

The background of the entire page is a soft-focus photograph of green leaves, likely from a tree, with a bright, natural light source filtering through them, creating a dappled light effect. The leaves are various shades of green, from vibrant to pale, and their veins are visible. The overall mood is fresh, natural, and environmentally conscious.

# environmental

2008 ANNUAL ENVIRONMENTAL REPORT

 UNIVERSITY OF MICHIGAN

## Letter from the President



Global climate change and dwindling natural resources present an unprecedented challenge to our society. The University of Michigan has a responsibility to address this challenge by conducting innovative research, educating new generations of leaders, and reducing the University's footprint on the environment.

It has been six years since a team of graduate students from our School of Natural Resources and Environment devised a prototype report for assessing sustainable practices on U-M's Ann Arbor campus. The ultimate goal was to educate our community about the institution's impact on the environment and how it can best be managed.

This report marks the second year we have shared data that document the University's energy use, emissions, water use, land use, solid waste, and cross-cutting issues. This information helps us plan carefully to ensure a sustainable environmental future for generations to come.

Sharing this information is one facet of our efforts to be a responsible institution committed to protecting and preserving our natural resources. From the Michigan Memorial Phoenix Energy Institute and the Graham Environmental Sustainability Institute, to the hiring of new clusters of faculty devoted to such diverse issues as energy storage, sea levels, and public policy challenges, we continually look to expand our contributions to our world.

The University of Michigan takes its responsibility of protecting and preserving resources very seriously, and every contribution can make a difference. As you read through this report, I challenge everyone in our community to think about how even the smallest efforts will work to make our great institution even greener.

Sincerely,  
Mary Sue Coleman  
President



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## University of Michigan 2008 Annual Environmental Report

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University of Michigan 2008 Annual Environmental Report

# environmental

## 2008 ANNUAL REPORT

executive summary

introduction

# EXECUTIVE SUMMARY

The University of Michigan is pleased to present the *2008 Annual Environmental Report*. During the 2008 fiscal year, the University of Michigan community witnessed the initiation of several University-wide environmental conservation programs. Planet Blue—developed in collaboration with the Institute for Social Research—engages the University community one building at a time. Planet Blue draws upon the unique skills and ideas of the U-M community to reduce resource consumption, save energy, and generate the excitement necessary to make conservation a standard of campus life.

U-M has also joined forces with industry to develop the Climate Savers Computing Initiative @ U-M (CSCI@U-M) to reduce the environmental impacts associated with the high-volume computer usage that has become today's standard. CSCI@U-M is investigating all aspects of information technology including energy saver programming, server room efficiencies, and material reuse and recycling.

This 2008 Environmental Report tracks 156 environmental indicator metrics from across the Ann Arbor campus over a five-year period from FY2004 through FY2008 (Table 1).

These metrics are explored in detail in the “Environmental Indicators” sections of this report. Key findings include:

- Building energy use remained essentially unchanged from FY2007 at 6.2 trillion BTUs. This metric is most significant when taking into consideration that the building square footage increased by 495,807 feet and campus population increased by 1,935 people.
- Transportation energy use increased 2.7 percent from FY2007. 77 percent of this increase can be attributed to additional charter bus service and an increase in bus service hours.
- University of Michigan carbon dioxide emissions increased from 664,000 metric tons in FY2007 to 687,000 metric tons in FY2008. This increase is a result of a decrease in on-campus energy production at the Central Power Plant and subsequent increase of purchased power.

- Total water use rose from 1.29 billion gallons in FY2007 to 1.30 billion gallons in FY2008, a less than 1 percent increase; again an important metric considering the increases in both campus square footage and population.
- Percentage of surface area impervious to storm water remained unchanged at 17 percent of the campus land area.
- Recycling efforts resulted in an increase from 28 percent in FY2007 to 29 percent in FY2008 of solid waste recycled.

The “Cross-Cutting and Emerging Issues” section recognizes the efforts of staff, students, and faculty whose creativity and dedication to the environment are of equal importance to all of the data captured in the metrics. Between research activities, academic courses, and operational efforts across campus, the examples of good stewardship throughout the University are many. This is a great measure of success, but it means we are still on the road to improvement and we fully recognize there is much more that can be done.

We invite you to become involved in the University of Michigan's commitment to the environment and preservation of its natural resources. Working together, we can help minimize our personal and institutional impact on the environment.

Table 1  
FY2004–FY2008  
Environmental Indicator Metrics

Environmental Indicator	Metrics Tracked
Energy	42
Air Emissions	27
Water Use	7
Land Use	16
Solid Waste	46
Cross-Cutting and Emerging Issues	14
Population	4

Source: OSEH Environmental Stewardship & Emergency Planning

# INTRODUCTION

**“The University of Michigan has unparalleled strength in the social sciences and a unique ability to examine complex topics from a collaborative interdisciplinary approach. Marshaling these forces to examine energy will give students deeper understanding of a topic that is vital to both Michigan and the rest of the world.”**

Terrence McDonald  
Dean of the School of Literature, Science, and the Arts  
LSA Energy Futures theme semester announcement

Our natural resources and the environment continue to be key points of interest and concern within the University of Michigan community and in the public arena. The volatile price of oil and gasoline, global awareness of the adverse impact of climate change, and the increasing demand for natural resources all receive national attention.

While the federal government struggles to advance a national energy agenda, there is evidence that people are taking seriously the need to modernize the way we utilize energy in this country. The U.S. Department of Energy reports that twenty-four states and the District of Columbia have Renewable Energy Portfolio Standards in place. Together, these states account for more than half of the electricity sales in the United States. Nationwide, changes are occurring regardless of a formal federal agenda. Registrations of new hybrid vehicles rose 38 percent in 2007 to a record 350,289 units. Photovoltaic installations increased from 141 megawatts in 2006 to 259 megawatts in 2007, an 84-percent increase in a single year.

Historically, universities and institutes of higher learning have been at the forefront of social and intellectual change. The environmental movement is another example where the unique energies that pervade the University community can



University of Michigan Biological Station



be utilized to both develop the technology and awaken the social consciousness necessary to steer civilization towards a sustainable future.

The University of Michigan has earned a reputation for being a leader in this area of national importance.

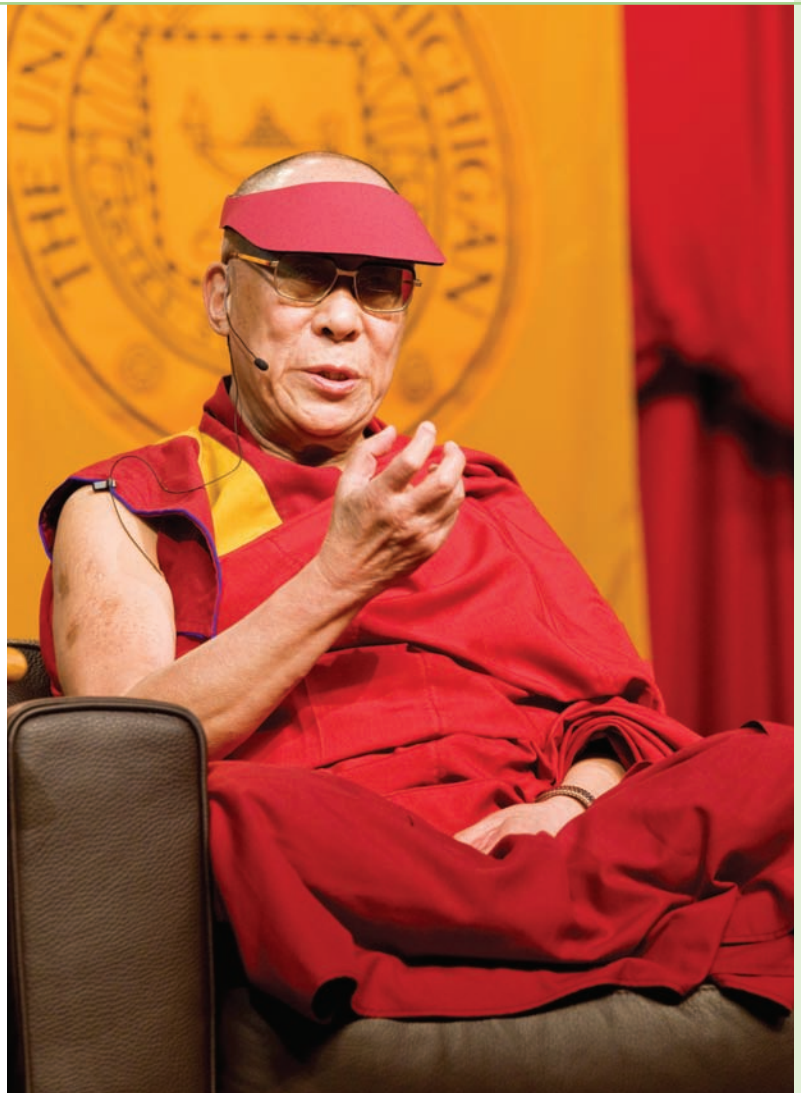
- The National Science Foundation listing of academic profiles consistently places the University of Michigan in the top four university research programs nationwide. Expenditures in support of research, scholarship, and creative activity total more than \$800,000,000 per year.
- The 2008 College Sustainability Report Card published by the Sustainable Endowments Institute recognized the University of Michigan's environmental stewardship efforts by granting U-M an overall grade of B+, placing it within the top 5 percent of colleges and universities participating in the study.
- As part of the 2008 Earth Day celebrations, the Wege Lecture on Sustainability presented his Holiness the 14th Dalai Lama to a capacity crowd at Crisler Arena, encouraging individuals to take personal responsibility to address global sustainability challenges.

The University of Michigan strives to lead by example. Through the open discussion and clear documentation of defined environmental performance indicators, the efforts of our faculty, staff, and students become the foundation for campus sustainability.

The *2008 Annual Environmental Report* presents an update of the University's stewardship activities using six principal environmental performance indicators defined by the 2003 President's Environmental Task Force:

- Energy Use
- Air Emissions
- Water Use
- Land Use
- Materials Use and Solid Waste
- Cross-Cutting and Emerging Issues

This is the second annual report produced by the University of Michigan. Data is presented for the periods July 1<sup>st</sup> through June 30<sup>th</sup> of FY2004–08. The scope of the report is the University of Michigan's Ann Arbor Campus and properties. There are 156 environmental metrics reported. Eighty-four are direct numerical data measurements from 21 key sources throughout the University. The remaining 72 metrics are derived through mathematical conversions.



**“Taking care of our planet environment is like taking care of our own home. We have a responsibility to take care of the environment. It is our only home.”**

The 14th Dalai Lama  
April 20th, 2008  
University of Michigan  
Annual Peter Wege Lecture on Sustainability

# INTRODUCTION

## Energy Use

Energy production, distribution, and use are essential elements of daily life and are directly linked to many of society's greatest environmental concerns. Multiple forms of energy—electricity, natural gas, and liquid fuels such as gasoline and biodiesel—are all utilized by the University. Forty-two energy indicator metrics pertaining to campus buildings and transportation are documented in this report.

Through energy conservation programs and alternative energy projects, the University of Michigan strives to reduce dependence on traditional fossil fuels. Through planning and innovative leadership, the University will ensure research and educational program growth in a sustainable manner.

## Emissions

A direct consequence of converting the Earth's natural resources into usable energy is the production and discharge of adverse air emissions. While the University of Michigan employs cleaner burning natural gas to generate steam and electricity for a large percentage of our buildings, pollutants

such as carbon dioxide, nitrogen oxides, and sulfur dioxide are still released into the atmosphere. This report documents emissions defined as Environmental Protection Agency regulated compounds: particulate matter, volatile organic compounds, carbon monoxide, sulfur dioxide, nitrogen oxides, and lead. The report also calculates emissions of the non-regulated, but of environmental concern, compound carbon dioxide.

## Water Use

Water is one of the planet's most plentiful resources, and unlike fossil fuels, it is constantly renewed through the earth's hydrologic cycle. At the same time, it is only a very limited amount of the earth's water—less than 1 percent—that is readily available as fresh ground and surface water. The University of Michigan is very fortunate to reside within close proximity to the Great Lakes, home to one-fifth of the world's surface freshwater. Through proper preservation and increased understanding of this vast resource, the water needs of the Great Lakes Basin should be met for generations to come.



Michigan Sea Grant, a joint program of the University of Michigan and Michigan State University, is part of the NOAA-National Sea Grant network of 30 university-based programs. Michigan Sea Grant promotes knowledge of the Great Lakes through education, research, and outreach.

## Land Use

When the University of Michigan first moved to Ann Arbor in 1837, the campus occupied 40 acres of land donated by the Ann Arbor Land Company. Now, 171 years later, the Ann Arbor campus consists of 3,070 acres integrated within the city of Ann Arbor and neighboring townships. Through well-planned environmentally sensitive expansion, the University of Michigan provides access to state-of-the-art academic and research technologies. Only through ongoing well-planned land use strategies can facilities continue to grow while preserving natural areas for wildlife and campus community enjoyment.

## Materials Use and Solid Waste

With a campus population of more than 78,000 people, production of municipal solid waste is significant. Through waste management practices such as source reduction and recycling, the University is striving to reduce the volume of waste entering the local landfills while at the same time conserving energy, reducing net gas emissions, and protecting water resources.

## Cross-Cutting and Emerging Issues

Many of the efforts going on around campus cannot be quantitatively measured, but still have a positive impact on the University's environmental footprint. The "Cross-Cutting and Emerging Issues" section of the report describes the efforts of the campus population in understanding sustainability and promoting and expanding awareness of environmental responsibility.

The University of Michigan endeavors to ensure an enriching and sustainable future for the people of Michigan while continuing to remain an institute of learning and research of the highest order. By informing the campus about the ongoing environmental initiatives of students, faculty, and staff, we encourage the total campus community to become active in this critically important undertaking. A University as diverse and multi-faceted as our own provides everyone an opportunity to join in and become part of the solution.



The University of Michigan co-generation power plant utilizes cleaner-burning natural gas to provide electricity, steam, compressed air, and domestic hot water to the University's Central and Medical Campuses.



Find out more about the exciting new Planet Blue initiative in the "Cross-Cutting and Emerging Issues" section.



# environmental

## INDICATORS

energy use

emissions

water use

land use

solid waste

# ENERGY USE

Energy powers the engine of our society. Without a reliable, affordable, and sustainable source of energy the modern world would be a very different place. There are many forms of energy available to promote society's growth, but technological breakthroughs will be required to develop new sources of energy and provide for more efficient use of existing energy. Every potential energy source comes with positive and negative traits. While this report cannot present all aspects of the energy debate, it does provide a platform to summarize benefits and concerns associated with common forms of energy.

**Petroleum:** Approximately 40 percent of the energy used in the United States (U.S.) is derived from petroleum. After being removed from the ground, crude oil is refined into multiple useful products. 70 percent of oil distillates are used to produce fuel, including gasoline, diesel, and jet fuel for the transportation industry. Heating oil and liquid propane are derived from petroleum and used for heating, cooking, and production of electricity. Residual oil products are used to make plastics, asphalt, and tires, and can be found in many common products such as medicines, dishwashing liquids, and even bubblegum.

While oil has proven to be a reliable, effective, and affordable source of energy for the past 100 years, and most likely will continue to be a part of our energy portfolio for years to come, there are many reasons to diversify. One concern is availability; rising demand for oil has resulted in a historically low level of spare oil production capacity worldwide. As a result, supply is easily disrupted by factors such as hurricanes in the Gulf of Mexico and political uncertainty in the Middle East. These uncertainties create volatile price changes in the commodities markets. Because our society is so dependent on oil, price increases in oil have ramifications felt throughout the entire economy.

Petroleum use can also create environmental problems. Oil is a complex mixture of chemical compounds, ranging from simple hydrocarbon chains to potential carcinogens such as benzene and multi-ringed polynuclear aromatics. The burning of petroleum products releases hundreds of pollutants into the atmosphere, including carbon monoxide, nitrous oxides, and mercury. Petroleum product combustion is also responsible for 44 percent of the United States' annual carbon dioxide emissions. Oil drilling and transportation via pipeline or shipping results in accidental spillage of raw crude oil into the environment every year.

**Natural Gas:** The second most utilized energy resource is natural gas, which is primarily composed of methane. Nearly 24 percent of the U.S. energy needs are met by natural gas. More than 62 percent of U.S. homes use natural gas for heating and cooking. Natural gas burns more cleanly than other fossil fuels; it has fewer sulfur, carbon, and nitrogen emissions than coal or oil have, and when burned, leaves almost no ash particles. Natural gas use also provides nearly twice as much energy per pound of carbon dioxide emitted than does coal use. Because natural gas is a clean fuel, its use, especially for electricity generation, has grown tremendously and is expected to continue to do so. Like oil, natural gas is a non-renewable fossil fuel.

**Coal:** Coal is a combustible sedimentary rock composed mostly of carbon and hydrocarbons, and is the most abundant fossil fuel in the United States. The United States has the world's largest known coal reserves; it has enough coal to last approximately 225 years at today's level of use. Over 90 percent of the coal used in the United States is employed to generate electricity. Approximately half of the country's annual electricity demand is met through the burning of coal. At present, in southeastern Michigan, that number is closer to 77 percent.



▲  
Regent's Plaza

# ENERGY USE

Environmental concerns continue to be coal's primary drawback. Even though environmental laws and modern technologies have greatly reduced coal's impact on the environment, coal mining can damage land, pollute water, and injure miners. The burning of coal releases greater quantities of carbon dioxide, sulfur oxides, nitrogen oxides, and mercury than does the burning of oil or gas. The coal industry has found several ways to reduce impurities from coal, and is working on effective ways of cleaning coal and sequestering carbon dioxide emissions.

**Nuclear:** Just over 8 percent of the United States' energy consumption is met by the nuclear industry. Nuclear power is used exclusively for the production of electricity. Nuclear power plants produce no air pollution or carbon dioxide, but they do produce radioactive waste, and heat. Spent fuels and other radioactive wastes are the principal environmental drawbacks for nuclear power. Most nuclear waste is low-level radioactive, including tools, protective clothing, and disposable items that have been contaminated with small amounts of radioactive dust or particles. These materials are subject to special regulations that govern their disposal so they will not come in contact with the outside environment. On the other hand, the spent fuel assemblies are highly radioactive and must be stored in a high security facility for many centuries. Furthermore, the potential for large-scale nuclear accidents has led to a significant anti-nuclear movement.

**Renewable Energy:** The establishment of a sustainable energy portfolio requires a shift from traditional non-renewable and environmentally detrimental sources. The environment provides a variety of clean, renewable, readily available, and affordable energy sources, such as solar, wind, biomass, hydro, and geothermal. While these renewable energy sources have the potential to contribute a much higher

percentage of our energy needs in the future, it will take a strong commitment from government, academic, and business leaders to ensure the necessary technological developments take place.

Expansion of renewable energy use has been driven by the concerns relating to non-renewable fuels discussed earlier—supply security, unstable pricing, and environmental issues. Within the United States, more than 50 percent of the energy generated by renewable sources is used in the production of electricity yet accounts for only 9 percent of total electricity. The remainder of the renewable energy produced annually in the United States is used to heat and power homes and industry, and to provide alternative transportation fuels such as ethanol and biodiesel.

As with any industry in its infancy, renewable energy faces a number of significant hurdles that must be overcome to ensure mainstream acceptance. Infrastructure is not currently in place to transport power from high energy locales such as the windy plains states or the sunny Southwest to areas with less renewable potential. Also, solar and wind electricity production are intermittent and efficient integration to the grid poses development challenges.

The University of Michigan makes use of many energy sources in order to meet the energy demands of a large teaching and research institution. The majority of University energy purchases go into heating, cooling, and powering our buildings with the remainder dedicated to fueling our transportation services. The University of Michigan is committed to reducing its dependence on fossil fuels through energy conservation measures and the expansion of its access to renewable energy.

The new 146,000 BTUs/hr Solar Collector located on the roof of the Central Power Plant is capable of producing water at 200° F, helping to reduce the University's dependence on natural gas. ►



## Building Energy Use

The University of Michigan's 380 buildings surveyed for this report consumed over 6.2 trillion BTUs of energy during FY2008 (Figure 1). That number is unchanged from FY2007 despite increases of nearly half a million square feet of building area and 1,900 more people living and working on campus. Building energy use is calculated by standardizing electricity, natural gas, propane, and fuel oil purchases into British Thermal Units (BTUs) and summing the total. The electricity component of Energy Use is derived from direct electricity purchases, and therefore does not account for the inefficiencies related to the conversion of primary fuel sources into electricity by the University's electricity provider. When the building energy data is normalized with respect to building square footage, there was a 1.5 percent reduction in energy use between FY2007 and FY2008. Likewise, when normalized with respect to population increase, there was a 2.4 percent reduction in energy use between FY2007 and FY2008 (Figure 2).

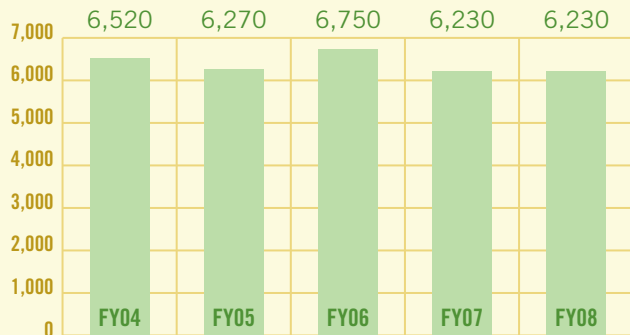
Nearly 75 percent of the University's energy requirements are met by natural gas (4,650 billion BTUs). Electricity purchased off the grid (1,570 billion BTUs) accounts for the majority of the remaining energy usage with fuel oil and propane providing less than 1 percent each (Figure 3). Most of the natural gas is purchased to fuel the University's EPA award winning cogeneration power plant.

Approximately 45 percent of the electricity consumed on campus is generated on-site at the Central Power Plant (CPP). The CPP uses a cogeneration process during which natural gas fires boilers to produce steam that is fed into a distribution system to buildings throughout the Central Campus for heating and cooling. Excess steam is fed into turbines that generate electricity. The process of cogeneration dramatically contrasts to the practice of most thermal-electric power plants, where steam is used exclusively for the production of electricity. By using the extra steam, the fuel efficiency of the CPP is approximately 78 percent, compared with fuel efficiency of approximately 30–40 percent for most public utility plants.

Energy conservation programs over the years have played a significant role in the University's efforts to reduce building energy use. New construction such as the C. S. Mott Children's and Women's Hospital replacement project, the Stephen M. Ross School of Business enhancement project, and the North Quad Residential and Academic Complex are being designed with energy efficiency from the blueprint phase forward. Energy saving measures such as maximizing insulation in walls and roof assemblies, reducing lighting

Figure 1  
U-M Building Energy Use\*

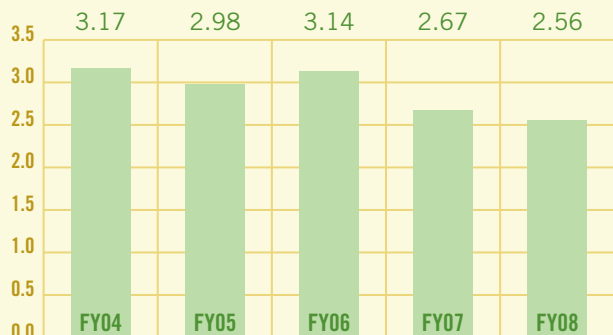
Total BTUs  
(In billions BTUs)



Source: Utilities and Plant Engineering, Annual Utilities Purchases

Figure 2  
U-M Building Energy Use\*

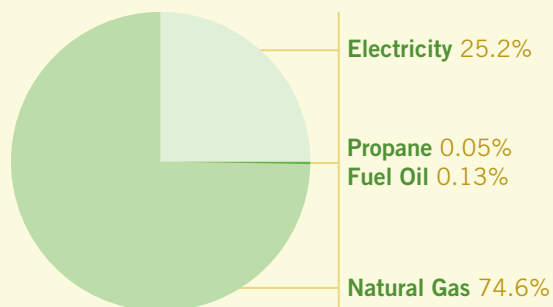
Normalized to Population and Building Square Footage  
(In BTUs per person per square foot)



Source: Utilities and Plant Engineering, Annual Utilities Purchases

Figure 3  
U-M Building Energy Use\*

By Energy Source—FY2008  
(In percentage total use)



Source: Utilities and Plant Engineering, Annual Utilities Purchases

\* Energy use calculations do not reflect inefficiencies related to off campus production of electricity that was purchased for the Ann Arbor Campus

# ENERGY USE

needs through the use of occupancy sensors, recovering heat lost in exhaust fan emissions, and the installation of variable flow exhaust hoods are included in all new construction projects.

In 2007, the University introduced a new approach to energy efficiency in our buildings. Planet Blue Teams, consisting of operations personnel, facility managers, and building occupants, conduct building-by-building energy and environmental audits; identify building-specific strategies to achieve energy and environmental conservation; and gain the commitment of building occupants to improve the operation of their working environment. During FY2008, Planet Blue Teams began implementing energy conservation measures (ECMs) in five pilot buildings—Institute for Social Research, Chemistry, Fleming, Rackham, and Space Research. Although actual savings are not yet available, the ECMs identified in FY2008 once implemented are projected to save the University more than \$800,000 annually in energy costs. The Planet Blue initiative is one facet of the University’s six-point Environmental and Energy Initiative, described in greater detail in the “Cross-Cutting and Emerging Issues” section of this report.

The University of Michigan is looking to expand the use of renewable energy. Currently the University has limited on-site renewable energy and recognizes the necessity to develop more. One source is a 33kW photovoltaic array that

is located on the roof of SNRE’s Dana Building. This unit has been in operation since 2005. In spring of 2008, a solar water heater was installed on the Central Power Plant. This solar collector has a peak output of 146,000 BTUs/hr, and has an annual output of 250,000,000 BTUs.

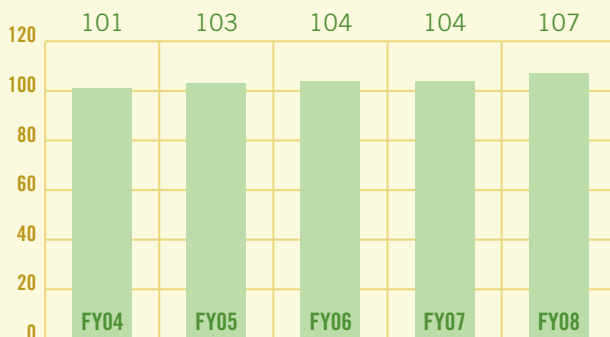
## Transportation Energy Use

The University of Michigan currently owns and operates a fleet of 1,098 vehicles. Five of the vehicles are gasoline-electric hybrid cars, 491 are fueled with E-85 ethanol, 504 with unleaded gasoline, and 98 trucks and buses with B-20 ultra low sulfur biodiesel. In FY2008 the fleet consumed 855,000 gallons of fuel, equivalent to 107 billion BTUs of energy, an increase of 2.7 percent from the 104 billion BTUs used in FY2007 (Figure 4). Twenty billion BTUs, or 19 percent of the transportation energy, was derived from the renewable energy sources ethanol and biodiesel. Nearly 41 billion BTUs were used to fuel the University’s bus fleet, the ridership of which has increased annually (Figure 5).

The University of Michigan encourages the campus population to use alternate modes of transportation. University buses, van pool, M-Ride and car pooling programs all help to reduce fuel use, traffic congestion, and parking requirements. Some University departments also offer flexible scheduling and work-at-home options in an effort to lessen commuter mileage and increase road efficiency in the Ann Arbor area.

Figure 4  
U-M Transportation Energy Use

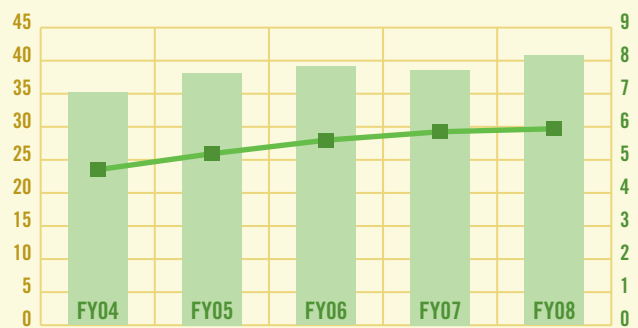
Total BTUs  
(In billions BTUs)



Source: Parking and Transportation Services

Figure 5  
U-M Bus Ridership

(Energy in billions BTUs)  
(Ridership in millions)



■ Energy (in billions BTUs) ■ Ridership (in millions)

Source: Parking and Transportation Services



## Total Energy Use

Total University energy use is defined as a combination of direct building and transportation related energy consumption. There was a 0.13 percent increase in total energy use between FY2007 and FY2008, and a 7.5 percent decrease from the record high of FY2006. The 6,340 billion BTUs used in FY2008 is 165 billion BTUs less than the five year average for FY2004–FY2008 (Figure 6).

The University of Michigan is home to many types of facilities including research laboratories and hospital buildings, all with increasing energy demands. Because U-M’s building size and campus population are always growing, it is appropriate that we look at energy use on a square footage and per person basis (Figure 7). FY2008 marks the second consecutive year of decreasing energy use by population and building area. Many circumstances can affect energy use at a large institution such as the University of Michigan. Building usage and populations change over time as do occupant energy demands. Only by continued progress in building efficiencies and a community-wide commitment to improving energy consumption habits will we see our energy usage decrease.

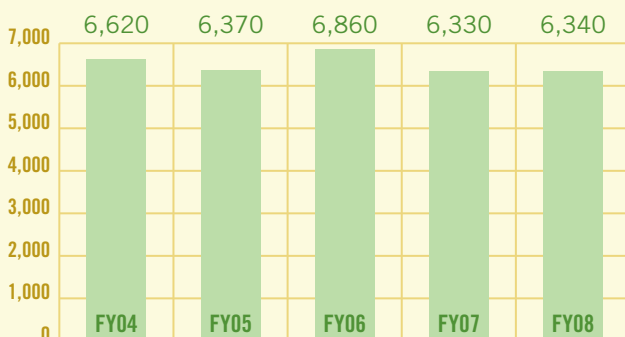


**“The successes in the state’s, the nation’s, and the world’s energy challenges are not going to spring from one source, but rather will come through thoughtful and energetic collaboration across many disciplines.”**

Gary S. Was  
Director of the University of Michigan  
Memorial Phoenix Energy Institute

Figure 6  
U-M Total Energy Use\*

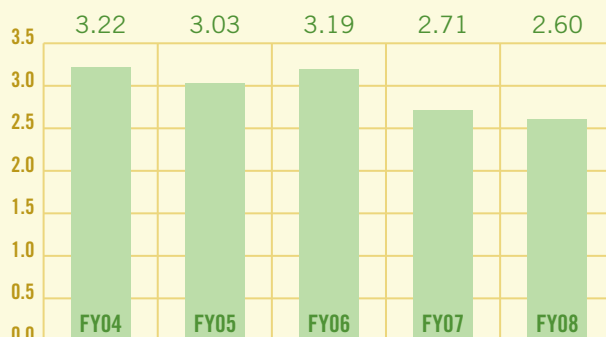
Total BTUs  
(In billions BTUs)



Source: Utilities and Plant Engineering, Annual Utilities Purchases

Figure 7  
U-M Total Energy Use\*

Normalized to Population and Building Square Footage  
(In BTUs per person per square foot)



Source: Utilities and Plant Engineering, Annual Utilities Purchases

\* Energy use calculations do not reflect inefficiencies related to off campus production of electricity that was purchased for the Ann Arbor Campus

# EMISSIONS

A direct result of fossil fuel combustion is the release of emissions that can be detrimental to the environment and human health. This section of the *2008 Annual Environmental Report* reviews the following emissions directly generated by the University of Michigan: particulate matter (PM10 and PM2.5), volatile organic compounds (VOCs), carbon monoxide (CO), sulfur dioxide (SO<sub>2</sub>), nitrogen oxides (NO<sub>x</sub>), lead (Pb), and carbon dioxide (CO<sub>2</sub>). This section will also review CO<sub>2</sub> emissions that are a direct result of University of Michigan purchases of electricity. Emissions are based upon calculations derived from fuel consumption, not actual measurements. Stationary source emissions come from the Central Power Plant and kilns, and laboratory fume hoods associated with teaching, research, and operational functions of the University. Mobile source emissions come from the University transportation fleet.

These pollutants have been chosen for monitoring because of their effects on the environment, and because they are regulated by the U.S. Environmental Protection Agency via the Clean Air Act. Particulate matter is defined by particle size of concern. Compounds with a diameter less than 10 micrometers (PM10) are able to pass through the nose and throat and into human lungs, a potentially serious health hazard. Compounds less than 2.5 micrometers (PM2.5) are also a major cause of reduced visibility, otherwise known as haze. VOCs, CO, and Pb are monitored because they are considered toxic compounds. SO<sub>2</sub> is a chief component of acid rain, known to damage trees, crops, and historic buildings and

monuments. NO<sub>x</sub> is a generic term for a group of compounds made from nitrogen and oxygen. NO<sub>x</sub> compounds are involved in the formation of smog, haze, and acid rain.

The main source of energy burned on the University of Michigan campus is natural gas. Emissions of pollutants are much less than if fuel oil or coal were used. Natural gas combustion emits very little NO<sub>x</sub>—92 pounds per billion BTUs—compared to coal’s 457 pounds. SO<sub>2</sub> emissions for one billion BTUs worth of natural gas is 0.6 pounds versus 2,591 pounds with coal use.

University of Michigan emissions of stationary source regulated pollutants showed a reduction for all compounds except SO<sub>2</sub> and Pb. NO<sub>x</sub> emissions for FY2008 were 1.5 percent less than in FY2007 and 12.8 percent less than the highest recorded amount from FY2004 (Table 2). The increase in SO<sub>2</sub> and Pb can be attributed to the 58,000 gallons of fuel oil that were consumed in FY2008, compared to none in FY2007.

Carbon dioxide, caused by hydrocarbon combustion, has been increasing in atmospheric concentration and is considered a major contributor to global climate change. CO<sub>2</sub> is not regulated by the Clean Air Act. However, many companies and institutions track emissions in an effort to establish a baseline from which to judge the success of future greenhouse gas reduction initiatives. A common practice when establishing CO<sub>2</sub> emission baselines is to calculate emissions from sources directly related to an institution (scope 1 emissions), and separately to calculate emissions generated from electricity purchases (scope 2 emissions). University of Michigan scope 1 emissions have decreased since FY2006. FY2008 saw a 1.3 percent drop from FY2007, and a 13 percent drop from FY2004 (Figure 8).

Table 2  
U-M Stationary Source Emissions

U.S. EPA Regulated Air Pollutants  
(in pounds)

	FY2004	FY2005	FY2006	FY2007	FY2008
<b>Pb</b>	3.5	2.6	2.6	2.3	2.4
<b>SO<sub>2</sub></b>	7,450	3,470	3,110	2,790	3,160
<b>PM2.5</b>	29,700	28,600	29,500	26,500	26,000
<b>PM10</b>	30,100	28,600	29,500	26,500	26,100
<b>VOCs</b>	28,600	27,600	28,500	25,600	25,100
<b>CO</b>	438,000	421,000	435,000	390,000	384,000
<b>NO<sub>x</sub></b>	693,000	663,000	684,000	614,000	604,000

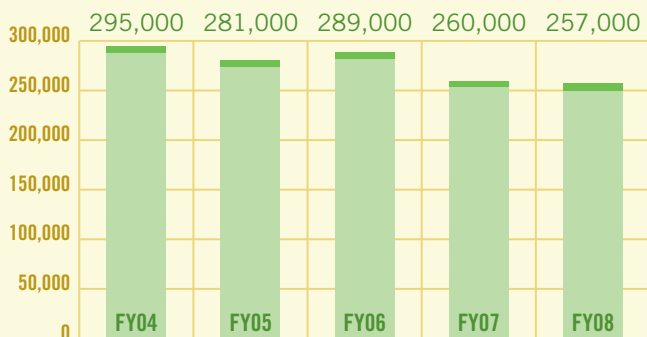
Source: Utilities and Plant Engineering, Annual Utilities Purchases

The University's scope 2 emissions have increased since FY2005. The 6 percent increase between FY2008 and FY2007 (Figure 9) reflects increased electricity purchases over the same time period. When scope 1 and scope 2 emissions are combined to create a total CO<sub>2</sub> emission report, we find that total CO<sub>2</sub> emissions increased from 664,000 metric tons in FY2007 to 687,000 metric tons in FY2008. This was still less than the high of 689,000 metric tons recorded in FY2006 (Figure 10). When normalized to account for population increases, the FY2008 increase over FY2007 is less than 1 percent (Figure 11).

The majority of the University of Michigan's emissions are directly related to the burning of fossil fuels to create electricity and steam for University buildings. U-M energy reduction initiatives such as those described in the "Cross-Cutting and Emerging Issues" section of this report should therefore have a direct and positive impact on emission levels.

Figure 8  
U-M Carbon Dioxide Emissions

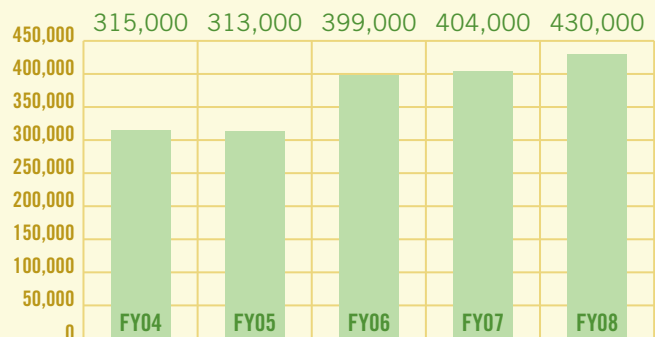
U-M Generated by Source  
(In metric tons CO<sub>2</sub>)



■ Mobile Source Emissions ■ Stationary Source Emissions  
Source: U-M Occupational Safety and Environmental Health

Figure 9  
U-M Carbon Dioxide Emissions

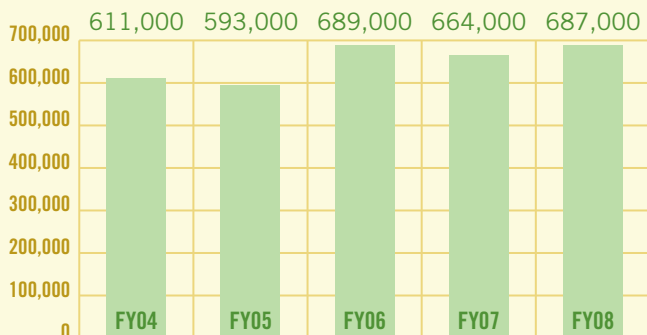
External Electricity Provider Generated  
(In metric tons CO<sub>2</sub>)



Source: U-M Occupational Safety and Environmental Health

Figure 10  
U-M Carbon Dioxide Emissions

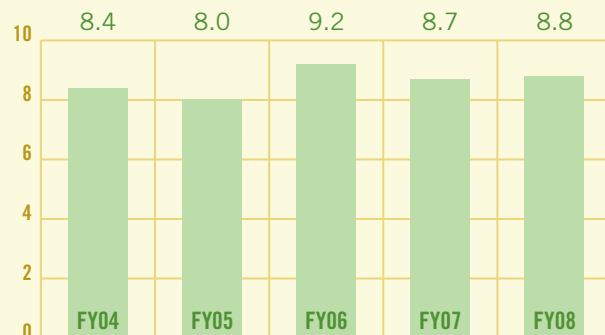
Combined U-M and External Electricity Provider Generated  
(In metric tons CO<sub>2</sub>)



Source: U-M Occupational Safety and Environmental Health

Figure 11  
U-M Carbon Dioxide Emissions

Combined U-M and External Electricity Provider Generated  
Normalized to Population  
(In metric tons CO<sub>2</sub> per person)



Source: U-M Occupational Safety and Environmental Health

# WATER USE

Water is one of the earth's most plentiful natural resources, covering over 70 percent of the planet. Not only do we require water for drinking, bathing, washing our dishes, and cooking our food, but also for irrigating crops and transporting goods across the globe. Water is used in industry and in research, and can be harnessed for generating electricity and heating and cooling buildings. Water is our primary means of removing waste from our homes and the ultimate receptacle for much of the industrial waste, agricultural fertilizers, and surface runoff pollutants released into the environment.

Of all the earth's water, less than 1 percent is available as fresh groundwater or in the surface waters of lakes, rivers, and streams. This 1 percent of the world's water provides most of civilization's water needs, and is the most vulnerable to contamination from pollutants. The University of Michigan is fortunate to be located in an area of vast freshwater resources. The Great Lakes, home to one-fifth of the world's surface freshwater, are facing increasing environmental pressure from pollution, global warming, and evasive species infiltration. Only through proper preservation and increased understanding will this vital resource continue to meet the water needs of our area.

The University of Michigan continues to implement water-saving measures such as low-flow toilets and sinks, high efficiency condensing units and autoclaves, and centralized chiller plants. University water use rose from 1.29 billion gallons to 1.30 billion gallons in FY2008, less than a 1 percent increase. This represents a 3.6 percent decrease from FY2006, the highest value reported (Figure 12).

When normalized to population and building square footage, water use continues to show a decrease. FY2008 water use in gallons per person was 16,660, or 45 gallons per person per day, down 1.5 percent from 16,900 in FY2007 and the lowest reading recorded (Figure 13). FY2008 water use in gallons per building square footage was 41.7, a 0.6 percent drop from FY2007's 42.0 gallons per square foot.

Water conservation is one important aspect of sustainability. Another is water quality preservation. During FY2008, the Ann Arbor area received a record 90 inches of snow resulting in the use of 3,200 tons of salt and sand in the University's ice removal efforts, compared to 1,890 tons in FY2007. Many compounds such as salt and sand, lawn fertilizers, and transportation fluids that are used for land-based applications are deposited into rivers and streams through storm water runoff. The University of Michigan operates a very aggressive storm water management program. Storm drains throughout campus are labeled with a high visibility marker informing residents to "Keep Our Michigan Waters Blue: Dump No Waste-Flows to River." Following storm events, U-M staff inspects storm drains near all construction sites to ensure that erosion control measures are in place and functioning as designed.

Wetlands, swales, and underground detention basins have been constructed throughout campus to allow storm water runoff to settle, and thereby filter out potential contaminants before the runoff enters the system and flows into the river. The 1,000,000-gallon detention basin under the parking structure in the Life Sciences Institute/Palmer Drive complex manages runoff from more than 60 acres of Central Campus. Storm water runoff from 90 acres of North Campus is managed through a large wetland detention basin located near the Art & Architecture Building. The North Campus Wetland Basin also provides an aesthetic natural feature for the campus community.

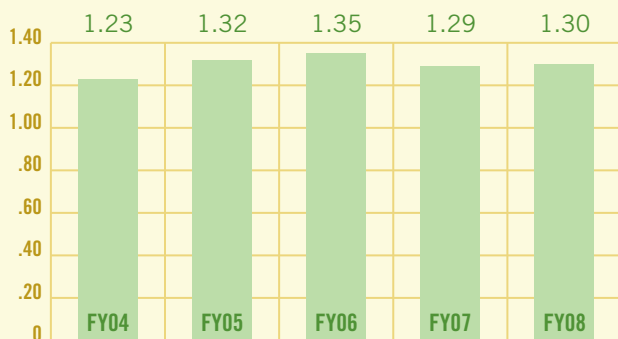


▲  
North Campus Wetland Basin



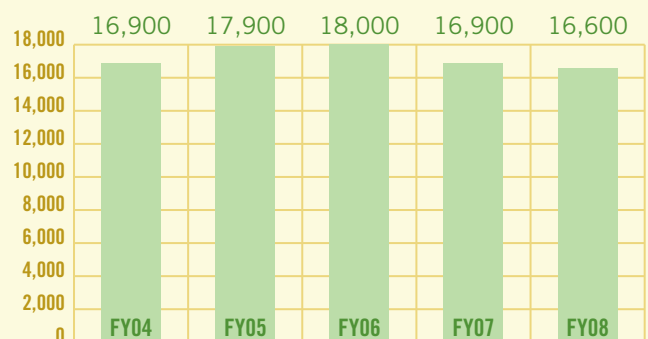
▲ University of Michigan Biological Station, Douglas Lake

Figure 12  
U-M Water Use  
(In billions of gallons)



Source: Utilities and Plant Engineering, Annual Utilities Purchases

Figure 13  
U-M Water Use  
Normalized to Population  
(In gallons per person)



Source: Utilities and Plant Engineering, Annual Utilities Purchases

# LAND USE



▲  
North Campus

The 3,070 acres of land that make up the University of Michigan Ann Arbor campus stretch for nearly six miles through the city of Ann Arbor and into neighboring townships. The University of Michigan campus continues to evolve since its inception 171 years ago. Building design varies from the traditional architecture of Angell Hall and the Law Quadrangle, to the contemporary Biomedical Science Research Building. Interspersed throughout the campus are areas of green lawn designed to encourage social gatherings as well as natural wooded areas that provide an opportunity for residents to enjoy time away from the urban life of a vibrant downtown. The University of Michigan Ann Arbor campus is actually comprised of five distinct areas, connected via the University and Ann Arbor Transportation Authority bus systems.

## South Campus

The majority of the University's athletic facilities and Plant Operations are located on South Campus. Built within one of Ann Arbor's residential districts, South Campus is home to the University Golf Course, Canham Natatorium, and Michigan Stadium.

## Central Campus

The original forty acres where U-M Ann Arbor was initially located is known as Central Campus. The Central Campus area is integrated into the central business district of the city. Within the boundaries of Central Campus are the majority of the University's housing facilities, as well as the College of Literature, Science, and the Arts; School of Natural Resources and Environment; Stephen M. Ross School of Business; School of Dentistry; School of Education; Law School; School of Social Work; School of Public Health; Division of Kinesiology; Horace H. Rackham School of Graduate Studies; and College of Pharmacy. Central Campus contains over 800,000 square feet of flower beds throughout the large tree-shaded areas of the Diag, the Law Quad, and Ingall's Mall.

## Medical Campus

The University Hospital, C. S. Mott Children's Hospital and Women's Hospital, and the U-M Medical School anchor this collection of internationally recognized health facilities, research laboratories, and teaching facilities. The 11-story, 796,262-square-foot University Hospital is the Health System's facility for adult patients. The 550-bed hospital first opened its doors in 1986. A 1,100,000-square-foot C. S. Mott Children's Hospital and Women's Hospital Replacement project, scheduled to be opened 2012, is pursuing Leadership in Energy and Environmental Design (LEED) certification. The Medical Campus also serves as one of the gateways into the University's 120-acre preserve, the Nichols Arboretum.

## North Campus

In 1952, then University President Harlan Hatcher announced plans to establish a North Campus for the University. The first building completed on the North Campus was the Cooley Memorial Laboratory. Much of the classified electronics research associated with the Willow Run Research Laboratory was conducted in the Cooley Laboratory. The campus quickly grew to include the world-renowned College of Engineering, A. Alfred Taubman College of Architecture + Urban Planning, School of Art & Design, School of Music, Theatre & Dance, and a large housing complex for students and their families. In FY2008, a new planning effort for North Campus was launched to strengthen connections with the other campuses, promote campus vitality through development of open social settings, and optimize future development capacity while respecting and incorporating environmental features.

## East Medical Campus

The newest addition to the Ann Arbor campus, East Medical offers a wide range of outpatient primary care, specialty care, and medical services to patients and their families. Also located on the East Medical Campus is the Rachel Upjohn Building, new home of the U-M Depression Center, and of nearly all outpatient psychiatry services for children and adults at the U-M Health System, as well as the U-M Addiction Treatment Services' outpatient programs for teens and adults. It serves as a hub for research in mental illness and addiction, including clinical trials that rely on volunteers from the community to make new discoveries. The Fleming Creek wetland area runs through this complex, and creates a pleasant pedestrian center. The University is very sensitive to environmental factors regarding the wetland and has focused land use planning to preserve and enhance it.

## Metrics Tracked

University planners ensure that facilities meet the requirements of our researchers, faculty, staff, and students while preserving the aesthetics that make the University of Michigan-Ann Arbor a place we can be proud to call home. While total building area grew 1.6 percent from FY2007 to FY2008, population increased 2.5 percent resulting in a 0.9 percent improvement in building usage efficiency (Table 3).

The inventoried tree population decreased slightly from 14,180 in FY2007 to 13,958 in FY2008. The number of parking spaces increased from 23,591 in FY2007 to 24,093 in FY2008, a 2.1 percent increase. Impervious surface area measured 534 acres, and maintained green space measured 571 acres.

Thanks to the careful planning and vision of the University of Michigan's past leadership, today's campus is able to prosper, meet the needs of a growing academic, research, and clinical mission, and preserve natural environments. This represents the very essence of sustainable planning and serves as an example of how appropriate actions today allow for the successes of tomorrow.

Table 3

## U-M Building Area Efficiency

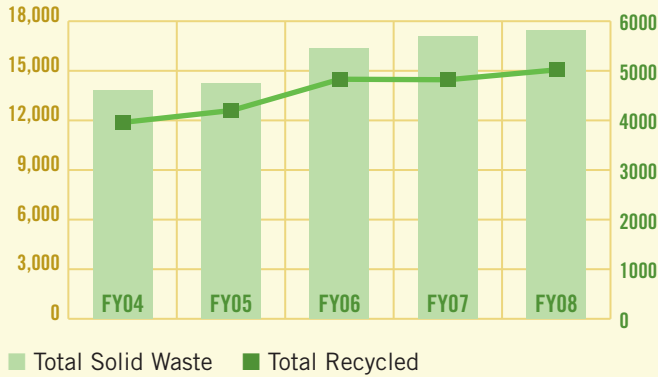
As Measured in Building Area vs. Campus Population

	FY2004	FY2005	FY2006	FY2007	FY2008
<b>Campus Population</b>	72,707	73,847	75,130	76,151	78,086
<b>Building Area</b> (sq. ft.) (includes parking structures)	28,303,787	28,490,282	28,619,505	30,674,494	31,170,301
<b>Building Efficiency</b> (sq. ft./person)	389	386	381	403	399

Sources: Office of Budget and Planning, and Utilities and Plant Engineering

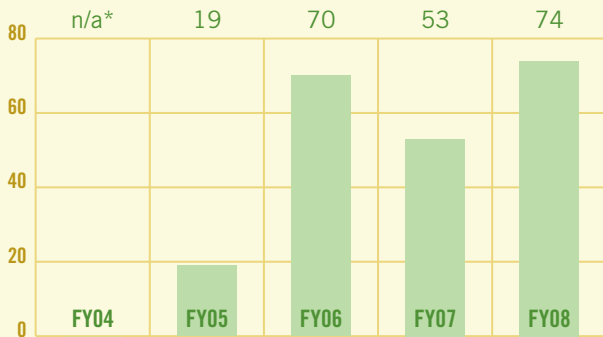
# SOLID WASTE

Figure 14  
U-M Waste Disposal  
(In Tons)



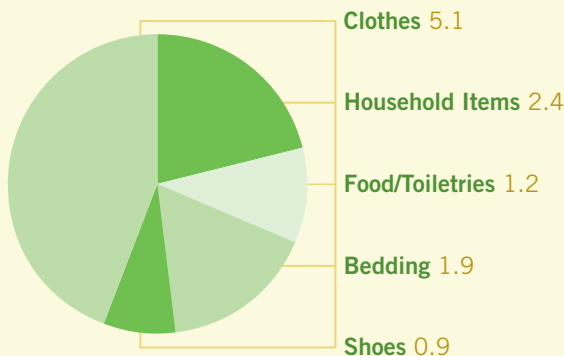
Source: Plant Operations Waste Management Services

Figure 15  
U-M Consumer Electronics Recycling  
(In tons)



Source: Occupational Safety and Environmental Health  
\* Program initiated 2005

Figure 16  
U-M 2008 Student Move Out Donations  
(In tons)



Source: Plant Buildings and Grounds, Waste Management Services

Forty thousand students, 5,600 faculty members, 17,700 full time employees, and 13,700 health care providers occupy the University of Michigan Ann Arbor campus. In addition, millions of visitors attend our libraries, museums, theaters, health centers, and sporting events every year. Each activity and operation occurring on campus produces waste that must be collected for disposal or recycling. Office activity generates a wide range of waste, including paper, used food containers, and even large items such as aged office furniture. Laboratories and health centers require frequent replacement of consumables, resulting in large volumes of packaging waste. Construction and renovation projects produce scrap lumber, metal, and concrete. Electronic devices such as personal computers, monitors, and testing equipment must be replaced regularly to keep pace with the latest technological advances.

A total of 17,430 tons of solid waste was collected from the University of Michigan in FY2008. That is an increase of 335 tons from FY2007 (Figure 14). The waste collected in FY2008 was equivalent to approximately 446 pounds per person, or 1.2 pounds per person per day, nearly consistent with the FY2007 rate of 449 pounds per person.

The University participates in a number of programs designed to divert as much solid waste as possible from local landfills. The University's Property Disposition Office provides a location where used items are resold to the University and local community. In FY2008, Property Disposition sold \$2.4 million worth of material. Items sold for re-use included laboratory equipment, office and dormitory furniture, and assorted computing supplies such as CPUs, monitors, and printers.

Recycling efforts during FY2008 resulted in 5,024 tons or 29 percent of the total waste stream being collected for recycling. Highlights of the recycling initiative include 241 tons of waste diverted from landfill disposal through composting, and the recycling of 3,700 tons of paper. 155 tons of regulated materials such as computer monitors, fluorescent light bulbs, and batteries were sent to companies that specialize in recycling these materials. Electronic waste recycling companies are audited to ensure that all University of Michigan electronics waste is fully recycled within the continental United States in a safe and environmentally appropriate manner (Figure 15).



Several annual recycling events not only reduce waste, but involve the campus community. The Student Move-Out and Move-In programs, begun in 1991, continue to collect donations from the student population. Items such as clothing, food, bedding, toiletries, kitchen appliances, and personal electronics have been diverted from the landfill and instead have been put to use by charitable organizations such as Purple Heart, Food Gatherers, St. Vincent DePaul, Salvation Army, and the PTO Thrift Shop (Figure 16).

The University's Football Stadium Recycling program, which began in 1994, is another event that not only helps the environment, but is a visible symbol of the University of Michigan's commitment to recycling as a core sustainability initiative. Every game day, paper, cardboard, and plastic containers are collected throughout the stadium from both vendors and fans (Table 4).

Recycling and waste reduction have been a part of the University of Michigan's environmental efforts since the late 1980s. Placing paper, plastic, metal, and glass into recycle bins is now second nature, but twenty years ago this was not the case. The change did not happen spontaneously. The recycling initiative was one of U-M's first environmental programs that relied on participation of the campus population to be successful. Dedication began with an informational campaign to increase community awareness of the environmental benefits associated with recycling. Marketing the campaign in association with conveniently located recycling receptacles made it easy for wide scale participation. This process resulted in a successful nationally recognized recycling program that is raising overall environmental awareness on campus.

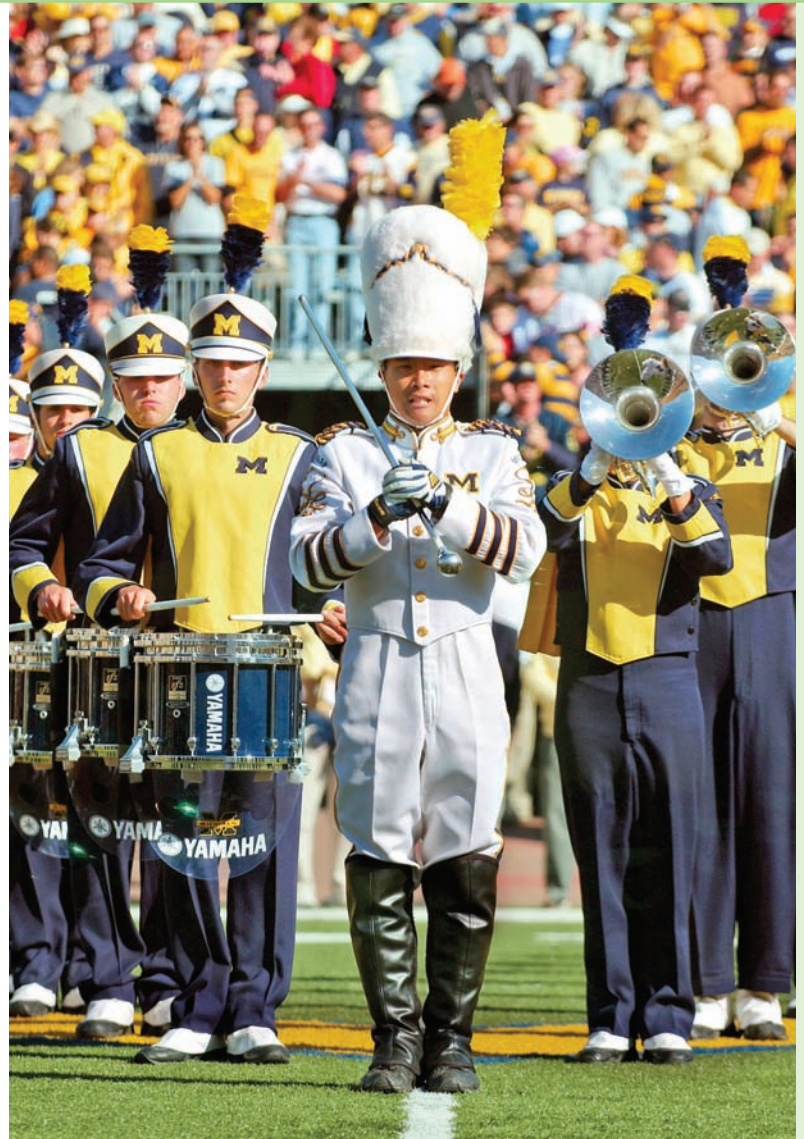


Table 4  
U-M Football Stadium Recycling Program

Year	Attendance	Cardboard/ Paper (tons)	Mixed Containers (tons)	Total Refuse (tons)	Percent Recycled	Water Saved (gallons)	Electricity Saved (kWh)	Trees Saved
FY2008	885,108	10.3	23.2	128	21.5	72,030	43,218	175
FY2007	769,183	10.9	15.7	120	18.3	76,580	45,948	186
FY2006	776,405	11.0	22.5	116	22.4	76,860	46,116	187
FY2005	666,149	8.8	17.6	97	21.4	61,390	36,834	149
FY2004	776,429	13.6	16.4	116	20.5	95,060	57,036	231

Source: Plant Buildings and Grounds, Waste Management Services

University of Michigan 2008 Annual Environmental Report

environmental

CROSS-CUTTING  
& EMERGING ISSUES

six-point environmental and energy initiative  
sustainability in campus life

In addition to documenting quantitative measures associated with the environmental indicators, the *2008 Annual Environmental Report* also provides a platform from which environmental initiatives from around the campus can be detailed. By combining quantitative performance measurements with non-quantifiable examples of effort and enterprise the *2008 Annual Environmental Report* provides an operational and academic perspective on the University's relationship with the environment.

As an institution of higher learning with over 40,000 students, the University of Michigan has a unique ability to shape future environmental thinking, provide solutions to worldwide concerns, and train future business and academic leaders.

During the 2007–08 school year, the 570 environmental related courses offered at the University of Michigan enjoyed a total enrollment of more than 13,500 students. Many more participated in annual activities such as the campus Earth Day celebration, joined environmentally themed student groups, or volunteered to help with community services of an environmental nature.

Faculty and staff have also increased their involvement this year. The Six-Point Environmental and Energy Initiative program introduced in 2007 is well under way, promoting energy efficiency throughout campus and increasing awareness of the University's commitment to environmental stewardship.

Centers and Institutes continue to focus on sustainability issues, funding research and coordinating seminars and conferences that encourage open academic discussion and cooperation.

To better publicize these efforts, encourage campus involvement, and provide access to environmental topics on campus, Occupational Safety and Environmental Health, the Graham Institute, and U-M News Services have coordinated the work of a group of students, faculty, and staff, representing ten departmental units charged with the responsibility of creating a University Sustainability Website.

The "Cross-Cutting and Emerging Issues" section of the *2008 Annual Environmental Report* provides the platform to showcase the environmental efforts of our community in greater detail.



▲ Members of the U-M student group Earth Week help get the word out.

The University of Michigan Six-Point Environmental and Energy Initiative is a three-year project designed to focus and increase environmental stewardship and energy conservation efforts where we believe the most gains can be made:

- Environmental Reporting
- Renewable Energy
- Alternative Transportation
- Green Purchasing
- New Construction/Renovation Projects
- Planet Blue

# SIX-POINT ENVIRONMENTAL AND ENERGY INITIATIVE

Introduced in the spring of 2007 and implemented in FY2008, the Six-Point Environmental and Energy Initiative is a Business and Finance undertaking designed to place commitment to environmental conservation at the forefront of University consciousness.

**Point 1—Environmental Reporting:** This *2008 Annual Environmental Report* is the second publication of the University's Annual Environmental Report. The concept of sustainability reporting was first introduced in 1999 at the Peter Wege Economicology Conference in Grand Rapids, Michigan. A prototype report was generated as a master's project by four School of Natural Resources and Environment (SNRE) graduate students soon after, and in 2004 the University of Michigan's Environmental Task Force released its advisory report recommending an annual report be generated to track the University's progress regarding a set of defined Environmental Performance Indicators (EPIs).

Following this recommendation, SNRE's Center for Sustainable Systems (CSS) developed the Environmental Data Repository, an Excel-based tool designed to collect more than 3,000 data points relating to the performance indicators. Data from throughout the University was recorded for 2004 and 2005, and a report was issued by CSS in November 2006. Responsibility for generating the annual environmental report was transferred to the University's Occupational Safety and Environmental Health (OSEH) Environmental Stewardship Program in 2007.

The purpose of the *2008 Annual Environmental Report* is to present a yearly update of the University's environmental stewardship activities and data relating to the EPIs:

- Energy Use (building use and transportation)
- Water Use
- Land Use
- Air Emissions
- Materials Use and Solid Waste
- Cross-Cutting and Emerging Issues

The scope of the *2008 Annual Environmental Report* is centered on the University of Michigan's Ann Arbor campus and its properties. Data is presented for the July 1<sup>st</sup> through June 30<sup>th</sup> FY2004–08. Information outside of this scope may be referenced, but not detailed, in the interest of displaying a larger overall picture when deemed appropriate.

A key element of the report is the consolidation of information from throughout the University. While a number of campus organizations are actively pursuing environmental initiatives, the efforts have remained largely decentralized. By collecting information from the Utilities Department, Waste Management Services, Grounds, Parking and Transportation Services, OSEH, University Housing, the University Health System, and several academic departments and centers, the Environmental Report is designed to characterize the overall University environmental footprint and activities to improve the environment.

The Environmental Report makes no long-term strategic recommendations for EPI targets, nor does it attempt to explain in depth why results are as reported. The report is designed to be an informational tool providing data from which University staff and academic units on campus can determine those areas of environmental performance that can be improved and actions that warrant future efforts.

**“The six-point plan will now engage the entire University community in reducing our energy footprint.”**

Rosina Bierbaum  
Dean and Professor of Natural Resources  
and Environmental Policy



▲  
The 2008 Annual Environmental Report is available electronically at:  
<http://www.oseh.umich.edu/stewardship/reporting.html>

**Point 2—Renewable Energy:** University of Michigan Plant Operations staff is looking into expanding the University's use of renewable energy. Currently, the University of Michigan has limited on-site renewable energy. One source is a 33kW photovoltaic array that resides atop SNRE's Dana Building, which has been operational since 2005. The array was installed to provide supplemental electricity for the building, increasing public awareness of solar energy, and an opportunity for students of SNRE to research the potential of solar voltaic as a renewable energy source for southeastern Michigan. The system generates approximately 42,000kWh of electricity per year; during peak sunlight hours, the system has provided up to 23 percent of the power demand of the Dana Building.

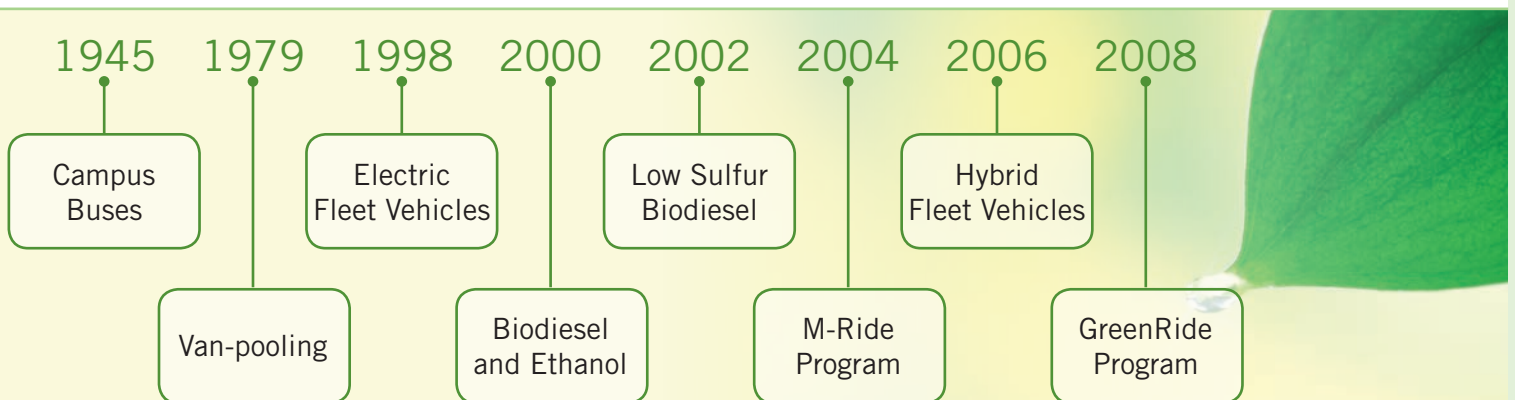
In spring of 2008, a solar water heater was installed on the Central Power Plant to preheat domestic water before it enters the main steam-powered water heaters. This solar collector, the first of its type installed in the United States, has a peak output of 146,000 BTUs/hr, and has an annual output of 250,000,000 BTUs, the energy equivalent of approximately 250,000 cubic feet of natural gas. The installed cost was about \$100,000, which is less per BTU than other types of thermal solar collectors. It is able to track the sun on a circular rail, which increases output by 35 percent and is capable of producing water that is over 200° F. The estimated 25-year life allows U-M to break even at current fuel costs while helping to protect the University from future fuel cost increases.

The University of Michigan is also researching the potential for adding wind generated electricity to our energy portfolio. A single 1.6 MW turbine, like those recently installed in Michigan's thumb area, can be expected to produce 2,800,000 kWh of electricity per year or approximately 0.5 percent of U-M annual electricity use.

**Point 3—Alternative Transportation:** The University of Michigan Department of Parking and Transportation Services (PTS) has long been committed to the incorporation of environmentally beneficial programs. Since the establishment of a campus bus system in 1945, initiatives have routinely been introduced to campus. The latest is the GreenRide program. GreenRide, a web-based ride-matching system, helps University of Michigan commuters find carpool/vanpool partners by searching for other employees who live nearby and have similar schedules. Over 2,500 potential carpoolers have registered on the site since the program's launch in May of 2008.

Carpooling has environmental benefits in addition to reducing gasoline use. The GreenRide program also saves on parking permits, vehicle maintenance, and vehicle depreciation expenses. It reduces parking and campus traffic congestion, vehicle emissions, and contributes to the improvement of air quality. To encourage participation in the program, U-M has authorized a number of incentives:

- Carpoolers are able to share the expense of one parking permit via pre-tax payroll deductions.
- Carpools of three or more riders may request (for a modest fee) a reserved parking space, specific to each pool, in a structure or lot in proximity to their workplace, where available.
- For the period of July–December, 2008, all new carpools will receive a 10 percent discount on their shared parking permit expense.
- For the period of July–December, 2008, weekly winners from new carpoolers are drawn for \$25 gas card prizes.



▲ Parking and Transportation Services has been at the forefront of alternative transportation for more than 60 years.

# SIX-POINT ENVIRONMENTAL AND ENERGY INITIATIVE

**Point 4—Green Purchasing:** Green Purchasing is the selection and procurement of products and services that minimize environmental impacts throughout the life cycle of the product. Examples of Green Products include energy efficient devices certified as ENERGY STAR compliant, or products made from recycled materials, or that themselves may be reused or recycled. Locally produced merchandise is considered environmentally preferable, as is the purchase of renewable energy. Additionally, products made using alternatives to hazardous or toxic materials and that minimize waste and the release of pollutants are considered environmentally advantageous to traditional choices.

The University's Procurement Services department supports and encourages the use of environmentally responsible items. A number of Green Purchasing Initiatives have been in place for many years now:

- The University Contracts page identifies vendors that offer green products such as 100 percent post-consumer recycled content paper.
- Special discount pricing has been negotiated for the purchase of mercury free thermometers.
- Departments can lower supply costs and reduce solid waste by using remanufactured toner and print cartridges.

Procurement Services and the OSEH Environmental Stewardship program area are working together to expand the green purchasing program. In order to increase awareness of green purchasing options on campus an extensive expansion

to the Procurement Services "Green Purchasing" Website has occurred. The Green Purchasing website helps guide the campus to manufacturers and distributors of green products, provides definitions, includes links to U-M and government initiatives, and other information not available on the contracts pages. Procurement has also expanded vendor contract pages to include information related to individual vendor environmental initiatives, and added the functionality to search suppliers by "green purchasing capabilities." Features include searching by suppliers that provide recycled products, energy efficient equipment, and those that are local suppliers. This website can be located at <http://www.procurement.umich.edu/greenpurchasing.html>.

The University of Michigan has developed strong ties with strategic contract vendors. By working together, U-M leverages environmental reductions that could not be accomplished alone. Vendors are making it more convenient for purchasers to identify environmentally preferable products by clearly labeling products that contain post-consumer recycled content, are energy efficient, minimize packaging waste, or are made from non-toxic chemical alternatives. One example of a synergistic approach toward reducing the environmental footprint was recently launched with strategic vendor, Office Max. By reducing the number of delivery days per week from five to four it is estimated that 2,327 fewer gallons of diesel fuel will be used, with a subsequent reduction of 26 tons of CO<sub>2</sub> emissions annually.

Another successful undertaking related to Green Purchasing is the Climate Savers Computing Initiative (CSCI). U-M is a founding member of this national partnership of



## 145 Tons of e-Waste Recycled

The e-Waste Recycling Events sponsored by the Climate Savers Computing Initiative @ U-M and Ann Arbor Public Schools were a great success. Over 145 tons of computer monitors, CPUs, televisions, and other e-waste materials were collected, enough to fill 11 semi-trailers.

eco-conscious consumers, businesses, and conservation organizations designed to ensure that computers meet strict energy efficiency standards. Since its launch, more than 135 companies have joined the initiative. The overall goal of the program is a 50 percent reduction in power consumption by computers by 2010, netting \$5.5 billion in global energy savings and an annual reduction of 54 million tons of CO<sub>2</sub> emissions per year. On campus, the CSCI @ U-M team has more than 60 volunteers from over 25 different units helping to grow green computing awareness, change behavior, and influence IT.

A successful Green Purchasing program requires more than implementation of leadership-mandated initiatives. A meaningful Green Purchasing Initiative can only succeed with the cooperation of the entire campus community. Once accustomed to considering green options whenever making purchasing decisions, it is expected that, like recycling and turning off lights when leaving a room, Green Purchasing will become second nature for all University of Michigan purchasers.

#### **Point 5—New Construction/Renovation Projects:**

During FY2008, 186 construction projects, affecting 1,400,000 square feet of building area, were completed. Architecture, Engineering and Construction (AEC) is responsible for managing the design and construction activities for all University of Michigan capital projects. The primary project management responsibilities include selection of consultants and construction contractors, and leadership throughout all stages of design and construction. AEC also accepts responsibility for the inclusion of sustainable design concepts and energy saving measures in every construction project. By demanding energy efficient equipment, and environmentally responsible architectural design, The University of Michigan routinely exceeds the baseline energy performance as mandated by code.

Twenty-four major projects, those budgeted at \$5,000,000 or more, were active during FY2008. These projects, when completed, will result in over 3,000,000 square feet of new and/or newly renovated space available for research, teaching, student living, and athletics. Of the 24 major projects, nine were completed in FY2008, four of which are highlighted here:

- The Charles R. Walgreen, Jr. Drama Center and Stamps Auditorium, an important addition to the North Campus, houses the Arthur Miller Theater and the School of Music's Theater and Drama Department. Situated along the west side of the North Campus Quad, Stamps Auditorium creates a strong architectural statement that marks the southwest gateway into this central space of the North Campus. The multi-story lobby presents a luminous and captivating

▶  
The Charles R. Walgreen, Jr. Drama Center, opened in January of 2008, houses the 250 seat Arthur Miller Theater as well as the 450 seat multi-purpose Stamps Auditorium.



# SIX-POINT ENVIRONMENTAL AND ENERGY INITIATIVE

environment to pedestrians. The auditorium's robust and powerful architecture of concrete, wood, and velour acoustic elements create a memorable space for important lectures, music recitals, multi-media presentations, and symposia. Mechanical, electrical, and architectural energy conservation features were designed into the project during initial planning stages. Shading projections above the south facing glaze mask windows during summer months while enhancing solar heat during the winter. The concrete floor and column surfaces provide a heat sink to offset cooling loads in summer and retain heat in winter months. Air handling systems have been optimized to reduce operation in unoccupied spaces, and are equipped with high efficiency motors for fans and pumps.

■ The Lurie Nanofabrication Facility Addition and Renovation Project consists of a 37,000 square foot addition and a 4,700 square foot renovation. Three floors were added to the existing structure, housing a clean room, chemical storage and support space for the College of Engineering. The building is designed to minimize exterior wall space by being nearly cubical in shape. The project includes state-of-the-art, high efficiency exhaust systems, air monitoring, and control systems.

■ The Henry F. Vaughan Public Health Building-School of Public Health I project, completed in December 2007, provides modernization to the sixty year old structure including new mechanical, plumbing, electrical, and life safety systems, as well as a new roof and air conditioning.

Energy conservation features include a laboratory exhaust heat recovery system, and variable volume air handling systems.

■ The Ray Fisher Baseball Stadium Renovation project is an approximately 8,000 square foot renovation within the existing Fisher Stadium with approximately 10,000 square feet of new construction. The existing grandstand was upgraded to include new seating and finishes with additional public restrooms, concession areas, expanded media space, team clubhouse and locker rooms, coaching offices and indoor practice facilities for the baseball program. Energy conservation measures incorporated in this project include lighting occupancy sensors, exterior lighting controls, waterless urinals, high-efficiency furnaces, and low-emittance window glazing. Furthermore, some public areas are zoned so that they can be shut down in off-season to reduce energy consumption.

## LEED Certification Review

Leadership in Energy and Environmental Design (LEED) certification is not mandatory for University of Michigan construction projects, however, the sustainable principles associated with certification are recognized as valuable. Projects over \$5,000,000 are subject to an environmental review process to help guide the design from a sustainable practices standpoint. At the conclusion of schematic design, AEC develops a preliminary LEED score, using accredited personnel. The University of Michigan currently owns one gold certified building, the Dana Building. There are two major projects, the C. S. Mott Children's Hospital and Women's Hospital Replacement Project, and the Stephen M. Ross School of Business Facilities Enhancement Project which are also seeking certification.

In preference to certification, AEC is concentrating their efforts towards maximizing energy efficiencies. This practice not only minimizes total energy resource use, but helps moderate future energy costs and reduces carbon dioxide emissions. The State of Michigan requires new construction to meet ASHRAE Standard 90.1 1999. University of Michigan is committed to exceeding this standard on all new construction and renovation projects.



▲ University of Michigan Baseball Stadium



**Point 6—Planet Blue:** In 2007, The University of Michigan launched Planet Blue to actively engage the University community to conserve utilities and increase recycling, thereby saving money and benefiting the environment. The University has been working for over three decades to improve the energy efficiency of the campus buildings. Now, Planet Blue Teams, comprised of facility managers, plant operations personnel, and unit/building representatives are going building-by-building, actively engaging with occupants and fine tuning systems to find ways to save energy, reduce water usage, and increase recycling. The Planet Blue program aims to create a community of environmental and energy advocates on campus. In order to effectively communicate with the campus population, an outreach, communications, and marketing platform was created with multiple tools such as websites, lobby boards, banners, posters, and informational stickers.

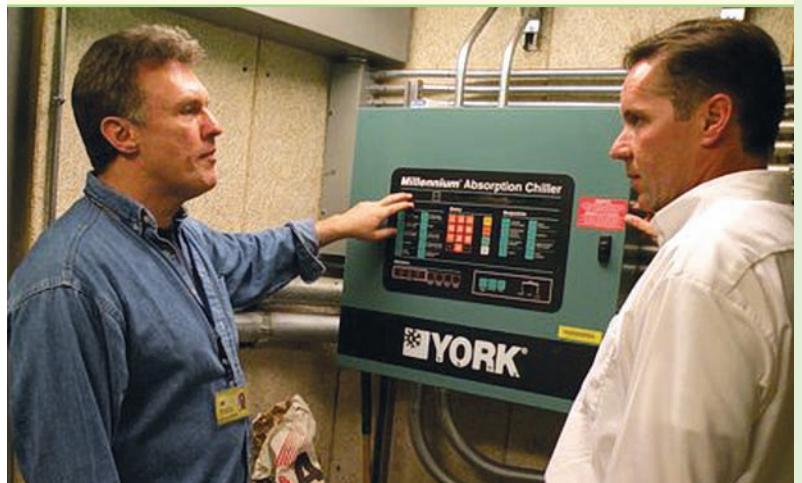
Planet Blue outreach efforts are guided in part by findings and recommendations from a study conducted by The Institute for Social Research (ISR) on the attitudes and practices of the University community regarding utilities conservation and energy efficient practices in the workplace. The study, *Behavioral Aspects of Energy Conservation and Sustainability*, was conducted by Robert W. Marans, PhD and focused on five pilot buildings. ISR-Thompson, Fleming, Rackham, Chemistry, and Space Research were chosen as a sample representation of all the buildings on campus. The research team utilized web surveys, focus groups, and observations to gather data from 1,470 participants. Information was collected from all five buildings pertaining to building occupants' satisfaction with building environmental conditions, awareness of current environmental initiatives, energy use habits, and willingness to adapt behavior in order to support the University's environmental initiatives. The study resulted in key recommendations used to create the Planet Blue effort. Among the key findings and recommendations, the study noted that strong leadership support at the presidential level was important to the success of this program. The study recommended creating a marketing campaign built around the initiative with innovative ideas to communicate with the rest of campus. The study also recommended that energy advocates be placed in buildings to encourage and support development of energy saving habits.

Currently, there are three active teams working within Planet Blue. The Planet Blue Teams have been assigned to evaluate approximately 30 General Fund buildings a year for three years. The teams conduct a thorough evaluation of the

assigned buildings utilizing information from Plant Engineering, Recycling, Building Services, and OSEH. Following the evaluation period, building teams composed of Planet Blue members and building residents are formed. Building teams interact with building users to develop and implement energy conservation measures. The teams have found that the active involvement by building occupants produces more energy saving ideas. With over 30 million square feet of buildings on campus, a joint effort from Facilities and Operations and building occupants leads to significant energy savings unique to the individual campus building.



▲ Planet Blue Teams inspect HVAC systems in Rackham Building.



▲ Planet Blue Teams examine building chiller operations.

# SIX-POINT ENVIRONMENTAL AND ENERGY INITIATIVE

During FY2008, Utilities and Plant Engineering Energy Management engineers and the Planet Blue Teams completed and commissioned 52 Energy Conservation Measure (ECM) projects. The ECMs, installed at a one-time cost of \$1,640,000, are expected to yield annual savings of \$490,000 once fully implemented.

The following highlights a few of the more interesting findings of the Planet Blue and facility teams in the pilot buildings:

## Institute for Social Research

- To reduce energy consumption, a reduced fan schedule reflecting scheduled working hours was implemented. As part of active involvement with staff, Planet Blue Teams identified and labeled all ventilation system override buttons. When needed, the manual override can be activated to offer two hours of ventilation to staff working in the building during off hours.
- As a way to involve building occupants in energy reduction, the building team created door hang-tags to encourage staff to turn off lights in their offices. The team found that staff frequently left lights on to indicate that they were in the office that day, but away from their desk. The door hang tag notifies visitors that the occupant is in the office today, just temporarily away.

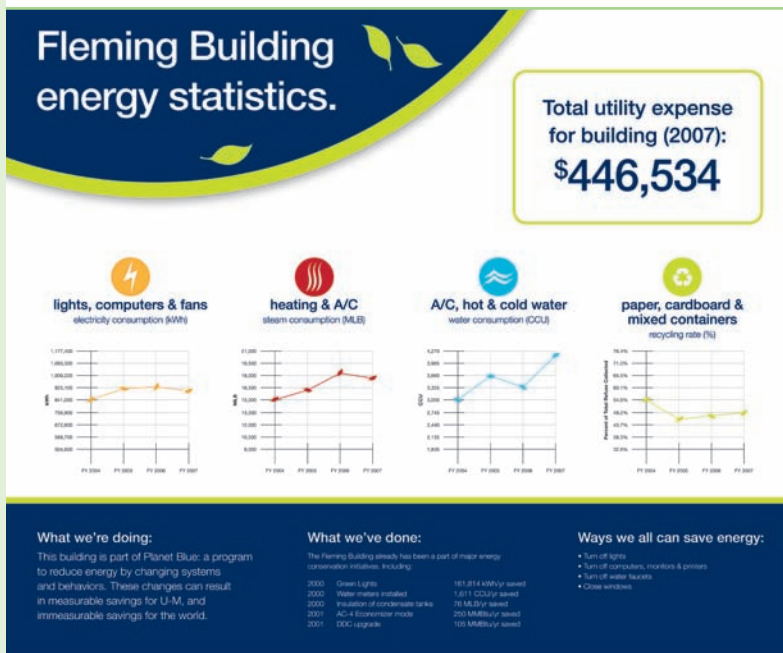
- Energy management engineers identified 11 ECMs at ISR for a total cost of \$720,000 and estimated annual savings of \$197,000. One example is a project to install insulation on perimeter heating pipes in ceilings, near exterior walls, and in mechanical rooms to reduce overall steam energy usage and provide protection for the Plant Operations personnel from these hot surfaces.

## Fleming Administration Building

- As in most campus buildings, the main cost driver for Fleming is the HVAC system. The building primarily houses offices, occupied from 8 a.m. to 6 p.m. While working with the A/C mechanics and building staff, the engineering team identified a computer server room in a basement space that was never intended as a server room. This added a significant and unplanned thermal load on the building cooling system. As a result, the building fans and chiller system were running 24/7 to provide extra cooling for one room. With cooperation from the Office of the Provost, Michigan Administrative Information Services, and Climate Savers Computing Initiative, the server room will be relocated into a dedicated data center facility. Subsequently, the fans and chiller will then be scheduled to match the actual use of the building occupants. Expected savings are approximately \$94,000 annually, or over 20 percent of the FY2007 utility bill.
- To reduce water consumption in the building, energy management engineers implemented reduced flow faucet aerators in all bathrooms in the Fleming Building. The new aerators save 1.7 gallons of water per minute of use. As an outreach tool, the building team affixed labels to the bathroom mirrors to inform all the staff of the new water saving feature.

## Space Research Building

- Energy Management engineers have proposed an ECM to upgrade the two main air handling units in the Space Research Building to include CO<sub>2</sub> sensors. Completion of this project will reduce the outside air requirements, therefore reducing the heating and cooling demand.
- Space Research team members requested an electronics and computer recycling container for their building. Planet Blue provided containers for the building occupants to collect and dispose of their high volume of computer and electronic waste.



For more information about this building, please visit [planetblue.umich.edu](http://planetblue.umich.edu)

## ■ Chemistry Building

- The Chemistry Building continues to be one of the most energy intensive buildings at U-M, due to the large quantity of once-thru airflow dictated by over 500 laboratory fume hoods. Airflow in a given laboratory is determined by the requirements for safe fume-hood operation. Currently the two-position HVAC systems operate at between 14 and 35 air changes per hour (ACH). Reducing the laboratory airflow to the required minimum of 10 ACH would result in significant energy savings and a reduced environmental footprint. To address this issue, Plant Engineering worked with AEC and OSEH on a pilot project to convert the HVAC system in one laboratory from a constant air volume to a completely variable air volume (VAV) design. The VAV system controls the flow of air based on the sash position of each fume hood. When the sash is fully open, the fume hood will have the maximum airflow, and if the sash is closed the airflow will be at the minimum level. In order for this to be effective, occupants must close the fume hood when it is not in use. To encourage this behavior change, Planet Blue is working with the Chemistry team to design a point of use tool that will prompt occupants to close the fume hood sash when not in use.
- The Chemistry Building Planet Blue team indicated interest in recycling pipette tip boxes. Many laboratory buildings utilize a large number of pipette tips and the boxes cannot be recycled through U-M's Recycling program. Fischer Scientific, the vendor that provides pipette tips, created a recycling program for the boxes and provided collection boxes for each lab to collect the pipette tip boxes. When full, the collection box is labeled and mailed back to Fischer Scientific at no cost to the University.
- Energy management engineers increased the efficiency of a condenser water system, thus reducing total water use, through the implementation of a non-chemical water treatment system. This system utilizes a catalyst to precipitate out dissolved solids and an ultraviolet lamp to aid in the removal of biological contaminants. The reduction in dissolved solids and biological contaminants leads to additional benefits beyond the reduction of water conductivity as the project will also realize additional savings from reduced maintenance costs.

## ■ Horace H. Rackham School of Graduate Studies Building

- Planet Blue Teams hosted a very successful Open House at Rackham with over 95 percent of the available occupants attending the event. Dean Janet Weiss gave her enthusiastic support of the joint effort between Plant Operations and Rackham faculty and staff during opening remarks. Due to effective leadership backing, Planet Blue Teams distributed motion sensing power strips to all of the building occupants.
- During Planet Blue Teams' evaluation, the team members noted that the reading and study rooms seemed overly lit during sunny days. Team members requested Plant Engineering to conduct a lighting study to determine if acceptable light levels were maintained based on natural ambient lighting. A pilot project was implemented with daylight and motion sensing lighting controls in one alcove room. The successful pilot project is being developed further to evaluate and implement controls for all the alcove reading and study rooms.
- The cross-functional partnerships of the Planet Blue Teams identified another energy saving opportunity unique to the Rackham Building. The temperature and humidity in the large auditorium have historically been strictly controlled to meet the requirements of a Steinway grand piano that is present during the September through April performance season. As a result of open discussions between the building manager, the piano tuner, and the performance schedulers, the auditorium environment is now being adjusted to standard auditorium settings when the piano is not on site.



▲ Planet Blue Team at Rackham during the building open house.



## Welcome to Planet Blue.

To find out how to do your part, visit [planetblue.umich.edu](http://planetblue.umich.edu)



Historically, most of the energy saving work was technology based, done behind the walls and above the ceilings. The ISR study indicated many faculty, staff, and students were not aware of the University's efforts in energy savings.

Planet Blue supplements past efforts with education and awareness of past, present, and future energy saving measures. Because occupants did not know of or understand building systems, occupants adopted behaviors that may seem energy efficient, but actually are counterproductive to efficient building operations. For example, occupants assume that opening windows uses less energy, like in homes, but in campus buildings open windows result in an imbalance of the building systems, forcing the heating and cooling to work harder to bring the building to the pre-set parameters.

Lobby boards are used to display the buildings current and past energy consumption figures and past energy conservation measures; posters and decals are used to reinforce proactive behaviors; and banners are used to build awareness and excitement of the initiative. To create a community feel, faculty, staff, and students can sign up to be Planet Blue citizens, and agree to do their part to reduce the environmental footprint on campus.

The teams also provide tools for building managers so they are better able to monitor building systems. One such tool is a fan run-time report generated by the Building Automation Systems group that details all the fans operating in the building. If the building has implemented a reduced fan operation schedule, the building manager can monitor the schedule and if there is an aberration in the schedule, it can be quickly identified and programmed back to the set schedule.

Planet Blue offers some point of use tools to promote energy savings including motion sensing power strips to all interested occupants in the buildings. Motion sensing power strips save energy by controlling desktop equipment. The power strips ensure that when people forget to turn off the appliances, they are turned off in a timely manner.

Recycling has played a big role on the U-M campus for many years and Planet Blue is continuing the effort by partnering with U-M Recycling. While surveying buildings for potential energy savings, the recycling coordinator determines if there are adequate number of recycling containers in the building and whether they are in the most convenient locations. Staff from U-M Recycling is also available as a resource to building occupants on any recycling related matters.

Regulated recycling activities, lead by the OSEH team member, plays a vital role in the Planet Blue building engagement. The OSEH liaison surveys the building to ensure that the building has adequate containers and procedures in place for regulated recycling streams such as batteries, light bulbs, and electronics. Liaisons also provide valuable information during open houses to building staff about other ongoing pollution prevention programs such as Green Chemistry and Mercury Elimination.

To provide building occupants with information about other sustainable energy-saving programs on campus, Planet Blue has also partnered with Alternative Transportation, Green Purchasing, and Climate Savers Computing Initiative. Each of these programs enhances the Planet Blue message and offers expert knowledge in their particular area.

# SUSTAINABILITY IN CAMPUS LIFE

“Sustainability in Campus Life” describes where and how actions we take on the University campus can have a direct impact on the environment. This section captures the ideas and measures of environmental awareness and progress that cross the traditional Environmental Performance Indicator (EPI) categories. In conjunction with the prior quantitative performance measurements, this section completes a total operational and academic perspective on the environmentally focused efforts of the University.

As an institution of higher learning, the University of Michigan is able to shape students’ views on the environment through academic pursuits and campus activities. Campus activities provide learning forums and discussion opportunities. For example:

- The annual Energy Fest held each year in September features displays from U-M departments and organizations, local government, and private businesses.
- The 2007 Arts on Earth WorkPlay competition encouraged multi-disciplinary teams of students, faculty, and staff to design—with sensitivity to the natural and built environment—a new destination on North Campus where people could interact informally with fellow colleagues.
- The Center for Sustainable Systems’ 8th Annual Peter M. Wege Lecture on Sustainability featured His Holiness the 14th Dalai Lama, who spoke to a full house at Crisler Arena about sustainability in the context of personal responsibility and compassion toward the environment and our communities.

## Involvement of University Schools and Colleges

Eight U-M schools and colleges play an active role in addressing environmental sustainability challenges through a wide range of research and academic programs. Many of these schools have environmental-themed studies integrated into their core curriculum. Additionally, environmental degree programs at both the graduate and undergraduate levels offer courses covering specialized topics in greater depth. These courses can also be taken as electives to enrich the students’ academic experiences. Selected courses incorporate content that extends beyond traditional departmental boundaries.

A brief summary of each of the eight schools’ environmental and sustainability academic focus is highlighted below.

- Alfred Taubman College of Architecture + Urban Planning: Designs and studies of sustainable architecture and urban planning that enhance a sustainable future.
- College of Engineering: Significant focus on energy, fresh water, new materials, sustainable infrastructures and manufacturing, and climate change. In 2007, a new dual degree Masters Program in Engineering Sustainable Systems was established in cooperation with the School of Natural Resources and Environment (SNRE).
- College of Literature, Science, and the Arts: Broad range of studies including biodiversity, geological history of change, impacts of chemistry on energy and pollution, and the study of human interaction with the environment. The school is also the host, in collaboration with SNRE, for the interdisciplinary undergraduate Program in the Environment (PitE).
- Gerald R. Ford School of Public Policy: Examines the role of government and policy relative to achieving environmental sustainability.
- School of Natural Resources and Environment: Broad spectrum of environmental studies ranging from the psychology of environmental protection, to environmental justice, landscape architecture, and studies of freshwater, land management, and sustainable systems.
- School of Public Health: Studies that include the impact of the environment on human health, infectious disease transmission and prevention.
- Stephen M. Ross School of Business: Major efforts include the Erb Institute for Global Sustainable Enterprise, which works to understand and communicate the complex, interconnected dynamics of human and natural systems in relation to economic production and consumption.
- Law School: Established an Environmental Law and Policy Program (ELPP) in July 2007 to enhance the Law School’s environmental and natural resources law curriculum, and provide clinical opportunities and externships for students seeking practical experience.

# SUSTAINABILITY IN CAMPUS LIFE

## **Established Sustainability Centers and Institutes**

**The Center for Sustainable Systems (CSS)** at the School of Natural Resources and Environment advances sustainability concepts through interdisciplinary research and education initiatives. CSS collaborates with diverse stakeholders to create and apply the tools and methodologies of life cycle assessment and design, industrial ecology, and environmental performance metrics to develop sustainable systems to meet societal needs. CSS helped launch a new dual degree Masters Program in Engineering Sustainable Systems (ESS), a graduate certificate program in industrial ecology, research opportunities, internships, and special lectures and workshops. CSS is currently developing life cycle models for plug-in hybrid electric vehicles, bottled water, photovoltaics, wind energy, household air conditioners, large scale organic dairy farms, and shrimp aquacultures.

**The Center for the Study of Complex Systems (CSCS)** focuses its research and educational efforts in the general areas of nonlinear, dynamic, and adaptive systems. CSCS presents many measurable goals including catalyzing and encouraging research in complex adaptive systems at the University, expanding and coordinating educational opportunities, and exploring the boundaries and overlaps between the complex systems approach and more traditional approaches within the business communities. Environmental research includes studies in hydrogen production, infectious diseases, modeling fish life history, and sustainable mobility and accessibility.

**The Frederick A. and Barbara M. Erb Institute for Global Sustainable Enterprise (Erb)** is a partnership between the Stephen M. Ross School of Business and the School of Natural Resources and Environment. Erb's research mission focuses on the role that institutions play in fostering sustainability. Particular emphasis is placed on climate change strategy, carbon markets, clean technology, urban mobility, and green development. In addition to three core faculty members, the institute employs a cadre of post-doctoral fellows and hosts international scholars each year to advance the research agenda. The core educational activity of the institute is the dual-degree MBA/MS Program—a three-year program in which students earn a Master of Business Administration and a Master of Science in Natural Resources & Environment. The MBA/MS program is the largest of its kind and develops sustainability-oriented leaders who are widely respected as content experts, holistic thinkers, community builders, and catalyzing agents of change within large corporations, small businesses, non-profit organizations, and government agencies.

**The Graham Environmental Sustainability Institute (Graham)** is a consortium of schools and colleges across campus, dedicated to innovatively supporting and encouraging multidisciplinary research, education, and outreach initiatives to better understand and inform complex environmental sustainability issues. Integrating a balanced approach to sustainability, Graham recognizes the need to foster environmental and social responsibility in concert with economic development goals. Current Graham initiatives include a graduate fellowship program, undergraduate fieldwork scholarships, undergraduate and graduate course development, and interdisciplinary research incentive funding for faculty teams addressing complex sustainability challenges. Graham is also responsible for the maintenance of two environmental databases listing contact information for over 300 research faculty involved in environmental research and for the 570 environmental course listings available at U-M. The Institute shares joint responsibility with OSEH and News Services for the new Campus Sustainability website to be launched in fall 2008.

**The Michigan Memorial Phoenix Energy Institute (MMPEI)** is charting the path to a secure, affordable, and sustainable energy future by applying U-M strengths in public policy, economics, business, and social sciences to lay the foundation for successful implementation of our scientific and technological achievements. MMPEI seeks to develop, coordinate, and promote multidisciplinary energy research and education across the University; grow the intellectual activity and infrastructure in key energy topics in addition to our existing strengths; establish new faculty and research appointments that combine strengths in science/technology with those in public policy, business, economics, and social sciences; and serve as a unified voice on energy research and education for the University. Research emphasis includes energy policy, economics, and social impact, carbon neutral energy sources; energy storage and utilization, and transportation and fuels.

Numerous other U-M centers, institutes, research programs, and initiatives address issues related to sustainability. Examples include the Center for Local, State, and Urban Policy; Center for Advanced Research Solutions for Society; the William Davidson Institute; Center for Biologic Nanotechnology; the Cooperative Institute for Limnology and Ecosystem Research; Michigan Nanotechnology; the Environmental Justice Initiative; the Ecosystem Management Initiative; Environmental and Sustainable Technology Lab; International Forestry Resources and Institutions; Michigan Sea Grant; and the Sustainable Mobility & Accessibility Research & Transformation Project.

## Spotlight on New Sustainability Initiatives

Environmental responsibility and sustainable growth are core values to the University's academic units, operations departments, and student groups. Each year the Environmental Report selects a number of recent environmental programs or initiatives that are addressing environmental sustainability issues or concerns. We look forward to highlighting the progress of these initiatives and other programs in future publications.

■ **Arts on Earth:** Arts on Earth promotes the full human capacity for creativity by integrating artistic modes of thinking and working into the life of the University of Michigan through interdisciplinary collaborations across campus. Arts on Earth's largest project to date—the WorkPlay competition—was launched in 2007. Sponsored by the five North Campus deans and Arts on Earth, the goal of the competition is to improve the physical, cultural, and social environment of North Campus. In an architectural environment that supports work much more effectively than play, the North Campus community remains largely fragmented and isolated in separate buildings without a central, outdoor gathering place to provide a focal point for the campus and opportunities for spontaneous meetings. To remedy this situation, teams of students, faculty, and staff were asked to design an innovative and compelling destination at the heart of North Campus that would result in a better equilibrium between work and play. Projects were expected to be sensitive to the built and natural environments and to incorporate sustainable design principles.

One hundred forty three students, faculty, and staff from across the University formed 31 teams and submitted proposals. Unable to choose just one winner, the Work Play jury awarded both "C'ing Energy" and "WorkPlay Ground" the first prize. Both teams are now combining efforts and working with a design professional to create a new design that will incorporate elements of both submissions while evolving into something altogether new and unified.

■ **Campus Sustainability Website:** The University of Michigan's Occupational Safety and Environmental Health office, Graham, and News Services joined forces in 2008 to co-lead the creation of a Campus Sustainability Website. The goal of the project was to provide an easily accessible electronic medium to communicate the wide range of U-M efforts that help to foster a more sustainable campus. A diverse committee with representatives from units and departments across campus was formed to ensure that the website would be reflective of the broad array of U-M sustainability initiatives and activities. University of Michigan units represented on the committee include Recycling; Architecture, Engineering, and Construction; Michigan Student Assembly; Health System; Center for Sustainable Systems; Parking and Transportation Services; Planet Blue; University Unions; University Housing; and Utilities and Plant Operations. The new Campus Sustainability Website will make it easy for people within and outside the University to easily find relevant information pertaining to six broad areas:

- Energy and Resource Management
- Purchasing, Waste Reduction, and Recycling
- Health and Safety
- Buildings, Grounds, and Preserves
- Research, Education, and Outreach
- Campus Life

The Campus Sustainability Website will be launched in the Fall 2008, and will be found online at <http://www.sustainable.umich.edu>.



▲  
The Michigan Union

# SUSTAINABILITY IN CAMPUS LIFE



■ **Center for Global Health:** This a new initiative of the University and the School of Public Health with participation from the Schools of Business, Dentistry, Engineering, Law, Medicine, Nursing, Pharmacy, Kinesiology, and Public Policy. In one of her first acts as provost, Theresa Sullivan endorsed the creation of the campus-wide center that will seek new solutions to pressing global health issues while training the new generation of professionals. The center will provide a central point for faculty and students from many of the University's schools and colleges who are engaged with a wide range of health research, training, and service initiatives around the world.

The center has a particular interest in global climate change issues and was involved in the three-day National Summit on Coping with Climate Change hosted by SNRE last year. The summit focused on how different organizations can anticipate and adapt to near- and long-term climate change and ongoing alterations in temperature, precipitation, sea level rise, and species range in four critical areas: public health, energy industry, water quality, and fisheries. The center will serve as the first point of contact for outside organizations and health professionals seeking information and advice. Lastly, the center will also be a campus meeting point, organizing seminars and other activities that will bring several disciplinary perspectives together to address global health concerns.

■ **Residential Dining Services—Fresh Michigan program:** U-M Residential Dining Services (RDS) is providing fresh, nutritious meals in residential dining halls to over 15,000 students. By building relationships with local food producers and processors RDS is increasing the University's ability to acquire locally produced food. Purchasing food locally promotes sustainability among the entire campus residential community by cutting down on the transportation required to deliver food from farm to table. The close proximity of local farms also makes it possible for RDS and University health officials to assess the quality and sanitation practices of these facilities. This summer RDS and U-M OSEH personnel toured local farms to confirm that the growers follow farming practices that promote food safety.

By spending over \$1,000,000 annually on food and dairy with local and regional food cooperatives, RDS is helping to strengthen the local and regional economy. The Michigan fall harvest coincides with fall enrollment, allowing for a steady supply of apples and apple products as well as the ingredients for an "All Michigan" salad bar featured at East Quad dormitory. RDS will offer a "Welcome to Michigan Meal" on September 9, 2008 and a "Sustainable Michigan Earth Day Celebration Meal" on Earth Day, 2009 in an effort to educate students about the environmental, social, and health benefits gained from eating locally.



## Student-Led Initiatives

The University of Michigan has a strong history of student activism around campus sustainability activities. For instance, students were a driving force behind establishing a University-wide recycling program and advocating for the use of green building standards in campus renovation and construction projects. Students have strongly supported the establishment and implementation of comprehensive University-wide sustainability goals and initiatives in teaching, research, service, operations, and financial administration. In FY2008, there were over 25 student-run clubs and organizations actively addressing issues of sustainability both on campus and in the surrounding local, national, and global communities. These organizations convey a sense of passion, urgency, idealism, and personal responsibility around sustainability, while providing an environment where students can develop important professional and life skills, improve leadership abilities, build relationships with peers and faculty, and network with professionals. We look forward to highlighting the progress of student activities in this and future publications. Here are just a few to start:

- Better Living Using Engineering (BLUElab) is an organization run by engineering students working to find sustainable solutions to development problems at home and abroad. The Biodigester Design Project is an attempt to develop a system where animal waste, human waste, and food scraps can be turned into useful biogas for cooking and heating water. BLUElab is also organizing an outreach program with middle school students in Detroit. These students will be given the opportunity to come to U-M and take part in workshops on alternative fuels, pollution, and sustainable design.
- The Michigan Student Assembly Environmental Issues Commission (EIC) promotes sustainability on campus by coordinating student efforts and collaborating with University faculty, staff, and administration to propose and implement campus sustainability initiatives. The EIC is currently engaged in dialogue with University administrators and officials at DTE Energy to encourage adoption of a University-wide plan for purchasing energy from renewable sources. EIC also collaborates with environmental organizations at other universities through the Michigan Student Sustainability Coalition to advocate for more state-level leadership around environmental stewardship issues.



◀ **Adventures in Composting**  
Members of the student environmental group Hayerukim

# SUSTAINABILITY IN CAMPUS LIFE

- Ross Net Impact is the U-M chapter of Net Impact—an international network of over 150 chapters and 11,000 members committed to using the power and influence of business to make a positive impact on society. In 2007, Ross Net Impact was named Chapter of the Year for the second year in a row. Part of the organization’s continued success has stemmed from the high level of student interest in the social and environmental impact of business. From 2006 to 2007, the Ross Net Impact membership grew 44 percent, from 143 to 206 members, representing nearly a quarter of the school’s full-time MBA program. Over the past year, the organization has hosted more than 29 major events and two multi-day conferences. It has continued to lead greening efforts for the Ross building and the C. S. Mott Children’s Hospital and Women’s Hospital, worked with professors to expand classroom attention to issues surrounding business’s social and environmental stewardship, and co-created, with Ross’s Dean of Leadership, the Leadership Crisis Challenge—a case study competition in which first-year MBA students will manage a simulated corporate social responsibility/sustainability crisis. This experience will become a requirement for all students in 2009.

- The University of Michigan Solar Car Team is a non-profit and entirely student-run organization. Its purpose is to design, finance, build, and race a solar-powered vehicle in competitions around North America and the world. The team is dedicated to the development of members as teammates, educators, and leaders, and to the education of our community on the potentials of alternative energy technology. Students who volunteer for the Solar Car are typically undergraduates, and they come from a wide range of academic disciplines, including majors within the College of Engineering, the Ross School of Business, and the College of Literature, Science, and the Arts. Each project operates on a two-year cycle and involves as many as 200 students. The team’s first car, Sunrunner, was constructed in 1989 and took first place in the 1990 inaugural SunRayce, and third in the World Solar Challenge in Australia that same year. In FY2008, the team unveiled its ninth car, Continuum, which competed in the World Solar Challenge in Australia.



## Go Blue Discover Green

U-M student volunteers visit Mott Children’s Hospital, bringing environmentally themed crafts and games to share with the children.



## U-M Solar Car—Continuum

# INTO THE FUTURE

The University of Michigan sustainability effort exemplifies its fundamental mission: “developing leaders and citizens who will challenge the present and enrich the future.” By developing leaders and citizens who are challenging the way environmental resources are being used today, the University is helping to provide for the present while ensuring a sustainable future for generations to come.

Access to information about University of Michigan environmental initiatives and operational metrics is an extremely important tool for ensuring the continued success of the University’s sustainability efforts. The annual publication of the Environmental Report is designed to capture and present environmental information from schools, colleges, and departments across the University of Michigan Ann Arbor campus. Identifying trends within this data enables the university to focus future environmental efforts in areas of need.

A number of new initiatives were launched in FY2008 and future annual Environmental Reports will provide the University community the opportunity to stay abreast of their progress. Data from the Planet Blue initiative will continue to be collected and the conservation measures employed will be evaluated and expanded. Investments in renewable energy continue to be explored along with alternative transportation options. The Climate Savers Computing Initiative @ U-M is another program started in FY2008 whose activity is expected to be highlighted in the 2009 Environmental Report.

Environmental and sustainability issues are complex and many. As in basic dynamics, for every action there is an equal and opposite reaction. As we delve deeper into the sustainability issues facing our world, this holds true for the consequences of our actions—our efforts must focus on making sure the reactions are not detrimental. Activities that support environmental causes in one field may adversely affect other fields. For example, evidence is growing that expansion of corn-based ethanol may increase fertilizer releases into the Gulf of Mexico expanding oxygen-depleted “dead zones.” At the same time many actions can produce a cascading effect of benefits over a range of environmental indicators. Energy-saving chiller units use significantly less water than traditional units, while carpooling programs designed to save gasoline also reduce air emissions and the need to pave green spaces for creation of additional parking. So environmental issues are complex and have no easy answers.

The University of Michigan will continue to meet our environmental responsibilities, exploring and employing new conservation methods while continuing to monitor existing efforts to ensure that expectations are being fulfilled and unexpected consequences are being addressed.

If you have any thoughts or suggestions, we welcome discussion. You can contact us through a general e-mail address at:

**[envstewardship@umich.edu](mailto:envstewardship@umich.edu)**



# APPENDIX A • RAW DATA OVERVIEW

Energy	FY2004	FY2005	FY2006	FY2007	FY2008
Total Energy Consumption (BTUs)	6,622,321,670,450	6,369,870,937,179	6,855,207,111,549	6,330,316,580,656	6,338,332,731,142
Total Energy Consumption (BTUs/person)	91,082,312	86,257,681	91,244,604	83,128,476	81,171,180
Building Energy (BTUs)	6,521,421,326,534	6,266,792,067,998	6,751,526,104,794	6,226,434,567,432	6,231,675,587,980
Building Energy (BTUs/ft2)	230,408	219,962	235,906	202,984	199,923
Building Energy (BTUs/person)	89,694,546	84,861,837	89,864,583	81,764,318	79,805,286
Building Energy (BTUs/ft2/person)	3.2	3.0	3.1	2.7	2.6
Transportation Energy Consumption (BTUs)	100,900,343,916	103,078,869,181	103,681,006,755	103,882,013,224	106,657,143,162
Transportation Energy Consumption (BTUs/person)	1,387,767	1,395,844	1,380,021	1,364,158	1,365,893
Bus Energy Consumption (BTUs)	35,211,394,723	38,112,564,726	39,121,208,939	38,598,636,969	40,747,624,296
Bus Energy Consumption (BTUs/passenger)	7,488	7,347	6,991	6,598	6,859
Fleet Vehicles Energy Consumption (BTUs)	65,688,949,193	64,966,304,455	64,559,797,816	65,283,403,086	65,909,518,866
Renewable Percentage for Transportation Energy (%)	18.3	18.5	19.6	19.0	18.7
Campus Bus Ridership (Total passengers)	4,702,261	5,187,602	5,596,054	5,850,234	5,940,576
Van Pooling (Vehicle miles)	471,210	894,017	1,291,409	1,436,915	1,396,910
Van Pooling (Passenger miles)	3,094,729	5,712,293	7,824,153	8,659,109	7,467,618
Van Pool Number of passengers	190	326	424	476	419
AATA Bus Ridership	0	1,552,996	2,014,753	2,091,564	2,212,941
Bicycle Ridership (Number of bike racks)	3,366	3,410	3,412	3,412	3,412
Purchased Electricity from Renew. Sources (MWh)	1,710	339	866	4,813	5,063
Purchased Electric (kwh)	341,949,118	339,062,424	433,064,274	437,583,452	460,274,660
Purchased Natural Gas (CCF)	51,760,422	50,069,997	51,770,377	46,460,401	45,675,423
Purchased LP Gas (Gal)	41,517	41,535	35,517	35,954	34,620
Purchased Fuel Oil (gal)	602,482	64,013	0	0	57,992
Gallons E85 Total	130,748	131,780	146,779	143,582	140,769
Gallons ULSD/20% Biodiesel Total	254,406	285,651	288,777	347,074	363,648
Gallons 20% Biodiesel Total	79,896	67,793	71,024	0	0
Gallons unleaded gas Total	344,166	339,835	326,802	345,035	351,025
Gallons E85 Buses	0	427	648	627	1,567
Gallons ULSD/20% Biodiesel Buses	215,724	243,271	248,966	279,275	294,708
Gallons 20% Biodiesel Buses	40,047	32,219	33,791	0	0
Gallons unleaded gas Buses	0	1,231	1,136	952	479
Gallons E85 Fleet	130,748	131,352	146,131	142,956	139,202
Gallons ULSD/20% Biodiesel Fleet	38,682	42,379	39,811	67,798	68,941
Gallons 20% Biodiesel Fleet	39,849	35,574	37,234	0	0
Gallons unleaded gas Fleet	344,166	338,604	325,666	344,083	350,546
Number vehicles	NA	NA	1,122	1,092	1,098
Hybrid vehicles	0	0	5	5	5
E85 fueled vehicles	NA	NA	471	483	491
unleaded gas cars	NA	NA	72	65	58
unleaded gas trucks	NA	NA	472	445	446
biodiesel bus	NA	NA	54	58	61
biodiesel trucks	NA	NA	48	36	37
<b>Air Emissions</b>	<b>FY2004</b>	<b>FY2005</b>	<b>FY2006</b>	<b>FY2007</b>	<b>FY2008</b>
Total Greenhouse Gas Emissions (MTCO2E)	610,618	593,419	688,737	664,025	686,688
Total Greenhouse Gas Emissions (MTCO2E)/person	8.4	8.0	9.2	8.7	8.8
U-M Generated Greenhouse Gas Emissions (MTCO2E)	295,187	280,651	289,257	260,377	256,890
U-M Generated Greenhouse Gas Emissions (MTCO2E)/person	4.1	3.8	3.9	3.4	3.3
U-M Generated Greenhouse Gas Emissions (MTCE)	80,505	76,540	78,888	71,011	70,060
U-M Generated Greenhouse Gas Emissions (MTCE)/person	1.1	1.0	1.1	0.9	0.9
Stationary Sources: Greenhouse Gas Emissions (MTCO2E)	288,061	273,367	281,935	253,040	249,352
Stationary Sources: Greenhouse Gas Emissions (MTCE)	78,561	74,554	76,891	69,010	68,005
Stationary Sources: CO (lbs)	437,800	420,908	434,871	390,267	383,964
Stationary Sources: CO (lbs/person)	6.0	5.7	5.8	5.1	4.9
Stationary Sources: NOx (lbs)	693,460	662,589	684,042	613,881	604,429
Stationary Sources: NOx (lbs/person)	9.5	9.0	9.1	8.1	7.7

<b>Air Emissions</b> (continued)	<b>FY2004</b>	<b>FY2005</b>	<b>FY2006</b>	<b>FY2007</b>	<b>FY2008</b>
Stationary Sources: Volatile Organic Compounds (lbs)	28,589	27,551	28,474	25,553	25,133
Stationary Sources: Volatile Organic Compounds (lbs/person)	0.4	0.4	0.4	0.3	0.3
Stationary Sources: PM-10 (lbs)	30,106	28,604	29,509	26,482	26,093
Stationary Sources: PM-10 (lbs/person)	0.4	0.4	0.4	0.3	0.3
Stationary Sources: PM-2.5 (lbs)	29,654	28,556	29,509	26,482	26,049
Stationary Sources: PM-2.5 (lbs/person)	0.4	0.4	0.4	0.3	0.3
Stationary Sources: SO2 (lbs)	7,450	3,466	3,106	2,788	3,159
Stationary Sources: SO2 (lbs/person)	0.1	0.0	0.0	0.0	0.0
Stationary Sources: Pb (lbs)	3.5	2.6	2.6	2.3	2.4
Stationary Sources: Pb (lbs/person)	0.0	0.0	0.0	0.0	0.0
Mobile Sources: Renewable GHG Emissions (MTCO2E)	1,232	1,273	1,355	1,316	1,334
Mobile Sources: Renewable GHG Emissions (MTCE)	336	347	369	359	364
Mobile Sources: Fossil GHG Emissions (MTCO2E)	5,893	6,011	5,968	6,021	6,204
Mobile Sources: Fossil GHG Emissions (MTCE)	1,607	1,639	1,628	1,642	1,692
Purchased Electricity GHG Emissions (MTCO2E)	315,431	312,768	399,480	403,648	429,798

<b>Water Use</b>	<b>FY2004</b>	<b>FY2005</b>	<b>FY2006</b>	<b>FY2007</b>	<b>FY2008</b>
Total Water Use (gal)	1,230,582,918	1,320,548,618	1,348,911,444	1,287,048,160	1,299,930,260
Total Water Use (gal/person)	16,925	17,882	17,954	16,901	16,647
Total Purchased Water (gal)	1,195,764,768	1,285,730,468	1,315,767,904	1,251,443,195	1,260,189,260
Total Purchased Water (gal/person)	16,446	17,411	17,513	16,434	16,138
Total Discharge to Sewers (gal)	956,611,814	1,028,584,374	1,052,614,323	1,001,154,556	1,008,151,408
Total Discharge to Sewers (gal/person)	13,157	13,929	14,011	13,147	12,911
Total Irrigation (gallons)	34,818,150	34,818,150	33,143,540	35,604,965	39,741,000

<b>Land Use</b>	<b>FY2004</b>	<b>FY2005</b>	<b>FY2006</b>	<b>FY2007</b>	<b>FY2008</b>
Total Impervious Surface Area (acres)	409	419	427	530	534
Total Impervious Surface Area (% of campus area)	13	14	14	17	17
Total Green Space (acres)	2,661	2,651	2,644	2,541	2,537
Total Green Space (% of campus area)	87	86	86	83	83
Maintained Green Space (acres)	625	718	512	512	571
Maintained Green Space (% of campus area)	20	23	17	17	19
Unmaintained (Natural) Green Space (acres)	2,036	1,933	2,132	2,029	1,966
Unmaintained (Natural) Green Space (% of campus area)	66	63	69	66	64
Total Land Area (acres)	3,070	3,070	3,071	3,071	3,070
Tree Population	7,198	7,198	14,180	14,180	13,958
Deck Parking (# of deck parking spots)	9,492	10,197	10,058	10,058	10,083
Total Parking (# of parking spots)	23,252	23,322	23,591	23,591	24,093
Deck Parking (% of parking spaces that are parking decks)	41	44	43	43	42
Total Building Area (ft2)	28,303,787	28,490,282	28,619,505	30,674,494	31,170,301
Total Building Area (ft2/person)	389	386	381	403	399
Total Number of Buildings	378	382	393	389	380

<b>Waste</b>	<b>FY2004</b>	<b>FY2005</b>	<b>FY2006</b>	<b>FY2007</b>	<b>FY2008</b>
Total Solid Waste (tons)	13,833	14,252	16,382	17,095	17,430
Total Recycled (tons)	3,956	4,202	4,826	4,815	5,024
% Recycled	29	29	29	28	29
Hospital Waste (tons)	3,111	4,422	5,885	6,405	6,772
Waste from U-M Campus (tons)	10,481	9,565	10,129	10,324	10,303
Paper Recycled (tons)	3,060	3,275	3,748	3,633	3,738
Paper Recycled (% of total waste)	21	21	21	19	20
Glass Containers Recycled (tons)	119	108	121	107	129
Plastic Containers Recycled (tons)	38	34	38	34	41
Metal Containers Recycled (tons)	24	22	24	21	26
Composting (tons)	234	216	253	259	241
Reuse-PD (\$)	1,300,000	1,400,000	1,251,000	1,872,000	2,390,576

# APPENDIX A • RAW DATA OVERVIEW

<b>Waste (continued)</b>	<b>FY2004</b>	<b>FY2005</b>	<b>FY2006</b>	<b>FY2007</b>	<b>FY2008</b>
Campus Paper Recycled (tons)	2,376	2,152	2,279	2,186	2,222
Mixed Container Recycled (tons)	199	180	202	178	216
Compost (tons)	64	63	49	34	41
Reuse Secondary Materials (tons)	3	2	5	7	6
Recycled Secondary Materials (tons)	18	37	52	17	28
Roll-off Other (tons)	14	0	5	13	50
Roll-off Recycled (tons)	153	150	129	193	223
Roll-off Wood Recycled (tons)	1	86	41	91	70
Roll-off Metal Recycled (tons)	152	64	88	103	153
Roll-off Trash (tons)	1,445	1,177	1,503	1,580	1,411
U-M Campus Trash (tons)	7,501	6,831	7,280	7,503	7,294
UHS Total refuse (tons)	2,362	3,219	4,270	4,764	5,063
UHS Paper Recycled (tons)	235	696	963	912	1,055
UHS Cardboard Recycled (tons)	448	427	507	535	461
UHS Recycled wood (tons)	0	0	0	0	0
UHS Scrap metal recycled (tons)	8	33	74	111	133
UHS Plastic recycled (tons)	17	9	35	51	32
UHS Yellow kitchen grease recycled (tons)	40	38	36	32	28
Regulated Recycling- Batteries (tons)	17	25	24	18	20
Regulated Recycling- Lamp Ballasts (tons)	18	31	23	24	22
Regulated Recycling- Consumer Electronics (tons)	0	19	70	53	74
Regulated Recycling- Fluorescent Bulbs (tons)	36	37	46	46	39
Regulated Recycling- Acetone (gallons)	400	372	360	295	271
Regulated Recycling- Xylene (gallons)	500	512	800	550	900
Regulated Recycling- Formalin (gallons)	180	600	1,200	250	480
Regulated Recycling- Alcohol (gallons)	475	438	880	566	900
Regulated Recycling- Transportation Oil (gallons)	0	1,150	0	5,536	4,816
Regulated Recycling- Latex Paint (gallons)	0	374	312	153	739
Regulated Recycling- Coolants (gallons)	0	1,270	500	3,146	1,116
Mulch (cubic yards)	2,000	1,800	2,400	2,656	2,350
Salt Use (tons)	1,513	2,006	1,638	1,886	3,080
Salt Use (pounds/person)	42	54	44	50	79
Sand Use (tons)	10	0	0	0	120
Sand Use (pounds/person)	0.3	0.0	0.0	0.0	3.1

<b>Cross-Cutting &amp; Emerging Issues</b>	<b>FY2004</b>	<b>FY2005</b>	<b>FY2006</b>	<b>FY2007</b>	<b>FY2008</b>
Building Utilization (total conditioned ft <sup>2</sup> )	12,521,796	17,224,085	17,184,347	15,664,421	17,184,347
Building Utilization (total conditioned ft <sup>2</sup> /person)	172	233	229	206	220
LEED Certification (# of LEED certified buildings)	0	1	1	1	1
LEED Certification (# of LEED Platinum certified buildings)	0	0	0	0	0
LEED Certification (# of LEED Gold certified buildings)	0	1	1	1	1
LEED Certification (# of LEED Silver certified buildings)	0	0	0	0	0
LEED Certification (# of LEED Bronze certified buildings)	0	0	0	0	0
LEED Certification (% of all buildings)	0	0	0	0	0
Undergraduate Degrees (sustainability related)	NA	10	9	10	9
Masters Degrees (sustainability related)	NA	11	12	11	12
Doctoral Degrees (sustainability related)	NA	15	14	15	14
Enrollment data (sustainability related)	NA	9,563	16,334	12,221	13,576
Courses offered this year (sustainability related)	NA	283	393	488	570
Enrollment per course (sustainability related)	NA	34	42	25	24

<b>Population</b>	<b>FY2004</b>	<b>FY2005</b>	<b>FY2006</b>	<b>FY2007</b>	<b>FY2008</b>
Total Ann Arbor Student Enrollment	39,031	39,533	39,993	40,025	41,042
Ann Arbor Campus Staff	22,450	22,576	22,739	23,016	23,316
U-M Hospital Staff	11,226	11,738	12,398	13,110	13,728
Total Campus Population	72,707	73,847	75,130	76,151	78,086

## APPENDIX B • ADDITIONAL RESOURCES

Additional information is available through the World Wide Web. The University of Michigan welcomes the reader to learn more about the various conservation initiatives on campus:

- The University of Michigan Campus Sustainability <http://www.sustainable.umich.edu>
- The Center for the Study of Complex Systems <http://www.cscs.umich.edu/>
- The Center for Sustainable Systems (CSS) <http://css.snre.umich.edu/>
- The Center for Sustainable Systems (CSS) Fact Sheets <http://css.snre.umich.edu/facts/index.html>
- Frederick A. and Barbara M. Erb Institute for Global Sustainable Enterprise <http://www.erb.umich.edu/>
- Graham Environmental Sustainability Institute (GESI) <http://provost.umich.edu/gesi/>
- Graham Environmental Sustainability Institute—Sustainability Course Listing [http://provost.umich.edu/gesi/academics/course\\_listing.php](http://provost.umich.edu/gesi/academics/course_listing.php)
- Graham Environmental Sustainability Institute—Student Run Environmental Activities <http://www.provost.umich.edu/gesi/umes/student.html>
- Michigan Memorial Phoenix Energy Institute (MMPEI) <http://mmpei.umich.edu/>
- Occupational Safety and Environmental Health (OSEH) <http://www.oseh.umich.edu>
- Environmental Stewardship and Emergency Planning [www.oseh.umich.edu/stewardship/](http://www.oseh.umich.edu/stewardship/)
- Architecture Engineering and Construction <http://www.aec.bf.umich.edu/>
- Green Purchasing <http://www.procurement.umich.edu/greenpurchasing.html>
- Institute for Social Research Energy Pilot Study <http://www.isr.umich.edu/energypilot/>
- Michigan Sea Grant <http://www.miseagrant.umich.edu>
- Plant Operations (PO) <http://www.plantops.umich.edu/>
- PO—Annual Utilities Report <http://www.plantops.umich.edu/utilities/Utilities/reports.html>
- PO—Planet Blue <http://planetblue.umich.edu/home.php>
- PO—Waste Management Services <http://www.plantops.umich.edu/grounds/recycle/>
- Transportation Services <http://pts.umich.edu/>
- The President's Environmental Task Force <http://www.umich.edu/pres/committees/envrpt/>
- U-M Health Systems <http://www.med.umich.edu/envsteward>
- University Housing <http://www.housing.umich.edu/sustainability/index.htm>

The *2008 Michigan Annual Environmental Report* is designed to provide data relating to environmental stewardship topics pertaining to the U-M Ann Arbor campus. Additional information has been included where appropriate to present the reader with a broader view of environmental issues in an attempt to demonstrate the University's relationship with the greater whole. These information sources include:

### Introduction

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