



**University of Massachusetts
Medical School Climate Action Plan**

November 16, 2009

**GROWING
GREEN**



*Sustaining the UMass Academic
Health Sciences Center*

Introduction

In support of its long-standing commitment to sustainability, and in recognition of the goals of Governor Deval Patrick's Executive Order 484 "Leading By Example—Clean Energy and Efficient Buildings" and the American College & University Presidents' Climate Commitment, the University of Massachusetts Medical School (UMMS) has coordinated a range of ongoing programs to create an institutional Climate Action Plan.

This plan will help guide UMMS's growing programs in research, education, and clinical care in order to achieve the dual goals of sustainable advancement and environmental stewardship. This plan, which by its nature will always be an evolving document, is currently focused on the UMass Academic Health Sciences Center: the Worcester, Massachusetts campus shared by the Medical School and its clinical partner, the UMass Memorial Medical Center (University Campus).

What follows is an overview of the ongoing, multi-layered sustainability program, which departments are working on cooperatively to reduce energy consumption, reduce greenhouse gas emissions, and expand recycling and other measures that collectively limit the carbon footprint of the shared campus.

Background

The University of Massachusetts Medical School (UMMS) was founded in 1962 as the first and only public medical school in the Commonwealth of Massachusetts with the principal mission of educating new physicians to fulfill primary care needs in underserved areas. In 1976, the Medical School was expanded to include a 371 bed, full-service medical center. Subsequent expansions resulted in the opening of the Graduate School for Biomedical Sciences in 1979 and the Graduate School of Nursing in 1986.

Today, the University of Massachusetts Medical School is a world renowned institution for health sciences education, research and public service. Its vibrant and growing research enterprise counts a Nobel Laureate among its distinguished faculty. UMMS investigators are making pivotal advances in a range of basic science research and in the treatments of infectious diseases, cancer, diabetes and other serious conditions. Through its Commonwealth Medicine programs, UMMS collaborates with public agencies to improve access and delivery of health care to at-risk and uninsured populations by leveraging the institution's research, academic, management and clinical resources. UMass Memorial Medical Center, the clinical partner for the medical school, provides comprehensive medical care for residents of central Massachusetts and contains the region's only level one trauma center, serves more than 20,000 trauma victims annually.

Sustainability at UMMS

Sustainable operations at the University Campus have been the Medical School's objective for many years. The UMMS Sustainability Committee¹ was established in 2004 to coordinate various sustainability efforts across campus departments, and for information sharing and dialog with the goal of reducing the school's carbon footprint. As of 2009, the committee has grown to include membership from UMMS departments of Auxiliary Services, Purchasing, Information Services, Facilities, Building Services, Public Affairs and Environmental Health and Safety. Additionally, the committee includes medical school students, representatives from UMass Memorial Medical Center and other interested parties. The committee meets regularly to assess and reduce the environmental and energy impact of current operations, in accordance with Massachusetts Executive Order 484², Leading By Example: Clean Energy and Efficient Buildings.

Over the past five years, key accomplishments of the sustainability effort at the University Campus include³:

- Improve and expand the tri-gen power plant on campus
- Implementation of a bottle/can and paper recycling program
- Use of green cleaning products that meet LEED standards throughout the campus
- Lighting upgrades, HVAC improvements, and purchase of energy efficient equipment
- Printer consolidation and use of remanufactured toner cartridges
- Reduction of staff and faculty travel carbon footprint
- Sustainability language on "Request for Proposals" from vendors
- In 2009, UMMS hired a full-time manager to oversee sustainability

UMMS Carbon Footprint Study

As one of its first steps in meeting the American College & University Presidents' Climate Commitment (ACUPCC), the Medical School conducted a campus-wide carbon footprint estimation study in 2007. Developed by the consulting firm ENSR, the survey compares green house gas (GHG) emissions between FY 2003 and FY 2007. Emissions of GHGs (Co₂, CH₄ and N₂O) at the University Campus were estimated for direct sources as well as indirect sources. The full report is attached as Appendix C of this plan.

The UMMS greenhouse gas summary (below) reveals a trend from 2003 to 2007 toward burning more natural gas and less oil in the campus power plant. In addition, more electricity was generated by the power plant, reducing the amount obtained from "the grid," which produces electricity through higher-polluting coal combustion. Thus, while overall emissions

¹ A full listing of the UMMS Sustainability Committee can be found in Appendix A.

² Massachusetts Executive Order 484, Leading By Example: Clean Energy and Efficient Buildings, was passed on April 18, 2007. Click [here](#) for the full text of the order.

³ For a broader description on previous UMMS Sustainability efforts, see Appendix B within this report.

increased for natural gas combustion, it decreased for oil combustion and externally-produced electricity. The study also reveals that student and employee commuting was the largest contributor to the campus's carbon footprint, accounting for 55 percent of total CO2 emissions in 2003 and 60 percent in 2007.

CO2 Emissions/Medical School (FY 2003):

Student and Staff Commuting – 55%
Natural Gas Combustion – 20%
Oil Combustion – 15%
Electricity Purchase – 10%
Emergency Generators - <0.1%
UMMS Owned Vehicles - <0.1%
Business Air Travel - <0.1%

CO2 Emissions/Hospital (FY 2003)

Natural Gas Combustion – 35%
Patient and Visitor Commuting – 28%
Oil Combustion – 27%
Electricity Purchase – 10%
Emergency Generators - <0.1%
Business Air Travel - <0.1%

CO2 Emissions/Medical School (FY 2007)

Student and Staff Commuting – 60%
Natural Gas Combustion – 24%
Oil Combustion – 7%
Electricity Purchase – 9%
Emergency Generators - <0.1%
UMMS Owned Vehicles - <0.1%
Business Air Travel - <0.1%

CO2 Emissions/Hospital (FY 2007)

Natural Gas Combustion – 47%
Patient and Visitor Commuting – 28%
Oil Combustion – 14%
Electricity Purchase – 11%
Emergency Generators - <0.1%
Business Air Travel - <0.1%

Growing Green

In 2009, the Sustainability Committee launched a campus-wide communications plan to educate and motivate the community concerning sustainability. Growing Green includes a new web portal to document and highlight the campus sustainability efforts.

Late in 2009, a campus-wide Growing Green electronic newsletter was launched to serve as a regular communication vehicle for sustainability to all faculty, staff and students. Future years of growth are expected for the Growing Green program that will include campus events, increased frequency of e-newsletters, incentive programs and other ways to feature and encourage sustainable practices at the Medical School.



UMMS Climate Goals

As a signatory to the American College & University President’s Climate Commitment, The University of Massachusetts Medical School is targeting to be climate neutral by 2060, with incremental steps over the next 50 years.

EMISSIONS TARGETS

<i>University of Massachusetts Medical School Emissions Targets</i>	
25% below 2007 levels	by 2025
50% below 2007 levels	by 2040
75% below 2007 levels	by 2050
Climate Neutral	by 2060

NARRATIVES

UMMS Greenhouse Gas Mitigation Plans

Greenhouse gas mitigation at UMMS will involve improvements to the building infrastructure on campus, transportation and sustainable business practices. Though challenges remain with the energy-intensive function of the Medical School and hospital, there are several improvements that will be made to impact the campus carbon footprint.

Building Efficiency

UMMS will look to continue energy and water efficiency upgrades to the HVAC systems, laboratories, plumbing and fixtures, lighting, refrigeration and other plug load. **UMMS is now constructing two new buildings on campus opening in 2010 and 2012 respectively, with the expectation of being LEED-Silver certified.** The Medical School is now evaluating technology options to optimize building performance and further increase efficiencies through automated solutions. UMMS is building a state-of-the-art data center replacing two existing data centers. There will be a significant energy savings because of the design of the new center, and the efficient use of equipment and maintenance practices. UMMS will investigate storm water collection for use in the University Campus Power Plant. Finally, UMMS is reviewing renewable energy options including wind and solar installations.

Transportation

Approximately 55 percent of the University Campus's carbon footprint is attributable to student and staff commuting to campus. **A large part of the mitigation strategy will look to reduce the number of vehicles coming to campus, as well as, increasing the overall fuel efficiency of those vehicles. Incentive programs, and carpooling/rideshare programs, will be expanded to further encourage a reduction in the vehicle traffic on campus.**

Sustainable Business Practices

Several UMMS departments have an impact on greenhouse gas emissions, including Purchasing/Contracts, Information Services, Environmental Health and Safety, Solid Waste and Recycling, and **Food Services.** UMMS sustainability staff will work with all departments to develop sustainability guidance that fosters waste reduction, green purchasing, energy efficiency, and water efficiency.

UMMS Sustainability and Education Experience Plans

As a Medical School, UMMS needs to be creative in the ways that it reaches employees, faculty and students. UMMS will engage employees, faculty and students, increasing their awareness of sustainability in their personal and professional lives. Reaching the UMMS community through existing channels as well as creating new opportunities for learning will help reduce the Medical School's carbon footprint. The following exemplify how UMMS will incorporate sustainability into the educational experience:

Students

In addition to including interested students within the UMMS Sustainability Committee, UMMS plans to investigate opportunities to include Growing Green information during orientation, in the Student Handbook, and at the annual Student Activity Fair.

Campus Events

UMMS will continue to promote sustainability at the annual Earth Day event held each April. In addition, other events will be planned to bring expert speakers to campus on various topics of interest (i.e. linkage between health and the environment, etc.). UMMS envisions collaborative partnerships will emerge with sustainable product vendors, and educational organizations. These partnerships will help to raise the awareness level of the UMMS community and impact individual behavior.

Faculty and Employees

Including information on the Growing Green program during employee orientation and Human Resource events can raise the awareness of new staff. The Growing Green e-newsletter, advertising on campus and the UMMS Intranet "Message of the Day" will be used to reach the campus community. In addition to the Growing Green communication program, UMMS sustainability staff will work with faculty of the School of Medicine, Graduate School of Biomedical Sciences and the Graduate School of Nursing to potentially include incremental information on how sustainability relates to health through case studies and assignments, recommended reading and community outreach. UMMS will look to other similar schools for course samples, lectures and materials to provide to faculty.

UMMS Sustainability Research Plans

By definition, UMMS is primarily focused on health sciences education, research and public service. There is an opportunity at UMMS to identify and track how health-related research relates to sustainability. Various linkages can then be made between the sustainability program and UMMS research.

In addition to the research and academic outreach, Growing Green plans to coordinate with the UMMS programs, centers and institutes within its system to encourage the adoption of sustainable practices and reveal the linkages between sustainability and health.

UMMS Sustainability and Community Outreach Plans

As a part of the Worcester, Massachusetts community, UMMS has the unique opportunity to partner with several organizations on sustainable programs. With nine other colleges and universities located in Worcester, UMMS is well-positioned to learn from and collaborate with its peers. As a part of this outreach, UMMS will work with the other University of Massachusetts campus sustainability programs at Dartmouth, Boston, Amherst and Lowell.

Outreach may include collaborative projects, policy outreach and discussion of challenges and joint ideas to overcome challenges.

UMMS will continue its collaborative relationship with UMass Memorial Medical Center to reach clinical staff and the public at the University Campus.

Sustainability at Home

Growing Green will work with faculty, students and staff to encourage sustainable practices at UMMS as well as highlight actions they can take at home. UMMS plans to use the Growing Green web site as a central location for information on sustainable practices at home. Also, as a part of campus outreach events, UMMS will seek partnership opportunities with organizations seeking to assist residential customers such as National Grid and NSTAR.

Next Steps

UMMS commitment to sustainability and reduction of its carbon footprint is a long-term effort. This initial plan will be the basis for future sustainability actions. Through the work of various departments, as coordinated by the Sustainability Committee, each aspect of the plan will be expanded upon to provide a detailed path to guide further efforts and decisions. These modules will be developed into complete action plans by relevant decision makers that will include scope, timelines, action items and expected outcomes:

1. Building Efficiency (New construction, Renovation)
2. Transportation
3. Sustainable Business Practices
4. Student, Faculty and Employee Education & Outreach
5. Research Linkages to Sustainability
6. Community Education & Outreach

Efforts will be made to develop an electronic tracking and reporting mechanism to comprehensively document UMMS sustainability efforts by departments, students, faculty and staff. This tracking system will provide ongoing feedback to help guide future decision making and provide interested parties with a look inside UMMS sustainability.

Appendix A

University of Massachusetts Medical School Sustainability Committee Members:

David Adrian
Mark Armington
John Baker
Dan Bolon
Michael Cohen
Joseph Collins
Jeff DiCiaccio
Cynthia Donges
Brian Duffy
James Fessenden
James Gardner
Mark Gustafson
Paul Hanbury
Madeline Herman
Judy Holewa
Julieane Frost
Alan Levine
Melissa Lucas
Kevin MacDonald
Peter Marleau
Brian McCarthy
Shawn McGuinness
Julie Merrill-Wisell
Larry Olson
Aimee Powelka
JoAnn Ranslow
Noah Rosenberg
Stephen Samara
Patricia Segerson
Mark Shelton
Charleen Sotolongo
Daniela Trombino
Bill Tsaknopoulos
Scott Wallen

Appendix B

Summary of University of Massachusetts Medical School Sustainability Projects through 2009

1. [Co-generation Plant](#)
2. [Renewable Sources of Energy](#)
3. [Printer Discovery](#)
4. [Water](#)
5. [Purchasing](#)
6. [Sustainability Language on Request for Proposals](#)
7. [Responsible Paper Use and Purchasing](#)
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9. [Reducing Travel Carbon Footprint](#)
10. [Green Vendors](#)
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12. [Buildings](#)
13. [Albert Sherman Center](#)
14. [ACCES Building](#)
15. [Power Plant Expansion](#)
16. [New Façade on the Medical School and Hospital](#)
17. [Groundwork for the Future](#)

Co-generation Plant

The UMMS co-generation power plant gives the campus a significant head start in reducing overall energy consumption. Generating electricity at the point of use saves up to 30-percent of the fuel that would have been used by a distant power plant to meet the Medical School's needs. This occurs because power is lost when electricity is transported great distances over power lines, so more must be generated to compensate for those losses.

Technically a tri-generation system, the plant burns primarily natural gas to produce 100 percent of the steam required for heating all buildings on the main campus in winter and 100 percent of the chilled water used for air conditioning in summer. The steam produced for heating and cooling is used a second time to produce 50 percent of all electricity used at the Medical School and associated hospital. Therefore, only half of the electricity consumed comes from external utility sources.

Since all buildings on the University campus are tied into the power plant, the Medical School's overall carbon footprint over the past 30 years has been 10 percent lower than it would have been if each facility had its own separate HVAC system. Modifications to the plant in 2002 resulted in even greater efficiencies; greenhouse gas emissions are now 15 percent lower than if the buildings had stand-alone systems. In addition, the amount of No. 6 fuel oil used to

supplement the natural gas burned to produce the steam has been reduced by half in the past five years. Natural gas burns cleaner than oil; therefore, this change has contributed to the decrease in emissions since 2003.

Renewable Sources of Energy

UMMS continues to explore how it can integrate renewable sources of energy on campus in a cost-effective manner, while maintaining 100 percent reliability for the hospital and research laboratories. It is working towards achieving the goal of obtaining 15 percent of its annual electricity consumption from renewable sources by 2012.

Conservation: UMMS has aggressively pursued rebates through National Grid by replacing light ballasts and installing fluorescent bulbs throughout the campus, installing motion-sensing light controllers, replacing incandescent exit signs with LED bulbs, installing variable frequency drives on HVAC fans and pumps, and purchasing Energy Star rated appliances. Additional improvements include replacing power plant transformers, air compressors, and chilled water coils for increased efficiencies. Through outreach efforts, Medical School employees are asked to shut off lights and computers and lower thermostats when leaving at the end of the workday. Plans are being developed to reconfigure desktop computers to save energy.

UMMS is one of only six healthcare facilities in Massachusetts that has joined the EPA Energy Star Partnership Program. As a member, the Medical School is committed to measuring, tracking, and benchmarking its energy consumption; developing and implementing a plan to improve its energy performance; and educating both the campus and wider community about the organization's achievements in the Energy Star partnership.

Printer Discovery

The hundreds of desktop printers at the Medical School are expensive to run and consume significant energy resources. Currently in the development stage, the Printer Discovery initiative will lower the number of printers and their overall energy cost on campus. Beginning with a printer inventory to determine the school's total printer footprint, specialists will work with the IT department and make recommendations on how to reduce the number of printers through networking. The remaining units will be programmed to be more energy efficient. Departments are encouraged to purchase and use multi-function printer/copier machines whenever possible and not to replace desktop printers when they fail.

Water

Conserving water on the UMMS campus is an ongoing priority of the Facilities Management Department. Nearly 10 years ago, the basic science, clinical science, and student laboratory wings of the main Medical School building were retrofitted with low-flow toilets and urinals, plus low flow faucet aerators. The more recently constructed Lakeside hospital wing and Aaron

Lazare Research building feature zero-flow and low-flow urinals and low-flow toilets and faucet aerators.

Water conservation continues outside the buildings with the goal of minimizing water consumption, as well as the ecological impact of surface runoff on nearby Lake Quinsigamond. Initiatives include limiting landscape watering to drip irrigation of seasonal plantings and using only the most environmentally-safe products available for snow and ice control in winter. Since snowmelt flows into the lake, rock salt is never applied to campus walkways, parking lots, and roads. The storm water management system includes eight underground vortex separators that collect all sand, oil, and gas runoffs. These are cleaned annually or semi-annually.

UMMS continues to consider and pursue technologies to conserve water use and minimize pollutants in the water stream.

Purchasing

The sustainability goal of the UMMS Purchasing Department is to pursue every available opportunity to encourage and facilitate buying green products and practicing economy on campus. The volume of materials and supplies used by the Medical School and associated hospital is literally mountainous. As just one example, 59,620 reams, or 29,810,000 sheets, of copier and printer paper were purchased in 2008. Stacked flat on top of each other, those two-inch reams would reach 9,936 feet, towering 3,648 feet above New Hampshire's Mount Washington. This product alone represents considerable consumption of natural resources and energy, as well as emissions of greenhouse gases.

By making responsible purchasing choices, individuals and departments at UMMS can decrease significantly the impact this campus has on the global environment. To promote buying green products and services, several non-clinical purchasing initiatives have been implemented.

Sustainability Language on Request for Proposals

To educate vendors about the University of Massachusetts' commitment to a sustainable future and to encourage their cooperation in this mission, the Purchasing Department has incorporated the following new sustainability language in its Request for Proposal (RFP) documents:

In 2007, the President of the University signed the American College & University President's Climate commitment. The University is committed to reducing the adverse environmental impact of its purchasing decisions; it is committed to buying goods and services from contractors who share its environmental concern and commitment.

The University encourages Bidders to include in their Proposals economical and environmentally friendly products and service options that serve to minimize waste, reduce excess packaging, recycle, reduce, reuse, prevent pollution, and/or offer resource efficiency. It is the University's

goal to maximize environmental responsibility on its campuses.

The University recommends that Bidders and Contractors use recycled paper and double-sided copying for production of all printed and photocopied documents, including their proposals for this RFP. Furthermore, the documents should be clearly marked to indicate that they are printed on recycled-content (minimum 30 percent post-consumer waste) paper.

Please indicate if your organization can provide data, on a quarterly basis, indicating the number and dollar transactions of the University purchases that are Energy Star compliant, EPEAT compliant and those that are not compliant to those standards.

Responsible Paper Use and Purchasing

In 2008, the Medical School and associated hospital purchased 157 tons of copier and printer paper. Only 4 percent of that paper had 30 percent post consumer waste (PCW) content, the current standard available for green copy paper (using 559 tons of virgin wood, 6,223 million BTU's of energy, and emitting 923,707 pounds of the carbon dioxide). If instead, 96 percent of the paper purchased last year had had 30 percent PCW content, it would have depleted 157 fewer tons of virgin wood, consumed 757 million fewer BTUs of energy, and emitted 95,496 fewer pounds of CO₂.

As a result of ongoing educational efforts throughout the campus, progress toward greener paper purchases is taking place. The amount of 30 percent PCW paper bought in the last quarter of 2008 increased from 4 percent to 7 percent.

The Purchasing Department aims to decrease the amount of copier and printer paper purchased overall. To that end, employees are encouraged to print on both sides of a sheet of paper whenever possible and to think twice before printing emails and other documents that can be read and stored electronically. To conserve paper, vendors who install multi-function copier/printer machines now automatically set the default to duplex, or double-sided, copying and printing.

Remanufactured Toner Cartridges

A recently-launched initiative by the Purchasing Department targets the multitude of used ink cartridges discarded by UMMS departments every year. By purchasing remanufactured toner cartridges for their printers, copiers, and multi-function machines, the campus community can lower its carbon footprint.

According to industry sources, the typical used toner cartridge weighs about 3 pounds and has the following composition: 40 percent engineering-grade polymer plastic, 40 percent metal, and 20 percent rubber, paper, foam, and toner. The manufacture of a single toner cartridge burns approximately three quarts of oil, uses virgin materials, and creates a substance that takes at least 1,000 years to decompose.

However, approximately 97 percent of the cartridge materials can be recycled and reused, with significant environmental and economic benefits. Through remanufacturing, used cartridges are cleaned, repaired, refilled, and reassembled. The cost is 30-60 percent less on a per copy basis than new cartridges. A used toner cartridge can be remanufactured up to four times, thus potentially saving up to 12 quarts of fuel and reducing landfill waste.

Reducing Travel Carbon Footprint

UMMS recently contracted with Garber Travel to manage staff and faculty travel requirements. The company's on-line booking tool includes a carbon footprint calculator. When making reservations, individuals can view the carbon footprint of a particular itinerary. The program's objective is to build awareness of the environmental cost of travel and to encourage responsible travel plans, such as changing to a more efficient route whenever possible. By tracking this activity over the coming years, the Medical School aims to reduce its travel carbon footprint.

Green Cleaning

All of the janitorial cleaning supplies purchased at UMMS meet the United States Green Building Council's LEED (Leadership in Energy and Environmental Design) standards. The products used throughout the campus are non-toxic, biodegradable, and do not emit volatile organic compounds (VOCs). These environmentally-safe products have proven to be just as effective as their conventional counterparts.

Green Vendors

The Medical School benefits from a variety of environmentally-friendly services and products offered by vendors. For example, all stationery imprinted with the UMMS logo is printed on 30 percent PCW paper by Dupli, a carbon-neutral printing firm that gets 100 percent of its electricity from wind power. W.B. Mason, the school's office supply vendor, offers a large selection of green business products, indicated in their catalog. In addition, Fisher Scientific, which supplies the campus' laboratories, has programmed all of its delivery trucks to turn off after idling for three minutes, thus reducing the amount of exhaust emitted.

For the past two years the Purchasing Department has hosted Green Vendor Tradeshow on campus to give employees a chance to learn about green products and services available through UMMS vendors.

Recycling

The Medical School is committed to reducing its overall trash stream and to increasing the amount of recycled waste from the current 27 percent of all waste to 50 percent. To help the campus reach that target, several initiatives recently have been implemented and others are

being developed.

The UMMS community has participated in conventional paper recycling for many years. In January of 2008, co-mingled recycling was introduced to expand collection to additional waste products. In co-mingled recycling, plastic, glass, and metal items are deposited into the same receptacle and are separated at the waste processing plant. To encourage recycling, collection bins for both paper/cardboard and co-mingled waste were placed in each elevator lobby throughout the Medical School. At the end of the program's first year, over 5 tons of co-mingled trash had been collected for reuse.

In the Lazare Research Building Café all consumer food containers and products, from trays to sandwich boxes, are now recyclable. All styrofoam products have been eliminated. In addition, the kitchen staff rinses cans, bottles and plastic containers and puts them into the recycling stream. Plans are underway to expand this comprehensive program to the hospital cafeteria as well.

Work station recycling is an important initiative to decrease the amount of paper trash accumulated on campus. Each desk in the Medical School is currently outfitted with a cardboard bin for collecting paper and cardboard. In addition, secure HIPPA-compliant containers are conveniently located on each floor of the hospital for recycling paper with confidential patient information. Under consideration are plans to remove trash receptacles from all work stations and replace them with a bin for co-mingled collection, along with the one the paper/cardboard. Non-recycled trash would be disposed of in a central location in each wing.

Over three dozen different items are currently collected for recycling at UMMS. For a complete list, visit inside.umassmed.edu/recycling.

Buildings

For three decades the Medical School has provided state-of-the-art facilities for education, research, and patient care. Today, it must continue to do so while also adapting to the environmental realities of the 21st century. To lower the overall energy consumption on campus the Facilities Management Department constantly explores opportunities to make the existing physical plant more efficient. The greatest potential for reducing the campus' future carbon footprint, however, lies with new construction. Therefore, the Medical School is committed to designing all new buildings to be sustainable, pursuing the highest levels of LEED certification whenever feasible.

Albert Sherman Center

Ground was broken in September of 2009 for the Albert Sherman Center, an interdisciplinary, state-of-the-art research and education facility. Made possible, in part, by funding from the \$1 billion Life Sciences Initiative signed in June 2008 by Governor Deval Patrick, the approximately

500,000 square foot building is slated to open in late 2012 with wet research space, clean rooms, research core space and administrative space. The Albert Sherman Center will attract researchers, physicians, faculty, students and industry partners, enhancing the Medical School's position as a leader in medical research and education.

The building will be designed to achieve at least a LEEDS Silver certification with the following green design features and concepts under consideration:

- Installing enthalpy energy recovery wheels in air handling units serving the laboratory areas. This technology will utilize the energy in exhausted air by removing latent heat in the summer and adding moisture and sensible heat during the winter, thus significantly lowering energy use while maintaining safe air quality.
- Incorporating chilled beam ceiling technology into the laboratory ventilation systems to create cooled air much more efficiently than a conventional fan circulating system. Chilled beams combine sensible cooling systems with overhead ventilation to reduce energy use, improve comfort levels, and reduce the amount of ventilated air required for safety.
- Utilizing low-flow fixtures, natural lighting, artificial light controls, and rain water recovery for non-potable use.

ACCES Building

When completed in 2010, the Advanced Center for Clinical Care, Education and Sciences (ACCES) will provide over 230,000 square feet for medical and nursing education, clinical research, and clinical practice programs, along with ambulatory clinic services. ACCES will be the Medical School's greenest building to date.

With the goal of achieving LEED Silver certification, the project integrates numerous sustainable features. These include diminishing the building's heat island effect with a white roof and smaller areas of asphalt pavement; optimizing energy performance through the latest efficiency technologies and enhanced mechanical commissioning; protecting habitat and maximizing open space in the site development; conserving water by installing low flow plumbing fixtures and eliminating landscape irrigation; enhancing air quality performance through increased ventilation and using low volatile organic compound (VOC) emitting materials throughout the building.

The structure also features a tight envelope with insulated double-pane, low UV glass. In addition, Consigli Construction, the project's general contractor practices comprehensive construction waste management to recycle building materials and minimize landfill waste. Several other LEEDs credits will be pursued and incorporated into the interior design and construction to make ACCES energy efficient and environmentally responsible.

Power Plant Expansion

The Medical School's co-generation plant will be expanded to accommodate the addition of the Albert Sherman Center to its load and to enhance the power plant's capacity for emergency electricity, steam, and chilled water. The project will add a 7.5 megawatt gas-fired turbine, two chillers and two cooling towers. In addition, full consideration will be given to new green energy-producing technologies that could improve the plant's existing 80/20 fuel ratio of natural gas and No. 6 oil.

New Facade on the Medical School and Hospital

From 2004 to 2006, the 30-year old Medical School and associated hospital received a much-needed facelift and update to meet the energy-efficiency needs of the early 21st century. The entire building envelope of the 1.5 million square feet facility, including metal panels, windows, curtain wall, and granite, was replaced with a new vapor barrier, increased insulation, curtain wall, double curtain wall, punch windows, and limestone. The resulting environmental and economic gains of the \$65 million project include decreased building infiltration and exfiltration, reduced thermal loss through the building envelope, and increased passive solar benefits. In addition, all of the removed granite was recycled and used for crushed stone at a local sand and gravel plant, and the old windows were recycled through the local co-mingled waste facility.

Groundwork for the Future

Much of the work on the UMMS Sustainability Plan over the past few years has laid the groundwork for future achievements in reducing carbon emissions on the academic health campus. In 2008 a Greenhouse Gas Survey was completed, establishing a baseline from which improvements can be made. All locations on the main campus are now metered for heat, chilled water, and electricity. Monitoring this activity provides important information about energy use in individual buildings that will be used to implement efficiencies. Plans for the future include sub-metering by department, leading to greater conservation by individuals and departments through awareness of how much energy they consume.

Additional initiatives under consideration and development include installing variable frequency drives on chilled water pumps and the boiler combustion system to decrease power output during low-use periods; installing "light harvesting" sensors, which dim electrical lighting with elevated levels of natural light in an indoor space; replacing old air handling units; updating the HVAC building control system; and installing new roofs with increased insulation and white fabric.

APPENDIX C

University of Massachusetts Medical School Carbon Footprint Estimate Study

ENSR

2 Technology Park Drive, Westford, Massachusetts 01886-3140
T 978.589.3000 F 978.589.3100 www.ensr.aecom.com

October 15, 2008

Mr. John Baker
Director of Facilities
University of Massachusetts Medical School
Worcester, MA 01655.

Via E-Mail: John.Baker@umassmed.edu

**Subject: Findings of the Carbon Footprint Estimation Study Conducted for University of
Massachusetts Medical School for FY 2003 and FY 2007**

Dear Mr. Baker,

University of Massachusetts Medical School (UMMS) had enlisted the services of ENSR in order to estimate the carbon footprint of the UMMS. This letter report presents our findings with respect to the estimation of Carbon Dioxide (CO₂) emissions from the UMMS campus at Worcester, MA. UMMS, located in Worcester, MA, is one among the five campuses of the University of Massachusetts (UMass) system. UMMS is a teaching and research facility and the campus houses three schools, the School of Medicine, the Graduate School of Biomedical Sciences and the Graduate School of Nursing. In 1976, a 370 bed hospital opened on campus, now known as the University of Massachusetts Memorial Medical Center.

This study was undertaken as a result of two initiatives to which the UMMS is subject. The Massachusetts State Sustainability Program, which was created under Executive Order 438 in the year 2002, aims to develop and implement sustainability policies for Massachusetts state agencies. In April 2007, Executive Order 484 was issued which mandates that state agencies reduce their greenhouse gas (GHG) emissions by 25% by 2007, relative to the 2002 base year. Although EO 484 does not explicitly require state agencies to develop carbon footprint estimates, it is a necessary step in establishing the baseline emissions with which future emissions will be compared. EO 484 defines the baseline period as fiscal year 2002 (July 1, 2001 through June 30, 2002) but does not specify a future year for which emissions need to be estimated. ENSR has used FY 2003 as the baseline year and fiscal year 2007 (July 1, 2006 through June 30, 2007) as the future year, which is the most recent year for which complete activity data was available.

UMMS has also become a signatory to The American College & University Presidents Climate Commitment (the Commitment). As part of that effort, the Presidents of colleges and universities have pledged to reduce and eventually eliminate their GHG emissions. The first step in that endeavor is to complete a GHG inventory for the present activity levels and subsequent steps involve formulating short- and long-term action plans to reduce GHG emissions going forward.

The purpose of this study was to determine the carbon footprint emissions of UMMS for the baseline period (FY 2003) and comparing them with the carbon footprint emissions for model year FY 2007. FY 2007 was selected as the model year because that was the latest year for which student and employee data was available with UMMS.

Facility Description

As mentioned previously, UMMS consists of three campuses (the School of Medicine, the Graduate School of Biomedical Sciences and the Graduate School of Nursing) and a hospital known as the University of Massachusetts Memorial Medical Center. The School currently has two buildings, the LRB and the Main school buildings. The LRB with an area of 361,862 square feet was built in the year 2000. The Main school building has an area of 819,484 square feet. With a combined area of 1,181,346, these two buildings lodge the three UMMS campuses. In 2007, the Lakeside building (area 222,477 sq. ft.) was added to the campus.

The UMMS owns and operates four dual-fired boilers in its Central Energy Plant (CEP). The CEP provides heat, chill water, and electricity to the campus and the hospital. In addition to the electricity generated by the CEP, UMMS also buys electricity from Massachusetts Electric. While firing No. 6 oil, two of the four boilers have a maximum heat input rate of 141 MMBtu/hr and the other two have a maximum heat input rate of 98 MMBtu/hr. While firing natural gas, two of the four boilers have a maximum heat input rate of 148 MMBtu/hr and the other two have a maximum heat input rate of 147 MMBtu/hr.

In addition, UMMS also has four emergency generators (200 KW, 560 KW, 1400 KW and 2000 KW). The 200 KW and 2000 KW generators were installed in late 2004 and hence were absent in the FY 2003 inventory. The facility also owns and operates approximately 30 medium sized (averages 22 miles per gallon) vehicles and 25 large sized (averages 18 miles per gallon) vehicles. Please note that these include any non-road engines that may be present onsite.

The University of Massachusetts Memorial Medical Center or, the Hospital, consists of three buildings. The Lakeside building (222,477 sq.ft area) was built in 2007 while the Main Hospital building (624,502 sq. ft.) and the Benedict building (70,055 sq. ft.) are older buildings. The CEP supplies heat, chill water, and energy to the Hospital also. Approximately 50% of the electricity and heat and chill water produced by the CEP is used by the Hospital. Additionally, half of the electricity purchased from the grid is for Hospital use. The Hospital leases ambulances that are used for emergency purposes but does not own them. For that reason, the emissions from the ambulance will not be accounted for in this GHG emissions inventory. The hospital also owns a helicopter whose emissions have not been accounted for in this inventory because the fuel used by the helicopter is not well documented. In any case, the emissions of GHG from the helicopter are negligible as compared to other source at the UMMS.

Emissions Estimation Methodology

Emissions of GHGs (CO₂, CH₄ and N₂O) from the School and Hospital were estimated for the following source categories:

- Natural gas combustion for heat, chill water, and electricity production in the cogeneration plant
- Oil combustion for heat, chill water, and electricity production in the cogeneration plant
- Fuel used by the emergency generators at the School and Hospital
- Fuel used by vehicles owned by the School
- Electricity purchased from the grid
- Employee and student commuting
- Hospital patient and visitor commuting
- Business Travel (Air) by students and staff

Direct Emissions from Natural Gas combustion:

UMMS uses natural gas in the boilers in the Central Heating Plant. The energy produced by natural gas combustion is used to produce electricity, chill water, and heat for the campus. UMMS provided ENSR with the gas usage data in million cubic feet of natural gas used for the FY 2003 as well as FY 2007. ENSR used emission factors provided by Calculation Tool for Direct Emissions from Stationary Combustion Version 3.0, World Business Council for Sustainable Development (WBCSD): Greenhouse Gas Protocol Initiative, July 2005 available at <http://www.ghgprotocol.org/templates/GHG5/layout.asp?type=p&MenuId=OTAx>. For natural gas combustion, the emission factor computation accounts for 100% oxidation to CO₂ and H₂O.

Direct Emissions from Oil combustion:

UMMS uses oil in the boilers in the Central Heating Plant as well as the 4 emergency generators. This category accounts for GHG emissions from the oil that is combusted in the Central Heating Plant. Oil combusted in the emergency generators is a separate source category, discussed later. The energy produced by oil combustion is used to produce electricity, chill water, and heat for the campus. UMMS provided ENSR with the gas usage data in gallons of oil used for the FY 2003 as well as FY 2007. ENSR used emission factors for No. 6 Oil provided by Calculation Tool for Direct Emissions from Stationary Combustion Version 3.0, World Business Council for Sustainable Development (WBCSD): Greenhouse Gas Protocol Initiative, July 2005 available at <http://www.ghgprotocol.org/templates/GHG5/layout.asp?type=p&MenuId=OTAx>. For oil combustion, the emission factor computation accounts for 99% oxidation to CO₂ and H₂O.

Direct Emissions from Fuel Used by the Emergency Generators at the School and the Hospital:

In the FY 2003, UMMS had only two emergency generators onsite, the 560 KW and the 1400 KW generators. The 200 KW and the 2000 KW generators were added to the campus in 2004 and 2005, respectively. Whereas the 200 KW, 560 KW and the 1400 KW generators are shared equally between the School and the Hospital, the 2000 KW generator is used exclusively by the Hospital. Fuel used by the four generators is low sulfur diesel (0.5% sulfur). Since there was no data available for diesel consumption for FY 2003, UMMS substituted the FY 2007 diesel use data for the same. The fuel consumption data have been included as input data in the spreadsheet. Emission factors for No. 6 oil combustion have been applied for computation of GHG emissions from diesel combustion in emergency generators

Direct Emissions from Fuel Used by Vehicles Owned by the School:

UMMS owns and operates 30 medium sized vehicles (averaging 22 miles per gallon of fuel) and 25 large sized vehicles (averaging 18 miles per gallon of fuel). UMMS decided to apply this conservative estimation since it was unable to provide the exact number of vehicles it owned. Due to the lack of fuel use data, it was also assumed that each vehicle travels approximately 12,000 miles per year. The emission factors for medium gasoline auto and large gasoline auto have been derived from Mobile Combustion CO₂ Emissions Calculation Tool Version 1.3, World Business Council for Sustainable Development (WBCSD): Greenhouse Gas Protocol Initiative, July 2005 available at <http://www.ghgprotocol.org/templates/GHG5/layout.asp?type=p&MenuId=OTAx>.

Indirect Emissions from Electricity Purchased from the Electric Power Company (Massachusetts Electric):

UMMS purchases electricity from Massachusetts Electric to supplement its energy needs. The emission factor (in units of lb CO₂/KWh) for this category has been derived from eGRID: Emissions and Generated Resource Integrated Database, Data Year 2004, Version 2.1, US EPA Office of Atmospheric Programs, April 2007 available at <http://www.epa.gov/cleanenergy/energy-resources/egrid/index.html>. The CO₂ emission factor value selected (0.91 lb CO₂/KWh) for UMMS was the one for the Northeast Power Coordinating Council (NPCC) which includes power generating plants throughout Massachusetts. UMMS has well documented data regarding its electricity purchase from the grid for both FY 2003 and FY 2007.

Indirect Emissions from Employee and Student Commuting:

Indirect CO₂ emissions from the vehicular emissions of students and employees of UMMS were computed for this source category. These estimates covered commuting by staff, faculty, and students, but not patient or visitor travel to and from the Medical Center (Hospital) because that has been addressed in the next source category.

To compute these emissions, ENSR was provided the following:

- The number of students attending UMMS during FY 2003 = 690;
- The number of students attending UMMS during FY 2007 = 1009;
- The number of staff and faculty working at UMMS/UMass Memorial in FY 2003 = 4307;
- The number of staff and faculty working at UMMS/UMass Memorial in FY 2007 = 5266.

ENSR assumed the following activity levels and UMMS agreed with these due to the lack of actual observation data:

Staff and Faculty:

- Days per year.....= 245;
- Portion that don't use motor vehicles to commute.....= 5%;
- Portion commuting via bus.....= 15%;
- Portion commuting via passenger cars.....= 80%;
- Commuting distance= 50 miles roundtrip for 50%; and,
.....= 10 miles roundtrip for 50%

Students:

- Days per year.....= 220;
- Portion that don't use motor vehicles to commute.....= 10%;
- Portion commuting via bus.....= 20%;
- Portion commuting via passenger cars.....= 70%;
- Commuting distance (bus and passenger cars)= 50 miles roundtrip for 70%; and,
.....= 10 miles roundtrip for 30%

It was assumed that both students and faculty drive a small car that averages about 26 miles per gallon. Emission factors for calculating CO₂ emissions from such small, gasoline-run cars were derived from Mobile Combustion CO₂ Emissions Calculation Tool Version 1.3, World Business Council for Sustainable Development: Greenhouse Gas Protocol Initiative, March 2005 available at <http://www.ghgprotocol.org/templates/GHG5/layout.asp?type=p&MenuId=OTAx>.

Indirect Emissions from Hospital Staff, Patient and Visitor Commuting:

To compute these, ENSR was provided an estimate of:

- The number of patient parking spaces at the Hospital = 200;
- The number of visitor parking spaces at the Hospital = 300;

The number of staff, visitor and patient trip miles per day was calculated based on the following information:

- The number of patient trips per day = No. of patient parking spaces × 24 hour visit;
- The number of visitor trips per day = No. of visitor parking spaces × 2 hour visit;
- The number of staff working at UMass Memorial = 3914
- Average round trip commute of each patient..... = 60 miles;
- Average round trip commute of each visitor = 60 miles;
- Average round trip commute of each staff..... = 30 miles;
- Number of days in a year = 365

The emission factors for this source category were derived from CO₂ Emissions from Employee Commuting Version 2.0, World Business Council for Sustainable Development: Greenhouse Gas Protocol Initiative, June 2006 available at <http://www.ghgprotocol.org/templates/GHG5/layout.asp?type=p&MenuId=OTAx>.

Indirect Emissions from Business Travel (Air) by Students and Staff of the School:

These estimates covered CO₂ emissions resulting from air travel by staff and faculty of UMMS.

To compute these, we were provided:

- The number of students traveling by air annually = 50; and,
- The number of faculty traveling by air annually ... = 50

We proposed (and UMMS agreed) to assume the following activity levels:

- Average distance of air travel = 2000 Miles

Two thousand miles is the average distance of a long flight halfway across the U.S.A.

Emission factors for this category were derived from CO₂ Emissions from Business Travel. Version 2.0, World Business Council for Sustainable Development: Greenhouse Gas Protocol Initiative, March 2005 available at <http://www.ghgprotocol.org/templates/GHG5/layout.asp?type=p&MenuId=OTAx>. Since the average distance of air travel was assumed to be 2000 miles, the emission factor applicable to long flights (>1,600 km) was used to compute CO₂ emissions from business travel.

Emission Factors of CH₄ and N₂O:

Emission factors for CH₄ and N₂O for purchased electricity were obtained from The Climate Registry General Reporting Protocol version 1.1, May 2008, Table 14.1. Emission factors for CH₄ and N₂O for

fuel combustion were obtained from 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Table 2.2.

Results and Discussion

Emissions of CO₂, CH₄ and N₂O (GHGs) were calculated based on the activity data provided by UMMS and, in some cases, proposed by ENSR. Appropriate CO₂, CH₄ and N₂O emission factors corresponding to the different source categories were applied. A detailed description of these factors has been provided in the previous section.

Table 1 below presents a summary of the CO₂ emissions in tons per year and GHG emissions in metric tons carbon dioxide equivalent for the various source categories for FY 2003. The emissions have been divided between the School and the Hospital depending on the entity that benefits from the source of those emissions. For example, the CO₂ emissions from the patient and visitor parking have been attributed to the Hospital since only the Hospital uses that amenity.

Table 2 below presents a summary of the CO₂ emissions in tons per year and GHG emissions in metric tons carbon dioxide equivalent for the various source categories for FY 2007.

Figures 1 and 2 are a graphical representation of the breakup of the CO₂ emission for the School for FY 2003 and FY 2007 from the seven source categories.

Emissions of CO₂ from electricity purchase have decreased by approximately 371 TPY in FY 2007 (19,852 TPY) when compared to the FY 2003 (19,483 TPY) baseline. This is partly attributable to the increased efforts by UMMS to produce more electricity at the CHP plant and purchase less from the grid. Electricity from the CHP plant at UMMS is produced by natural gas and oil combustion. In contrast, the electricity that is bought from the grid is produced by coal combustion which is not as clean.

Emissions of CO₂ from oil combustion were 37,497 TPY in FY 2003 and 18,553 TPY in FY 2007 which shows a decrease of 18,944 TPY. Emissions of CO₂ from natural gas combustion, however, have increased by 15,275 TPY. The reason for this observation is two-fold. Firstly, the decreased use of oil has called for substitution by natural gas which has led to greater emissions. Secondly, the decrease in the quantity of electricity bought from the grid has led to an increase in its production onsite which in turn has resulted in greater natural gas consumption.

CO₂ emissions from the diesel combustion in emergency generators has increased by approximately 57 TPY due to the addition of 2 generators, 200 KW and 2000 KW in the FY 2007 inventory. Please note that the 2000 KW generator was added only for the purpose of serving the Hospital whereas the other three generators are used for emergencies by both the School and the Hospital.

There is no change in the emissions of CO₂ between FY 2003 and FY 2007 for the source category "UMMS owned vehicles" because ENSR assumed that the number of vehicles owned by UMMS and the average number of miles traveled by each vehicle remained the same between the two years. This assumption was made due to the lack of actual data.

CO₂ emissions from employee, student, patient and visitor commuting to and from the campus as well as from business travel increased by 17,435 TPY between the two years because of the increased number of students and staff in FY 2007 as compared to FY 2003. The activity level data for these source categories remained the same between the two years.

Figure 1 presents a graphical view of the division of CO₂ emissions between the various source categories for the School for FY 2003. During FY 2003, employee and student commuting was the highest contributor to the CO₂ emissions from the School and accounted for 55% of the total CO₂ emissions. Natural gas and oil combustion together accounted for 35% of the CO₂ emissions from the School, purchased electricity accounted for 10% of the CO₂ emissions and UMMS owned vehicles, emergency generators and business travel accounted for less than 1% of the total CO₂ emissions from the School.

Figure 2 presents a graphical view of the division of CO₂ emissions between the various source categories for the School for FY 2007. Employee commuting was again the highest contributor (60%) to the CO₂ emissions at UMMS. Natural gas and oil combustion together were the second highest contributors to CO₂ emissions and accounted for 31% of the total CO₂ emissions from the School. Purchased electricity accounted for 9% of the CO₂ emissions and UMMS owned vehicles, emergency generators and business travel accounted for less than 1% of total CO₂ emissions from the School.

Figure 3 and **Figure 4** present CO₂ emissions break up between the various categories for FY 2003 and FY 2007 for the Hospital. For FY 2003 the highest contributor to CO₂ emissions from the Hospital was natural gas and oil combustion (62%) and for FY 2007 the highest contributor to CO₂ emissions from the Hospital was also oil and natural gas combustion (61%).

It is clear that a substantial part of the CO₂ emissions are emissions from employee, student, patient and visitor commuting. Therefore, reduction in emissions from commuting will play a major role in reducing the campus wide CO₂ emissions. UMMS will need to undertake initiatives to encourage car-pooling among employees and students. This is discussed further in the following sections.

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Table 1 Carbon Footprint Estimation Summary FY 2003

FY 2003	Electricity Purchase CO2 Emissions	Stationary Unit Fuel Combustion			Commuting CO2 Emissions	Air Travel CO2 Emissions	Commitment Total CO2 Emissions	UMMS-Owned Motor Vehicles CO2 Emissions	Total Carbon Footprint CO2 Emissions
		Boilers Oil CO2 Emissions	Boilers Natural Gas CO2 Emissions	Emergency Generators CO2 Emissions					
Medical School (TPY)	12,501	18,749	24,931	47	66,232	21	122,480	328	122,809
Hospital (TPY)	7,350	18,749	24,931	47	19,466	21	70,496	Not estimated	70,496
CAMPUS TOTAL (TPY)	19,852	37,497	49,862	93	85,698	42	192,976	328	193,304
CAMPUS TOTAL (MTCO2e)	18,134	34,125	45,277	85	77,744	38	175,281	298	175,363
Medical School (tons/sf)	0.011	0.016	0.021	0.000039	0.056	0.000018	0.104	0.00028	0.10396
Hospital (tons/sf)	0.011	0.027	0.036	0.000067	0.028	0.000030	0.10	Not estimated	0.10150
CAMPUS TOTAL (TPY)	0.021	0.043	0.057	0.000106	0.084	0.000048	0.21	0.00028	0.20545
CAMPUS TOTAL (MTCO2e/sf)	0.010	0.018	0.024	0.000	0.041	0.000	0.093	0.000	0.093

Table 2 Carbon Footprint Estimation Summary FY 2007

FY 2007	Electricity Purchase CO2 Emissions	Stationary Unit Fuel Combustion			Commuting CO2 Emissions	Air Travel CO2 Emissions	Commitment Total CO2 Emissions	UMMS-Owned Motor Vehicles CO2 Emissions	Total Carbon Footprint CO2 Emissions
		Boilers Oil CO2 Emissions	Boilers Natural Gas CO2 Emissions	Emergency Generators CO2 Emissions					
Medical School	12,269	9,276	32,569	49	83,666	21	137,851	328	138,179
Hospital	7,214	9,276	32,569	101	19,466	21	68,525	Not estimated	68,525
CAMPUS TOTAL (TPY)	19,483	18,553	65,137	150	103,132	42	206,375	328	206,704
CAMPUS TOTAL (MTCO2e)	17,798	16,885	59,148	137	93,559	38	187,390	298	187,518
Medical School	0.010	0.008	0.028	0.000042	0.071	0.000018	0.117	0.00028	0.11697
Hospital	0.008	0.010	0.036	0.000110	0.021	0.000023	0.07	Not estimated	0.07472
CAMPUS TOTAL (Tons/sf)	0.018	0.018	0.063	0.000152	0.092	0.000041	0.19	0.00028	0.19169
CAMPUS TOTAL (MTCO2e/sf)	0.008	0.008	0.028	0.000	0.045	0.000	0.089	0.000	0.089

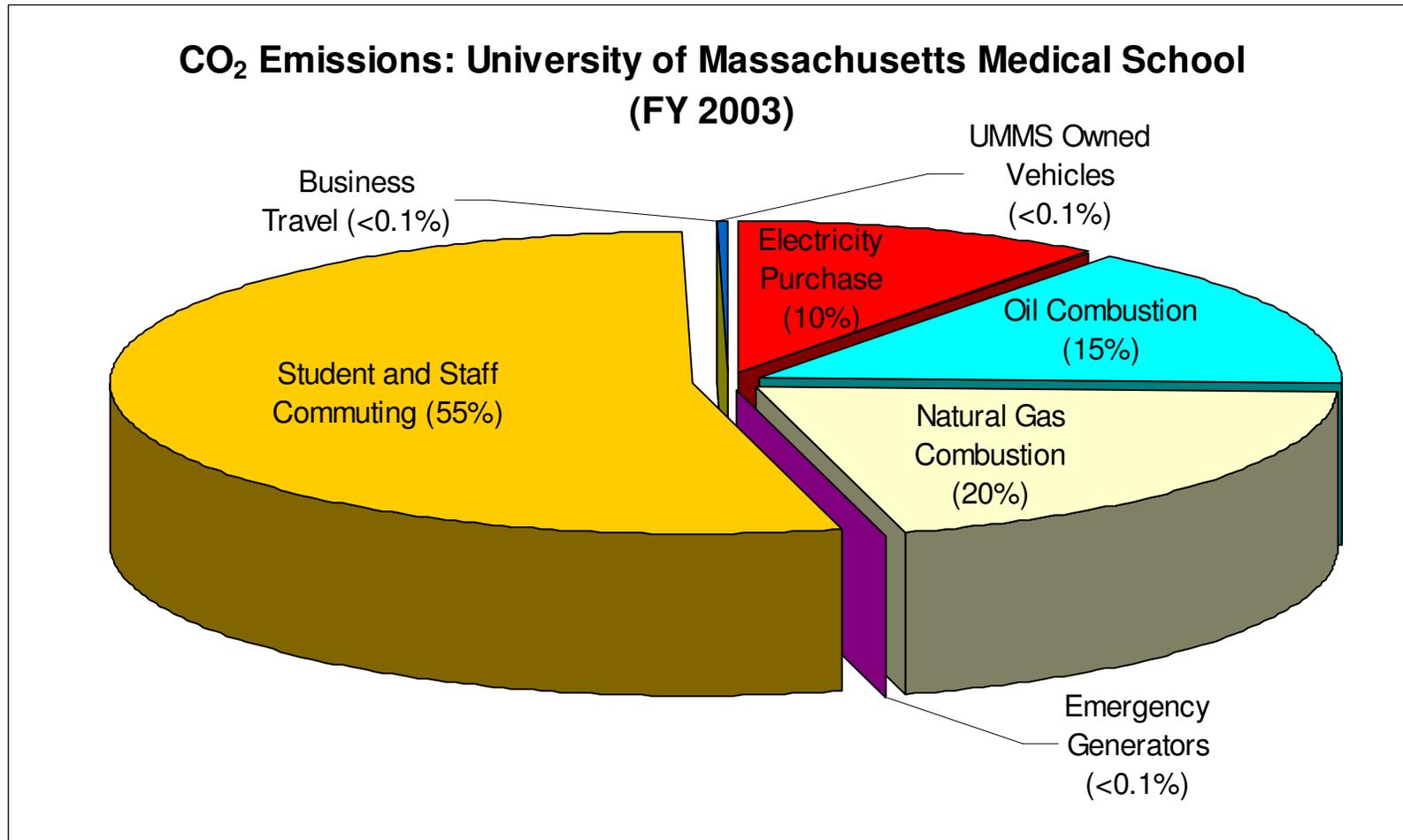


Figure 1 Graphical Representation of the Carbon Footprint Emissions from the School for FY 2003.

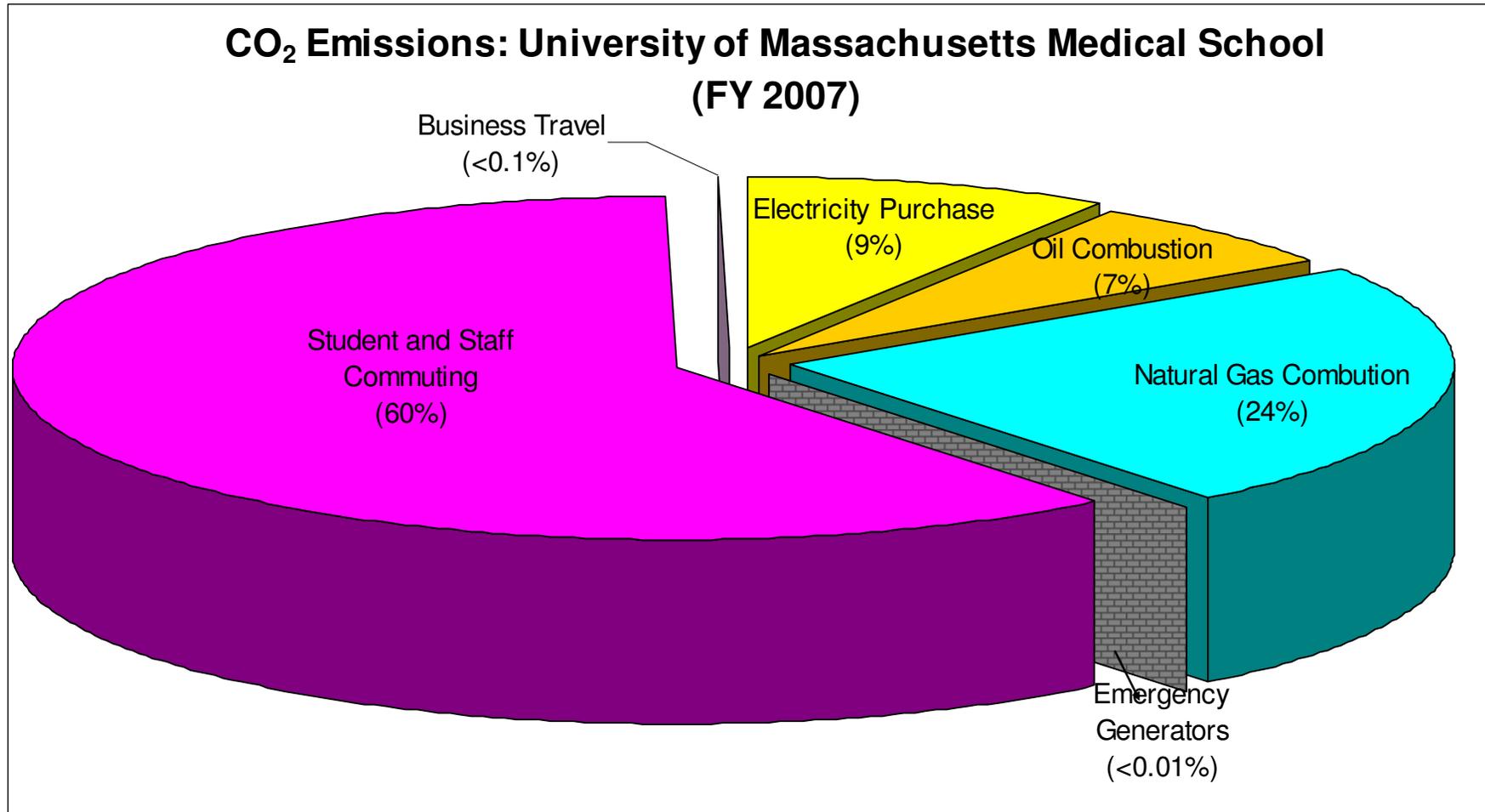


Figure 2 Graphical Representation of the Carbon Footprint Emissions from the School for FY 2007.

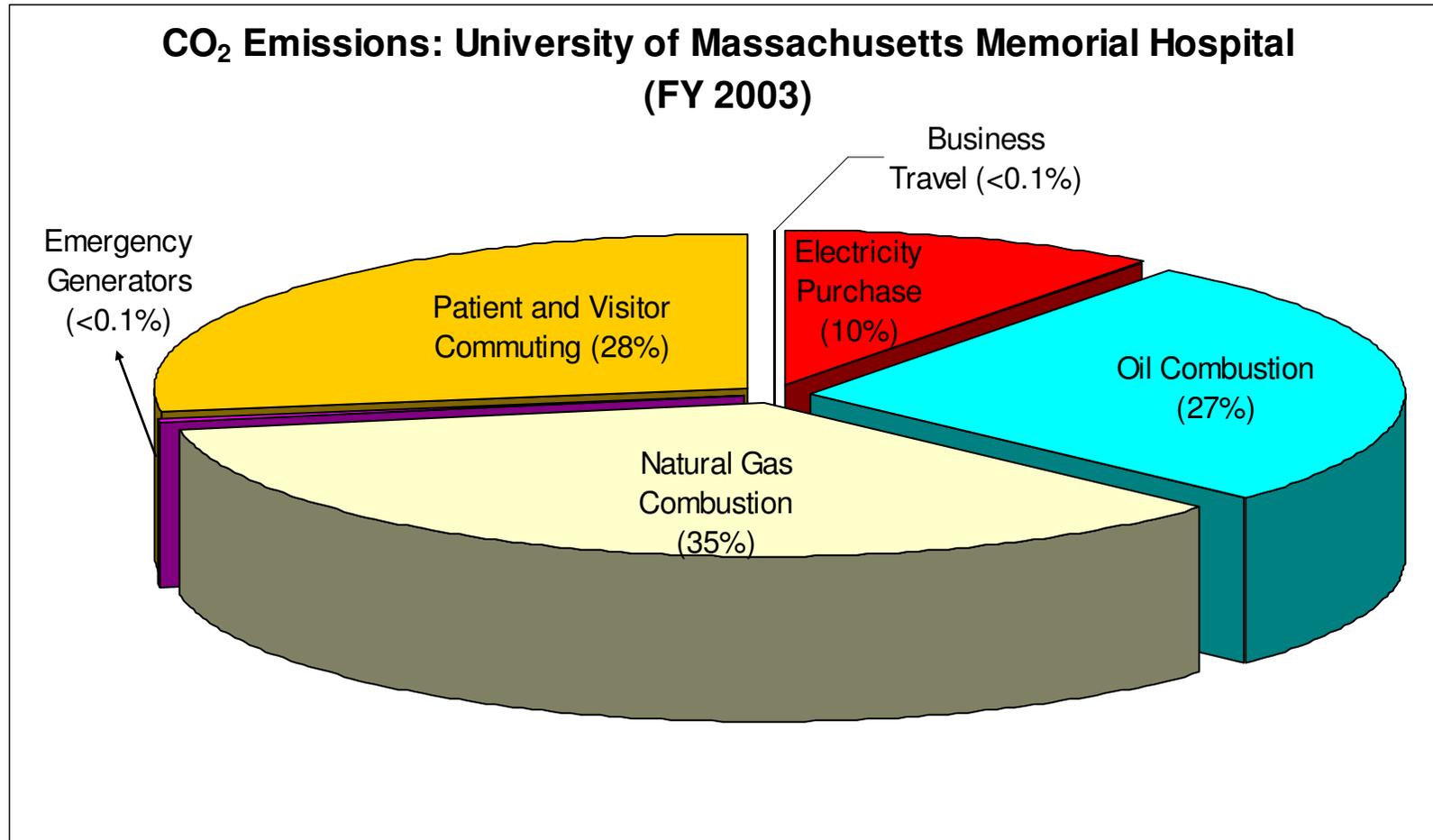


Figure 3 Graphical Representation of the Carbon Footprint Emissions from the Hospital for FY 2003.

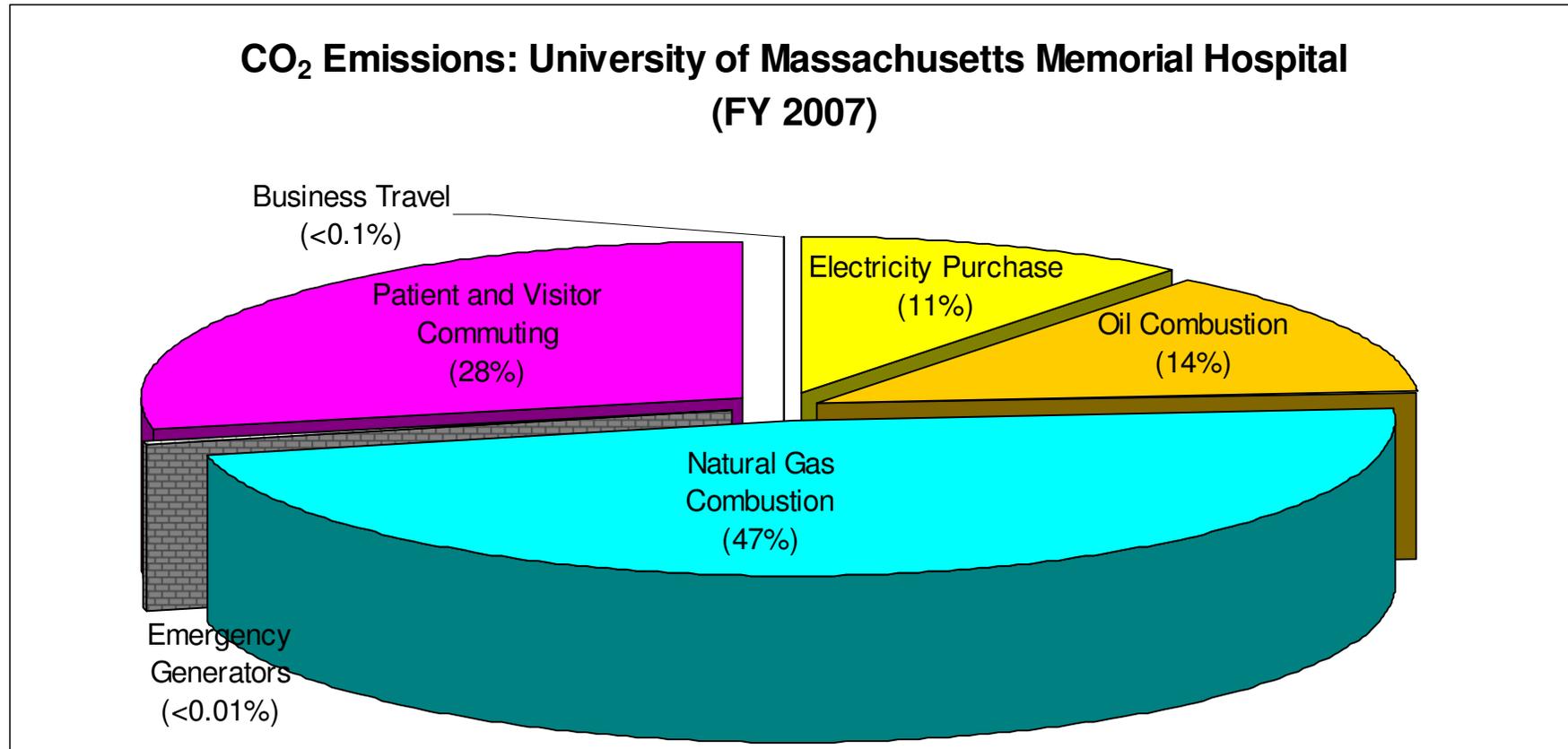


Figure 4 Graphical Representation of the Carbon Footprint Emissions from the Hospital for FY 2007.

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As part of the initiative, UMMS has established its baseline (FY 2003) and is working towards achieving the goal of 25% reduction by CY 2007. Since the model year used for FY 2007, it is difficult to ascertain whether the goal of 25% reduction has been realized. Compared to FY 2003 base year, emissions of CO₂ appear to have increased in FY 2007 for source categories such as employee commuting and natural gas combustion but decreased for oil combustion and electricity purchase. The reasons for this may be the increased square footage of the campus due to the addition of the new Lakeside building in 2007 as well as the increased number of students and employees at the School and Hospital. ENSR conducted further analysis by normalizing CO₂ emissions to the square foot of building area of the school and hospital present a more accurate picture of the CO₂ reductions or increases. **Tables 1 and 2** above present the results of that analysis.

For the FY 2003, total CO₂ emissions in tons per square foot for the Hospital are 0.102 tons CO₂/ sq. foot while those for the School are also 0.104 tons CO₂/ sq. foot. For FY 2007, total CO₂ emissions per square foot for the Hospital are 0.075 tons CO₂/ sq. foot while those for the School are 0.117 tons CO₂/ sq. foot. This reflects an increase of 12.5% in the tons/ sq. ft. emissions of the School and a 26.5% decrease in the tons/ sq. ft. emissions of the Hospital.

UMMS and the Medical Center are working towards reducing their carbon footprint by increasing the use of cleaner burning fuels (natural gas) at the CHP plant, reducing electricity purchase from the grid as well as exploring prospective energy efficient options for future expansion projects. Since a large part of the total CO₂ emissions are emissions from employee and student commuting, UMMS needs to encourage car-pooling. UMMS being an educational facility can also investigate the option of providing on-campus housing to the students which will lead to a decrease in emissions from student commuting.

Please note that these emissions have been derived using educated estimates for the activity level data (for some source categories) and emission factors that enjoy industry-wide acceptance. Actual observational data will further refine these estimates to provide more accurate results. The effort and time spent on acquiring actual data on activity levels for some of the source categories (business travel and UMMS owned vehicle) cannot be justified because their contribution to the campus-wide emissions is negligible. However, data collected through employee and student surveys regarding their driving practices will be a valuable refinement to this analysis since these emissions form a large part of the total CO₂ emissions.

Please feel free to contact me or Michael Kravett at 978-589-3000 if you have any questions regarding the contents of this report.

Sincerely yours,



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