lowell	Millbury Solar, LLC [1]	Millbury	Active	2.10	Millbury	37.50%	$127,500	$3,000,000
Subtotal [3]				15.90			**$875,500**	**$20,502,000**
Amherst	Clean Energy Collective	CEC Solar #1032, LLC	Active	1.00	Hadley	15.00%	$10,000	$271,429
Amherst	Nexamp Fairview Farms Solar, LLC [4]	Whatley	Active	2.40	Whately	21.00%	$46,000	$1,101,000
Amherst	Nexamp Hadley Solar, LLC [4]	Hadley	Active	1.50	Hadley	18.00%	$16,000	$400,000
Amherst	Borrego	Hadley	4/1/2017	2.80		12.00%	$35,000	$950,000
Subtotal [3]				7.70			**$107,000**	**$2,722,429**
Dartmouth	ConEdison	Dartmouth-II	Active	2.40	Dartmouth	30.00%	$125,000	$2,855,000
Dartmouth	Freetown Solar, LLC [1]	Freetown	Active	6.00	Freetown	34.25%	$330,000	$7,563,000
Subtotal				8.40			**$455,000**	**$10,418,000**
~~Medical School~~	~~Hecate Monson I, LLC [11]~~	~~Monson-I~~	~~6/1/2015~~	~~3.50~~	~~Monson~~	~~38.00%~~	~~$220,000~~	~~$5,200,000~~
~~Medical School~~	~~SolarCity~~	~~West Brookfield~~	~~11/1/2015~~	~~1.40~~	~~West Brookfield~~	~~51.00%~~	~~$126,192~~	~~$2,533,677~~
Medical School	SolarCity	Williamsburg	Active	2.10	Williamsburg	51.00%	$258,404	$6,000,000
Medical School	Mass Midstate Solar 2, LLC [1]	Warren B	Active	6.00	Warren	37.50%	$365,000	$8,500,000
Medical School	Palmer Solar, LLC [8]	Palmer	Active	2.50	Palmer	35.00%	$130,000	$3,000,000
Subtotal				10.60			**$753,404**	**$17,500,000**
~~Boston~~	~~Rustcraft Road Solar, LLC [9]~~	~~Rustcraft Road Solar~~	~~12/1/2014~~	~~2.00~~	~~Dedham~~	~~20.00%~~	~~$73,000~~	~~$1,690,000~~
~~Boston~~	~~EMI~~	~~East Boston~~	~~12/1/2014~~	~~1.00~~	~~Boston~~	~~20.00%~~	~~$36,500~~	~~$845,000~~
Boston	Altus	Woburn Solar Canopy	10/1/2016	0.65	NEMA Zone	25.00%	$28,826	$665,213
Boston	EMI	480 McClellan Solar LLC	11/1/2016	0.60	NEMA Zone	20.00%	$21,287	$491,234
Boston	Borrego	Wildcat Solar System	12/1/2016	4.24	NEMA Zone	25.00%	$188,211	$4,343,326
Subtotal				**5.49**			**$238,323**	**$5,499,772**
System-Wide Totals [3]				**48.09**			**$2,429,227**	**$56,642,201**

There have been other significant development throughout the year related to or in direct support to the University's sustainability efforts.

In early 2016, the University of Massachusetts Building Authority Board approved the creation of a Sustainability Committee tasked with the responsibility of advancing their sustainability efforts through the various projects undertaken by the Building Authority at all the campuses. The committee will actively participate in the discussion on green building standards and in other initiatives to align sustainability goals with infrastructure improvements throughout the system.

In June 2016, the University Board of Trustees endorsed a decision by the UMass Foundation Board of Directors to divest direct investments in fossil fuels from the University's endowment. The decision to divest direct holdings marks the culmination of a student-led effort across the system strongly advocating for immediate divestment. The historic commitment builds on the decision made by the UMass Foundation in December 2015 to divest direct holdings in coal companies. These actions taken by the University Foundation speaks to the commitment for socially responsible investing and makes UMass one of the largest public research universities to act on this commitment.

In July 2016, the UMass System won approval of federal and state hazard mitigation plans to help in climate preparedness and resiliency measure on each campus. Development of UMass's Hazard Mitigation Plan began four years with three grants totaling $650,000 from MEMA and the Massachusetts Department of Conservation and Recreation, which allowed the campuses to identify areas of critical importance, collect data, analyze risk and estimate the costs of lessening those risks.

The following pages have been reported through each of the campuses Sustainability teams to provide updates on relevant topics, success and efforts that have been undertaken under the course of the last year. Topics included in each campus section are outlined below with an example from one of the campuses.

1.) Clean Energy

UMass Amherst - UMass Amherst has installed solar canopies in the parking lot of the Robsham Memorial Center for Visitors. The three large solar photovoltaic parking canopies are estimated to produce 330,000 kilowatt hours of power per year.

2.) Climate Resilience and Preparedness

UMass Boston leads BRAG (Boston Research Advisory Group) established in 2015 to develop consistent projection and groundwork on climate changes and sea level rise that will impact Boston and Metro regions by 2030, 2050, 2070, and 2100.

3.) Green Building Design and Sustainable Building Operations

Throughout FY 2016 UMass Lowell continued its rapid rate of expansion and work continued on campus to drive emissions down per FTE and square foot. Aggressive sustainability-focused renovations, retrofits and upgrades have allowed GHG emissions per FTE student to decrease by more than 15% since the CAP was adopted at UMass Lowell.

4.) Sustainable Transportation

UMass Lowell added two additional electric vehicle charging stations to campus this year, bringing our total to six. To improve efficiency, these units are installed as part of larger capital projects. In addition, we took advantage of state grant programs to acquire the charging stations. In FY2016, UMass Lowell averaged 120 hours of EV charging per month.

5.) Environmentally Preferable Purchasing

UMMS and UMMHC hospital uses self-generated Orbio multi-surface cleaner to clean approximately 1.7 million square feet for floors, equaling over 60% the cleanable square footage roughly on campus. This non-hazardous muti-surface cleaner is created onsite from tap water and a small amount of salt which are combined and flow through an electrolyte cell in the Orbio onsite generation system (OGS) to create a 0.05% sodium hydroxide cleaning solution.

6.) Sustainable Food Services

At UMass Amherst, UMass Dining has developed a How-To Guide called Making Local, Healthy, Sustainable, Delicious, that demonstrates how high volume food service providers can provide healthy, sustainable and delicious food to their customers in a cost effective manner.

7.) Sustainable Water Systems

UMass Dartmouth is in the third year of a multi-phased project that will replace more then 80% of the distributed steam and condensate lines utilized to provide heat and air conditioning to the campus. The replacement of these lines has resulted in the return of an additional 30% - 40% of condensate significantly reducing the amount of water, natural gas and chemicals required to produce steam.

8.) Waste Reduction and Recycling

UMass Dartmouth negotiated a new waste-hauling contract this year. In cooperation with the consultant hired through the President's Office, we instituted a "pay per pick up" contract rather than one where we paid by weight. As such, we were able to reduce our bill by approximately 40%. We also switched to a single stream approach to our recycling, as that was an effective approach that reduced our costs for storage and transportation.

9.) Academic Programming, Research, and Community Engagement (courses, majors, certificates, masters programs, etc)

UMass Boston School for the Environment undergraduate environmental science students have traveled to Brazil in 2016 to better understand global climate history. Led by Prof. Allen Gontz, UMB students in northeast Brazil are conducting research in the coastal state of Sergipe through a partnership with Universidade Tiradentes.

10.) Public Recognition of Efforts

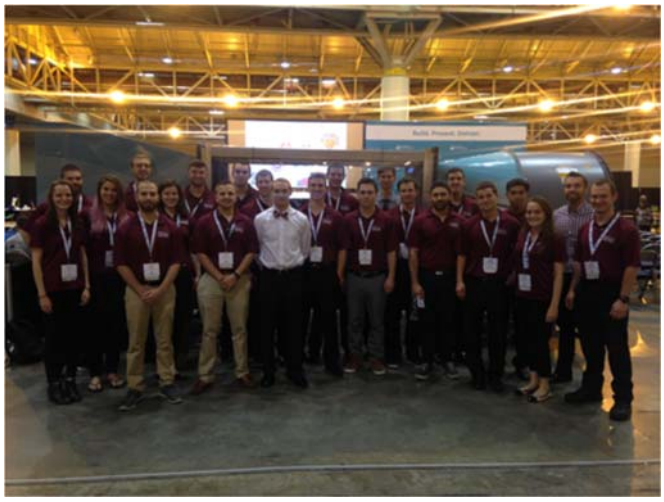
UMass Medical School achieved a Sustainability Tracking Assessment and Rating System (STARS) rating of Bronze through the Association for Advancement of Sustainability in Higher Education in May 2016 making UMMS the only Medical School with a STARS rating.

UMass Lowell achieved a (STARS) rating of Gold through the Association for Advancement of Sustainability in Higher Education in August 2016. In comparison to the peer universities identified in UMass Lowell's 2020 Strategic Plan and Annual Report Card, Lowell is the only university to have achieved this significant certification.

Section 2: Amherst Campus

Robsham Visitor Center Solar Canopy

Solar on CHP, 2 parking lots, 6 buildings



Students at the U.S. Department of Energy (DOE) 2016 Collegiate Wind Competition

Design Building Being Built with Wood Structural Systems

UMass Amherst lives and leads sustainability through its academics, research, and community engagement. The university is a resource and living laboratory for the global issue of climate change.

Clean Energy

UMass Amherst has installed solar canopies in the parking lot of the Robsham Memorial Center for Visitors. The three large solar photovoltaic parking canopies are estimated to produce 330,000 kilowatt hours of power per year and consist of over 1,000 photovoltaics modules that collect photons from sunlight, which are then converted into electrical energy. The canopies are the first of their kind in the Amherst area and were supported by a $146,000 Leading by Example (LBE) Clean Energy grant from Massachusetts Department of Energy Resources (DOER).The project is estimated to have an annual cost savings of $46,289 and estimated total income from SREC Production of $848,000 over 20 years, giving the project a 10 year payback.

The university has also installed a solar hot water system on its Central Heating Plant (CHP). The system pumps water from a condensate tank to the CHP's roof where it is heated and then returned to the condensate tank. The heated water from the tank is then used by the CHP's steam boiler system that heats the UMass Amherst campus. The system is meant to reduce the amount of fossil fuel used in the CHP's steam boiler system. The solar hot water system was made possible through a DOER Clean Energy Grant and a Massachusetts Clean Energy Center (MassCEC) rebate and is expected to save the university $5,000 in energy cost per year.

Construction is underway on a new solar installation that will place 15,576 photovoltaic panels on buildings and in parking lots, providing 5.5 megawatts (MW DC) of electrical power for the campus. Panels will be added to six building including: Recreation Center, Computer Science, Champions Center, Fine Arts Center, Police Station, and the Bus Maintenance Garage; solar canopies will also be added to parking lots 25 and 45 providing shade for parked cars. Brightergy, a national energy company with offices in Massachusetts, through its partnership with Sol Systems, arranged for project finance, ownership and ongoing maintenance of the solar installations with ConEdison Solutions for up to 20 years. The university will pay no up-front cost for the project and ConEdison Solutions will sell the electricity produced by the panels at a discounted rate to the university. Also, DOER has provided a $500,000 Leading by Example that will be used to support the two parking lot canopy installation. The project is expected to reduce greenhouse gas emissions for the regional electric grid by the equivalent of 31,000 non-metric tons of carbon dioxide and cut the university's electric bills by $6.2 million over 20 years. In addition the agreement with Brightergy has provided the university with $41,000 in educational funds for UMass Amherst students over the first three years and internship opportunities for four students over the next three years.

Two solar powered charging stations are available Haigis Mall and Skinner bus stops. The stations come with 110 VAC power outlets and four USB inputs and provide power day and night. The stations can be used to charge most mobile devices and are a gift from the Class of 2014.

The Pioneer Valley Transit Authority has installed a solar-powered sign at the Fine Arts Center bus stop that displays estimated departure time for the next bus on each of five PVTA routes.

Climate Resilience and Preparedness

UMass Amherst is home to multiple research centers and institutes that focus on issues related climate change. The university also has faculty and staff that continually study the effects climate change has on the environment.

Since 2011, UMA has led a consortium of seven universities and hosted the Northeast Climate Science Center (NESRC) through a five-year, $7.5 million federal grant. It is supported by federal, state, and other agencies providing scientific information, tools, and techniques that managers and other parties interested in land, water, wildlife and cultural resources can use to anticipate, monitor, and adapt to climate change.

UMass Amherst's Climate System Research Center (CSRC) focuses on the climate system, climatic variability and global change issues. In April 2016, scientists at the CSRC released a set of state-specific reports describing likely effects of carbon emissions targets, agreed upon in December 2015 at "COP21" in Paris, on the future climate of 22 states including all those in the Northeast. The COP21 (December 2015 version) agreement sets out targets for each country to reduce their carbon dioxide emissions to try to keep the average global annual temperature from rising more than 3.6 degrees F (2 degrees C) above the pre-industrial level.

In January 2016, Political Economy Research Institute, which promotes human and ecological well-being through original research, released its the Greenhouse 100 index. The index identifies the top companies responsible for greenhouse gas emissions. The Greenhouse 100 relies on the U.S. Environmental Protection Agency's Greenhouse Gas Reporting Program, which reports information from facilities in electric power and other industries that directly emit large quantities of greenhouse gases. In addition to the total amount of greenhouse gases released by companies and the Federal Government, measured in metric tons of carbon dioxide equivalent (CO2e), the Greenhouse 100 also reports data on environmental justice populations living near each facility noted on the list.

Additional climate change related research can be found in the "Academic Programming, Research, and Community Engagement" section.

Green Building Design and Sustainable Building Operations

Green Building

In 2016, the Green Building Guidelines were updated by the Chancellor's Sustainability Advisory Committee - Green Building Committee (GBC) to provide a framework for approaching the new LEED v4 system for release in October 2016. For the last six years UMass Amherst has used the Green Building Guidelines, developed by UMass Amherst students, faculty, and staff, to provide a framework for approaching new construction and major renovation projects on campus. The guidelines encourage active conversations between designers, stakeholders, and building users. The current guidelines require that all new design and major renovations be certified LEED Silver plus. In 2016, the Green Building Guidelines were updated by the Chancellor's Sustainability Advisory Committee - Green Building Committee (GBC) to provide a framework for approaching the new LEED v4 system for release in October 2016.

In October 2015, the Commonwealth Honors College Residential Complex became the seventh building on campus to be certified LEED by the U.S. Green Building Council (USGBC). The Complex earned

LEED Silver and joins six LEED Gold Certified buildings on the UMass Amherst campus that include: George Parks Marching Band Building, Police Station, CNS Research & Education Greenhouses, Hampshire Dining Commons, Life Science Laboratories, and the Football Performance Center. In addition to these certified LEED buildings, the university's Integrated Learning Center and the Champions Center Basketball Facility are both targeting for Gold certification and its Paige Laboratory Renovation, and the Lincoln Campus Center Renovation are targeting LEED Silver certification.

Also in October 2015, UMass Amherst began construction on the Design Building, a state-of-the-art teaching facility being built with innovative wood construction technologies and featuring exposed structural and mechanical elements to demonstrate techniques. This unique 87,000-square-foot building, projected to open in 2017, will be made with renewable and recyclable materials and will have sustainable features that include: low-flow water fixtures, automatic lighting, and energy-efficient heating and ventilation systems. The Design Building is targeted for LEED Gold (with the possibility of Platinum) and will house three academic programs from three separate colleges: Landscape Architecture & Regional Planning from the College of Social and Behavioral Sciences, the Department of Architecture from the College of Humanities and Fine Arts, and the Building Construction Technology program from the College of Natural Sciences.

Sustainable Building Operations

Energy Performance

Since 2013, Campus Planning has used the Building Energy Use Intensity (EUI) project to evaluate on-campus building energy consumption in order to establish internal energy benchmarks and share them with staff and consultants. The EUI takes total consumption and divides it by gross square footage. The EUI can be used to compare buildings of similar size and function with one another or for understanding usage of a particular building over time. The project was developed through a thesis from Kathrine McCusker and now includes data for up to 5 years, including building's chilled water information when available. The EUI information will be made available to the public through an interactive map.

UMass Amherst and Eversource are in the midst of completing a 3-year MOU, which has provided a road map and mutual plan for energy efficiency and improved building operations. Over 60 projects in existing buildings or LEED certified new construction projects have been implemented. So far, the program has resulted in over 8.6 million kwh in reductions, exceeding the 3-year structure goals of the MOU. The programs projects have included: lighting upgrades far a variety of campus buildings and upgrades to existing HVAC systems (repairs, new chillers, addition of VFDs to fans, additional sensors and control elements, and control enhancements). The program has yielded energy savings for new campus buildings and major renovations when compared to Massachusetts State Energy Code.

UMass Amherst's Physical Plant and Environmental Health & Safety, also partnered with Eversource to design and implement an energy efficiency pilot program for food hoods in campus labs. Eversource provided funding for a student who tracked energy usage for 75 fume hoods in 20 campus labs.

Green Offices

Since 2010, the Green Office Program has encouraged and facilitated best practices for energy and waste reduction for offices across campus. The program now has 85 participating offices and is managed by students in the College of Natural Sciences' Sustainability Fellowship.

Campus Trees Database

Todd Beals, a Stockbridge School of Agriculture graduate who works for UMass Amherst's Physical Plant, has developed a searchable website cataloging the 8,000 plus "actively managed" trees that make up the campus' Waugh Arboretum. The website allows users to search for campus trees by location, species and common name. The data collected for the interactive website can be used to protect trees during construction on campus.

Sustainable Transportation

Bike Share

The Student Government Association (SGA) has approved the purchase of 20 additional bicycles for the UMass Amherst Bike Share Program. The program, managed by SGA and the Physical Plant, will now have 34 bicycles available to students, faculty, and staff to borrow for free bike for 24 hours or for an entire weekend.

UMass Amherst, along with the Pioneer Valley Planning Commission (PVPC) and the cities of Springfield, Holyoke and Northampton and the Town of Amherst have committed to a pilot regional bike share program. The pilot program, tentatively named ValleyBike, will establish a regional automated bike sharing program across the Pioneer Valley.

Electric Vehicle Charging Stations

The campus has added two Level II dual vehicle charging stations and one Fast charging station at the Robsham Memorial Center for Visitors. The campus has also added two Level II charging stations in the Physical Plant building's parking lot.

Car Sharing & Incentives

UMass Amherst continues to offer students, faculty, and staff easy access to a fleet of vehicles through a partnership with ZipCar. Zipcars are available on demand and can be reserved 24 hours a day, seven days a week.

UMass Amherst promotes the use of NuRide, a free incentive program that rewards members for walking, biking, or carpooling. Its network connects members with one another for carpooling and commuter company.

The university also encourages students, faculty, and staff to carpool by offering half price parking permits for those that carpool and by having carpool only parking spaces. A carpool matching service is also available to students, faculty, and staff.

UMass Amherst offers discounted parking permits for "clean" vehicles; qualifications are based upon California Air Resources Board and American Council for Energy Efficient Economy standards. Low-emitting vehicles are classified as zero-emission vehicles (ZEVs) by the California Air Resources Board and fuel-efficient vehicles achieve a minimum green score of 40 according to the annual vehicle-rating guide of the American Council for an Energy Efficient Economy.

Greening the Campus Fleet

UMass Amherst has added 5 new all electric Nissan Leafs to its campus vehicle fleet. The fleet now has a total of 25 alternative energy vehicles consisting of 12 electric and 13 plug-in hybrids.

Public Transportation

UMass Transit Services provides fixed route bus service for the Pioneer Valley Transit Authority in the northern tier of the Pioneer Valley region. In FY16 UMass Transit provided 3,600,466 rides for passengers, a 6.12% (207,615) increase in ridership over the previous fiscal year. There are 7 hybrid buses in the 35 bus fleet, which reduce overall fuel consumption by 40%. A normal bus gets 4.5 mpg, while hybrids get 7.5 mpg

Environmentally Preferable Purchasing

In FY16, UMass Amherst purchased 50% of recycled content paper, totaling 275,000 pounds, for the campus. In 2015, UMass Amherst Print Services began phasing out all non-recycled "virgin" white letter-sized copy paper and replaced it with 30% recycled white letter-sized copy paper for all orders. The change added no additional charge to departments ordering paper and has the potential to save 500 trees per year.

UMass Transit purchases tires and re-caps them up to two times during the life of each tire, extending the useful life of each tire and reducing the expense associated with tire replacement. New bus tires (steer tires, used on the front wheels of the bus when brand new) cost roughly $700 each. Recaps (used on the rear dual tires of the buses) cost $200 for the first recap and $100 for the second recap. UMass Transit use approximately 70 tires per year with an average of 25 brand new tires purchased per year.

UMass Transit also purchases shredded coconut husks instead of clay speedi-dry to absorb oil spills. The coconut material is lighter to transport and simple to use.

Sustainable Food Services

UMass Dining has developed a How-To Guide called Making Local, Healthy, Sustainable, Delicious, that demonstrates how high volume food service providers can provide healthy, sustainable and delicious food to their customers in a cost effective manner. UMass Dining guide sets forth an actionable approach to the planning and development of local, healthy food-system initiatives in New England. Serving as both a case study and a guide, it details the lessons UMass Dining learned in two years of concentrated effort to boost local sourcing and reimagine our menu cycle in favor of healthy, sustainable, delicious meals. It underscores the necessity of team buy-in of these initiatives if a true cultural shift is to be achieved. The guide makes a case for thinking of sourcing and serving local, nutritious food as part of a holistic dining program aimed at decreasing overall costs while increasing value and quality in foodservice programs. In 2015-16, using the principles outlined in the guide, UMass Dining increased its local purchases and met budgeted food cost targets.

The Permaculture Initiative maintains five gardens throughout the campus: Berkshire, Hampshire, Hillside, Worcester, and Franklin, which collectively educate over 1,200 people and produce over 1,600 lbs of food annually. The gardens also facilitate cost savings for research and development by functioning as living laboratories where new plants can be beta-tested before investing in other local sources.

Currently, UMass Dining has several projects in the works that use the gardens play a key role in, as both a place for research and an inexpensive source of products. The projects include: increasing the implementation of whole plants into the menu (aka root to frond), increasing utilization of certain plants that the garden has in abundance but have only been used minimally in the past, and increasing the use of plant-based proteins on the menus in place of traditional meat-based proteins. The gardens are also used as a barometer for regional crop conditions, which enables dining staff to adapt the menus according to crop conditions. All of this keeps food-cost percentages in line while also promoting the use of local seasonal items in the menus. Finally, the gardens are a destination of choice for students who want hands on experience in permaculture and agriculture.

UMass Dining is committed to increasing sourcing of lean, local, low-carbon proteins. The first phase of this goal involves pursuing local sources of sustainably and humanely raised poultry. Currently, UMass Dining sources over 30% of its produce from local farmers. Subsequent phases include increasing local plant-based proteins and increasing sustainable seafood. Sourcing local proteins has many benefits, such as reducing food -miles. In addition, poultry and plant based proteins are less carbon-intensive than some other proteins, such as beef. In an effort to improve poultry farming in Massachusetts, UMass Amherst is planning to coordinate a gathering that will bring together key members of the poultry industry - including farmers, buyers, and policy makers - in order to address key issues.

UMass Dining is re-visioning the conventional food system and transforming it into a regionally based, just system that fosters world class, healthy foods. In November 2015, the UMass Amherst Auxiliary Enterprises Sustainability team was awarded a $500K grant by the Henry P. Kendall foundation to promote regional food systems through increased purchases of lean local proteins and the creation of a food hub. UMass Auxiliary Enterprises received $1M in grant funds over the past three years.

In 2013, UMass Amherst has signed the Real Food Challenge agreement committing the institution to assuring that 20% of the universities' food purchases come from local, organic, fair-trade, or humane sources by 2020.

The UMass Dining’s Sustainability department has developed a strategic plan outlining three high level goals: to develop a resilient & sustainable food system, to increase local economic development, and lastly to increase environmentally conscious practices. The department looks to accomplishing these goals by evaluating purchasing for areas of opportunity, creating lower cost menu designs that support regional business, cutting waste to increase what is spend on local food, and increasing local sourcing for animal proteins. Additionally, UMass Dining will be increasing food accessibility with the creation of a UMass Food Hub.

Operating every Thursday out of the Chef’s Table in the Blue Wall at UMass Amherst’s Campus Center, the Pledge initiative challenges diners to take a "Pledge of the Day", with pledges range from reducing food waste to increasing daily physical activity. The goal of Pledge is to promote practices that will make better global citizens that focus on sustainability, social responsibility, health, and wellness, and to build community. In addition to the daily pledge, this initiative highlights a unique handcrafted and healthy menu that features gleaned ingredients, local sustainable seafood, under-loved produce, lean proteins, vegetable-forward main courses and healthy grains. This menu, where possible, will come from ultra local partners and farmers.

The UMass Food Recovery Network, a student-run campus organization, works with UMass Dining to coordinate food donations in the Pioneer Valley. The Food Recovery Network is a national organization whose

mission is to reduce food waste and fight hunger through activating the local and campus community. Freed from liability, universities can feel comfortable using the Food Recovery Network as the vehicle for providing meals for local homeless shelters. Currently, the UMass Food Recovery Network donates to Craig's Doors, a homeless shelter in Amherst. Currently, food donated for the Network comes from Worcester Dining Commons.

Sustainable Water Systems

UMass Amherst takes the final treated wastewater from the City of Amherst's wastewater treatment plant, treats the water for use in the boilers through a state-of-the-art reverse osmosis system, then feeds process water to the Central Heating Plant and Cooling Towers.

The university has retrofitted and updated every shower in Orchard Hill and Northeast Residential Areas to low-flow showerheads. This program was originally proposed by a student in the College of Natural Sciences' Eco-Rep Program and funded by DOER and the Sustainability, Innovation & Engagement Fund.

20 hydration stations, used for filling reusable water bottles, have been recently installed in Administrative and Academic Buildings, as well as in each of the 52 Residential Halls on campus. In the residence halls alone, over 2 million water bottles have been saved through the use of hydration stations.

Waste Reduction and Recycling

Single Stream, E-Waste, Styrofoam

UMass Amherst uses a Single Stream Recycling System, which includes paper, cans, bottles, and some cardboard. Items are collected and shipped to the Springfield Materials Recovery Facility (SMRF) where they are sorted through a combination of both mechanical and manual techniques. Since instituting the system, the universtity has steadily reduced the amount of waste it produces each year.

UMass Amherst's Waste and Recycling Transfer Station accepts electronic waste for recycling. Items that are accepted include, but are not limited to: toasters, microwaves, appliance and electronics batteries, computer systems, electronic measuring instruments, A/V equipment, refrigerators, freezers, air conditioners, lightbulbs, and cathode ray tubes. The Waste and Recycling Transfer Station now also accepts #6 styrofoam, which is picked up by a company for processes in Ludlow, MA.

Residential Life Infrastructure & Survey Campaign

To match coloring for the campus's Single Stream Recycling System, Residential Life's Maintenance & Operations staff replaced and/or coordinated all bins to be blue that are located in the Residence Halls, including bins in recycling rooms and student rooms. Additionally, new and improved graphic signage was installed in every recycling room and 9 "package recycling stations" were built for the residential service desks for recycling packaging materials picked up at Residential Service Desks.

In an effort to increase the awareness of recycling and waste reduction through social media, Residential Life coordinated two Instagram and Twitter campaigns. The first was the creation of an incentivized "Living Sus-

tainably at UMass Quiz" which was taken by over 600 students or over 4% of the total on-campus living population. This quiz gave a general temperature reading of student attitudes and beliefs surrounding sustainability and recycling on campus. Secondly, humorous videos with Sam the Minuteman were developed and posted on Instagram and Twitter to spark more sustainable behavior among the student body.

Composting

UMass Amherst composts over 1,400 tons of organic waste each year, the largest recycling stream on campus. The university accepts food waste in every dining common and most retail dining locations. The campus also offers the Minute Riders Program, a compost pick-up service providing student-run, bike powered waste management solutions for green offices who want to compost their food scraps in their kitchens and break room areas. Students use tandem bikes with a trailer to pick-up and haul the compost to central composting areas at the dining commons.

UMass Amherst's Residential Life along with the Office of Waste Management has initiated a pilot compost program for North D apartments in fall of 2015. After positive results, the program was expanded to include all North apartment buildings (A, B, C, & D) for spring of 2016. The pilot program was initially developed by a student in the College of Natural Science' Sustainability Fellowship and then implemented by Residential Life's new sustainability coordinator and UMass Amherst graduate student Kevin Hollerbach. The program is expected to continue in FY16.

Events

Each year the New2U program collects unwanted items like futons, lamps, and TVs from across campus during spring move-out and resells these collected items each fall during move-in. The program is organized by students, supported by the Sustainability Innovation and Engagement Fund, and is a collaboration between the Physical Plant, student leadership, Residential Life, the Office of Waste Management, Moving Services, and New Student Orientation. The program also gets planning assistance from the Post-Landfill Action Network (PLAN) Proceeds from the sale are used to fund future New2U events and sustainably related programming.

At the beginning of each fall semester, the College of Natural Sciences (CNS) hosts its College Day Barbecue, a green cookout that brings together CNS students, faculty, and staff to enjoy the start of a new school year, with delicious, locally sourced food, and each other’s company. The cookout strives to be a zero-waste event with a cross-campus Green Event Planning Team that includes members from Auxiliary Services, Physical Plant, and CNS. Eco-Reps are on hand to provide education about sustainable practices and to help those attending place their compostables into the appropriate receptacles. Guests are treated to finger foods made from locally grown ingredients, and served on compostable plates, napkins, and cups. The events’ entertainment uses no power with a performance from an acoustic band. The décor for the event consists of hay bales and cornstalks borrowed from the university’s Hadley Farm and pumpkins from the student farm. These items are returned to their respective farms after the event. Based on the success of the CNS College Day Barbeque, a Zero-Waste Events guide is being development for campus events.

UMass Amherst placed in two categories in the EPA's Game Day Challenge event. The campus was first in the category of Green House Gas (GHG) Reduction and second in the Recycling category within its conference for efforts made at tailgating during the Nov. 21 game. Over the season the university recycled a total of

18,693 pounds of material from the three games played at Warren P. McGuirk Alumni Stadium.

UMass Amherst won third place for Food Service Organics in the RecycleMania Tournament, which promotes waste reduction through friendly competition between colleges and universities. Over the course of eight weeks the university tracked and weighed its bottles, cans, paper, cardboard, trash and food waste — with the final recovery total for recyclables and compostables representing 903 metric tons of CO2 reduction.

On-Board Truck Weigh Scales

The Physical Plant's Office of Waste Management (OWM) is currently installing on-board truck weigh scales on five of its six waste collection "packer" trucks as a new tool for tracking waste generation and recycling performance for most campus buildings. Two trash trucks, a cardboard truck and a single-stream recyclables truck, will be receiving scales. The contract with Loadman Scales and Creative MicroSystems for approximately $100,000 will allow OWM to begin recording weights for the trash and recyclables collected at each of the 150 collection locations (approximate) on campus. OWM expects to go live with the building-by-building waste tracking tool this summer. The on-board truck scales and associated electronics will assist OWM with the task of identifying buildings and departments that, alternatively, are high performance or low performance sites. Once identified, education and enforcement efforts, and potentially waste user fees, can be matched appropriately to the conditions in those buildings and departments for the purpose of encouraging waste reduction and improved recycling/composting rates.

Recycling Station Installations in Food Cafes Located in Academic Buildings & Food Waste Prevention

UMass Amherst Custodial & Grounds Services purchased 7 receptacles that collect: trash, recycling and compost. Each receptacle is made out of 1010 recycled plastic gallon jugs and available in food cafes located in academic buildings on campus.

Food waste reduction is central to the UMass Dining strategic plan. Over the past three years UMass Dining diverted $750k of food waste through menu engineering and food waste prevention initiatives.

Paper Reduction

In spring 2016, the UMass Dining's Sustainability department began using the storage system Box for paperless communication and file storage. The long-term goal is to eventually utilize Box for all sustainability documents. Using the system has several perks - it reduces waste for in-office activities, allows staff to work asynchronously, and creates an environment of openness and transparency. It allows several individuals to work as a group on a project without having to be in the same physical location and facilitates continuous communication. By utilizing Box, the UMass Dining Sustainability staff is shifting to a culture where checking the shared documents becomes a part of daily routine, just the same as checking one's email or social media.

Academic Programming, Research, and Community

UMass Amherst students learn about sustainability theory and practice through 300 courses, 25 undergraduate majors, an online certificate program, 15 graduate programs, co-curricular activities, and undergraduate research experiences focused on sustainability. The university also has more than 200 faculty in 36 different departments engaged in sustainability research.

Academic Programming

The UMass Amherst has established a new School of Earth and Sustainability (SES), which serves as a central hub for a suite of academic programs, research, innovation, outreach and extension activities dedicated to finding solutions to the complex, global environmental challenges of the 21st century. Approved by the UMass Board of Trustees in the spring of 2016, SES joins together 18 undergraduate programs, five graduate programs, research, and extension/outreach work that share a common focus on earth, sustainability and environmental sciences. The school is home to over 100 faculty members, 250 graduate students, and 1,000 undergraduates from across the three founding departments (Environmental Conservation, Geosciences and Stockbridge School of Agriculture). SES supports a diverse community of scholars and practitioners - many whom thrive on collaboration, and cutting-edge, interdisciplinary approaches to problem solving. Some of the shared areas of focus for SES include: climate and resiliency, sustainability, energy, ecology and conservation, society and technology, water, food systems, earth systems, and the build environment. Collectively, SES provides expertise, innovation, and training that benefit students, the Commonwealth, the workforce, and communities throughout the region. Additionally, SES enhances inter-unit communication, coordination, and collaboration with partnering departments as well other campus units. It streamlines processes and creates shared services (e.g., career advising) and facilities to supplement gaps and maximize efficiency with limited resources. SES is strategically poised to support trans-disciplinary initiatives, student services, development, and engagement with on- and off-campus partners.

The Sustainability Fellowship Program began in the fall of 2009 with one student intern and has since grown to engage as many as twenty interns in a given semester. Fellows work on specific aspects of sustainability for the campus and are mentored by a faculty sponsor and Ezra Small, the program coordinator and Facilities' Campus Sustainability Manager. Topics for the program include: energy, green buildings, food systems, academics, green office, transportation, and waste and recycling. The Program looks to make UMass Amherst sustainable in all areas of operation, while providing an enriching experience for individual program participants.

In 2015, the Chancellor added $10,000 for the Sustainability Curriculum Fellowship (SCF) to the Sustainability, Innovation & Engagement Fund (SIEF), a fund that supports green ideas from students, faculty, and staff. The SCF, which was originally funded through the UMass Amherst Libraries, is a year-long interdisciplinary fellowship program that enables faculty to cultivate teaching excellence. Over the past three years, 30 faculty members from across 18 disciplines have participated in the SCF, including: chemistry, Education, Engineering, Environmental Conservation, Isenberg School of Management, Journalism, Judaic and Near Eastern Studies, Resource Economics and others. Fellows receive a $1,000 professional development grant along with a range of support services for a sustainability course. SCF Fellows attend monthly forums to discuss pedagogy, course redesign, and learn about library and campus sustainability resources. SCF Fellows will also share best practices through teaching demonstrations, a Moodle forum, and by participating in occasional sustainability

site visits on campus. The SCF is supported by the Chancellor's Sustainability Advisory Committee, UMass Amherst Libraries, the Campus Sustainability Manager, Institute for Teaching Excellence and Faculty Development (TEFD), and sustainability-engaged faculty.

The College of Natural Sciences' Eco-Rep program is focused on working towards environmental literacy and leadership both within the program, and on the campus at large. This course is open to students of all interests and education levels; it especially encourages student who wish to gain or expand their knowledge in sustainability and environmental literacy. Eco-Reps build a foundational knowledge surrounding issues of sustainability and explore how best to raise awareness about these issues amongst their peers. Focusing on the role and impact of the individual, Eco-Reps work to promote environmentally responsible behavior in the campus community.

The Integrated Concentration in Science Program (iCons) is a 20-credit undergraduate science program offered by the College of Natural Sciences. The program provides integrative science education in the concentration areas of renewable energy and biomedicine/biosystems. iCons does not replace a major, it enhances a major by giving students the opportunity to work in interdisciplinary teams and apply their knowledge to existing problems of global significance. Past focal issues include the cholera epidemic in Haiti, endocrine disruptors, and developing biofuels from algae.

In September 2016, the Stockbridge School began offering a fully online associate of science degree in sustain- able food and farming. The 60-credit associate degree will allow students to study sustainable food and farming from anywhere in the world. The degree will cover basic knowledge of plant and soil science, and train students in agricultural techniques, community development, public policy and education. The program is designed to be flexible, allowing students to focus on specific career objectives. Students enrolled in the program will earn credit online and by working in their local farm communities. The program currently offers 24 online courses from "Introduction to Permaculture," "Global Food Systems," and "Urban Agriculture" to "Pastured Poultry" and "Organic Vegetable Production."

For this year's Earth Day on April 20, 2016, students learned about sustainable features of campus through scavenger hunt. Over the course of four hours, participating student teams received clues via the university's sustainability instagram account, UMass_Sustain. Teams earned points by finding locations, answering questions, and doing bonuses. The teams were required to write down locations as well as post images of themselves at locations on social media in order to engage a broader audience with sustainability ittuse. The team with the most points from the Scavenger Hunt received $1,000.00 worth of Amazon gift cards and the team with the second most points received a $100 Amazon gift card.

Research

UMass Amherst is one of the nation's top public research universities as measured by national and international rankings, academic citations, and research funding. The university does a variety of research relating to sustainability. The following is a small selection of recent research projects.

Energy Research

In March 2016, UMass Amherst computer science and engineering researchers began testing a solar-powered data center at the Massachusetts Green High Performance Computing Center in Holyoke to demonstrate that even powerful servers can be run sustainably.

A team of researchers that includes two engineers from UMass Amherst are developing a new mooring

system for floating offshore wind turbines that uses an integrated network of anchors and lines to hold dozens or even hundreds of turbines in place in the ocean in industrial-scale, offshore wind farms. Civil and environmental engineers Sanjay R. Arwade and Don J. DeGroot from UMass Amherst, along with Charles P. Aubeny from Texas A&M University and Melissa Landon of the University of Maine, are conducting the research with a three-year, $497,341 grant from the National Science Foundation. The funding comes jointly from the NSF's Grant Opportunities for Academic Liaison with Industry and Geotechnical Engineering programs.

Computational chemist Scott Auerbach has been awarded a three-year, $330,000 grant from the National Science Foundation to improve basic understanding and optimize the process of producing fuels such as gasoline from plant biomass instead of from petroleum.

A team of researchers from the UMass Amherst and Texas A&M University are developing a blade-mounted, ultrasonic whistle for wind turbines that will protect bats by warning them to stay away. The project is funded by a $250,000 grant from the U.S. Department of Energy's Office of Energy Efficiency & Renewable Energy and a $62,500 grant from the Massachusetts Clean Energy Center.

Climate Mapping Research

UMass Amherst geoscience professor and climate scientists Robert DeConto and David Pollard from Pennsylvania State University released a study that suggests that the most recent estimates by the Intergovernmental Panel on Climate Change for future sea-level rise over the next 100 years could be too low by almost a factor of two.

A comparison between climate and ice sheet modeling study from UMass Amherst researchers Edward Gasson and Robert DeConto, with colleagues at Pennsylvania State University and GNS Science, New Zealand and an analyses of a 3,735-foot sediment core from McMurdo Sound by Richard Levy of New Zealand and colleagues with the National Science Foundation's Antarctic drilling program (ANDRILL) has revealed Antarctic ice sheet is more vulnerable to CO2 than expected.

Food / Animal Research

A new state apiary to be used for education, outreach demonstrations and research related to agricultural sustainability, pollination, honeybee health and hive management opened in June at the campus' Agricultural Learning Center. Massachusetts Department of Agricultural Resources (MDAR), in collaboration with the Stockbridge School of Agriculture, created the apiary consisting of 12 honeybee hives within an 80-foot by 30-foot plot adjacent to the UMass Pollinator Conservation Project. The apiary is surrounded by a solar-powered electric fence to deter animals and serve as a safety barrier for visitors. It consists of six wooden stands, capable of holding five hives each. partitioned into two horizontal rows. The apiary will also be used by the UMass Beekeeping Club, a student organization, and for hives maintained for campus beekeeping courses.

A study of population trends among 46 ecologically diverse bird species in North America conducted by avian ecologist Joel Ralston and colleagues at the UMass Amherst overturns a long-held assumption that the climate conditions occupied by a species do not change over time. The study indicates that birds that have increased in abundance over the last 30 years now occupy a wider range of climate conditions than they did 30 years ago, and declining species are occupying a smaller range of climate conditions than 30 years ago.

The results from a 15-year study of factors affecting population levels of Eastern brook trout in the face of climate change show that high summer air temperatures have a large influence, in particular on the smallest fry and eggs, which are most important to wild trout abundance in streams.

To identify how climate influences fish abundance in streams, Ben Letcher, fisheries biologist at the U.S. Geological Survey and adjunct faculty in environmental conservation and colleagues at UMass Amherst, USGS, the USDA Forest Service and the University of Oxford, England, studied native brook trout in a small cold water main stream with three tributaries.

Plant ecologist Kristina Stinson received a two-year, $149,800 grant to study the impact of climate change on the quantity and quality of sugar maple sap, including its chemical composition, and of sap from red maples, a species less sensitive to climate change. The study is believed to be the first to look at sap quality.

Researcher Minsoo Kim, former undergraduate student Chris Waters, and professor Dong Wang of UMass Amherst's biochemistry and molecular biology department, with colleagues at the Noble Foundation in Oklahoma, have discovered a "double agent" peptide in an alfalfa that may hold promise for improving crop yields without increasing fertilizer use.

Om Parkash, agriculture biotechnologist at the Stockbridge School of Agriculture, and Richard Peltier, environmental health sciences, have been awarded funding from the Worldwide Universities Network (WUN) to initiate global projects designed to ultimately impact millions of people in the developing world. Parkash will lead a Climate Resilient Open Partnership for Food Security (CROP-FS) team, which includes 12 experts from six institutions in China, India, the United Kingdom and the U.S. The goal of CROP-FS is to develop research strategies that will enable major food crops to grow under more extreme environmental conditions, such as drought, high temperature and irrigation with brackish or sea water.

Peltier's Air Sensors Everywhere project aims to develop a framework for distributed systems of low-cost air pollution sensing hardware and software that can be used to address a global pandemic responsible for millions of premature deaths and altering the global climate balance.

Community Engagement

UMass Dining's Sustainability department is currently working with the Chicopee and Boston public school systems as well as Westfield State University to improve their sustainable food option. UMass Dining's Sustainability department strives to be a replicable model that can act as a resource to any institution, regardless of scale. Through outreach, the department is working to build a synergy around the regional food system as well as promoted the sustainability learning opportunities at UMass Amherst.

Housed in Student Activities and Involvement, UMass CALLS (UMass Community Action through Leadership, Learning, and Service) is a central portal into the array of volunteer, community service, leadership, and community building programs and opportunities at UMass Amherst. UMass CALLS offers its own suite of programs, serves as a resource for both students and communities interested in student engagement, and collaborates with both on-campus groups and community organizations in their own engaged efforts. Through these activities, UMass CALLS facilitates and strengthens relationships between UMass Amherst and surrounding communities. Building Community through Community Economies: meeting today's social, economic and ecological challenges requires effective, active leadership and service; it also requires new ways of thinking about community development, new ways of relating to one another, and new ways of doing business. UMass Amherst supports and is host to numerous programs and initiatives that build

community through economic exchange, consumption, and development.

Campus initiatives include student cooperatives, community supported agriculture, permaculture, local purchasing, bike-sharing, and an overwhelming number of volunteer efforts and philanthropic giving—encourage community engagement and service, provide opportunities for leadership development, create social connections, and can enable cooperative, ethical, sustainable, and socially-just practices. UMass CALLS endeavors to support and connect the diverse economic activities on-campus and in our surrounding communities through leadership and engagement programs.

In March 2016, the Wind Energy Center hosted the Future of Offshore Wind Energy Forum. The event featured Chancellor Subaswammy and Massachusetts Senate President Stan Rosenberg who spoke about energy needs and introduced a panel of industry experts from global leaders in wind development.

Madeleine Charney, sustainability studies librarian, was the keynote speaker at an international conference in Hong Kong co-sponsored by the Hong Kong University of Science and Technology (HKUST) Library and the Chinese University of Hong Kong Library. The conference, "Academic Librarian 4 – Sustainable Academic Libraries: Now and Beyond," addressed the topic of sustainability as it relates to academic libraries and was held at HKUST June 2-3, 2016.

In fall of 2015, faculty and staff presented educational programming at the new Boston Public Market (BPM), a 28,000-square-foot, self-sustaining market featuring all locally sourced food. Andy Danylchuk, assistant professor of environmental conservation, presented a film he co-produced called, "Fish Meat," a documentary that focuses on fish farming and highlights declining fish population; Andy Danylchuk also presented his other film he co-produced called "Raising Shrimp", which explores the ways in which shrimp are farmed. Wesley Autio, professor and director of the Stockbridge School gave a presentation on the various types of apples. Carolyn DeMoranville, extension associate professor and director of the UMass Cranberry Station in Wareham, MA, discussed the history, sustainability, and new uses for cranberries.

During the fall 2015, UMass Amherst Libraries, the Department of Environmental Conservation, the Office of Civic Engagement and Service Learning, and the Psychology of Peace and Violence Program, hosted a series of events on climate called the "Talking Truth: Finding Your Voice Around the Climate Crisis". The series offered experiential workshops, speakers, films, and discussions to educate, motivate and connect the campus community around the critical issue of climate change, that effects everyone. "Talking Truth" spawned a new student climate group called "The Climateers" and produced a collection of written materials related to Climate Change from students, faculty that will be housed in the University Archives at the Du Bois Library.

The history department's David Glassberg and Samuel Redman, who is also director of the oral history lab, started a project titled "Climate Change and Environmental Justice: Toward a Climate Action and Resiliency Plan for Springfield." The project is being supported by a $13,000 grat from the Public Service Endowment Grants (PSEG), a special campus fund designed to boost outreach and extend the campus resources into the surrounding community.

Public Recognition of Efforts

UMass Amherst was rated STARS Gold University by the Association for the Advancement of Sustainability in Higher Education (AASHE) in 2015, 2014, and 2011. It is also on the Princeton Review's Top 50 Green College 2015 list.

Waste Awards

In May 2016, UMass Amherst won third place for Food Service Organics in the RecycleMania Tournament, which promotes waste reduction through friendly competition between colleges and universities.Over the course of eight weeks the university tracked and weighed its bottles, cans, paper, cardboard, trash and food waste—with the final recovery total for recyclables and compostables representing 903 metric tons of CO2 reduction.

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Building & Infrastructure Awards

In October 2015, the Commonwealth Honors College Residential Complex became the seventh building on campus to be certified LEED by the USGBC. The Complex earned LEED Silver and joins six LEED Gold Certified buildings on the UMass Amherst campus that include: George Parks Marching Band Building, Police Station, CNS Research & Education Greenhouses, Hampshire Dining Commons, Life Science Laboratories, and the Football Performance Center.

In April 2016, UMass Amherst was recognized by the Arbor Day Foundation as a 2015 Tree Campus USA for its commitment to effective urban forest management. The university achieved the title by meeting Tree Campus USA's five standards: maintaining a tree advisory committee, a campus tree-care plan, dedicated annual expenditures for its campus tree program, an Arbor Day observance and a student service-learning project.

Food Systems Awards

UMass Dining received a Silver NACUFS Sustainability Award in Procurement Practices for their How-To Guide for foodservice operators, Making Local, Healthy, Sustainable, Delicious.

UMass Dining reviewed Global Restaurant Award for its commitment to sustainability. The awards offer an opportunity for industry leaders worldwide to recognize those businesses that have shown innovation, vision and leadership in their concepts and operations. Award winners were chosen for being the best at engaging

with their consumers through social media, technology, design or sustainability.

The UMass Amherst Student Farm was ranked fifth nationally among best sustainable college-run farms by College Values Online. The farm is cited for its organic programming, student empowerment and local distribution, which includes two local Big Y Supermarkets. The ranking also notes that student farmers go on to open their own farms and work for sustainable farming organizations.

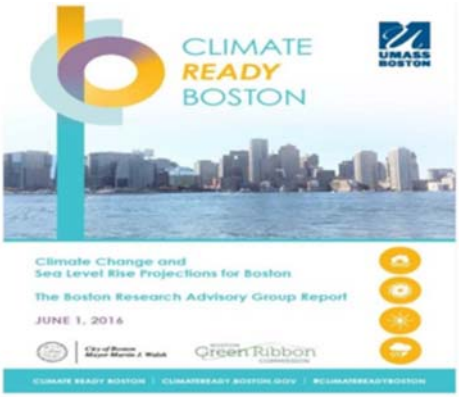
Students, Faculty & Staff Awards

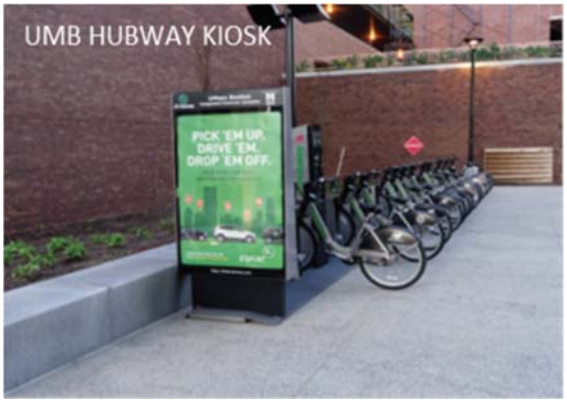
Geoscientist Robert DeConto won the 2016 Tinker-Muse Prize for Science and Policy in Antarctica for his work on past and future Antarctic climate and for research integrating geological data with modeling to reveal likely consequences for future sea level rise from ice sheet melt. The Tinker-Muse Prize includes a $100,000 unrestricted award to "an individual in the fields of Antarctic science and/or policy who has demonstrated potential for sustained and significant contributions that will enhance the understanding and/or preservation of Antarctica."

In November 2015, Marina Qutab, junior majoring in both communication and Arabic took second place in Turning Green's Project Green Challenger, a national competition that asked college and high school students to make their lives more sustainable through a month-long series of daily green challenges.

Green building expert Simi Hoque received a five-year, $508,714 National Science Foundation CAREER award to develop an integrated planning tool that will measure, evaluate and predict the impacts of energy, water and land use, waste management and transportation systems at an urban scale.

Section 3: Boston Campus





The University of Massachusetts Boston is Boston's only public university and is a doctoral degree granting research institution with a student body of 17,030 undergraduate and graduate students. UMass Boston was the only public university in Massachusetts in the1990s to sign the historic Talloire's Declaration on sustainability, was part of the leadership circle in 2007 for signing the ACUPCC Climate Commitment and the first campus in the UMass system to establish a comprehensive sustainability program in 2002.

Clean Energy

UMass Boston installed its first Solar Photo-Voltaic Installation on the roof of the Wheatley building, a 74 kW capacity installation with 350 panels, which was connected to the grid in late 2011. UMass Boston Wheatley solar PV installation is featured in the City of Boston's Greenovate site as part of Boston's Solar Map created by an MIT spinoff Mapdwell.

The Integrated Sciences Complex (ISC) which opened in Spring 2015 occupies 220,000 gross square feet of space featuring: Research lab and support space (for biology, chemistry, environmental sciences, physics, and psychology); Undergraduate introductory biology teaching laboratories; Interdisciplinary undergraduate sandbox teaching lab; Infant cognition lab and new research center—the Center for Personalized Cancer Therapy

The targeted LEED credits in sustainable sites, water-efficiency, use of certified wood and recycled content materials and clean energy include:

- Solar Hot Water System, Chilled beams for lab ventilation, high efficiency energy recovery system.
- An energy cost savings of 26.8% using the ASHRAE 90.1-2004 Appendix G methodology. Energy efficiency measures include an improved thermal envelope, high efficiency glazing, reduced interior lighting, power density, occupancy sensors, daylighting controls, exhaust air energy recovery, and demand control ventilation.
- Lighting controls are provided to enable 92% of occupants to make adjustments to suit individual task needs and preferences, and to permit transient groups to share lighting controls in all shared multi-occupant spaces. A narrative has also been provided describing the project's lighting control strategy with a description of the type and location of the lighting controls. Daylighting is a design feature.
- Base building HVAC systems use no CFC-based refrigerants. The project selected refrigerants and HVAC equipment that minimize or eliminate the emission of compounds that contribute to ozone depletion and global warming. The completed Refrigerant Impact Calculation indicates that the project's total refrigerant impact is 66.1 per ton, which is less than the maximum allowable value of 100.

UMass Boston has an opt-in Renewable Energy Fee created by student Sustainability Club since 2007.

UMass Boston participated in the Boston Green Ribbon Commission (GRC) Clean Power Purchasing event. The GRC is multi-sector group of business, institutional and civic leaders in Boston working to develop shared strategies for addressing climate change in coordination with Boston's city leadership and Boston's Climate Action Plan. The two key areas of focus for the group are GHG emissions reductions and climate preparedness.

UMass campuses attended Second Nature's Clean Power Purchasing event and Clean Energy vendor Altenex was invited in Fall 2015 for a presentation at a monthly meetings of the UMass System Sustainability Council at the UMass President's office to discuss Power Purchase Agreements and ways of meeting emissions targets.

UMass Boston Master Planning Sustainability Advisory Committee (MaPSAC) was established in Fall 2014 and is working on the new 2016 UMass Boston Climate Action Plan to comply with its Integrated Climate Commitment GHG reduction goals while balancing campus growth and resiliency needs. There are currently 13 members, co-chaired by a faculty member Economics department, School for the Environment and A&F Campus Planning office representative. Students also participate in class projects such campus energy audits and MaPSAC.

In October 2015 UMass Boston Campus Center leadership and UMass Boston Sustainability office hosted the Sustainability staff for the National Union of Students UK, which focuses on real-world campaigns and student services across UK campuses, with one of current campaigns focused on sustainability.

On December 3, 2015, a historic announcement for socially responsible investing (SRI) was made by the UMass Foundation with a Coal Direct Divestment commitment. UMass Amherst led this initiative in recent years, with other campuses including the UMass Boston Master Planning Sustainability Advisory Committee (MaPSAC) hosting representatives of 350.org a non-profit that has been working with campuses. All 5 campuses also have Socially Responsible Investing (SRI) as part of potential STARS accreditation in the upcoming UMass Sustainability Policy Draft led by the UMass President's office. Details about the UMass System Coal Divestment can be found here: https://www.umb.edu/news/detail/umass_foundation_to_divest_from_investments_in_coal_companies .

On May 25, 2016 www.umass.edu/newsoffice/article/umass-becomes-first-major-public The University of Massachusetts became the first major public university to divest its endowment from direct holdings in fossil fuels. The decision was made by a unanimous vote of the Board of Directors of the UMass Foundation, a separate not-for-profit corporation that oversees an endowment whose value was $770 million at the end of the last fiscal year.

On October 2015 UMass Boston's SERC hosted a presentation by Austin Blackmon, City of Boston Chief of Environment, Energy and Open Space, who discussed the City's recent initiatives and remaining challenges in reducing reduce greenhouse gas emissions and improving the environment for all residents and companies in Boston.

Climate Resilience and Preparedness

UMass Boston is a leader in climate resilience and preparedness research. Led by UMass Boston's Dean Robyn Hannigan, School for the Environment, the Boston Research Advisory Group (BRAG) was established in 2015 to develop a consensus on the possible climate changes and sea level rise that the City of Boston and Metro Regions will face in the future by 2030, 2050, 2070, and 2100. Working to achieve a consistent climate projection, the BRAG group works with UMass System, faculty experts, institutions, foundations, government and State-wide stakeholders and beyond in the laying the groundwork for climate resilience planning and measures. In addition, UMB Faculty Ellen Douglas and Paul Kirshen are also working with Federal Highways and Mass DOT on climate resilience and transportation systems as well as flooding impacts of climate change on the Charles and Mystic Rivers.

On June 1, 2016, a landmark presentation and report on "Climate Ready Boston" was presented to the Mayor of Boston and the full meeting of the Green Ribbon Commission where Boston's leading business, civic, and institutional leaders share best practices, renewable energy procurement, climate resilience and support the City of Boston's climate plan. https://d3n8a8pro7vhmx.cloudfront.net/greenovateboston/pages/1182/attachments/original/1464889728/5-16_UMass_-_ClimateReadyBOS_-_rev6.pdf?1464889728

This was also reported in the Boston Globe on June 22, 2016 http://www.bostonglobe.com/metro/2016/06/22/climate-change-could-have-even-worse-impact-boston-than-previously-expected/S6hZ4nDPeUWNyTsx6ZckuL/story.html. In Fall 2016 BRAG will lead Phase 2a: Assessment of Climate change on financial &governance & in 2017 Phase 2b : Assessment of Green infrastructure and climate adaptation.

In March 2016, UMass Boston joined leading universities nationwide to sign on to the Integrated Climate Commitment (Carbon neutrality + Resilience) introduced by Second Nature that reiterates its long term commitment to carbon neutrality and include climate resilience and creating a new climate action plan for the campus.

Regional Mayor's Climate Preparedness Summit, Community Engagement Forums In May 2015, UMass Boston campus hosted the Regional Mayor's Climate Preparedness Summit. Boston Mayor Martin Walsh was joined by more than a dozen Greater Boston mayors to formalize a commitment to climate preparedness and resilience. The summit concluded with a dozen Greater Boston mayors signing the "Metro Boston Climate Preparedness Commitment," a regional agreement to establish a common policy framework throughout the Metro Boston area to prepare for climate change. A Metro Boston Climate Preparedness Task Force will also be meeting every two months, coordinating regional, cross-government action to prepare for the effects of climate change such as rising sea levels, storm surges, and other weather events.

In July 2016, UMass system won approval of federal and state hazard mitigation plans to help in climate preparedness and resiliency measure on each campus. The Federal Emergency Management Agency (FEMA) and the Massachusetts Emergency Management Agency (MEMA) approved the university's multi-campus plan that will help identify and protect students, faculty and staff, buildings and critical services like heat, electricity and data storage from potential hazards, according to Jeffrey Hescock, director of University Emergency Management at UMass Amherst quoted in the press release http://www.massachusetts.edu/news/press-releases/umass-wins-approval-federal-and-state-hazard-mitigation-plans

Development of UMass's Hazard Mitigation Plan began four years with three grants totaling $650,000 from MEMA and the Massachusetts Department of Conservation and Recreation, which allowed the campuses to identify areas of critical importance, collect data, analyze risk and estimate the costs of lessening those risks. In the event of a hurricane risk, campus emergency planners would assess the potential impact on facilities, project where rain or flooding might cause the most damage, and highlight the critical services needing to be protected, Hescock said. This included a $1 million state grant to fund the purchase of emergency generators that further strengthen the safety infrastructure.

UMass Boston's Sustainable Solutions Lab (SSL) is a collaborative, cross-disciplinary institute designed to address the complex impacts of climate change on human and natural systems. Created through the joint support of the College of Liberal Arts, the College of Management, the John W. McCormack Graduate School of Policy and Global Studies, and the School for the Environment, the SSL works on engaging multiple stakeholders, connecting faculty, conducting applied research, confronting problems in Boston, the commonwealth, and the wider coastal region. In keeping with the drive to achieve the United Nation's new sustainable development goals, the SSL also intends to connect its learning and experience across the United States and the world.

April 20th, 2016: SERC co-sponsored with SSL and other colleges and centers, a one-day invitational symposium in late April 2016 to examine the potential impacts of large scale climate mitigation, adaptation, and associated infrastructure projects on economically and socially marginalized communities in Boston. More than 100 people attended, including many high level city officials, businesspeople, and academics.

Green Building Design and Sustainable Building Operations

Integrated Sciences Complex (ISC): On April 1, 2015, state and university officials celebrated the Ribbon Cutting for the Integrated Sciences Complex (ISC), the first new academic building on the University of Massachusetts Boston campus in nearly 40 years and the first new facility in the University of Massachusetts Boston 25-year Master Plan.

Designed by Boston-based architectural firm Goody-Clancy, the ISC's 220,000 gross square feet of space features research lab and support space for biology, chemistry, environmental sciences, physics, and psychology; undergraduate introductory biology teaching laboratories; an interdisciplinary undergraduate sandbox teaching lab; an infant cognition lab; two new research centers—the Center for Personalized Cancer Therapy and the Developmental Sciences Research Center; exhibition space; conference rooms; and food service and lounge space.

As the first building on campus to track U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) Gold certification the building encompasses a variety of green design and sustainable features including 26% energy savings over baselines, high efficiency energy recovery program, solar hot water systems, water efficient landscaping and low flow fixtures, recycled content materials and a number of design innovations including energy recovery, transportation options, composting, green informational dashboard, state of the art indoor air quality, daylighting, certified wood, inbuilt hydration stations, indoor and outdoor recycling bins and more.

The ISC was selected as a green design showcase site for the Second Nature's ACUPCC Presidential Summit on Climate Leadership Green Campus Tour in October 2014.

University Hall (UH): University Hall is the second new academic building in the UMass Boston Master Plan, and began a phased opening in January 2016. The 190,000 gross square feet facility features more than 25 general-use classrooms, including 18 classrooms seating 40 or fewer students, and specialized spaces that will help meet pressing academic needs and promote interactive teaching.

Designed by Wilson Architects, it houses faculty and staff offices, a café, a student lounge, and study spaces. All spaces have state-of-the-art amenities. .Special features include two case method classrooms, the first on campus, be a multi-media studio classroom, four 150–200-seat discussion halls, and a 500-seat lecture hall. It is a great example of a multi-disciplinary, mixed use featuring classrooms, Art, Performing Arts and Chemistry labs.

- Tracking LEED Gold, key green design and sustainable features at University Hall include:
- Lab Ventilation Lighting
- High performance exterior envelope and glazing system
- Cantilevered roof shades the southeast-facing glazed wall at the atrium to balance aesthetics and user comfort
- LED theatrical lights to reduce electrical load by 84 KW and the associated cooling load by 24 tons/year
- reduced lighting power density (20% better than code)
- heat recovery for lab space (run-around loop)

- Cascade Economizer" control for lab ventilation
- reduced ventilation during unoccupied hours
- occupancy based control classroom AHUs- units are manifolded within mechanical
- penthouse for redundancy and to optimize system turn-down due to building diversity.
- During partial occupancy, possible to operate one unit to meet building load.
- Inbuilt hydration stations as well as indoor and outdoor recycling bins.
- Building Design efficiency including exterior wall, roof insulation, interior lighting, day light dimming, HVAC systems

Following an extensive qualification and review process in Fall 2015, the University of Massachusetts Building Authority (UMBA) engaged a team from Capstone Development Partners, a national leader in public-private partnership (P3) student housing, to develop residential housing on the UMass Boston campus. In early 2016 UMBA received approval from the state, the UMBA Board, and UMass Board of Trustees to move forward with the project. This will be a LEED certification seeking project.

The university has begun planning and design for the campus's first free-standing parking garage as envisioned in the Campus Master Plan and is exploring ways to include solar, EV charging stations and other green certification and/or green design criteria for parking garages.

Sustainable Transportation

As a commuter school of more than 17,000 students on the peninsula, parking and access to transit from the MBTA Red Line JFK/UMass station is crucial for access to the campus. In the midst of a unprecedented construction boost as part of its master plan, the campus is engaged in an increasing variety of commuting, transportation and innovation strategies that underscore its commitment to being a vibrant, growing and accessible campus. These include:

- A free shuttle bus service using eco-friendly hybrid technology used by about 40% of the campus' community, moving students and employees to the tune of 1.3 million rides yearly on shuttles that run non-stop 7 days a week. Congestion around the school is also reduced by transporting more than a 1000 employees and students daily from the Bayside Expo parking lot.
- The shuttle bus system is also the transportation mainstay during storms and campus events such as commencement so as to reduce the traffic congestion on the major arteries leading to the campus such as I-93 South and an integral part of the campus green transit commuter options which include:
    - Discounted student and pre-tax transit and parking passes.
    - Carpool, vanpool, and rideshare options with MassRIDES programs such as NuRide.
    - Bike racks and shower amenities.
    - Spaces for motorcycles.
    - Bike sharing programs (Hubway).
    - Cars-on-demand program (Zipcar).

- Real-time GPS apps for monitoring the location and arrival access to the shuttle buses, reducing wait times.

The campus is in the 1st phase of its 25-year master plan that will change the University's infrastructure and landscape. Two new buildings the ISC and the UH have integrated existing sustainable transportation options, without the creation of additional parking.

The UMB campus master plan also increases circulation and pedestrian connections on campus by providing over five and half miles of sidewalks and walkways, three miles of bike lanes and 200 bike parking spaces.

The university inaugurated its section of the HarborWalk in 2015 to beautify and enhance walkability around campus - the new stretch features benches, lighting, gathering spaces, native plants, and interpretive signs with historical narratives, and an area to display artwork. This is part of our innovative approaches towards promoting UMass's multimodal transportation plan.

The rollout of the master plan has reduced campus parking by 975 parking spaces and prompted us to seek additional TDM outreach expertise and commit to a more robust MassRIDES partnership.

The UMB Massrides/NuRide partnership hosts monthly tabling events including Welcome weeks, Orientation events, Human Resources Benefits Fair, Winter Preparedness Orientation events, Off-site and satellite campus departmental events. UMB staff increasingly enrolled for its new Emergency Ride Home Program up from 2014 to a total of 65 members. Additionally, outreach and communication also occurs through university-wide broadcasts, social media feeds, Transportation website, Sustainability website, and distribution of campus-wide brochures and information materials as well as during Earth Day, America Recycles Day events.

Environmentally Preferable Purchasing

UMass Boston has a broad commitment to environmental preferable purchasing (EPP) as highlighted in the other subsections of this report:

- EPP varies from local foods to eco-friendly recycling bins, toner cartridges to hybrid buses and 30%-100% recycled paper (appox.79,000 lbs./yr.) to local food or green interiors and lighting in the new ISC and UH buildings.
- Varied campus dining and bookstore offerings include Fair Trade, GMO-free and cruelty-free personal products, food, sustainable stationary, BPA-Free bottle options, reusable cups etc.
- The campus also has a green cleaning program in place and uses eco-friendly cleaners including Green Seal Certification.
- Zero-waste dining uses corn-starch biodegradable bags for pre-and post-consumer composting.
- The UMB Campus Bookstore participates in the Better World Books Donation Program, where students are able to donate their textbooks that have a zero buyback value. Other book recycling programs are also ongoing on campus.

Sustainable Food Services

UMB Dining offers a variety of local, vegetarian, and international offerings. It also hosts Global Chef culinary events and campus users can even order a special Earth Day menu and works with local vendors and farms for baked goods, meats, cheeses and fruit.

UMB Dining uses 100% Cage-Free shelled eggs and has made efforts to educate its leadership and team on local and sustainable seafood and dining choices via educational workshops, site visits to Red Best Seafood, hosting celebrity chefs such as Boston's Barbara Lynch on campus etc.

UMass Boston's kitchens and dining service use biodegradable and compostable bags. The campus has had a zero-waste dining program since 2004 developed in collaboration with the sustainability office.

UMB Dining purchased floor scrubbers that use less water than traditional mopping.

Organics composting began at UMass Boston in the late 1990s and has grown to become a comprehensive zero-waste program over the years.

Organic and fair trade coffees are now widely available all over campus.

UMass Boston offers a reusable cup discount program at all dining cafes on campus since 2002.

UMass Boston also hosts Campus Kitchens, which participates in food recycling, hunger relief, and nutritional information programs. Recently, there has been an expansion of Campus Kitchens space allocation to allow for greater capacity and more meals served.

Student government at UMass Boston passed a resolution in February 2012 to limit the use of disposable bottles. Hydration stations in campus buildings have save more than 900,000 bottles/yr. from reaching the landfill.

UMass Boston's Fall Farmers Market has become a regular feature on campus, partnering with Marshall's Farm, Gloucester, Massachusetts every semester.

Sustainable Water Systems

New construction at UMB features numerous sustainable water systems as they track LEED Gold:

At the ISC the project has reduced potable water use by 45.9% from a calculated baseline design through the installation of water closets, urinals, lavatory faucets, showers, and kitchen sinks, no permanent irrigation system has been installed. A narrative has also been included describing the landscaping design strategies installed on the site stating that the planting will only be watered during the initial plant establishment period.

In September 2015, the newly constructed section of the HarborWalk, between the JFK Library and Museum and Harbor Point Apartments, was opened to the public. The 800-foot stretch of shoreline features a paved walkway, benches, lighting, gathering spaces, bike racks and an area to display artwork. The construction project, begun in 2014, placed 3,200 tons (6.4 million pounds) of stone along the shoreline to stabilize it, before adding the walkway and other amenities. A significant amount of granite blocks unearthed from the Big Dig was donated by the Massachusetts Department of Transportation. The HarborWalk links UMass Boston to the JFK Library and the Edward M. Kennedy Institute for the U.S. Senate, to Carson Beach and Castle Island, to the Seaport District.

UMB's Chancellor Motley thanked children from Dot Art for creating the first sculpture to be featured on the HarborWalk. The children visited the beach several times last summer to gather shells, seagrass, and stone for their sculpture, which is built on a recycled wooden cake that celebrated the 375th birthday of Mather Elementary—the first public elementary school in the nation.

Areas along the section of the HarborWalk have been seeded with grass and native plants.

All trees and bushes are drought resistant and will not need to be watered after initial planting.

About half of the grass being planted in the hilly area (closer to the DCR and lot D side) is meadow grass seeds. This area will not need to be mown, except once a year. Meadow is also a feature at the ISC.

The rest of the grass near the site furniture (benches and scored concrete areas) is grass that needs to be mown regularly, but does not require watering.

The newly installed rip rap will significantly improve resiliency of the shoreline.

Waste Reduction and Recycling

As a commuter campus, UMass Boston has one the earliest leading zero-waste cafeterias offering compostable food ware since 2004, composting more than 260,000 lbs. of food prep and post-consumer food, greenhouse and dinnerware waste per year. The University Dining Club is another more upscale venue offering a zero-waste, washable dishware and cutlery for faculty, graduate students, visitors etc at this commuter campus.

UMass Boston recycled more than 1.4 million lbs. of paper, cardboard, bottles and cans, pallets, bulk recycling, e-waste, toner and ink jet cartridges and pre- and post-consumer compost last year.

Hydration stations were installed to support a student resolution to minimize plastic bottle waste, available in most campus buildings and have saved more than 900,000 bottles/year from reaching the landfills and are included in all new buildings such as the ISC and University Hall. All new buildings have hydration stations to reduce the use of plastic disposable bottles and source reduction of waste.

UMass Boston is the one of the Boston's designated drop off point for Hazardous and Household waste recycling for Boston residents.

Campus e-waste program "Don't just Recycle – E-cycle!" has recycled more than 1500 lbs. of e-waste and small office electronic recyclables since 2005.

Campus Kitchens, a national Food Leftover Harvesting and distribution program works with Campus Dining to avoid food waste and avoid hunger in economically-compromised students.

UMB Campus dining offers a reusable cup discount at all cafe venues on campus, encouraging re-use and reduce the use of disposables.

UMass Boston bookstore vendor has a made number of pre-consumer sustainable operations commitments including using post-consumer recycled materials, energy and the bookstore features many Fair Trade, Recycled content supplies, cruelty-free products and book donation programs.

The UMass Boston ISC program includes an animal care facility that supports research programs in the building. Animal care/husbandry is provided in compliance with national standards. The husbandry program involves regular changing of caging to provide clean caging and bedding materials for the animals. Although at

most animal facilities, bedding is landfilled, UMass Boston has developed a program for comporting the used bedding material as described in the attachment, diverting approximately 1200 lbs. per month of materials from landfill. This is part of a larger composting program at the university and the overall program composts 260,000 lbs. of materials each year.

The campus celebrated America Recycles Day in Nov 2015 by partnering with a vendor giving out 100s of LED lightbulbs to students in exchange for older bulbs.

Academic Programming, Research, and Community

It is estimated that at least 25% percent of students at UMass Boston have taken a sustainability-related course, some of which are highlighted below. UMass Boston offers a diverse array of programs that focus on climate change, sustainability and natural resource management. We are fortunate to have the Harbor Islands and our Nantucket campus as living labs from which we teach, research and engage the community. Clean-tech and sustainability related employment has been growing much faster than other sectors, around 8-10% a year, even through the recession, and the Boston region has emerged as a key center for this activity.

SUSTAINABILITY-RELATED PROGRAMS AND COURSES

UMass Boston's School for the Environment (SFE) is its premier interdisciplinary environmental school. It offer BA and BS degrees in Environmental Sciences, Community Development, and will launch a BA in Environmental Studies and Sustainability in 2017. We offer over 6 environmental and sustainability minors including clean energy and sustainability, an MS in Urban Planning and Community Development, MS and PhD degrees in Environmental Sciences and Marine Science & Technology as well as on-water programs in boating and diving,. With over 600 undergraduate students and 120 graduate students engaged in environmental and sustainability focused programs and numerous local communities engaged through K-12 outreach, community service, and citizen science programs, UMB leads the region in urban coastal environmental research and in training the next generation of environmental problem solvers. Additionally, the following offer a wide variety of degrees, immersions, outreach and expertise in sustainability and environmental academic programming.

- GIS,
- Clean Energy,
- Green Chemistry,
- Sustainable Management,
- Center for Sustainable Enterprise and Regional Competitiveness (SERC),
- Urban Harbors Institute,
- Biology,
- Living Labs and Biomimicry,
- Environmental Economics,
- Coastal, Harbors and Oceans,
- Center for Governance and Sustainability

- Honors College

SERC collates all the courses available each semester for these programs and promotes them. We have launched a web portal to promote all UMB's sustainability-related programs https://www.umb.edu/serc/sustain

The UMASS Sustainable Seafood Collaboratory – engaging expertise across the UMass system to support sustainability and climate resilience along the seafood supply chain from source to plate.

The Gloucester Higher Education Ocean Cluster – bringing together academic, industry, and municipal leaders to extend entrepreneurship and economic development in Gloucester through new technology and new start-ups centered on adding value to the seafood landed in Gloucester.

The Sustainable Solutions Lab – established by School for the Environment, College of Liberal Arts, College of Management, and the McCormack School to focus on tackling issues of climate justice in Boston and other urban coastal cities around the work through integrated science, technology, governance, business, and engineering research and planning.

In Fall 2016, UMB will welcome their third cohort of two College of Management graduate students, funded through the $3.1 million IGERT grant from NSF in collaboration with the School for Environment and the McCormack Graduate School of Policy and Global Studies. The students are studying complex business and environmental issues affecting coastal areas, such as climate adaptation and marine economies in the Boston region and in developing countries.

GREEN INTERNSHIPS, STUDENT AND COMMUNITY ENGAGEMENT

Business Involvement in CES Curriculum & Faculty examples

SERC continues its efforts to engage companies in curriculum development and sustainability workforce training through guest lectures, student projects and research. Some of the past year's guest speakers include:

- Matt Moscardi, ESG Research, MSCI (Large financial investment company)
- Elizabeth Levy, Senior VP, Portfolio Manager and Research Analyst, Trillium Assets Management
- Charlie Myers, President, Massachusetts Hydrogen Association
- Gami Maislin, Lead Power Enterprise Campaign, Raytheon
- Alicia Barton, CEO, MassCEC
- Austin Blackmon, Chief of Environment, Energy and Open Space, City of Boston

- Annie White, Associate Director Research, Sustainalytics (company that develops ESG data sets for investors)
- Berkeley Cue, Principal, BWC Pharma Consulting, LLC
- Martin Wolf, Director Product Sustainability & Authenticity, Seventh Generation
- Josh Lynch, Director of Policy and Outreach, Next Step Living
- Aaron Holmes, Field Marketing Recruiter, Next Step Living

Prof. Haigh invited Eversource, Cape Cod Cranberry Growers Association, Boston Beer Company, and Mass General Hospital to participate in the climate scenario project for graduate students taking the MBAMGT688L Climate Change and International Business Management course in Fall 2015

Prof. Veleva is worked with Cambridge Scientific, a small company focused on biotech and pharma equipment remanufacturing, which provided a project for students enrolled in MGT481 Introduction to Environmental Management and Clean Energy course in Fall 2015. The previous year students in this course had the opportunity to provide recommendations for improving PerkinElmer water reporting to the Carbon Disclosure Project (CDP).

Prof. Dave Timmons of the Economics Department offered undergraduate and graduate special-topics course on economics of the UMass Boston Climate Action Plan. Students learned economic approaches to decarbonization that should be useful in many contexts, and student research contributed directly to the 2016 Climate Action Plan revisions currently underway.

Green Internships, Community and Global Environmental Outreach

Of particular interest are:

1) The UMASS Sustainable Seafood Collaboratory – engaging expertise across the UMass system to support sustainability and climate resilience along the seafood supply chain from source to plate.

2) The Gloucester Higher Education Ocean Cluster – bringing together academic, industry, and municipal leaders to extend entrepreneurship and economic development in Gloucester through new technology and new start-ups centered on adding value to the seafood landed in Gloucester.

3) The Sustainable Solutions Lab – established by School for the Environment, College of Liberal Arts, College of Management, and the McCormack School to focus on tackling issues of climate justice in Boston and other urban coastal cities around the work through integrated science, technology, governance, business, and engineering research and planning.

SERC's Green Internship Program has continued to expand and attract employers and students since 2012 with over 180 internships, weekly postings on the SERC Green Internship website and a growing number of employers are reaching out to UMB to publicize their openings. Some of the available summer internships include: Product Stewardship Institute Summer Project Intern, Union of Concerned Scientists Climate Accountability Intern, The Green Bean Home Energy Auditing Marketing Intern, UMass Boston Recycling/ Sustainability Office Intern, Consortium for Energy Efficiency Graduate Summer Intern, as well Massachusetts Clean Energy Center Summer Internships, CERES, Haley & Aldrich and more. https://www.umb.edu/serc/events.

For a second year SERC partnered with Biogen to conduct sustainability research under the Biogen-SERC Fellowship in Sustainability and Clean Energy (Funded by Biogen). MBA Candidate Gavin Bodkin conducted research on current waste management practices and strategies at Biogen and identified opportunities to improve their waste diversion and achieving zero waste to landfill goal.

UMass Boston's Office of Internships and Career Services organized the 4th Annual Green Career Forums, which featured 14 local employers with Alicia Barton, CEO of Mass Clean Energy Center as the keynote speaker. Over 100 students attended the event and were given the opportunity pursue summer internships or job opportunities.

UMass Boston School for the Environment undergraduate environmental science students have traveled to Brazil in 2016 to better understand global climate history. Led by Prof. Allen Gontz, UMass Boston students are in northeast Brazil are conducting research in the coastal state of Sergipe through a partnership with Universidade Tiradentes. The trip is funded by a grant from the Partners of the Americas 100,000 Strong in the Americas Innovation Fund, which Prof. Gontz and Chancellor J. Keith Motley accepted at a White House ceremony in December

UMass Boston Center for Governance and Sustainability global outreach involves a partnership of The Horn of Africa Regional Environment Center and Network (HoA-REC&N), University of Hohenheim, the Oromia Coffee Farmers Cooperative Union, and UMass Boston received a prestigious R&D grant from "Powering Agriculture: An Energy Grand Challenge for Development", an initiative sponsored by USAID, SIDA, BMZ, OPIC and Duke Energy, to introduce state-of-the-art infrared drying technology to the coffee industry of Ethiopia. Proposed technological solution brings access to clean energy to farmers, minimizes post-harvest loss, increases farmers' profits, reduces greenhouse gas emissions, as well as improve work conditions for women and children.

UMass Boston Center for Governance and Sustainability Environmental Conventions Initiative: International Environmental Agreements. During the 2015-2016 academic year the Environmental Conventions Index continued its work to measure and explain the level of implementation of global environmental conventions. With the support of the Government of Switzerland, the project has been exploring different options for data management and communication, including the development of a database and the definition of outputs to make the index information available to the public. In partnership with the Yale Center for Environmental Law and Policy (YCELP), the Center has also been working on a project on Environmental Law Effectiveness (PELE). It has also been developing different approaches to collaborate with the United Nations Environment Program to support their efforts on evaluating the effectiveness of Multilateral Environmental Agreements.

Student Clubs and Organizations:

UMB students have many opportunities to join sustainability activities such as: Net Impact Graduate and Undergraduate UMass Boston Chapters collaborations, sustainability internships, SERC, professional Greek organizations such a Sigma Gamma Epsilon, Fair Trade Club, Coast Sweep beach cleanup, activities with Boston Harbor Islands recreational areas, as well as Food harvesting and food waste reduction organizations like Campus Kitchens, public interest research groups such as MASSPIRG, and individual student efforts and academic "for-credit" internships and in-class projects offered by faculty e.g. research about UMass Boston's Climate Action Plan (led by Prof. David Timmons) etc. or structure projects and coursework around

UMass Boston Sustainability Initiatives (Maria Petrova: Sustainability 101 class). UMass Boston holds memberships in several national sustainability and climate change organizations including the National Council for Science and the Environment, the Centers for Ocean Education.

Other Boston-area University and UMass System events:

Among other events, UMass Boston UMass Medical staff and other members of the Green Ribbon Commission Higher Ed Working Group (GRC-HEWG) attended the second Green Labs Symposium, hosted by Harvard University in March 2016 to explore state of the art green building technology in campus labs.

Boston GRC-HEWG participants include Boston University, Emerson, Harvard University, MIT, Northeastern University, Boston College, Tufts, UMass Boston along The GRC Health Care Group Participants included Beth Israel Deaconess Medical Center, Boston Medical Center, Cambridge Health Alliance, Boston Children's Hospital, Covenant Health Care, Dana Farber Cancer Institute, Heywood Hospital, Massachusetts Eye & Ear Infirmary, MetroWest Medical Center's Framingham Union and Leonard Morse Hospitals, Partners HealthCare, Brigham and Women's Hospital, Faulkner Hospital, McLean Hospital, Massachusetts General Hospital, Newton Wellesley Hospital, North Shore Medical Center, Spaulding Rehabilitation Hospital and Network, Steward Health Care, Carney Hospital, Saint Elizabeth's Medical Center, Tufts Medical Center, UMass Memorial Medical Center.

Public Recognition of Efforts

In October 2015 UMass Boston was awarded the Massachusetts Leading By Example (LBE) 2015 Public Higher Education for outstanding environmental and energy achievements. The award was presented to UMass Boston, one of only six winners statewide at a ceremony at the State House October 21, 2015 in Boston. UMass Boston accomplishments in recent years have included making sustainability as a "leading guiding principle" in its 25 year master plan. The campus is playing a major role in regional climate preparedness and resiliency efforts. A massive utility corridor and roadway relocation project (UCRR) is underway that includes substantial biking infrastructure, extensive tree plantings, and a storm water management system to reduce runoff and pollution in Boston Harbor. The campus opened its first LEED-designed building, the ISC in 2015, and recycles over 900,000 lbs. of paper, bottles and cans, cardboard, compost, e-waste, cartridges and bulk recycling annually.

In March 2016 UMass Boston was awarded the 2016 Leadership in Commuter Options and 2016 Spotlight Award for UMass Boston's Outstanding Leadership in Commuter Options for Walkability by the Massachusetts Dept. of Transportation. UMass Boston was awarded for Leadership in the Excellence in Commuter Options (ECO) Leadership Award in 2015 by the Massachusetts Department of Transportation. It also earned this recognition from 2014, 2013, 2012 and 2011.

UMass Boston's Dean Robyn Hannigan of the School for the Environment (SFE) led the Boston Research Advisory Group (BRAG) SFE Faculty member Dr. Ellen Douglas presented its landmark report "Climate Ready Boston" on June 1, 2016 at the full meeting of the Green Ribbon Commission in Boston, attended by the Mayor of Boston. The group is a wide collaboration, see link, established in 2015 to develop a consensus on the possible climate changes and sea level rise (SLR) that the City of Boston and its metro regions will face in the future by 2030, 2050, 2070, and 2100. BRAG is overseen by the UMass Boston project team: https://d3n8a8pro7vhmx.cloudfront.net/greenovateboston/pages/1182/attachments/original/1464889728/5-16_UMass_-_ClimateReadyBOS_-_rev6.pdf?1464889728

Boston Globe also reported on UMass Boston Climate Resiliency Leadership and Climate Ready Boston n June 2016.

www.bostonglobe.com/metro/2016/06/22/climate-change-could-have-even-worse-impact-boston-than-previously-expected/S6hZ4nDPeUWNyTsx6ZckuL/story.html

In April 2016, UMass Boston's Sustainable Solutions Speaker Series hosted a talk by Christina Figueres of the UN Framework Convention on Climate Change at the Edward M. Kennedy Institute for the United States Senate.

UMass Boston's Dean David Cash, (Dean of the John W. McCormack Graduate School of Policy and Global Studies and former Commissioner of the MA DEP) contributed to a recent whitepaper by the Brattle Group Economists examining Clean Energy Policy Options for Massachusetts to reduce GHG Emissions.

Founder and director David Levy is the recipient of the Aspen Institute 2011 Faculty Pioneer Award, and the 2016 UMB Chancellor's Scholarship Award.

Chris Whynacht, a first year PhD student working with advisor David Levy in the Organizations and Social Change track, won an award for his paper at the Acad. of Mgt. Conference in Vancouver, Aug. 2015, from the Organizations and Natural Environment division.

Debra Butler, a PhD student in the IGERT program and the OSC track of the PhD in Business Administration, was awarded in May 2016 a highly prestigious one-year National Academy of Sciences, Gulf Research Program Fellowship, to study social and economic impacts of climate change in the Gulf Coast region of the US.

2015 Business for Society Inspirational Paper Award at European Academy of Management Conference for Chacko Kannothra and Stephan Manning for paper titled "Creating Shared Value in Global Value Chains: The Case of Impact Sourcing Service Providers.

UMass Boston Alum Beth Pratt Bergstrom, currently the Director of the California National Wildlife Federation published her book "When Mountain Lions are Neighbors" proceeds from which all go back to the conservation work done on behalf of wildlife in urban environments.

UMass Boston is Princeton Review one of 353 most environmentally friendly colleges in the U.S. and Canada – 2015. UMass Boston was also recognized by Princeton Review in 2014, 2013, 2012, 2011 and 2010 as one of the country's leading green campuses.

Section 4: Dartmouth Campus

UMass Dartmouth for the fourth consecutive year is one of the 332 most environmentally responsible colleges in the U.S. and Canada, according to The Princeton Review. The University's strong commitment to the environment and sustainable practices is profiled in the fifth annual edition of The Princeton Review's free downloadable book, "The Princeton Review's Guide to 332 Green Colleges". Schools were chosen based on a 2013 survey of administrators at hundreds of four-year colleges to measure the schools' commitment to the environment and to sustainability. The institutional survey included questions on the schools' course offerings, campus infrastructure, activities and career preparation. The Office of Campus Sustainability and Residential Initiatives serves as a catalyst for action for students in residence halls and on campus; working with students and the campus community to change their beliefs and behaviors.

Clean Energy

UMass Dartmouth is taking a proactive approach with its energy and utility infrastructure. The University utilizes a distributed steam system to provide the majority of it's facilities with heating, domestic hot water, and air conditioning.

UMass Dartmouth is working hard to implement efficiency and conservation efforts. Strategically working from the central boiler plant out to each of the facilities feed by steam:

- Combined Heat and Power (CHP) System produces much of the campus electricity needs more cost-effectively than traditional electrical distribution and allows for the recovery of waste heat. The CHP generates 1.627 megawatts of electricity and the waste heat from this process is utilized to produce steam for heating and air conditioning.
- At an average age of 50 years the steam and condensate piping at UMass Dartmouth was in such poor condition that less than 40 percent of the supplied steam returned to the central plant as condensate; heavy steam plumes poured from manholes in the main academic quad. The failing system caused substantial energy loss, building damage, water and chemical treatment costs, environmental liability and mounting deferred maintenance costs. UMass Dartmouth is currently in the fourth year of a multi-phase program to replace all deteriorated steam and condensate piping. This program has produced immediate benefits:
    - O At the completion of phase IV of this program it is projected that 80 percent of supplied steam will be returned to the central plant as condensate. Increasing the condensate return will:
        - Improve the feed water temperature of the system and improve boiler and CHP efficiency. This projects into the lower use of fuel thus lowering the overall fuel bill;
        - Reduces the quantity of makeup water required;
        - Reduces the amount of water that is discharged into the sewer system;
    - O Insulation of steam and condensate lines have been replaced and repaired to prevent heat loss;
- Partnered with EverSource and Conservation Solutions to replace forty-six (46) steam traps. Focusing on preventing steam leaks enhances both water and energy efficiency, improves system reliability and increases the life expectancy of equipment.

Although UMass Dartmouth depends on natural gas as the primary fuel source for the campus it is committed to investing in renewable energy. These investments include:

- Installation of 136KW of roof mounted solar panels on five (5) campus facilities;
- Partnering with the Division of Capital Asset Management and Maintenance on the erection of a 600KW wind turbine. Although the performance of the wind turbine has been disappointing to date the parties are committed to making this turbine work;
- Participation in two solar metering contracts a 2.4MW installation by ConEdison in Dartmouth and 6MW installation by Freetown Solar in Freetown.

Climate Resilience and Preparedness

The UMass Dartmouth campus is home to one of the largest contiguous forests in the area. At over 705 acres, the multi-aged habitat provides a tremendous opportunity for land conservation and a large Living Classroom for educational endeavors.

The forest is located in northeast Dartmouth, MA, approximately 1.5 miles west of the New Bedford town line. The forest is comprised of three main blocks:

- North Block - 50.5 acres
- South Block - 307.4 acres
- Cedar Dell Block - 40.2 acres

Charged with the responsibility to protect this valuable resource, the university strives to enhance the health of the forest, conserve the quality of timber products, preserve scenic beauty, protect water quality, promote the unique and cultural values of the forest, and develop educational resources for students and community members.

The university believes its Living Classroom should be enhanced and maintained because of its value to wildlife and to promote long-term goals in forest management.

The Living Classroom project goes beyond natural habitats, however, to include studies of manmade structures on campus and how to make them more sustainable. Faculty in the natural and physical sciences, plus policy, business, and graphic design are involved in developing studies and signage that make the entire campus a place of learning about human interactions with land and energy.

Green Building Design and Sustainable Building Operations

UMass Dartmouth has committed to new construction projects meeting or exceeding the U.S, Green Building Council's Leadership in Energy and Environmental Design (LEED) silver level.

- The Charlton College of Business Expansion, which will open in the Fall of 2016, is tracking LEED Gold. The facility is 22,000 square feet and contains classrooms and student learning spaces. The project was designed to meet or exceed the Massachusetts Energy Code by 20% and strives to use environmentally preferable products and enhance indoor environmental quality.
- The construction of the School for Marine Science and Technology second facility in New Bedford in projected to be complete for the Fall of 2017 and is tracking LEED Silver.
    - (3) EV charging stations for up to 5 Vehicles;
    - Water efficient landscaping utilizing native species
    - 30% reduction in water consumption utilizing water conserving plumbing fixtures
    - 10% recycle materials content in construction materials and interior finishes
- Implementing Green Housekeeping practices utilizing sustainable cleaning products, disposable janitorial products derived from rapidly renewable resources
- Targeting 16% reduction in energy consumption by use of an automated lighting control system, energy efficient lighting, etc.

UMass Dartmouth has committed to the preservation of the core academic buildings designed by Paul Rudolph as an academic utopia. This is best demonstrated by the Claire T. Carney Library Addition & Renovation. As noted in the 2015 AIA/ALA Library Building Awards submission:

"Formed out of concrete, the library's heroic structure provides a level of durability that will far outlast many typical building materials. Yet this robust material, built without insulation, performed poorly from a sustainability perspective. For both environmental and economic objectives, drastically reducing energy consumption was imperative to the University. The project is eligible for LEED Certification.

Perhaps the greatest act of sustainability was to creatively repurpose the 40 year old structure rather than to demolish and replace it. This strategy also provide to be financially sustainable, creating a 'new; learning environment at half the cost of replacement. The project was achieved for under $250/SF while the library remained in operation through construction."

Sustainable Transportation

The Dartmouth Campus operates a multifunctional transit program providing transportation on and off campus during the academic year.

In partnership with the Southeastern Regional transit authority the campus will offer all students the ability to ride all SRTA buses at no cost by simply showing their UMass Pass card. Opening up transportation access to our students to all routes and stops in the city of Fall River, New Bedford, and the surrounding area.

The New Bedford Harbor commission Loop Bus is another alternative transit option for the campus offering a free ride to and from Star Store campus in downtown New Bedford with your UMass ID. It is a direct route (makes no stops) and runs seven days a week.

Carpool to campus and reduce your impact on the environment by limiting the number of cars on the road. Other benefits including lower individual parking permit fees and designated carpool spaces.

DATTCO Bus provides transportation to South Station in Boston. Stops include Fairhaven and Taunton.

MegaBus is a long-distance bus that travels to Rhode Island, New York, and Connecticut.

ZipCar allows you to rent a car by the hour or day. Gas, insurance, maintenance and 180 miles/day are included in every reservation.

As the urbanization of the region progress the possible addition of the South Coast Rail Project will restore passenger rail transportation from South Station in Boston to Fall River and New Bedford along an existing freight rail corridor. The project has far-reaching environmental, social, and economic benefits: this project addresses long-standing transportation inequity, encourages economic development and job-creation, and promotes smart and sustainable growth.

The addition of bike racks and skateboard racks strategically placed around campus, has increased the usage of bikes and boards within the community. The campus is engaging proposals from bike sharing firms; including Zagster. The campus will review proposals to determine the 3 levels of options, small, moderate and expansive, ranging from 30 to 70 bikes in size.

Lastly, the campus is currently pursuing grants to acquire battery-electric vehicles as a part of the campus fleet. The campus will begin to install charging stations for the general public. The Dartmouth campus will be conducting a fleet inventory review to identify most efficient and effective vehicles.

We are currently conducting a transportation study which is leading to the creation of a transportation master plan. The results of that study will be available this fall, as we balance the needs of our students with our current resources available and a better sense of what our peer institutions also provide.

Environmentally Preferable Purchasing

The campus has focused on three areas in support of purchasing of Environmentally Preferred Products. They include recycled content paper, cleaning supplies, and water filtration filling stations. These efforts will progressively continue to reduce the campus carbon footprint.

The purchase of sustainable paper that is either FSC compliant or minimally 30% post-consumer recycled content paper continues to be implemented in phases on the campus. The Campus Print Shop has standardized on paper that is either FSC compliant or 30% post- consumer content recycled paper, that represents over 80% of paper used in their operation. The testing of 30% recycled paper in the print equipment in the computer labs demonstrated there were no mentionable reduction in quality of the print or reduction in functionality of the equipment. All computer labs starting in the fall of 2016 will use 30% Post Consumer Content paper. The final initiative is to encourage all departments on campus to utilize 30% post-consumer content paper in their print devices.

Three years ago the campus standardized on the janitorial products used across the campus. One of the objectives was to create standards that included the use of "Green Products". In addition to reducing the number of products purchased by 50%, approximately 80% are green certified.

In an effort to reduce the purchase of non-environmentally friendly purified water in single use plastic bottles, the campus has continued to install water bottle filling stations that purify water. To date there are 25 filling stations across campus. These filling stations have reduced the purchase of purified water in single use plastic bottles by 743,486 bottles.

Sustainable Food Services

UMass Dartmouth Dining Services Sustainability Focus on Four Key Areas

Environment:

Minimize our impact on the environment with primary focus on REDUCTION. Our approach is to bring awareness and education and implement best practices were viable for waste management, water conservation, energy efficiency, and pollution control.

Purchasing Initiatives:

Encourage responsible and sustainable practices in our supply chains. Our purchasing initiatives provide food choices which celebrate flavor, affirm cultural traditions, and support local communities, and include local purchasing, fair trade coffee and sustainable seafood programs.

In the Community:

Support and encourage charitable initiatives and community reinvestment without associates and partners corporately and locally where we do business.

Nutrition & Wellness:

Provide programs and education that foster and promote healthful, productive workplaces and communities for the benefit of our associates and guest. Program include; Balanced Choice, our healthy lifestyles nutrition program, and healthy work place reward and development program.

The Dining program enhances the students experience with sustainable initiatives and programs such as:

Eat Local: A yearlong, cross-sector campaign that kicks off in the fall and continues throughout the rest of the year. The goal of this campaign is to support the viability of the mid-sized American family farmer and local communities by promoting local produce and creating awareness of its many benefits.

TrimTrax: A food waste reduction program that is used to track, measure, and reduce the amount of kitchen food waste in our facilities on campuses. It is designed to increase operational efficiencies and create awareness about reducing food waste and its environmental impact.

Tray-less Dining has swept across college campuses throughout America and is gaining international attention. Tray less dining curtails food waste, promotes healthier eating habits through portion control, and reduces the amount of water and energy used for washing the trays. Going tray less in dining facilities is one of the ways to combat food waste and educate students about its environmental impact.

Project Clean Plate: Used in conjunction with a tray less dining which helps reduce food waste in our resident dining halls and create awareness among students. Food waste is monitored at the disposal area and an estimate of wasted goods are recorded and posted in the servery showing students week-by-week results. The posted result educates students about how much wasted food is thrown out on a daily basis which could be prevented.

Highlighted Dining Sustainability Program:

UMass Dartmouth received a new addition to campus in the form of a 40 ft. insulated container from agriculture technology company Freight Farms. The container is outfitted with vertical hydroponics, LED lighting, and intuitive climate control allowing for the growth of lettuce and herbs year-round.

UMass Dartmouth's Dining Services, through its food services partner Chartwells, is one of several pilot sites for the sustainable and connected food system. The Freight Farms container is also equipped with integrated technology into its system where dining services staff and students can monitor the growing process 24/7. Freight Farms is a Boston-based agriculture technology company on a mission to create a more sustainable and connected food system. The company provides the tools and services that enable fresh food production in any environment. Freight Farm's flagship product, The Leafy Green Machine (LGM), is a complete hydroponic growing facility built entirely inside a shipping container, with environmental controls and indoor growing technology. The LGM allows for immediate growing of a variety of crops regardless of weather conditions resulting in access to year-round local, fresh produce that is always in season. The farmhand suite of apps allows for "cloud-connected" farming allowing users to monitor their operation from any location, and purchase all of their growing supplies directly from their smartphone.

Sustainable Water Systems

Four East Campus Residence Halls Switch to Water Conservation Aerators Based on a standard showers lasting 8.1 minutes used a day per person, 400 users per building, the switch to water conservation aerators (from 2.2 gallons per minute to 1.75 gpm) will save over 13,000 gallons of water a day for all four residence halls, potentially saving UMass Dartmouth 2.9 million gallons of water a year.

Reduction in Bottled Water: The University stopped funding bottled water for campus offices. At the same time, campus bubblers were repaired and fitted out with filtration systems. Water filling stations have been installed in high trafficked locations on the campus. Sustainability events serve tap water in pitchers rather than bottled water. Many other offices are following Sustainability's lead.

As a part of the Energy performance contract; the campus facilitated domestic water upgrades to include the replacement and retrofitting older water-consuming equipment—such as toilets, faucets and showerheads. The with modern and more efficient devices they measure the flow rates in gallons per flush and gallons per minute cutting down on unnecessary usage.

Waste Reduction and Recycling

New waste-hauling contract

In collaboration with the President's office the Dartmouth campus negotiated a new waste-hauling contract instituting a "pay per pick up" contract rather than previously established by weight. The campus has received a cost reduction of approximately 40%. The new waste contract provided the campus with the opportunity to transition to a single stream approach to our recycling, reducing our costs for storage and transportation.

Residential Recycling through Single Stream

Phase one of the campus' single stream recycling program began in the Fall of 2007 as a pilot program in 4 Residential Halls and all Departments and Offices within the residential halls. With the success of the Pilot program, the campus moved to Phase two of the recycling initiative was implemented in all 14 Residential Halls. Every student room is provided with a blue recycling bag at the time of Move- In. Recycling guidelines are printed on the bag. Students can use the bag to keep recycled materials separated from trash. Students are asked to deliver their recyclables to the designated area outside of the building. Phase three of the initiative; a campus wide effort new recycling bins have been deployed throughout the campus; co-locating bins with garbage cans. A success marketing campaign and change to the campus culture has allow the Dartmouth campus to stream line Recycling.

The New2U

For the fourth consecutive year UMass Dartmouth's New2U program (previously titled Green Move Out) worked diligently throughout the University's Residence Halls to collect donated items during Finals Week and Commencement ceremonies collecting unwanted clothing, appliances, household goods, and nonperishable food. The program was a resounding success collecting 6,000 pounds of clothing, two 40-foot trailers full of household goods, and 27 shopping carts full of food. Donations were made mostly of the clothing to Gifts to Give, a local charity, and donated the food to the UMassD Students Helping Students Food Pantry to distribute.

The student-run program is under the guidance of The Office of Campus Sustainability and Residential Initiatives, Campus Facilities, and the Green Fee. The New2U program engaged 45 students to help educate fellow students about the program, collect and sort donations, then finally donate these items. These students also helped in the continuing efforts by the University to enforce the waste bans in the Commonwealth of Massachusetts by sorting through recycling bins from every residence hall and academic building from the beginning of finals through the last day of Commencement.

http://www.umassd.edu/news/featurestories/magazine-spring2016-recycleresellredistribute.html

Academic Programming, Research, and Community

On the Dartmouth campus numerous activities have contributed to increased community awareness of climate impacts and the importance of efforts to mitigate climate change through reduction of greenhouse gas emission, as well as adapt to changes and promote resilient coastal communities. Faculty, staff and students are involved in making presentations in public venues (K-12, lay presentations, etc.) on ongoing research on the consequences of increasing levels of CO2 in the atmosphere. These include sea level rise, increased storm intensity and frequency, ocean acidification, and associated changes in distribution and vitality of marine life. Faculty members also interact with local and regional news media to provide public information about these issues and what research is being done to address them.

A new state of the art ocean/atmospheric model, developed by UMass Dartmouth Professor Chagnsen, now allows for the first time anthropomorphic input via land and riverine run off as well as carbon sequestration by biochemical processes. This model is being made available for land and coastal use development planning.

The Department of Fisheries Oceanography, under the leadership of Professor Kevin Stokesbury, is examining the effect of climate change on regional fish stocks and migration patterns. It is now established that warm water fish are appearing much further north in the past decade than in the previous millennia. In addition, we are educating our students who live on campus about how to be aware of their own carbon footprint and how changing their behaviors can make a difference.

Campus Life Programs

UMass Dartmouth's Green Navigators organized a campus Sustainability Day. Campus sustainability days are organized by colleges and universities across the country during the month of October aimed to draw students, faculty, and staff together for the exchange of ideas and knowledge from all departments and disciplines.

They also sponsored the America Recycles Day, which helped to raise awareness of the campus' multi-stream approach to recycling. They have also partnered with NORESCO to promote behavior changes for students living in the residence halls. Campaigns like "Be bold, go cold" (washing clothes), "Slash the Trash" (recycling), "Reduce the Juice" (unplugging unused electronics) and "Strive for 5" (shorter showers).

These campaigns are supported through information tables in residence hall lobbies, Resident Assistant bulletin boards and programs as well as reinforced through the new "Green Rooms" program which verifies how "green" our students are living in their residences.

Since September 2013, 35 members of the Green Navigators have worked in conjunction with one member of the facilities staff to process all recycling on campus.

Academic:

As part of its objective of developing strong and interdisciplinary educational experience for its students, UMass Dartmouth started course offerings in Sustainability Studies in 2007. Although sustainability is a discipline in its own right, impactful training in sustainability requires true collaboration between many related disciplines. Faculty with sustainability expertise from various departments and colleges have been working together to offer sustainability courses and programs as well as supervise students involved in individual research projects.

The University currently offers over a dozen courses with Sustainability (SUS) designation and over 50 undergraduate and graduate sustainability related courses. A flexible course titled "Topics in Sustainability" is a perfect example. The course, which focuses on various issues related to growing and distribution of food, carbon cycle, consumption, water, coastal zones and urban environments, has become very popular among students. This team taught course involves faculty from several departments reflecting the interdisciplinary nature of sustainability

The University also offers the following sustainability related programs.

1. An undergraduate Sustainability Studies Minor: Emphasizes a multidisciplinary approach in which students gain an understanding of the theory and practice of sustainability.

2. Environmental Policy (online) Post-Baccalaureate Certificate: Offers an excellent opportunity to achieve advanced knowledge and professional certification in the formulation and implementation of policies that achieve sustainable operations.

3. Sustainable Development (online) Post-Baccalaureate Certificate: Designed to enable professionals and students to identify, explore and formulate best practices in Sustainable Development.

In addition, a few other programs offer students the opportunity to take sustainability related courses as electives towards meeting their degree requirements.

Carbon management is a focus of many different sectors of society and government in efforts to attain climate neutrality. Effective implementation of regulatory and market approaches requires a greater understanding of how different management options affect future climate change and, in turn, human activity.

NASA funded research project at UMass Dartmouth's School of Marine Science and Technology, led by Dean Steve Lohrenz examines the linkages between terrestrial and coastal carbon cycling and how changes in land use, land cover, and forestry affect uptake and the release of carbon dioxide and other greenhouse gases. The integrated land-ocean modeling approach includes assembling model products along with associated uncertainties and errors in a geospatial framework to facilitate decision support for carbon and land use management. The project engages the National Climate Assessment program and USDA efforts to achieve climate neutrality with respect to the earth atmosphere ocean carbon ecosystem.

UMass Dartmouth Professor Mark Altabet is developing new techniques of in situ measurements of nitrogen cycling, which in many cases can be related to carbon cycling. Professor Pilskan is examining how carbon from uptake in the coastal ocean can be transported to the deep ocean and thus sequestered.

Research conducted at the University of Massachusetts Dartmouth Highway Sustainability Research Center (HSRC), under the direction of Dr. Walaa S. Mogawer P.E., has provided a means to reduce emissions during the production and placement of roadway paving materials. In addition to reducing paving emission, the HSRC is committed to increasing environmental stewardship through increased recycling and utilization of new environmentally friendly technologies in paving materials. Examples of recycled materials include existing paving materials already on the road known as Reclaimed Asphalt Pavement (RAP), shingles from roofs and manufacturers waste known as Recycled Asphalt Shingles (RAS), and rubber from scrap tires known as Ground Tire Rubber (GTR). Dr. Mogawer's recent work aims at evaluating the performance of a New England asphalt mixture designed using asphalt binders modified with recycled engine oil. Planning is an essential part of implementing climate neutrality.

UMass Dartmouth is taking a leadership role in applied policy research aimed at protecting and expanding valuable terrestrial carbon sinks in the Commonwealth, while also working on the development of coastal land use planning that fully internalizes the costs of carbon intensive activities. For example, UMass Dartmouth Public Policy Professor Chad McGuire, an expert in property law and land use planning and a gubernatorial appointee to the stewardship council of the Massachusetts Department of Conservation and Recreation, actively works with public land managers across the Commonwealth to expand protections for open space and protect critical carbon sinks. In addition, Professor McGuire is currently research.

Public Recognition of Efforts

Leading By Example (LBE) State Higher Education Award

UMass Dartmouth received a Leading By Example (LBE) State Higher Education Award by the Massachusetts Department of Energy Resources for their commitment to clean energy and reducing their environmental impact of the campus. University officials received the award at the annual LBE Awards ceremony, which recognizes state agencies, municipalities, public colleges and universities and individuals for significantly reducing energy use and greenhouse gas emissions, increased recycling, the use of renewable energy and other clean energy and environmental initiatives.
In the past five years, UMass Dartmouth has substantially increased the efficiency and renewability of its energy generation, including the installation of a 600kW wind turbine, a 265 kW solar PV array, and a 1.7MW CHP system that, coupled with efficiency improvements will enable the University to generate on site close to half of its total energy consumption.

Other efforts include being the first public university in the state to adopt a voluntary Green Fee to fund sustainability projects on campus, as well as increasing student recycling efforts and impacting behaviors to reduce energy.

http://archives.lib.state.ma.us/bitstream/handle/2452/218968/ocn898221737-2014-10-20.pdf?sequence=1&isAllowed=y

http://www1.umassd.edu/communications/articles/showarticles.cfm?a_key=3484

Global Awareness Education and Action (GAEA) event

UMass Dartmouth hosted the Global Awareness Education and Action (GAEA) event, a two-day program focusing the impacts of climate change on the region. Sponsored by UMass Dartmouth, the Island Foundation, and the New Bedford Whaling Museum in collaboration with seven daily newspapers located south of Boston, the event convened a region-wide conversation that brought together scientists, policy makers, business leaders, and citizens from all 54 cities and towns to discuss the issues in a manner that educates and mobilizes individuals and communities.

Presentations by Dr. Anthony Janetos, co-author of the White House Climate Report; Amy Schatz, producer of HBO's six-part climate change documentary "Saving My Tomorrow;" and several lectures by UMass Dartmouth scientists

Four regional planning agencies discuss resiliency work that is already in effect across southeastern Massachusetts. These discussions accounted for current measures and future plans that are still being considered.

http://www.southcoasttoday.com/article/20151128/NEWS/151129515

http://www.umassd.edu/publicaffairs/gaeasummit/

UMassD Alumni Magazine:

The campus took the opportunity to spotlight campus sustainability initiatives; in the areas of academic sustainability minors, innovation and entrepreneurship initiatives and research.

To view an online version:

http://issuu.com/umdpublications/docs/umassd_spring_2016_magazine/3?e=1227777/35495136

UMass Dartmouth's sustainable presence

Consistent with the growing need for sustainable measures, Charlton college of Business has become a leading initiator. In 2010, UMassD became the first public university in the world to publish an A-level Global Reporting Initiative report, an accomplishment that continues to this day. This was accomplished with the University's business chapter of NetImpact.

"This puts the school in elite company, as one of just five universities with a report listed on the GRI website. UMass Dartmouth broke new ground last year when it became the first university in the world and the United States to release a self-declared A-level sustainability report according to the GRI's G3 guidelines."

The GRI framework is the most widely used methodology for reporting an organization's environmental, societal, and economic impacts. This type of reporting is known by several names: sustainability, corporate social responsibility (CSR), triple bottom line (TBL), or environmental, societal, and governance (ESG) reporting. It provides the consistency that shareholders, potential investors, analysts and other stakeholders seek when evaluating and comparing an organization's ESG performance.

http://www.triplepundit.com/2011/01/universities-embrace-gri-sustainability-reporting/

Highlights of UMass Dartmouth sustainability initiatives include:

•Instituting the first public university or college in Massachusetts a voluntary Green Fee which was instituted by student vote to fund sustainable projects.

•Teaching sustainability in the classroom as a minor, a concentration in the Liberal Arts major, and as a concentration in the Masters in Business Administration and Public Policy degrees.

•The University just renegotiated the waste hauling contract and implemented a single-stream recycling program increasing the recycling rate on campus from 8.7 percent in 2013 up to 26 percent in 2014.

•Researching multiple areas of sustainability including highway pavement, ocean acidification, oceanic carbon sequestration, fisheries, public policies regarding land use and oceanic modeling.

•20 percent carbon emission reduction since 2008.

•UMass Dartmouth has substantially increased the efficiency and renewability of its energy generation, including the installation of a 600kW wind turbine, a 269 kW solar PV array, and a 1.7MW CHP system.

•New 40 ft. insulated container provided by agriculture Technology Company Freight Farms, which offers the campus the opportunity to grow farm-fresh produce on campus year-round.

•The Green Navigators and the Green Fee Committee have also teamed up to provide green move out, which this past year produced 6,000 pounds in clothing donations, 23 shopping carts of food donations to the campus food pantry as well as launching a New2U campus yard sale where donated items were resold to new students in the fall.

•Our campus Green Fee funded 17 of the 18 proposals it heard and implemented several of the projects that carried over from the previous year. Projects included summer research projects, a solar picnic table, as well as water bottles for all incoming members of the campus community. To date, the water bottle filling stations installed around campus have saved 466,586 bottles of water.

•Lastly, the University sponsored a two-day summit on Resiliency, examining the science behind climate change as well as the policy implications for the South Coast region of Massachusetts. Over 175 people attended the summit including members of three regional planning agencies.

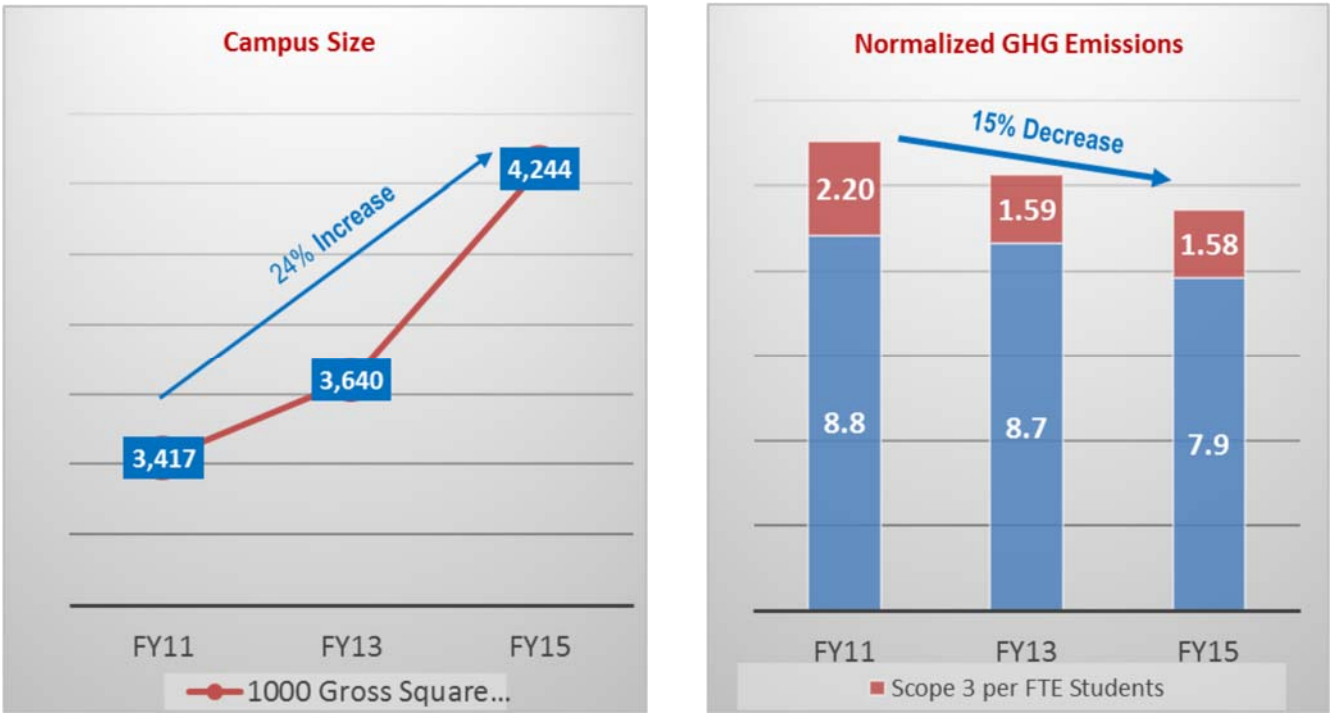
Section 5: Lowell Campus

The University of Massachusetts Lowell is committed to climate neutrality as an institution and is a leader in sustainable education, research and innovation. Sustainability is at the core of the university's comprehensive strategy to manage growth and respond to societal needs.

UMass Lowell is a charter signatory of Second Nature's Climate Commitment. This commitment is supported at the highest level through the university's 2020 Strategic Plan which has a clear sustainability focus on both academics and research, and campus operations.

We take an aggressive approach to implementing our Climate Action Plan. Between FY2011 and FY2015, full time equivalent (FTE) student enrollment has increased by 18% and the physical size of the campus has grown by 24%. At the same time, GHG emissions per FTE student have decreased by more than 15%. In addition, we have reduced our Energy Use Index (EUI) by 25% since FY2011 and 37.6% since FY2005.

Figure 1: UMass Lowell Campus Growth and GHG Emissions Reductions



In this past year our campus has achieved considerable milestones utilizing Lowell's unique urban setting to practice our own distinct brand of sustainability. Our campus serves as a wonderful example of a living sustainability laboratory, while world-class, sustainability focused, teaching and research continues to expand. In recognition of these efforts, UMass Lowell has achieved a STARS Gold rating from the Association for the Advancement of Sustainability in Higher Education (AASHE). In comparison to the peer universities identified in UMass Lowell's 2020 Strategic Plan and Annual Report Card, we are the only university to have achieved this significant certification.

We are proud of the progress we have made in FY2016 and look forward to continually advancing our sustainability efforts in line with the upward trajectory of our university and the entire University of Massachusetts system.

Clean Energy

UMass Lowell's 2020 Strategic Plan requires that the campus "Evaluate and implement renewable energy opportunities to provide significant energy efficiency and conservation enhancement at UMass Lowell in line with our commitment to climate neutrality". As a result, we take an aggressive approach to implementing our Climate Action Plan (CAP).

In FY2015, the university achieved a major milestone in relation to clean energy by meeting its FY2020 Phase 1 interim greenhouse gas reduction (GHG) goals for Scope 1, 2 and 3 emissions five years ahead of schedule. Despite rapid campus growth; between FY2011 and FY2015 full time equivalent (FTE) student enrollment has increased by 18% and the physical size of the campus has grown by 24%, we have realized significant emissions reductions. GHG emissions per FTE student have decreased by more than 15% since the CAP was adopted at UMass Lowell. In addition, we have reduced our Energy Use Index (EUI) by 25% since FY2011 and 37.6% since FY2005. Fuel combustion emissions per square foot have decreased by 19.3% since FY2011 through energy conservation and efficiency projects.

UMass Lowell's Accelerated Energy Program (AEP), which is the largest AEP in the state, continues to serve as our flagship project in relation to clean energy. The AEP is estimated to save the campus over $1.4 million annually in energy savings while reducing energy use by more than 20% for the buildings in the project scope. The cumulative effect of the AEP will be a reduction in the annual campus utilities usage by 6 Million kWh; 500,000 therms and 2.5 Million gallons of water. In addition, deferred maintenance will be reduced by $10 million. Clean energy projects as part of the AEP include solar thermal heating of potable water at UMass Lowell's Inn and Conference Center (ICC), and a 200 kW Parking Canopy Solar PV at South Campus Garage.

UMass Lowell was notified by the Department of Energy Resources in July of a $150,000 grant approval for the Canopy PV array to be situated on the roof deck of South Campus Garage. It will be the first garage Canopy PV installation conducted by agencies of the Commonwealth of Massachusetts.

Climate Resilience and Preparedness

UMass Lowell takes a proactive approach to climate protection in both its campus operations and the university's academic and research programs. While our Climate Action Plan has served as a guiding document since its inception in 2012, this year, we took a further step towards excellence in climate protection and resiliency by becoming a charter signatory for Second Nature's Climate Commitment. Our Chancellor, Jacqueline Moloney, recognized this as an excellent opportunity to continue to advance the university's efforts around sustainability, climate protection, and resiliency.

In late 2015, UMass Lowell received FEMA approval of the campus' first Hazard Mitigation Plan which includes a proactive campus strategy to address and educate the campus on climate related hazards. UMass Lowell was also actively involved in the development of the UMass System sustainability policy which includes climate resiliency and preparedness as a priority.

UMass Lowell continues to lead on climate through our world class teaching and research. The Climate Change Initiative (CCI) brings faculty, students, and communities together to address climate change.

The Initiative draws its members from all six Colleges and Schools of UMass Lowell and from departments and disciplines as diverse as environmental science, public health, engineering, education, management, sociology, art, and others. The goal of the CCI is to address climate change through education, research, and developing solutions to transition to a more sustainable and resilient society.

The CCI utilizes an annual Climate Change Teach-In as a catalyst on climate change and sustainability issues on campus and beyond. Internationally renowned climate scientists, policy experts, and activists have been featured with this year's speaker being Naomi Oreskes, an expert on climate change communication.

The CCI also partners with Climate Interactive to utilize a simulation called World Climate which provides resources to lead and engage people in thought-provoking, mock United Nation climate negotiation simulations. The World Climate exercise enables participants to experience the dynamics that emerge as nations negotiate to reach a global agreement on climate change and to develop a deeper understanding of how to address climate change. The exercise is framed by current climate change science, through the interactive, systems thinking application called C-ROADS. The model empowers participants to find out how their decisions impact the global climate system through a real-time simulation. This year, the CCI Director, Professor Juliette Rooney-Varga utilized the World Climate simulation at the COP-21 Sustainable Innovation Forum in Paris, France.

Green Building Design and Sustainable Building Operations

Throughout FY 2016 UMass Lowell continued its rapid rate of expansion and work continued on campus to drive emissions down per FTE and square foot. Aggressive sustainability-focused renovations, retrofits and upgrades have allowed GHG emissions per FTE student to decrease by more than 15% since the CAP was adopted at UMass Lowell. In addition, we have reduced our Energy Use Index (EUI) (KBTU/SF) by 25% since FY2011 and 37.6% since FY2005. Fuel combustion emissions per square foot have decreased by 19.3% since FY2011 through energy conservation and efficiency projects. Overall stationary Building Energy Usage (electricity, nat. gas and fossil fuel oil) for FY 16 (estimated within 1 or 2 % accuracy) is 402,032,583 kBtu as compared to the same for FY 15 of 449,453,643 kBtu. This is a 10.5% reduction in stationary Building energy usage in FY 16 for UMass Lowell.

The university ensures new buildings constructed on campus are sustainable and meet LEED standards. In FY 2016 three new buildings were certified by the US Green Building Council. The Health and Social Sciences Building (HSSB), University Suites, and University Crossing were all certified LEED Silver by the USGBC. In addition, the major, LEED designed, renovation of McGauvran Center was completed this year. The building opened at the start of the spring semester and has been a key piece in the transformation of UMass Lowell's South Campus. McGauvran Center is currently in the LEED certification process, with a Gold rating expected. In addition, McGauvran Dining Hall has been recognized as the university's first "3 Star Certified Green Restaurant" by the Green Restaurant Association (GRA), a national nonprofit organization that provides benchmarks for restaurants to become more environmentally responsible.

Table 1: UMass Lowell LEED Certified Buildings

Building	LEED Certification
Emerging Technologies and Innovation Center (ETIC)	Gold
Health and Social Sciences Building	Silver
University Crossing	Silver
University Suites	Silver

Construction continues on the Manning School of Business' future home — the new $45 million Pulichino Tong Business Building. Scheduled to open in fall 2017, the Pulichino Tong Building will feature 54,000 square feet of world-class classrooms, offices and collaborative spaces, including a state-of-the-art trading room. Once again, this building was designed to maximize its setting on North Campus and with sustainable design, construction, and operations to the forefront.

As mentioned in the Clean Energy Section, work continues on the $26 Million Accelerated Energy Project. The project will ultimately improve 30 buildings and 6,700 pieces of equipment on campus. When work is completed in 2017 it is expected to save the university $1.4 Million annually. Significant heating and cooling upgrades along with major lighting renovations and additions were completed this year.

UMass Lowell is also one of two sites selected in the state to pilot the contract implementation of the Commonwealth Building Energy Intelligence program. The University was selected because it extensively used the real-time energy metering system to meet its energy and climate goals when a similar contract was launched in August of 2011.

In conjunction with real-time metering, UMass Lowell is initiating the installation of a monitoring-based commissioning (MBCx) system through a pilot project in our Health and Social Sciences Building. Monitoring-based commissioning uses real-time metering; data mining algorithms and web-based technologies to reduce a building's energy consumption. The potential for energy savings is significant. If successful, more

Sustainable Transportation

In November 2015, the City of Lowell, in partnership with UMass Lowell, secured a $13.4 million federal TIGER grant that will help pay for the repair or replacement of eight of the city's canal bridges, including several that serve as vital links to the campus. This grant will have a positive impact on transportation-related GHG emissions both for the university and the city through more direct transportation links and added amenities for bicyclists and pedestrians. The grant team was led by UMass Lowell staff, with strong support from our Chancellor and the now University of Massachusetts President, Martin T. Meehan. In addition to greenhouse gas emissions reductions, the TIGER project will result in significant operational savings for UMass Lowell's transit system through the elimination of costly and time-consuming detours.

Sustainable transportation options continue to grow at UMass Lowell. UMass Lowell was again recognized by MassDOT with a Pinnacle Award for Excellence in Commuter Options marking our third year in a row to receive the highest level of recognition from our state partners. Notable highlights include:

- UMass Lowell was recognized as a Bicycle Friendly University by the League of American Bicyclists. We are the only public educational institution in the state to have received this designation, with Harvard and M.I.T. being the only additional college/university from Massachusetts to achieve this designation.
- UMass Lowell added two additional electric vehicle charging stations to campus this year, bringing our total to six. To improve efficiency, these units are installed as part of larger capital projects. In addition, we took advantage of state grant programs to acquire the charging stations. In FY2016, UMass Lowell averaged 120 hours of EV charging per month.
- Car sharing, through Zipcar, continues to grow at UMass Lowell. This year, two additional cars were added to campus, bringing our total fleet to ten vehicles. All of the Zipcars at UMass Lowell are at a minimum EPA Smart-Way Certified Vehicles.

Environmentally Preferable Purchasing

UMass Lowell has continued to make major strides in improving our environmentally preferable purchases in the areas of electronics, cleaning products and office paper.

Through efforts in the University's Procurement Department to increase the use of punch-out catalogs on Buy Ways 94% of all purchases of desktops, displays, laptops, televisions, tablets and imaging equipment met EPEAT Gold or Silver standards in Calendar Year 2015. We expect to increase this percentage moving forward as a new Sustainable Electronics Procurement policy is implemented.

UMass Lowell's Facilities Management Department has worked to increase its purchase of green chemicals under its new Green Cleaning Policy. As a result, 100% of all Janitorial Paper Products are made of 100% recycled content and Forest Stewardship Council (FSC) certified. In addition, 51% of all cleaning chemical expenditures are on Green Seal Certified products. UMass Lowell was GreenGuard Healthy High Performance Cleaning certified in 2012, the first campus in New England to receive this certification. Our Facilities team continues to build on this achievement and implement sustainable solutions in the management of campus space.

Throughout FY2016, 44% of all paper purchases were 30% post-consumer content or higher. At the conclusion of FY 2016 a Sustainable Paper Purchasing policy was approved, noting a stated preference for purchasing paper with 50% post-consumer content.

Each of the policies referenced above were developed through the Climate Action Plan Steering Committee, which, in September of 2015 was recognized by Governor Baker with a Commonwealth Citation for Outstanding Performance.

Sustainable Food Services

UMass Lowell works closely with our dining contractor Aramark to ensure that sustainable food practices inform our dining strategy. This year, Aramark and the Office of Sustainability contracted with FarmLogix, a national technology platform that connects local farmers to large institutional kitchens. Once the report is complete, FarmLogix will be helpful in identifying local sources that can handle the university's high demand for popular products such as ground beef, chicken, French fries and mozzarella cheese. This will result in a significant increase in local sourcing of products. Responsible sourcing is a priority at UMass Lowell. We are focused on finding ways to buy more local, seasonal and responsibly raised, grown and sourced products. This approach to purchasing strengthens local and global economies, improves the health and wellbeing of people and animals, and conserves our environment.

In FY2016 we've taken important steps to demonstrate our commitment to sustainable food services, including:

- Shifting to 100% sustainably sourced canned skipjack and albacore tuna
- Over one third of our food purchases on campus come from local vendors
- Dining employees are trained each semester on common energy and water conservation practices in order to conserve precious natural resources.
- 100% of University Dining's used fryer oil is recycled and used for generating an alternative fuel option.

The Office of Sustainability and Dining Services also hold two Farm-to-Fork events each year. The intent of these events is to educate the campus community around sustainable food services.

McGauvran Dining Hall, which opened on South Campus in January as part of the $34 million McGauvran Center renovation, has been recognized as the university's first "3 Star Certified Green Restaurant" by the Green Restaurant Association (GRA), a national nonprofit organization that provides benchmarks for restaurants to become more environmentally responsible.

Sustainable Water Systems

The Climate Action Plan Steering Committee also developed a Stormwater Policy this year. UMass Lowell aims to continuously improve stormwater management on campus. The University already complies with city, state and federal stormwater management policies, and it will continue to do so for all ongoing campus operations and future development. In addition to compliance with mandated regulations, the University seeks to incorporate supplementary sustainable stormwater management practices whenever feasible as part of its commitment to sustainability and green building practices.

The university has had water-efficient fixtures in its Design Standards since the first Plumbing Standard and Sustainability Guidelines were written in early 2011. All LEED designed buildings and renovations

completed this year were fitted out with water-efficient fixtures.

The Student Government Association (SGA) has taken the lead on advocating for filtered hydration stations in each building on campus. The Facilities Planning Department has added a number of new hydration stations to campus this year in light of SGA efforts.

Waste Reduction and Recycling

The university's primary goal is to reduce our overall output of waste and increase waste diversion wherever possible. In order to advance this goal in the latter half of FY 2016 the university updated the trash and recycling signs on indoor receptacles. The new signs clearly outline what can and cannot be thrown in each bin using color photographs. They are expected to increase indoor recycling rates. In conjunction with this revitalization plan, a first-time recycling program was launched at the UMass Lowell Tsongas Center with newly designed bins and arena specific signage.

The university continues to compost at all dining halls, eateries, and coffee shops across campus. In FY 16 the EPA's Region 1 presented the university with a Certificate of Achievement for our continued efforts in sustainable food management practices. UMass Lowell has been working to continue to expand this program, planning to launch its first front-of-house composting program at the Crossroads Café in University Crossing, our campus center early in FY 2017.

The end of the spring 2016 semester marked our third and most successful move out donation program. The university donated 14,144 pounds of goods and nonperishable food to Lowell organizations. All of the material was donated by residential students and collected by the Office of Sustainability. The university donated more than double the 6,045 pounds collected in 2015 and four times more than what was collected in 2014.

Academic Programming, Research, and Community

In light of the new sustainability goals contained in UMass Lowell's 2020 Strategic Plan, an Academic Sustainability Committee was established to "integrate sustainability and climate change literacy in learning and research". The committee aims to encourage strong research, education, and outreach programs to educate students, faculty, their broader communities, our elected officials, and other stakeholders about sustainability, climate change mitigation and resiliency.

Industry leading sustainability, climate neutrality, and clean energy research continues to grow through our various research centers including the Climate Change Initiative, Center for Wind Energy, Toxics Use Reduction Institute, and Lowell Center for Sustainable Production. These centers focus on discovery, education, and policy, all to help advance new technologies and critical decision-making. Work began this year on the Perry Hall renovation on North Campus. As part of this project, the university is investing over $7 million to establish an entire floor of Perry Hall as a center of excellence for clean energy research. This will further cement UMass Lowell's position as a leader in clean energy research leading to sustainable innovations.

Using the criteria established through AASHE's STARS system, UMass Lowell currently offers 204 courses focused on sustainability and 499 courses related to sustainability. The following is a sampling of degree programs at UMass Lowell that are focused on sustainability and climate change:

- College of Engineering: M.S & Ph.D. Energy Engineering; Graduate Certificate Energy Conversion, Energy Engineering Minor
- College of Sciences: B.S. & M.S. Environmental Science: Concentrations in Environmental Studies and in Atmospheric Science; B.S. Biological Science: Ecology Concentration
- School of Health & Environment: B.S. & M.S. Work Environment Policy, B.S. Environmental Health; M.S. & Ph.D. Cleaner Production & Pollution Prevention
- College of Fine Arts, Humanities, & Social Sciences: B.A. Liberal Arts: Environment & Society Concentration; Environment & Society Minor

Community Engagement Opportunities

UMass Lowell received the 2015 Carnegie Foundation for the Advancement of Teaching, which is considered the gold-standard system for measuring the service universities provide to their local communities. This year, 8,493 students completed community service hours. In addition, the faculty union contract indicates that the criteria for promotion and tenure include convincing evidence of excellence or strength in teaching, research and service that includes service to the community.

Opportunities for students include various departmental internships in the Office of Sustainability, Environmental & Emergency Management, Facilities Management (Planning, Project Management, Maintenance & Operations and Energy) and Transportation. In addition, UMass Lowell works with our industry partners to offer internships that are solely or jointly funded. In FY2016, UMass Lowell students interned with industry leaders such as Tesla, FirstWind, and Constellation Energy.

Public Recognition of Efforts

- Association for the Advancement of Sustainability in Higher Education (AASHE) – STARS Gold
- Second Nature and U.S. Green Building Council - Climate Leadership Finalist 2016
- Carnegie Foundation for the Advancement of Teaching
- League of American Bicyclists – Bike Friendly University Designation
- U.S. EPA Region 1 Certificate – Sustainable Food Management Practices
- Tree Campus USA

- MassDOT – Pinnacle Award for Excellence in Commuter Options
- Post Landfill Action Network – Most Improved Campus for Sustainable Move-Out Operations
- Green Restaurant Association Certification – McGauvran Dining Hall
- 2015 Ramakumar Family Renewable Energy Excellence Award
- 2015 Commonwealth Citation for Outstanding Performance – UMass Lowell Climate Action Plan Steering Committee
- 2015 Commonwealth Citation for Outstanding Performance to the UMass Strategic Energy Committee
- 2016 Boston Society of Architects Education Facilities Award – Health and Social Sciences Building

Section 6: Medical School

GROWING GREEN

www.umassmed.edu/growinggreen/
@UMassMedSustainability

SUSTAINABILITY TRACKING, ASSESSMENT & RATING SYSTEM
stars
a program of aashe
BRONZE

The University of Massachusetts Medical School (UMMS) prioritizes energy efficiency and sustainability in its mission to advance the health and well-being of people through pioneering education, research and health care delivery with its partner UMass Memorial Healthcare (UMMHC). This effort is broad-based, with participation from students, faculty and staff. UMMS continues to partner with UMMHC on campus, sharing its committees, coordinating events and education of its staff.

Clean Energy

UMASS Medical School operates a 17.5 MW natural gas fired combined heat and power plant which supplies the campus with all of the steam and chilled water needs and roughly 80% of the electricity needs. While campus infrastructure depends on natural gas as the primary fuel source, UMMS continue to find ways to invents in renewable energy infrastructure and improve the efficiency of the campus Plant.

Net Metering

Through the President's Office, UMMS is participated in three solar net metering contracts with the support of Competitive Energy Services. These projects include a 2.5M-DC array in Palmer, MA, a 6MW-DC array in Warren, MA and a 2.1MW-DC project in Williamsburg, MA. The net metering contracts achieve significant cost savings for UMMS: $55,000 in FY14, $616,000 in FY15, and over $700,000 in FY16. With the Williamsburg project that came online late in the spring of 2016, UMMS will save an estimated total of $850,000 in FY17.

Climate Resilience and Preparedness

Business continuity of healthcare and research are major priorities for UMMS and UMMHC. The Medical School in collaboration with utility providers and with assistance from state and federal agencies continue to evaluate campus infrastructure to improve resiliency.

Electrical Power System Resiliency

Several projects are currently underway in support of the Medical School's ongoing effort to increase electrical power system resiliency. During FY2016 UMMS negotiated an agreement with National Grid aimed at significantly enhancing utility service feeder reliability. In the first phase, National Grid recently completed the replacement of the two aging underground electric service feeds to the campus all of the way back to their substation. An additional project under design will isolate the campus from all other National Grid customers. This express feeder work at the National Grid substation is scheduled for completion in the fall of 2017.

Design continued during FY2016 on a project aimed at significantly improving resiliency at the UMMS Power Plant as well. This project will modify the existing electrical inter-connection between National Grid, the Power Plant, and University Campus buildings in order to fully load onsite generation. In doing so, the Plant will be capable of operating as a microgrid, providing electrical power to the majority of the campus during utility outages. Completion of this work is scheduled for summer 2017.

Campus electrical infrastructure projects completed during FY2016 also include the overhaul of (9) 480V main and tie circuit breakers as well as replacement of 18 under voltage relays in the Medical School electrical substations.

Multi-Hazard Mitigation Plan

UMass Medical School's Campus Multi-Hazard Mitigation Plan was approved by Massachusetts Emergency Management Agency (MEMA) and Federal Emergency Management Agency (FEMA) in February 2016. The Plan builds upon existing hazard mitigation planning efforts that have been completed on the campus, identifies vulnerabilities, helps to prioritize capital projects to reduce risk, and evaluates potential for future state and federal assistance to mitigate the risks. UMMS utilized a grant allocated by the Massachusetts Emergency Management Agency (MEMA) and the Massachusetts Department of Conservation and Recreation (DCR) and funded by the Federal Emergency Management Agency (FEMA) to develop the Campus Multi-Hazard Mitigation Plan.

Greenhouse Gas Mitigation Plan

In FY16 UMMS underwent and exercise to assess current progress toward climate goals including the ACUPCC President's Carbon Commitment and E.O. 484. The Greenhouse Gas Mitigation Plan, a follow up to the 2008 Climate Action Plan, includes a high level review of UMMS' existing greenhouse gas (GHG) emissions inventory and baseline, an assessment of the GHG reduction potential associated with UMMS energy conservation measures (ECMs), an assessment as to the feasibility of actually meeting the ACUPCC and E.O. 484 GHG reduction goals without purchasing offsets, future projections of GHG emission reduction timelines of several scenarios, and estimations of the cost and payback associated with each scenario. The Greenhouse Gas Mitigation Plan is expected to be finalized in the fall of 2016.

Green Building Design and Sustainable Building Operations

Improving energy efficiency and optimizing building performance remains a focus for UMMS. A cross functional team within facilities management including, engineering and construction, power plant operations, maintenance, finance, and sustainability continue to meet bi-monthly to evaluate utility consumption and building performance of all campus buildings and drive energy efficiency projects.

Retro and Continuous Commissioning

UMMS is recently completed the retro-commissioning the Albert Sherman center as a part of a project to optimize building operations. Majors energy conservations (ECMs) measures incorporated into this project included reducing air flow and static pressure set point in office areas and optimizing the enthalpy wheel. The project successfully met the retro-commissioning goal and has realized weather normalized savings to date of over $100,000 and decreased the buildings energy use intensity by 24.5kBtu/SF.

Continuous commissioning to review building system operations and set points in the Ambulatory Care Center (ACC) through the use of fault diagnostic software occurred in FY16. The ECMs identified and implemented included significant reductions in ventilation, the implementation of night and weekend setbacks, and use of occupancy sensors.

LED Lighting Upgrades

In FY16 UMMS received 3,500 LED bulbs at no cost through Mass Save program. Once installed, throughout the Main School Building and Lazare Research Building, these bulbs will save roughly 350,000 kWh and approximately $35,000 annually.

Building Management System (BMS) upgrade

A project to replace the old Johnson Controls building management system (BMS) in Main School Building with Automated Logic (ALC) began in FY16. This project includes commissioning of the new BMS following the conversion to review ALC's existing sequences and the optimization of some sequencing such as static pressure reset and optimized DA-T reset. Commissioning and optimization of the BMS systems is expected to enhance building performance and reduce utility consumption.

Sustainable Transportation

UMMS continues encourage sustainable transportation by providing free bus passes to employees, collaborating with MassRides to provide incentives for green commuting options and by continuing to expand EV infrastructure.

EV Charging

In the spring of 2015, a new Tesla wall charger was installed to go along with the existing Tesla wall charger, two level 2 charging stations and two "trickle" outlets installed on the first floor of the First Road employee garage. This new charger allo ws for quicker charging of Tesla's which require more electricity to charge efficiently than the standard level two chargers provide.

Environmentally Preferable Purchasing

The Medical School continues to collaborate with the President's Office Purchasing Council to support University's goals to support Massachusetts based and minority owned business enterprises, promote sustainability, and leverage cost savings opportunities. This includes the FY16 pilot initiative to hard swap OEM toner cartridges with recycled toner cartridges from a minority owned local business.

Sustainable Office Products

UMMS continues to encourage the purchase of office paper containing post-consumer recycled content. Approximately 27% of all paper purchases, by dollars spent, contained 30% post-consumer recycled content or greater. Additionally, approximately 20% of the toner cartridges, based on dollars spent, contain some post-consumer recycled content.

Green Cleaning – Orbio Water

UMMS and UMMHC hospital uses self-generated Orbio multi-surface cleaner to clean approximately 1.7 million square feet for floors, equaling over 60% the cleanable square footage roughly on campus. This non-hazardous muti-surface cleaner is created onsite from tap water and a small amount of salt which are combined and flow through an electrolyte cell in the Orbio onsite generation system (OGS) to create a 0.05% sodium hydroxide cleaning solution. Through the use of Obrio multi-surface cleaner, UMMS is improving the health and wellbeing of our employees by minimizing exposure to hazardous cleaning chemicals, and reducing waste by minimizing the number of clearing chemicals and bottles brought and disposed of on campus.

Sustainable Food Services

UMMS continues to support sustainable food systems on campus by minimizing solid waste through the donation of approximately 10,000 gallons of pre-consumer food waste to a local pig farmer and the recycling of 5,000lbs of waste oil from fryers annually. The campus community is provided opportunities to access local food and products during the farmers market which is held weekly from June through October on the campus green and through the Massachusetts Local Food Cooperative which offers monthly distribution at the Worcester campus.

Local food – Red's Best

An agreement between Sodexo and their produce provider requires UMMS to receive the most local product available, however, in FY16 local products available through dining services expanded to include fish from the Boston Harbor. Not only does Red's Best provide local fish to campus, they also help licensed fishermen, sectors, and community supported fisheries (CSFs) comply with sustainable fishing regulations.

Sustainable Water Systems

UMMS and UMMHC are large consumers of domestic water due to the nature of campus operations. Significant efforts to reduce water consumption including the recapturing of rainwater and condensate water from the Albert Sherman Center for use in the campus Plant. FY16 facilities management began to significantly evaluate campus water consumption as a priority.

Evaluation of campus water meters

The Medical School continues tracking domestic water usage as a key performance indicator looking specifically at irrigation, building water usage, and Power Plant water usage. In the spring of FY16 a cross departmental team including facilities maintenance, power plant operations, business administration, and sustainability began an extensive process to validate domestic water meters on campus to ensure accurate reporting. In doing so, the university will be able to gain a better understanding of how water is used on campus and develop strategies to reduce water consumption in the future.

Waste Reduction and Recycling

The Medical School in collaboration with UMMHC continue to increase and improve consistency and availability of recycling infrastructure on campus in an effort to reach increase our waste diversion rate from 33% to our goal of 40%.

SWAP Shop

The SWAP (surplus with a purpose) Shop, an exchange room for unwanted office and lab items in good condition, opened in October 2015 to facilitate the reuse of items on campus. The Shop is located in the Main School Building and is a resource to faculty, staff, and students of the medical school. Since opening, over 2,800lbs of items have been reused with a value of over $35,000.

Centralized trash program

The centralized trash program was a pilot initiative launched in the summer of 2014 in the Lazare Research Building designed to increase recycling rates by removing desk side trash bins from office areas, leaving only blue recycling bins in place. Centralized trash bins were installed in a couple of locations on each floor. By design, the experiment kept recycling at hand, but throwing something away required getting up and walking down the hall. This pilot program was successful in increasing recycling rates in the Lazare Research Building, so in January of 2016 the program was expanded to the Albert Sherman Center.

Implementation of Hospital Recycling Program

Beginning in the summer of 2015, the sustainability office and UMass Memorial's housekeeping department started working with the center for innovation and transformative change, the department focused on process improvement within UMass Memorial and UMass Medical School, to develop a process for implementing recycling within the Hospital. Utilizing the LEAN methodology, the team was able to develop a plan to implement a recycling program that was effective, did not add additional work to housekeeping staff, and remained in compliance with Joint Commission guidelines. To date, recycling bins are now located in all staff breakrooms, patient waiting rooms and clinic in the teaching hospital.

Academic Programming, Research, and Community

UMass Medical School works to engage campus community member through outreach campaigns, bi-monthly newsletters, events, and through the sustainability committee and student groups. As a graduate institution focused on medical education and research, the Medical School's academic programing and research therefore does not include sustainability as part of the course work or degree programs.

Earth Day photo pledge

As part of the annual Earth Day Celebration at UMMS, the 2016 events included a photo pledge where over 300 campus and community members pledged their support to reduce, reuse and recycle by having their photos taken. Pledge participants were given an "I pledge to do my part" water bottle or lanyard and the photos were posted to the @UMassMedSustainability Facebook page.

It's a Green IDEA

In April 2016 the "Green IDEAs" initiative was launched by the UMMS Sustainability office in collaboration with UMass Memorial Medical Center housekeeping, and Center for Innovation & Transformational Change (CITC). This joint initiative encourage the generation and implementation of ideas, through the use of idea systems on campus, that reduce energy consumption, conserve resources, increase recycling, or reuse materials on campus. Once the idea is implemented a reusable mug is presented to person or group and the idea is shared on the @UMassMedSustainability Facebook page so others can learn from and adopt green practices on campus.

Campus Sustainability Day

In October 2016 UMMS participated in Association for the Advancement of Sustainability in Higher Education (AASHE) campus sustainability month by hosting a campus sustainability day. During campus sustainability day, the UMMS sustainability office in collaboration with the WooCycle, the campus' student sustainability group, and E.L. Harvey, the campus' waste and recycling hauler, hosted a variety of events to encourage sustainability on campus and at home. The features of the day included the distribution of over 10,000 LED light bulbs to faculty staff and student, the opening of the SWAP (Surplus with a Purpose) Shop, and an electronics recycling event.

Public Recognition of Efforts

Sustainability Tracking Assessment and Rating System (STARS) – Bronze

UMMS achieved a Sustainability Tracking Assessment and Rating System (STARS) rating of Bronze through the Association for Advancement of Sustainability in Higher Education in May 2016 making UMMS the only Medical School with a STARS rating.

Pinnacle ECO Award

UMMS was received the Excellence in Commuter Options (ECO) Pinnacle award for through the Massachusetts Department of Transportation.

Harvard Green Labs Symposium

David MacNeil, Senior Mechanical Project Manager at UMMS and Suzanne Wood, Sustainability & Energy Manager at UMMS presented on The Albert Sherman Center: Achieving Predicted Energy Use at the Harvard Green Lab Symposium in March 2016

AIM Roundtable

Suzanne Wood, Sustainability & Energy Manager at UMMS presented on The Albert Sherman Center: Energy Use Models - Predicted vs. Actual Use at the Associated Industries of Massachusetts (AIM) sustainability round table.

Massachusetts Green High Performance Center

The MGHPCC operates as a joint venture between the University of Massachusetts, Boston University, Harvard University, the Massachusetts Institute of Technology, and Northeastern University. Completed in November 2012, the 90,000 square foot, 15 megawatt facility is located on an 8.6-acre former industrial site just a few blocks from City Hall in Holyoke, MA.

The MGHPCC [1] has three principle missions. It is:

- **A research computing data center** supporting the growing research computing needs of five of the most research-intensive universities in Massachusetts: Boston University, Harvard University, the Massachusetts Institute of Technology, Northeastern University, and the University of Massachusetts.
- **A historic collaboration** among the five MGHPCC universities, state government and private industry – the most significant collaboration among government, industry and public and private universities in the history of the Commonwealth.
- **A partnership with Holyoke, the Pioneer Valley, and the Commonwealth.** The MGHPCC has worked closely with the Holyoke Innovation District Task Force to leverage the benefits of the MGHPCC facility's location in Holyoke, and is partnering with K-12 public schools and community colleges on new educational and workforce development initiatives.[2]

The MGHPCC was the first university research data center ever to achieve LEED Platinum Certification. Its creation was only possible because of the unique university-government-industry collaboration. The UMass Shared HPC environment is supporting over 1300 researchers across the five campuses.

A high performance research computing data center, powering and cooling the equivalent of hundreds of thousands of computers, is not often associated with sustainability. The Green Design[3] of the MGHPCC is resulting directly in reduced energy costs and reduced carbon emissions when compared to a reference facility.

PUE is Power Usage Effectiveness, is defined by the Green Grid to be Total Facility Power consumption divided by Compute Power Consumption.[4] Lower PUE equates to improved energy efficiency. The MGHPCC Average PUE for FY16 (7/1/15-6/30/16) was 1.27. Putting this into financial perspective, MGHPCC energy costs for the year were approximately $1.2M lower compared to a reference data center facility. Also, MGHPCC power consumption yielded approximately 11,000 fewer tons of C02 in the past year compared a reference facility.[5] This is due to both MGHPCC energy efficiency and HG&E's use of 90+% carbon-free generation.

With the increasingly integrated role of computation in fundamental and applied research, the MGHPCC is a critical piece of infrastructure that will fuel the world-leading innovation economy of the Commonwealth of Massachusetts through cooperative research, education and outreach activities with the lowest possible environmental impact.

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[1] http://www.mghpcc.org
[2] http://www.masstech.org/innovation-economy/regional-economies/holyoke-innovation-district
[3] http://www.mghpcc.org/about/green-design/

[4] http://www.thegreengrid.org/~/media/WhitePapers/WP49-PUE A Comprehensive Examination of the Metric_v6.pdf

[5] Reference Facility

Industry average PUE: = 1.7 (Journal of the Uptime Institute – 2014 and 2015)

Energy rate: $0.13 cents per kwh (Massachusetts average – US DOE)
US Mean C02 per kWh: 0.559 (US mean, US EPA)