Appendixes

Appendix I
University of Michigan Ann Arbor Campus
Environmental Audit Results

General Information about U-M's Ann Arbor Campus

Contact:

Admissions Office
1220 Student Activities Bldg.
313/764-7433

Personnel Office
6048 Fleming Administration Bldg.
313/763-1248

The University of Michigan is a public institution in an urban setting. The Ann Arbor campus has 17 schools and colleges in four geographical areas (the North, Central, Athletic, and Medical campuses). In fall 1991, there were 23,126 undergraduate students, 13,102 graduate students, 3,732 faculty, and 13,642 staff. U-M's physical plant oversees 205 major buildings; there are also 221 apartment buildings which constitute family housing on North Campus. Fiscal years run from July 1 to June 30.

Solid Waste

Contact:

Erica Spiegel, special projects coordinator
Plant Grounds and Waste Management Services
326 E. Hoover
Ann Arbor, MI 48109-1002
e-mail ericas@umich.edu
313/763-5539

Waste Audit

How much total solid waste does your campus generate annually?

Fiscal year	1989-90:	42,413 cy (cubic yards)
	1990-91:	37,731 cy
	1991-92:	30,133 cy

These numbers do *not* include medical waste, construction waste, or litter collected by Grounds staff.

Construction and demolition concrete are also not included in these figures, nor is sheet metal—disposal of most of these streams are contracted out as the need arises.

What disposal methods are used?

Landfilling of solid waste, leaf composting, and recycling are the disposal methods currently used.

Who is in charge of solid waste disposal contracts?

U-M is extremely decentralized, so various individuals control waste disposal contracts. However, most of the regular building trash flow is handled by Grounds and Waste Management Services.

What are the projected costs of solid waste disposal for FY 1993?

The total refuse disposal cost will be approximately $906,250, based on an average cost of $23/cy ($105.92/ton). These figures cover collection, travel, downtime, truck maintenance, labor costs, disposal or landfill tipping fees, and overhead. [This does not include recycling costs.]

Does your campus have a recycling program? Is the program run by students or by the University administration?

The University's institutional recycling program is managed by Grounds and Waste Management Services, Recycling Office. Some additional volunteer recycling programs exist, but these are not coordinated by the Recycling Office. The collection of materials inside of the buildings is provided by custodial staff. Collection of materials from outside of the buildings is handled by Grounds and Waste Management Service staff. Students are not involved in the collection of materials.

Family Housing has its own curb-side, multi-family, recycling program which is contracted to a private non-profit collection company. Since its inception, participants have recycled approximately 528 cy.

How much material is recycled?

Approximately 6,108 cy were recycled at U-M for FY 1991-92. This includes 111 cy of mixed containers (bottles, cans, items made of #2 plastic, and aluminum) as well as pallets, newspapers, office paper, food service containers, and corrugated cardboard. In that year, 28.9% of the solid waste collected by Grounds and Waste Management was recycled. (Excluding the 2,008 cy of cardboard recycled by the Hospital, the percentage of solid waste that is recycled or re-used drops to 25.3%.)

What materials are recycled/re-used?

U-M is endeavoring to increase the percentage of materials recycled and find organizations that can re-use materials that would otherwise be landfilled.

Newspaper, office paper, corrugated cardboard, glass bottles, cans, and plastics are picked up in residence halls and academic and administrative buildings on a regular schedule. In a special program, 29 tons of phone books were recycled in FY 1992-93.

Some University departments shred confidential documents. Waste Management Services provides a referral service for offices to donate bagged, shredded paper to organizations that can use it, such as the Humane Society and the Museum of Art.

Between July 1992 and March 1993, 167 cy of scrap wood were recycled. The wood is usually chipped and used on campus, given to the U-M Arboretum, or sold to a local pallet or disposal company. Grounds and Waste Management charged customers approximately $1,721 for this program.

Scrap pallets are also picked up and recycled (mulched) by U-M. Reusable pallets are picked up by University Stores for re-use in shipping. An estimated 11,003 cy were recycled in FY 91-92. The current method of counting pallets, however, occasionally leads to double-counting.

U-M composts leaves collected by the Grounds crew. The majority of yard waste (95%) is taken to a composting area on North Campus. The volume of wood chips composted is estimated at 900 cy/year; leaves, 200 cy/year.

No food is currently composted due to potential sanitary problems.

An annual program exists to minimize waste generated during Residence Halls move-out. Students can donate clothing, furniture, and other items to charity rather than putting them in the dumpsters.

U-M has a three areas on campus where scrap metal is stored. Periodically a contracted company will come and pick the metal up.

How frequent is pick-up of recyclables?

Source-separated recyclables are picked up on a regular schedule at more than 200 sites on campus. Clients are selected on the basis of volume generated and loading-area accessibility. Special pickups may be arranged for departments meeting a minimum volume requirement (4 cy of cardboard; 2 cy of office paper, newspaper, or wood waste; or at least 10 pallets).

U-M customers are not charged for recycling service—the cost is covered under solid waste services.

Have recycling programs met any obstacles?

One difficulty has been in getting all students and staff to participate in a recycling program. Students are transient and therefore less likely to be informed about what can and/or should be recycled and when. In addition, costs are prohibitive.

What is the cost of the recycling program?

The projected cost of the recycling program for FY 1992-93 is $344,500.

The costs/cy to collect and process recyclable materials (as compared to the refuse disposal cost, which is approximately $23/cy) are:

mixed office paper	$45.18
corrugated cardboard	23.68
newspaper	45.12
mixed containers	5.11
pallets	4.32

As a result of recycling, how much have disposal costs decreased?

The costs of recycling are roughly equivalent to the savings from the avoided landfilling, hauling and labor costs.

While the average costs of disposal and recycling are similar, a disclaimer should be placed on them: the University is now keeping records on more types of materials, record-keeping has become more efficient, and refuse (which is paid for by the cubic yard rather than on a weight basis) is now compacted more tightly. .Therefore, the results of more complete recordkeeping may show a larger cost savings by including fuel cost.

How has your campus promoted source reduction?

Waste Management Services attempts to involve University faculty and staff in recycling and other programs but, because there is no "official" University policy, it is very difficult to encourage participation. A Task Force on Recycling and Procurement was established in 1991, but it has not met since 1992.

Does the city operate a recycling program? Is it voluntary or mandatory?

Ann Arbor has an extensive curbside recycling program for many years. Recycling for households is mandatory. In 1990 the city began weekly co-mingled pickups; these pick ups include mixed containers (glass, plastics, tin, aluminum) as well as newspaper, corrugated cardboard, and batteries. The City is currently in the pilot stage of a commercial recycling program.

Hazardous Materials

University Contacts:

Ken Schatzle, director 313/764-4420
Hank Baier, hazardous waste coordinator 313/763-4568
Occupational Safety and Environmental Health (OSEH)
1101 NUBS

Sources: Hacala, Jeff. 1992. *Strategies for Hazardous Waste Reduction at The University of Michigan.*

Community Contacts:

Tracey Easthope, Ecology Center Toxics Office
417 Detroit Street
313/663-2400

OSEH. *How to Properly Dispose of Hazardous Waste.*

Waste Audit

What types of hazardous wastes are generated on your campus?

Although OSEH deals with the disposal of all hazardous materials used at the University, EPA divides these wastes into hazardous and non-hazardous categories. Hazardous materials include ignitable materials, corrosive materials, spent halogenated solvents or their mixtures, and mercury. Non-hazardous solids include chemotherapy waste and biohazard waste; non-hazardous liquids include crankcase oil, other oil, and other wastes.

How much hazardous waste does your campus generate annually and what are the costs involved?

Hazardous Waste Generated

Fiscal Year	Amount (pounds)	% Change from Baseline
1989-1990*	165,864	—
1990-1991	214,389	+29%
1991-1992	228,823	+38% (projected)

Disposal Costs

Fiscal Year	Amount (constant dollars)†	% Change from Baseline
1989-1990*	$ 462,167	—
1990-1991	655,867	+41.0%
1991-1992	680,000	+9.3%

*Baseline †Adjusted for 1990 and 1991 inflation rates

Where and how are hazardous wastes stored?

All hazardous waste materials must be packaged and labeled by the laboratories or departments using them. This is done according to the procedures outlined in the OSEH manual, *How to Properly Dispose of Hazardous Waste.* The materials are then picked up by OSEH, which contracts with the Drug and Lab Company to dispose of the waste.

Are any hazardous wastes incinerated on campus?

The University currently owns and operates four incinerators, one which incinerates medical waste for the University hospital, one which incinerates waste for the Medical Science Research Facility, the crematorium which incinerates human cadavers from the medical school and the North Campus Municipal Waste Incinerator (NCMWI).

The NCMWI is authorized to burn low-level radioactive wastes by a license issued by the Nuclear Regulatory Commission in August, 1990. In 1982 Michigan Department of Natural Resources issued a permit to burn pathological waste. Currently the University incinerates low-level radioactive carcasses as pathological waste.

This incinerator has been a great source of contention, because it is adjacent to University family housing.

Since 1988, the Medical Science Unit has been licensed to burn only pathological wastes, but it has applied to include the capacity to radioactive waste.

The main Hospital Incinerator burns waste from chemotherapy and incidental radioactive waste. All biohazards are picked up by OSEH and brought to the Hospital for incineration.

Has your campus initiated a hazardous waste reduction program?

How to Properly Dispose of Hazardous Waste includes recommendations to help reduce the production of hazardous materials at the University. These include detoxifying certain materials so they can be disposed of as normal refuse and separating hazardous and non-hazardous materials during the waste-packaging process.

Jeff Hacala, a former OSEH intern, conducted a survey of U-M science professors in 1991 to see if they would be interested in participating in a chemical sharing program. He included the results of this survey in a report titled *Strategies for Hazardous Waste Reduction at the University of Michigan.*

Does your campus have a history of violating hazardous waste handling regulations?

The most recent and outstanding concern over the proper handling of radioactive and pathological wastes has been centered around the use of the NCMWI for the storage of hazardous and radioactive materials. In August 1991, the Michigan Department of Natural Resources (MDNR) found that the University of Michigan allegedly committed substantial violations of the Resource Conservation and Recovery Act (RCRA) and the Hazardous Waste Management Act (HWMA). The University had improperly stored mixed waste which is classified as both radioactive and hazardous waste. The alleged violations issued by MDNR are partially the result of a nation crisis in disposal opportunities for this type of waste.

The other violations are regarding operational practices. DNR objected that the temperature was not high enough at the time the pathogenic materials were loaded into the incinerator. Subsequently the loading procedures were, changed and now material is loaded when the incinerator is hot enough to burn it.

Policy Audit

What regulations govern the disposal of hazardous materials on your campus?

The disposal of biohazards and chemotherapy wastes are governed by Centers for Disease Control, the Environmental Protection Agency (EPA), and the National Institute for Health guidelines.

The disposal, incineration, and transportation of hazardous materials are governed by the Michigan Department of Natural Resources and by the EPA Air Quality Division. Laws that govern hazardous materials include Michigan Act 64 Hazardous Waste Conservation Act; Title Code 40 parts 100-399: Hazardous Waste Regulations; Title Code 42 part 72.3 (Public Health); Title Code 49 parts 100-199 (Transportation of Hazardous Materials); and Title Code 29 parts 1915-1917 (Labor).

Radioactive Materials

University Contact:

Ken Schatzle, director,
Occupational Safety and Environmental Health (OSEH)
1101 NUBS
313/764-4420

Community Contact:

Tracey Easthope, Ecology Center Toxics Office
417 Detroit Street
313/663-2400

Waste Audit

How widespread is the use of radioactive materials on campus?

The University has nearly 1,000 medical and research labs; many of these use radioactive materials. There is also a nuclear reactor on campus used for peaceful research on applications like, for example, art historical purposes, medical imaging and others.

Is there a campus office in charge of radiation safety?

Radioactive materials at U-M are monitored by OSEH's Radiation Safety Service Program. OSEH conducts radiation safety training courses, publishes and distributes a radiation safety manual, and creates guidelines for the proper packaging and labeling of radioactive wastes.

What sorts of radioactive materials are used at campus facilities?

Radioactive materials can be broken into four general categories:

- Solid Waste: short-lived radionuclides (≤ 90 days half-life)
  long-lived radionuclides (≥ 90 days half-life)
- Liquid Waste
- Liquid Scintillation Vials
- Incinerated Materials (Lab Animals)

[The volumetric data (gallons/year) for radioactive materials can be found in OSEH's *Annual Radioactive Waste Summary.*]

How are radioactive wastes disposed of on your campus?

All packaging of radioactive waste materials must be done by the authorized users on-site, using OSEH-provided storage containers. OSEH is responsible for collecting and disposing of all radioactive materials once they have been properly segregated, packaged, and identified.

Radioactive materials at U-M are disposed of in three ways:

- High-level radioactive materials which are generated at the Phoenix Project Reactor are returned to DOE for recycling. In this country, all uranium, which is what constitutes high-level radioactive waste is owned by the U.S. government. It is leased by DOE to the U-M for research purposes.

- Low-level radioactive materials are shipped off campus for disposal by the Atomic Disposal Company of Chicago. The disposal site is Quadrex in Florida

- Low-level radioactive materials with half-lives of less than 65 days may be stored for up to 10 half-lives (2 years) and then disposed of as normal waste.

- Pathological waste (lab animals) containing low-level radionuclides may be incinerated in the pathological waste incinerator at the NCPWI. They also may be put down the drain to the publicly owned treatment works (POTWs). U-M targets only 20% of the amount allowed by the NRC license to go to the POTW.

- The North Campus incinerator has been used for burning pathological wastes containing low-level radiation and for storing other low-level radioactive wastes and hazardous wastes.

What are the costs for the disposal of radioactive materials?

According to the *Radiation Safety Manual,* U-M pays about $100,000 per year for the transportation and disposal of radioactive wastes.

Does the University accept radioactive waste from outside sources, for incineration or otherwise?

The NRC has not authorized U-M to accept radioactive materials from any other facility.

Has your campus initiated a radioactive waste reduction program?

OSEH has established a set of waste minimization and waste segregation guidelines to which all authorized users of radioactive materials must adhere. Existing waste minimization programs include the replacement of chemically hazardous scintillation vials with biodegradable vials, the use of micro chemical quantities in lab experiments as opposed to macro quantities, and a reduction in the use of lab animals.

Policy Audit

What are the terms and conditions of the University's license for handling radioactive substances?

The NRC has granted U-M a license for the possession of radioactive materials. This is license #21-00251-04.

Medical Waste—University Medical Center

Contact: George Martin, manager, Hospital Stockroom and Estimating
1654 E. Medical Center Drive
313/936-5079

Source: Martin, George D. and David W. Tyler. 1992. *Medical Center Incineration: A Case History,* Incineration Conference, May 11-15, 1992, Hyatt Regency Hotel, Albuquerque, NM.

SPECIAL NOTE: In August of 1992 our master's project representative met with George Martin to interview him about the medical waste incinerator operating on campus. As in all our interviews the purpose was to research the inputs and outputs at the University to aid our assessment of potential pollution prevention opportunities. In January 1994, after the project was finished and edited, Krista Johnsen sent the two page entry we

had on how the medical waste is handled and incinerated for review before final dissemination by the National Pollution Prevention Center for Higher Education. Mr. Martin gave no response until Pam Bloch called him in March 1994 to ask one more time for any corrections. At that time he wrote a letter affirming his verbal directions: "Due to this data being extremely outdated, and also the fact that I had no notion that this information was to be published, I have verbally informed Ms. Pam Block [sic] that absolutely none of the 1992 data can be used for any publication." These instructions covered everything from the definition of medical waste, which is the same for any university or hospital, to the U-M hospital policies and practices for waste reduction.

Therefore, all information in this section had to be deleted or obtained using the Freedom of Information Act or other less adversarial avenues. George Martin clearly knew this information was to be used by students interested in studying waste reduction at their campuses, and rather than choosing to cooperate by making any changes or additions to the "outdated" data to make it creditable enough for our combined purposes, he chose to impede progress by non-participation. We can only hope that in the future more open-minded, cooperative individuals will work with the university community, rather than take such a stand. In addition, remember that as a citizen, anyone is entitled to request permit information and other reports on a facilities' operations. Choosing to cooperate can often be the best alternative for all parties involved.

Waste Audit

> *Infectious waste is categorized as 'special or medical' waste because it requires separate handling and disposal from general waste. Infectious waste is typically identified as blood specimens, surgical specimens, dressings, IV apparatus, and other waste at hospitals.*

How is the medical waste disposed of?

The University of Michigan Hospital operates its own on-site incinerator.
Incinerator information: All information is from the Michigan Air Use Permit Application to the Air Quality Division of DNR for the Incinerator application number 26-85IA
Type: controlled air movable pulse hearth® with three-stage destruction
Model: 1500 special
Rating: 12 million BTU/hour (continuous 24-hour design with heat recovery).
Installation: Began 1987. Completed January 9, 1989 (started formal operation).
Construction funding: (capital investment) $4,000,000

Medical Waste—University Health Service

Contact: Nancy Palmer Swindress
University Health Service Infection Control Unit
University Health Service (UHS)
313/763-4511

Waste Audit

How much medical infectious waste does University Health Services (UHS) generate annually?

The two Treatment Centers and Gynecology Unit generate approximately one medium size waste receptacle per day (the containers are cylindrical, 35" tall, 21.75" in diameter). The lab generates two medium size waste receptacles per week.

How is the medical waste disposed of?

Dry table paper that comes into contact with patients is thrown into the trash and is subsequently landfilled. Sharps (i.e. needles) are placed in special, red plastic sharps containers, and other infectious waste is placed in medical waste containers. Both are shipped to the Medical Center for incineration.

What are the total costs of disposal contracts for the year?

Because UHS is part of the M-Care Health Maintenance Organization, it ships its waste to the Medical Center incinerator. When the incinerator is down for cleaning, the medical waste is taken to a landfill in Chicago.

Has the health service initiated a medical waste reduction program?

No, they feel that their medical waste is fairly negligible.

Medical Waste—University Dental School

Contact: University Dental School
Oral Surgery and Pathology
North University
313/764-1568

Bob Milke,
Dental School Maintenance
313/763-3332

Waste Audit

How much medical/infectious waste does the Dental School generate annually?

The majority of the waste comes from biopsies and the suction of blood from patients. The Oral Surgery Division of the Dental School sees an estimated 7,050 patients per year. This number fluctuates based on the number of undergraduates assigned to the division and the number of incoming emergency patients.

How is the medical waste disposed of?

It is bagged as biohazard, and suction residue is placed in tubs/sealed containers in a refrigeration unit so that it will gel. It is then taken to the docks as biohazard for shipment to the Hospital incinerator.

Air Emissions

Sources of air pollution at U-M are decentralized and difficult to monitor. Therefore, this section contains no quantitative data for air emissions on Campus.

What are the sources for air pollution on Campus?

Sources of air emissions at U-M include:

- power plants
- incinerators
- laboratory fume hoods
- paint booths
- fuel dispensing locations
- fleet and private vehicles

For a discussion of the incinerators, see the "Hazardous Materials" section of this chapter.

What is the quantity of emissions from University vehicles?

No data is available.

Energy Consumption

U-M Contact:

Bill Verge and Yoshiko Hill, utilities engineers
David Anderson, energy management coordinator
U-M Plant, Utilities Department, 313/764-2492

James Jones, research assistant
Energy Cost Avoidance Project (ECAP), 313/764-2492

Helpful Contact:

Lindsay Audin, Utilities Engineer
Columbia University
B-230 Central Mail Room
New York, NY 10027
212/854-691; fax 212/866-9664

[Columbia saves significant money and electricity with EPA's Green Lights Program; to learn more, call 202/479-6936 or fax 202/233-9568.]

Sources: The Utilities Department provided us with its 1990-'91 and 1991-'92 *Utilities Reports*, which are the source for most of the numerical data in this section.

Energy Audit

Does the University generate any of its own electricity?

Yes. U-M's Central Power Plant (CPP) has been in operation since 1915.

Does on-site power generation meet the University's needs?

The CPP produces half the electricity used on campus. This electricity is co-generated when the campus demands steam for heating or cooling. CPP is also the location at which Detroit Edison electricity comes on to Central Campus; Edison has separate feeds on North Campus and at the Hospital. "We're lucky we're on natural gas," said Verge—"it's a lot cleaner" than the coal burners used at universities such as Michigan State and Purdue.

How much energy did the campus consume in the FY 1990-91, and what were the costs associated with each type of fuel?

Electricity: 348,232,378 kilowatt hours (kWh) at a total cost of $27,859,641.00 (8¢ per kWh).

Area Served	Source	kWh	Cost	per kWh
Most Central Campus buildings	Co-generated at CPP and purchased from Edison	182,716,266	$15,348,165.87 *	8.4¢
Hospital, Kellogg Eye Center, etc.	Purchased from Edison	93,839,956	6,466,802.87	6.9¢
North Campus	Purchased from Edison	71,676,156	6,044,672.26	8.4¢

Fuel Oil: 28,047 gallons at a total cost of $30,933.14 ($1.10 per gallon). Note that these numbers cover campus buildings, *not* vehicles.

Liquid Petroleum: 17,439 gallons at a total cost of $15,482.87 (89¢ per gallon).

Natural Gas: 7,341,060 CCU at a total cost of $2,293,103.04 (31¢ per CCU); purchased from many sources through a bidding process.

Steam: 1,796,131 MLB (million BTU) at a total cost of $17,961,304.11* ($10.00 per MLB); co-generated on campus at Central and Hoover power plants.

Street Lighting: total cost of $314,806.45 (based on number of fixtures).

Water and Sewer: 1,712,047 CCU at a total cost of $3,647,984.19; purchased from City of Ann Arbor along with stormwater service.

Power Plant Purchased Utilities:

Type	Amount	Cost
Electricity (for CPP)	95,707,205 kWh	$7,274,215.23
Fuel Oil (for CPP)	95,000 gallons	54,852.14
Natural Gas (for CPP)	30,085,979 CCU	8,599,805.94
Water & Sewer (for CPP)	200,151 CCU	484,907.83
Natural Gas (for Hoover)	1,068,257 CCU	332,674.06
Water & Sewer (for Hoover)	5,680 CCU	5,599.00

In FY 1990-91, U-M's Utilities Department provided energy for 22,377,175 square feet of space at a total cost of $52,803,807.33, or $2.33 per square foot. (Note that this is not completely accurate, because some of the utilities for

*Not purchased. This figure includes natural resources, labor, & maint. See "Power Plant Purchased Utilities."

rental property may be included in the rent figure.) Staff calculate this at 167,033 BTUs per square foot, using the following conversion factors:

Electricity:	3,413 BTU	per kWh
Fuel Oil:	135,000 BTU	per gallon
Natural Gas:	101,800 BTU	per CCU
Steam:	1,000,000 BTU	per MLB

Does this campus have an energy conservation program?

According to Verge, "U-M didn't quit energy conservation after the seventies." However, conservation is mostly driven by *financial* concerns—"Conservation of the natural resources that provide the energy" is not always the same thing as "conservation of the dollars that pay for the natural resources," Verge said. The intention is to reduce the money taken out of the General Fund.

The Energy Cost Avoidance Project (ECAP) was formed in 1984. Through ECAP, actual energy consumption can be compared with a baseline model of 20 Central Campus buildings in order to discover relative, rather than absolute, changes in consumption. The intention of ECAP was to foster cooperation between the academic community and the physical plant departments concerning energy conservation on campus.

Current ECAP baseline models are based on outdoor air temperatures. In an energy-management prototype system in the Art and Architecture Building, the baseline also considers day of week and season. This is also the first building in which ECAP has studied nighttime ventilation. Other advanced energy-management technology is being tested in the studio on the building's third floor. For instance, this will be the first campus location with an integrated lighting and air-conditioning control system.

In 1986, at ECAP's request, Plant installed daylight photo-sensors. But students vandalized the sensors to keep the lights on even in the daylight. Plant will therefore move the sensors to the roof where they can not be tampered with. Jones, of ECAP, and Assistant Research Scientist Mojtaba Navvab recircuited and reoriented the ambient light to better complement natural light and students' existing task lighting; Hill secured funding for the hardware and fixtures.

Plant tries to save money on all buildings, whether they are monitored through ECAP or not. Staff know the average energy costs per square foot in each building and investigate anomalies in consumption.

Verge examines BTU consumption per square foot and then works on reducing the consumption in buildings or areas that are using the most. He sometimes applies for grants—the U.S. Department of Energy (DOE) provides matching funds for some projects administered at the state level. For instance,

DOE provided $100,000 for a Heat Recovery project in the Medical Science II Building. It also provided $85,000 for a project to convert pneumatic controls to more efficient direct digital controls in Medical Science I.

What technology does the campus Plant Utilities Department use to save energy? Is Plant working with any academic departments?

Scheduling. If Plant Utilities Department staff know the occupancy and scheduling for a building, they can program computers to run fans, etc., only at the times when they are needed. This system saves hundreds of thousands of dollars per year. If anyone manually changes the temperature, "alarm" notices are printed at the Central Environmental Control (CEC) office, on a printer as well as on the bottom of the CEC computer screens. Staff acknowledge receipt of the alarm and then decide whether to handle the problem on-site or from within the CEC office. Some alarms require no response.

Isolation. Tighter control of heating and cooling zones also helps reduce energy use. For instance, Towsley Center has occupancy zones with isolation dampers, which isolate the areas that are in use and therefore need to be heated, cooled, or ventilated.

Energy Recovery. As stated earlier, some rooms need to have 100% of their air replaced, but some of the *heat* from that air can be retained with heat-recovery units. The exiting warm air passes over coils of water. That water is then pumped to the intake system, where it heats up the cool outside air being drawn in.

What projects are the Plant Utilities Department working on?

Pneumatic Temperature Controls. Utilities is working to upgrade the older pneumatic controls to newer, more efficient direct digital controls, which are connected to the CEC system.

Laboratory Fume Hoods. Fume hoods may be modified to reduce the amount of air that is needlessly exhausted.

Efficient Use of Nighttime Air. Utilities and ECAP are experimenting to more efficiently incorporate "advanced/predictive control strategies" (e.g., involving nighttime outside air) to heat and cool University buildings.

Energy Managers. Since 1984, ECAP has proposed that zones of larger, more inefficient buildings should have their own energy managers. These managers would provide an interface between building occupants, Plant's maintenance staff, and CEC. The managers would get to know the building's construction and operational characteristics as well as the occupants' schedules and usage patterns.

This proposal is currently being implemented. Besides giving occupants a human contact, the program provides them with a financial incentive to understand and cooperate in energy-saving strategies: the money saved will pay for the managers' salaries, and 20% of the savings will be returned to the units occupying the building.

Carbon Dioxide (CO_2) Sensors. Utilities is evaluating carbon dioxide (CO_2) sensors for possible installation in highly occupied areas. The CO_2 sensor might help gage the number of people in a room and then signal the computer-controlled fan system to bring in only as much fresh air as needed. Currently, engineers must program the air exchange system to accommodate the amount of CO_2 produced in an auditorium filled to maximum capacity. If the a CO_2 sensor idea is shown to be effective, it could signal that far fewer people are actually present and then notify the system to bring in (and therefore heat and cool) much less fresh air.

What new lighting technology is used on Campus?

In lighting projects, Hill's plan of attack is to assess energy consumption in public areas (such as hallways, lobbies, and waiting rooms). If she determines that they need energy conservation measures, she then calculates whether those measures would pay for themselves in five years.

Much progress has been made in the area of lighting. Utilities is in the process of replacing older fluorescent lights and their ballasts with newer-technology fluorescent lamps and electronic ballasts which use less energy. Older fluorescent fixtures were noisy and produced an artificial-looking light; the newer ballasts work at a higher frequency than the old ones and are thus quieter, and new technology in fluorescent lamps gives them a color rendering index (CRI) closer to sunlight. For instance, new tri-phospors have a higher CRI. The new ballasts have longer lifespans. Incandescent bulbs are also being replaced by fluorescents. Where dimming capabilities are needed, Plant sometimes uses Halogen IRs (a 60-watt Halogen IR is equal in brightness to a 150-watt incandescent, and it lasts 2,500 hours longer).

What are some examples of different lighting projects on Campus?

The Electrical Engineering and Computer Science Building on North Campus has a fairly sophisticated system. The ballasts are connected to the Utilities computer which is run by CEC's Dave Anderson. The fourth-floor hallways have occupancy sensors—if there is no movement for 15-20 minutes, the lights dim to 20%. A long time period was chosen because constant turning on and off is hard on the equipment. This system uses 40% less energy than the previous one, where lights were traditionally left on all the time. According to Hill, there has been no negative feedback concerning this new system.

In the Central Campus Recreation Building, Utilities replaced one hundred and forty 400- and 175-watt mercury vapor lights with sixty 400-watt metal halides. The halides provide more lumens per watt than the mercury vapor lights. This should have an economic payback of five years, making it "a real success story."

In the Graduate Library reading room, Hill replaced forty 400-watt mercury vapor lights with 20 175-watt metal halites. The problem with mercury vapor lights is that they will keep consuming 400 watts, even though rather than giving out usable light, after time they begin to simply glow.

Another potential project would focus on the Graduate Library's extensive stacks area, which has very low but irregular occupancy.

Does this campus have a plan to encourage the use of renewable energy sources?

There is no official plan to use renewable energy sources. One factor, said Verge is that "energy is dirt cheap now, compared to the early 1970s"—when the natural gas industry was deregulated in the mid-1980's, natural gas prices dropped about 40%. Any utilities delivery system on campus is evaluated on a cost/benefit basis—most need a "simple" payback period of less than five years to get any funding (i.e., costs are not discounted over time).

It is also difficult to use renewable energy in most parts of Michigan—this state ranks third lowest in terms of annual sunlight, and there are no steady winds. Therefore, neither solar nor wind power are very feasible. The Art and Architecture Building, however, does have a solar water heater.

Under what constraints does the Campus Plants Utilities Department operate?

Public Health. The Plant Department has to balance standards for public health with financial constraints. For instance, U-M must comply with American Society of Heating, Refrigeration, and Air-conditioning Engineers (ASHRAE) standards for indoor air quality. For example, one standard determines the amount of cubic feet of "fresh air" per minute (CFM) that is needed to replace indoor air which has too much CO_2 (from people breathing) or which has been contaminated by carpet or particle board outgassing, molds, bathrooms, animal quarters, chemicals used in labs or for cleaning, etc. The minimum ASHRAE standards are 15 CFM per person for auditoria, classrooms, and libraries; 20 CFM per person in offices and laboratories; and 100% air exchange in locker rooms and animal quarters. The amount of air exchanged therefore depends on occupancy per square foot. In many cases, said Anderson, U-M exceeds these indoor air quality requirements. (However, no one is

assessing the *quality of* the outside air.) Even with heat-recovery units, energy is lost during air exchange.

Safety. Campus lighting must meet National Fire Protection Association (NFPA) standards. NFPA 101 requires at least one footcandle for hallway lighting to ensure safe egress in emergencies.

Aesthetic Considerations. Design architects and engineers may be more concerned with the appearance of a fixture than in its energy-efficiency. For instance, the globes along the Diag are decorative but inefficient—some of the light goes up to the sky and trees rather than down to the sidewalk. The Utilities Department, Plant Extension's Facilities Evaluation and Commissioning Department, and ECAP all advocate energy-efficient designs.

Authority. The Plant Department is a service unit and does not have the authority to prescribe how energy should be used. Plant regularly makes recommendations to building staff to encourage efficient behavior. However, Anderson believes that changes are more likely if they are decreed within a school. Administrators such as deans may decree that temperatures in their building be kept within a certain range.

Accommodating People's Needs. If one professor wants to work all night, the building fan might have to run all night too, thus cooling much more space than that one professor is occupying.

Though there is no data supporting this, this project intuitively feels there is an interesting human constraint which sometimes emerges when more efficient lighting systems are installed. University staff may see occupancy sensors as signaling their work patterns. Leaving lights on is a way of showing they are at work—that they have already been in their offices and have just happened to step out.

Departments may want to reduce energy used in heating and cooling. However, for people to work effectively the temperature must be within a certain "comfort zone"—this has been proven by research conducted through U-M's Institute for Social Research.

Automation. Because computers consume much electricity and also generate heat, thereby increasing the air-conditioning load, the increased use of computers on campus has greatly increased the demands on campus utilities. Due to the BTUs generated by people, lights, computers, and other equipment, the Computing Center on North Campus and other buildings sometimes require cooling in the winter.

Water Usage

Contact:

Jack Thams, General Foreman
Plant Operations, Maintenance Service and Renovations,
313/747-2059

Bill Verge, Utilities Engineer
Plant Operations, Utilities Department
313/764-2492

Marvin Pettway, University Forester
Plant Operations, Grounds and Waste Management,
313/764-3422

George SanFacon, Director of Facilities
Housing Division, Residence Operations
313/763-3175

Audit

How many gallons of water did the campus use in FY 1990–91?

According to the *Utilities Report 1,712,047* CCU were used (this total includes Housing). Given that there are 748 gallons to one CCU, U-M's total usage is equal to 1,280,611,156 gallons. Total usage is comprised of clean water, the wastewater that flows into a water treatment plant, and the stormwater that is discharged into the Huron River. All buildings are metered separately.

Is water use metered separately for individual building?

Yes. Most of U-M's water is billed as water/stormwater service. Water that will go down the sewer is metered at a higher rate than water that does not go down the sewer (i.e., water used for sprinklers or in air-conditioning cooling towers). Plant is billed for all water except that used by Housing, which gets its own water bill.

What type of irrigation system does the campus use?

According to Pettway, U-M uses a pop-up sprinkler system. Almost all of the sprinklers on campus are Rain-Bird® pop-up rotors or pop-up mist-heads.

Does this campus have a system to monitor for leaks or water efficiency?

Each building-maintenance person is responsible for approximately 300,000 square feet of building area. Therefore, small leaks are reported mainly by building occupants.

Housing staff monitor water usage by examining monthly and annual reports. There are also meters on "closed" systems (the Family Housing hot water heating-system tanks, which should not lose any water at all). Students who notice leaks can report them by dialing F-I-X-I-T.

Are water utility costs for the campus increasing or decreasing?

Different buildings have different rates, depending on the different mixes of water usage and sewer service. For FY 1990-91, U-M paid $3,647,984.19 for 1,712,046 CCU water and stormwater service (average: $2.13/CCU). The next year, the price was $3,856,244.94 for 1,568,089 CCU (average: $2.46/CCU). According to Verge, the price of water increased about 18%, while the stormwater price went up 48%; such rate adjustments are based on city costs and approved by the Ann Arbor City Council.

Do campus buildings have low-flow water devices? Have older buildings been retrofitted?

According to Thams, all the athletic facilities have low-flow showerheads (1.5 gallons/minute, or GPM). Most toilets on campus have chrome-valve flushing devices which are more efficient than the tank type found in most homes. When faucets need to be replaced, they are generally retrofitted with aerators.

About ten years ago, Housing surveyed all plumbing fixtures in its buildings.* The flow rates then were 5-7 GPM for showerheads and faucets and 5-7 gallons flush for flush-valve toilets. Housing installed aerators and restrictors to reduce the shower flow rates to 3.5 GPM and the faucets to 1.8 GPM; the toilets were retrofitted to use only 3 gallons/flush.

Because Family Housing residents use the most water per capita, Housing is proposing that showers be retrofitted to use 2 GPM, faucets, 1.8 GPM. The existing tank-type toilets (found only in Family Housing) also would be retrofitted to use 3 GPM (down from the current 5 GPM); any new tank toilets would be the ultra-low volume variety which use only 1.8 GPM. "I imagine this will be completed by mid '94," said SanFacon. The job will be contracted out.

---

* U-M residence halls house approx. 10,000 people; another 6,000 live in U-M Family Housing.

Is reclaimed water being used in any facilities or for landscaping purposes?

No. "It's something we've given some thought to," said Pettway, but there are two barriers: the high cost of setting up a collection system and the fact that landscaping water needs are so variable (based on weather and season).

Wastewater

Contact: Mike Adrounie
Ann Arbor Wastewater
Treatment Plant
49 South Dixboro Road
313/994-2811

Janis Bobrin,
Washtenaw County
Drain Commissioner
110 N. Fourth Avenue
313/994-2525

Liz Fanta, Billing
City of Ann Arbor
100 N. Fifth Avenue
313/994-2666

Waste Audit

How much wastewater does U-M generate annually?

According to the U-M Plant Department, the University used 1,712,047 CCU (100 cubic feet) during FY 1991. This translates into 3.5085 million gallons/day (see formula below for calculations). This number includes water intake and sewer output combined.

Formula for calculating the amount of water used daily: 1 cu ft = 7.48 gallons
100 cu ft = 748 gallons

1,712,047 x (100 CCU)/year = 1,712,047 x 748
= 1,280.6112 million gallons
= 3.5085 million gallons/day

Where does the waste water go?

Waste water from the sanitary sewer system is treated at the City of Ann Arbor Waste Water treatment plant on South Dixboro Road which processes 18.5 million gallons of water per day. The waste water undergoes a five step treatment which includes physical, biological, and chemical processing.

1. Preliminary stage screens inorganic substances out of the water.
2. Primary filtration then settles out all non-soluble organics in the water.

3. In the third stage, all three processes are used: a flock soluble food source —biological; iron salts to precipitate phosphorous—chemical; removal of flock and phosphorous precipitate in settling tanks—physical. The precipitation of phosphorous is a recent addition to the process and most of the work takes place in this stage. In order to remove of phosphorous, flock and precipitate are separated out in settling tanks.
4. In the fourth stage mixed-media rapid sand filters remove fine solids.
5. The final stage, a chemical treatment, uses chlorine to disinfect the water and sulfur dioxide to remove the residual chlorine. The treated water is then released into the Huron River.

What costs are associated with treating waste water?

For the FY 1991-1992, treatment costs were as follows:

	Cost	Rate	Gal/Capita/Day
Clean water supply	$1,104,411.77	$1.18/CCU	36*
Sewage	1,369,772.28	1.92/CCU	
Storm water	105,025.36		

*36,228 students and 17,374 faculty and staff

What pollutants might our campus contribute to our local Huron River?

In general, during the 1980s the Ann Arbor storm drain system had a variety of pollution problems caused by used motor oil, gasoline, fertilizer, and road salts that were washing directly into the Huron River. Especially with regard to petroleum products, illegal connections to the stormwater system were suspected to be a major source of pollution. A comprehensive six year program involving inspection and dye testing was implemented to pinpoint the discharges of commercial institutions and industrial facilities, including the University of Michigan. There was significant water quality improvement as many illegal connections were eliminated.

Janis Bobrin, Washtenaw County Drain Commissioner, contends that today, the largest source of water pollution at this time is non-point source pollution, primarily due to construction and paved surface runoff.

According to Landman (1991), the Ann Arbor treatment plant staff cite the following compounds as being found in the drinking water: ammonia, calcium, chloride, chlorine, fluoride, magnesium, nitrate, nitrite, organic nitrogen, phosphorus (meta), potassium, silica, sulfate, organic carbon, bromodichloromethane, chloroform. However, the scope of such information is determined by the limited tests available. Bear in mind that many of these compounds naturally occur in water.

Transportation

Contact: Patrick Cunningham, manager
Transportation Services
1213 Kipke Drive, 313/764-3427

Waste Audit

How many fleet vehicles does the campus operate? How and where are they serviced?

There are approximately 700 fleet vehicles. There are three service stations for refueling, one each on North Campus, Central Campus, and the Athletic Campus. All vehicles are serviced at Kipke Drive.

How many vehicles travel onto campus daily?

This number can be inferred by the number of University parking spaces and permits issued:

Parking Spaces	10,842	staff paid
	228	loading zones
	514	service vehicle spaces
	1,705	metered
	2,684	student tenant spaces
	1,523	commuter spaces
	477	handicapped
	18	van/carpool
	411	restricted visitor (mainly at Hospital)
	363	card key access
	1,714	cashier spaces (ramps)
	21,148	total spaces in U-M parking system (excluding City of Ann Arbor meters and structures in the campus area.)
Permits	16,898	total (excluding resident housing)

Students' commuter-lot permits are free.

How much waste oil and solvents are produced from the campus garage?

The garage produces approximately 3000-4000 gallons of waste oil per year.

How are wastes materials disposed of ?

Transmission and other fluids are combined with the oil and recycled. Car and flashlight batteries are recycled. The life of bus tires is prolonged through

retreading (new treads are cut into the thick tires) and recapping (once the second tread wears down a third tread is placed over it). Recapping can be performed once or twice and then the tires are recycled through the supplier.

Are any campus fleet vehicles operated using alternative fuels?

There are currently no alternative fuel vehicles at the University. U-M is hoping to implement a project with electric vehicles in the near future.

Has the campus initiated a program to encourage alternatives to the single occupancy vehicle? Ridesharing programs? Bike lanes? Mass transit?

A van-pooling program serves five pools with 15 passenger vehicles at a cost of $65-$70 per month. Parking also promotes ridesharing but this is a separate program. Regular University bus service has 3.6 million passengers per year.

Food

Contact: Barb Daoust, food service supervisor, Housing Division Central Area, Student Residences Services, 313/764-1166

Hal Pattullo, manager, Food Stores
Purchasing and Stores, 313/998-7065

Waste Audit

Who operates campus food services?

The Housing Division, Dining Services.

Who is responsible for making decisions about menu planning?

Housing's Executive Chef (Steve Meyers) and the Menu Planning committee (MPC) make up five-week cycle menus for all residence halls. This always includes two meat entrées (preferably one fish or poultry) and one vegetarian entrée per day. Each residence hall makes slight modifications in accordance with the needs of the residents, such as serving more kosher meals or more vegetarian meals. Over the last year, the Nutrition Education Advisory Committee (NEAC) has made recommendations to Steve Meyers. The NEAC is made up of Dining Services supervisors and managers, some of whom are registered dietitians. It is run by Nutrition Specialist Paula Herzog, R.D.

What are Dining Services' purchasing criteria? What kind of food items are purchased, when, in what volume, and at what cost?

U-M Food Stores publishes fresh produce and meat prices each week. There are separate purchase requisitions for fresh, frozen, and canned food.

How does Food Stores decide what's "too expensive" to stock or special-order?

Food Stores generally purchases whatever items Housing Dining Services orders. However, if an item is very expensive (e.g., out-of-season produce can be 10 times as expensive), Food Stores will check to make sure Dining Services still wants it.

Dining Services staff in each hall order food, but the final decision of what to buy is up to Jean Casey, Director of Housing Dining Services, Residence Operations, Student Residences.

In the bid process, does Food Stores specify organically or locally grown food? Or food that has minimal or recyclable packaging?

Food Stores is responsible for procurement and its purchasing criteria has not included buying locally or organically grown food. According to Hal Pattullo, University Housing's executive chef can say "this is the product I need to be able to perform my job of preparation"—under that direction, Food Stores creates criteria for local brokers. (For example, the best baking potatoes come from Idaho.)

"We want to ... make sure we get bid quotations from many suppliers," said Pattullo, "who can meet delivery schedules" and supply the specified quantity at the best price. Produce comes from the Detroit Produce Terminal. The companies represented there contract from producers all over the world.

Because University Housing has shown interest in products that are easier to dispense, Food Stores is experimenting with certain products that are packaged in non-recyclable plastic pouches instead of metal cans. However, Pattullo thinks that the pouches might actually be more difficult for food preparers to handle.

Does Housing purchase any certified-organic produce, dairy, or meat products?

By default, some dried beans and legumes (from Eden and Midwest distributors) are organic, as is the granola. There used to be a separate "natural foods" order once a month, but now a lot of the bulgher, basmati rice, etc., come from Al Hirt Co., a Detroit distributor; these are probably not organic. Students have not been demanding organic food.

For Earth Day 1991, the executive chef planned a menu specifying organic carrots and broccoli; each residence hall then placed a special order or requisition for those items (anything without a University Stores stock number has to be ordered this way). This was part of a completely ovo-lacto vegetarian dinner at which some residents expressed outrage because of the absence of meat.

Has Residence Hall Dining Services discontinued the purchase of any food products for environmental reasons?

A couple of years ago, students did push for a boycott of California table grapes because migrant workers were being poisoned by pesticides. Some went so far as to petition U-M President Duderstadt. Now, Housing only orders Chilean grapes. Student complaints also lead to a great reduction in the serving of veal, but this was an animal rights rather than a pollution prevention issue.

Are there any guidelines to minimize food waste?

Students can eat as much as they want in the cafeterias. Also, to decrease the amount of time spent waiting in line for second helpings, staff will serve two entrées at a time to anyone who wants them. Everything is self-serve except entrées and yogurt, which are served by staff; these can vary in size depending on what each student requests. The salad bars seem to work well—there is less waste and more satisfaction.

Food for a particular meal is cooked in batches rather than all at once. For example, staff cook one pan of hamburgers and set that out, even though they might predict that six pans will be consumed during the meal. Staff try to be cost-effective in using up leftovers. The goal, however, is to serve enough fresh food to allow everyone a choice without creating too many leftovers.

What is the current practice for disposing of food waste?

All vegetable trimmings and wastes from the dishwashing process go down the garbage disposal. (Rice is disposed of in the trash because it clogs the disposal.)

Unprocessed meat waste from Food Stores' butcher shop on Varsity Drive is picked up by Coldwater Rendering. In the kitchens, staff put all bones and removed fat in special "bone barrels." Bones left on trays are also put in the barrels. However, students are not specifically asked to save the bones and some are thrown away along with paper napkins. The barrel contents are picked up by Darling and Company, a Melvindale renderer. Currently, Darling neither charges nor pays for the barrel contents. However, they may

begin to charge. U-M is therefore investigating arrangements with other rendering companies.

Mixed fat and bones are processed into "bleachable fancy tallow" (purchased by the soap and cosmetics industries) and "choice white grease" (used in lubricants and rust inhibitors by the steel industry); bones and meaty parts are processed into bone meal (purchased by the animal-feed industry).

Have any food recovery programs been initiated?.

When there are leftovers, staff try to use them "in-house." Some can be reheated once, thus reducing the amount of new portions that have to be cooked. Daoust said the Business School's Executive Residence donates leftovers to Food Gatherers, a local group which collects food and distributes it to homeless shelters. At the end of each semester, most residence halls also donate to this organization.

Are any of the containers used in Food Services recycled?

In the kitchens, all corrugated cardboard has been recycled since 1990. Cans, clear glass bottles, aluminum foil and pie plates, and #2 HDPE plastic ("with a seam, not a circle") are now recycled in each residence hall. In the cafeterias, newspapers are recycled, but paper napkins and yogurt containers are not.

Most non-recyclable containers go in the trash. However, some get reused: 5-pound cottage cheese and sour cream containers are used to store canned food that has been opened or the sanitizing solution employees use to clean up; 5-gallon buckets are used to mix the punch and lemonade that go in the Jet-Sprays (bubble machines that mix and refrigerate).

Is there a food composting program on Campus?

No food is composted because of potential sanitation problems.

Policy Audit

Ideally, the MPC guidelines consider cost, nutrition, color, flavor, texture, popularity, variety, production (number of ovens, stockpots, fryers in use), season, and availability, repetition, education of clients (ethnic foods, nutrition information). There are not currently any goals for:

- buying organic products
- buying food with minimal packaging

- planning less energy-consuming meals. (When staff are feeding 1,000 people per meal, all ovens might be on at once. However, staff try to use ovens that are already hot.)

Is student feedback encouraged?

Students can fill out comment cards, which are answered by Dining Services management and posted on the bulletin board. Housing administers a survey developed at U-M's Institute for Social Research each semester. Students can communicate informally with cafeteria staff. Finally, some residence halls have "food committees," where one member of the student House council brings concerns to cafeteria staff.

Pesticides

Contact: Marvin Pettway, University Forester
Plant Operations, Grounds and Waste Management, 313/764-3422

Dale Hodgson, OSEH Pesticides Management
1077 North University Building, 313/747-1142

Who is in charge of pesticides on your campus?

Three departments handle pesticides at U-M. The biology department applies indoor pesticides in the botanical gardens; OSEH handles all other indoor pesticides. The Grounds and Waste Management Division and OSEH handles all outdoor pesticides.

Pesticide use is decentralized, and different departments do not appear to work in conjunction with one another in this area.

What are the most commonly used pesticides on your campus?

Grounds uses Roundup®, the brand name for the chemical glyphosphate, most commonly. Fertilizers are used more than pesticides.

Are warning signs posted when pesticides are used?

Yes. Postings follow regulations.

How are pesticides disposed of?

Both unused pesticides and empty containers are disposed of according to manufacturers' directions on labels. If the label is destroyed, the container is given to OSEH to dispose of.

Are non-chemical pesticides used?

Both Grounds and OSEH use an integrated pest management approach. Pesticides are not used unless there is no other choice. Pesticides are applied when the target pest is the most vulnerable, and herbicides are applied when plants are young. When plants are older, weeds cannot grow as well.

Procurement Policies

Contact: Steve Royce, merchandising manager
University Stores, 313/998-7070

Waste Audit

Does your campus buy recycled paper?

U-M purchases and sells recycled legal pads, Post-It® pads, and other items. A catalog distributed by University Stores lists all recycled items available for sale to the University community. This catalog contains the prices of the materials, the amount of recycled content, the number of items issued per order, and the annual usage of some of the items. Most of the paper products contain 50% recycled paper, while some contain 65% (printer and copier paper). Post-consumer content is not listed.

Does your campus purchase other recycled products?

U-M purchases printed materials, office supply, custodial, and plant related materials that are made with recycled content.

What programs and policies have been established on your campus to promote the use of ecologically sound products?

There is no "official" University policy. Decisions to use ecologically sound materials are made on a departmental level.

Glossary

Authorized User

An individual member of the teaching or research faculty who has been approved by the Radiation Policy Committee to use or supervise the use of radioactive materials under conditions specified by an application for authorization.

Ballast

Device used with electric discharge lamp to obtain necessary circuit conditions (voltage, current, and wave form) for starting and operation.

Biohazardous and Chemotherapy Wastes

Those materials containing biological agents capable of producing adverse effects or disease in plants, animals, and humans. The terms "biohazardous," "etiologic," "infectious," and "pathogenic" are commonly used to define the same materials.

Central Environmental Control (CEC)

A computerized building management system that U-M uses to control and monitor heating, ventilation, and air conditioning (HVAC) equipment throughout the campuses.

Central Power Plant (CPP)

The plant on Huron Street that provides power for Central Campus.

Cogenerate

Use steam heat to power turbines to create electricity.

Color Rendering Index (CRI)

A measure of the degree of color shifts objects undergo when illuminated by the light source as compared with the color of those same objects when illuminated by a reference source of comparable color temperature. Sunlight is 100 CRI.

General Fund (GF)

GF buildings do not get billed—the University's central administration takes care of paying for what they use. Utilities meters all buildings and then bills General Fund, Auxiliary Fund, etc., as appropriate.

Grounds

University of Michigan Department of Plant Operations, Grounds and Waste Management

Half-Life

The time needed for a radioactive substance to be reduced to 50% of its starting activity. The most commonly used term is physical half-life which refers solely to radioactive decay.

Hazardous Waste

Any waste or combination of waste which, if improperly treated, stored, transported, disposed of, or otherwise managed, may cause or significantly contribute to adverse effects in the health and safety of humans or the environment, due to its quantity, quality, concentration, or physical/ chemical/infectious characteristics. This includes all waste listed by the EPA in 40 Code of Federal Regulations Part 261 or any waste exhibiting a characteristic of ignitability, corrosivity, reactivity, or Extraction Process toxicity.

Hoover Power Plant

The plant on Hoover Street that provides power for South Campus.

Kilowatt (kW)

Kilowatt: 1,000 watts; a measure of power.

kWh

Kilowatt hour: 1,000 watts provided for one hour; a measure of energy.

MLB

1,000 pounds (mass).

Plant

University of Michigan Department of Plant Operations

Utilities

University of Michigan Utilities Department

Watt

The practical unit of active power which is defined as the rate at which energy is delivered to a circuit. It is the power expended when a current of one ampere flows through a resistance of one ohm.

Appendix II
University of Michigan School of Business Administration - Environmental Audit

Recycling and Waste Management

Contacts: Erica Spiegel and Buck Marks, Waste Management Division

Recycling

Business Administration

Collected Items	FY 1991	FY 1992	FY 1993 to date
Old Newspaper (ONP)	21.1 cy	35.5 cy	21.4 cy
Corrugated Cardboard (OCC)	n/a	211.4 cy	163.2 cy
Mixed Office Paper*	32.58 cy*	50.65 cy*	44.4 cy*
White Office Paper*	18.15 cy*	46.5 cy*	*
Mixed Containers	n/a	(1-6/92) 22 cy	20.2 cy

*As of Fiscal Year 1993 (July 1 - June 30), white and mixed office paper are being marketed together despite separate sorting containers Source separation is maintained in the event that market prices decline for mixed office paper. Existing co-collection minimizes the waste management collections costs.
Despite a University-wide decline in recycling rates. The School of Business Administration has maintained high numbers.

Conversions: OCC = 65 lbs/cy
MOFC/WOFC = 585 lbs/cy
ONP = 376 lbs/cy

July – September Comparisons

Collected Items	7–9/1990	7–9/1991	7–9/1992
Old Newspaper (ONP)	5 cy	6.1 cy	11.65 cy
Corrugated Cardboard (OCC)	0.5 cy	11.75 cy	65.70 cy
Mixed Office Paper* (MOFC)	11.75 cy		20.75 cy

Executive Residence

Collected Items	7-91991	FY 1992	FY 1993 to date
Corrugated Cardboard (OCC)	n/a	326 cy	132 cy

July - September Comparisons

Collected Items	7-9/1990	7-9/1991	7-9/1992
Corrugated Cardboard (OCC)	35.75 cy	57.50 cy	106.50 cy

Solid Waste Disposal

Business Administration
During the fall and winter, waste management picks up Municipal Solid Waste (MSW), commonly referred to as trash, three times per week. During the spring/summer terms, two pick-ups are scheduled.
Waste Average Constants: 816 cy/year @ 45 lbs/cy; 77.4 cy/mo average term; 51.6 cy/mo average summer.

Executive Residence
One pick up per week serves the executive residence.
400 cy/year @ 400 lbs/cy; 34.4 cy/mo average.

Comments/Input
• At a printing services conference, the attendees from the business school were very interested in the use of glossy, coated paper, with color inks, non-recycled or recyclable paper. This may be an area to examine. What sort of documentation is produced on a large scale? Does glossy necessarily mean high quality? Can marketing tools be modified to fit into a high-profile image while being less environmentally degrading?

Administration / Management

Contact: Brent Chrite, Administrative Manager

He expressed an openness to the project and offered to supply any necessary or helpful information. He also furnished us with an organizational chart of the Business School. In addition, he suggested that we examine the White Papers from the Dean regarding the strategic direction of the school. He thought it would be helpful to understand the context of the Total Quality Initiative — one of continuous cyclical improvement. Last, he supplied our team with a copy of Dean White's speech to the Economic Club of Grand Rapids, a copy of the building blueprints, and a site diagram board of the building and grounds.

Maintenance and Grounds Management

Contact: Fran Jade, Horticulturist with Grounds and Maintenance

She discussed the landscaping policies. She outlined that there has been no spraying of herbicides or pesticides in the past two years, only lawn fertilizers. Her office has been composting the leaf refuse as bed dressing and has been chipping the woody materials for re-use. At the Business School's expense and request, a raised planter outside of the main entrance has been planted and replanted for seasonal color. Last year, the shrubs and trees were rearranged and perennials were added to the bed thereby reducing the number of annuals needing to be planted but still maintaining the aesthetically pleasing seasonal color. Ken Rapp, the landscape architect in charge of the raised planter, has more information on this subject.

Food Services and Food Waste

Facilities: Executive Dining Room has full kitchen facilities. Serves breakfast, lunch, and dinner.

Student Snack Bar — has no dish room or vents (for frying, etc.) Serves cold foods.

Contact: Judy Manneter, Supervisor of catering and snack bar 747-4997

Operations

Food services are run under contract by the housing division. There are four supervisors: dining room service, catering and snack bar, breakfast and lunch production, and dinner production. These four are overseen by the chief supervisor, Susan Stahl.

Decisions regarding menu planning are made by staff at the business school. Judy Manneter makes decisions for the student snack bar. In the executive dining room, the choice of entrees at lunch includes a vegetarian alternative. A smaller number of guests are served at dinner and a guest must request a vegetarian alternative in advance. Judy says that menu decisions are based on a combination of customer preference, health considerations, and trends in the food industry such as the move toward foods lower in fat.

The primary food purchasing criteria are quality and availability. Most food is ordered through the University of Michigan food stores, and such decisions are made by University Food Stores. The Business School does not order organic products. Such orders, however, could be made through Food Stores. Judy says that she would have to be convinced that the customer wants organic foods before she included these items in the menu. Customer preferences are gauged through evaluations. As yet, no one has specifically requested organic products.

Disposal Practices

Packaging: corrugated cardboard, metal, glass and most plastics are recycled. A company outside of town takes plastics other than #2.

Disposable tableware: cocktail napkins from the break service are thrown away. At the student snack bar, all plates, cups and napkins are disposable and are thrown in the trash.

Kitchen waste: most organic waste goes in the garbage disposal. Fats, bones and heavy or starchy foods are put in the trash. Fresh flowers are set out in the dining-room each day.

Food Recovery/Compost programming

Dining Room: If quality considerations allow, leftovers are reused. The Business School does not serve reheated meals. However, any large quantities of unused leftovers are donated to Food Gatherers (a local food re-distribution program to feed the hungry/homeless).

Break Service: At the end of the day, uneaten fruit and croissants are given to the staff. Any surplus is thrown away.

Composting: The Business School does not arrange for any composting.

As far as food purchasing is concerned, no changes have been made due to environmental considerations; however, the California grape boycott is campus-wide. Most changes implemented have been in the area of solid waste reduction and recycling. Plates and cups used for the break service were all disposable. For purposes of cutting costs and waste reduction, now only washable plates and cups are used.

Utilities: electricity, steam, and water & sewer

Contact: Bill Verge, Utilities Engineer
Yoshiko Hill, Utilities Engineer

	Business Administration	Business Administration Assembly Hall	Paton Accounting Center
Electricity	1,621,900 kWh $136,239.60	246,960 kWh $20,744.64	254,400kWh $21,3696.60
Steam	6,931 MLB $69,307.00	7,075 MLB $70,745.00	1,311 MLB $13,106.00
Water & Sewer	3,297 CCU $9198.14	1,430 CCU $1,980.88	480 CCU $1328.93
Total size/cost	143,533 SQFT $214,744.74	25,856 SQFT $93,470.52	15,239 SQFT $35,804.52
Annual BTU usage/yr/ft	86,853	306,210	142,980
Energy cost/sqft/yr	$1.496	$3.615	$2.350

Buildings with many computers have SQFT costs of $4-5/sqft

Conversions: 1kWh = 3,413 BTU
1 MLB = 1,000,000 BTU
CCU = 100 cubic feet

Transportation

Contacts: Diane Delatorre, Transportation Services 747-3615
Susan Kirckpatrick, Transportation Services Mgr., Parking Operations

The parking structure on the grounds of the Business School has 501 spaces, including one loading zone and eight handicapped spaces. There is one reserved carpool space. All spaces cost the same.

Drivers buy a one-year parking pass that allows them to park in any structure on campus. The 1992 passes cost $349.00. The rate is determined by the regents based on recommendations by the transportation department. People do not buy reserved spaces, and passes can be returned for a prorated refund at any time during the year.

Carpools

An official, registered carpool must be made up of four or more regular staff who work the same shift. Applicants must turn in an employment verification form signed by their supervisor. Members of a carpool split the cost of one parking space and may reserve a space in the structure of their choice. Currently there are six or seven reserved carpool spaces in the entire university. Diane Delatorre estimates that there are approximately 100 non-reserved carpools. If there were more reserved carpools, transportation services would increase the number of reserved carpool spaces.

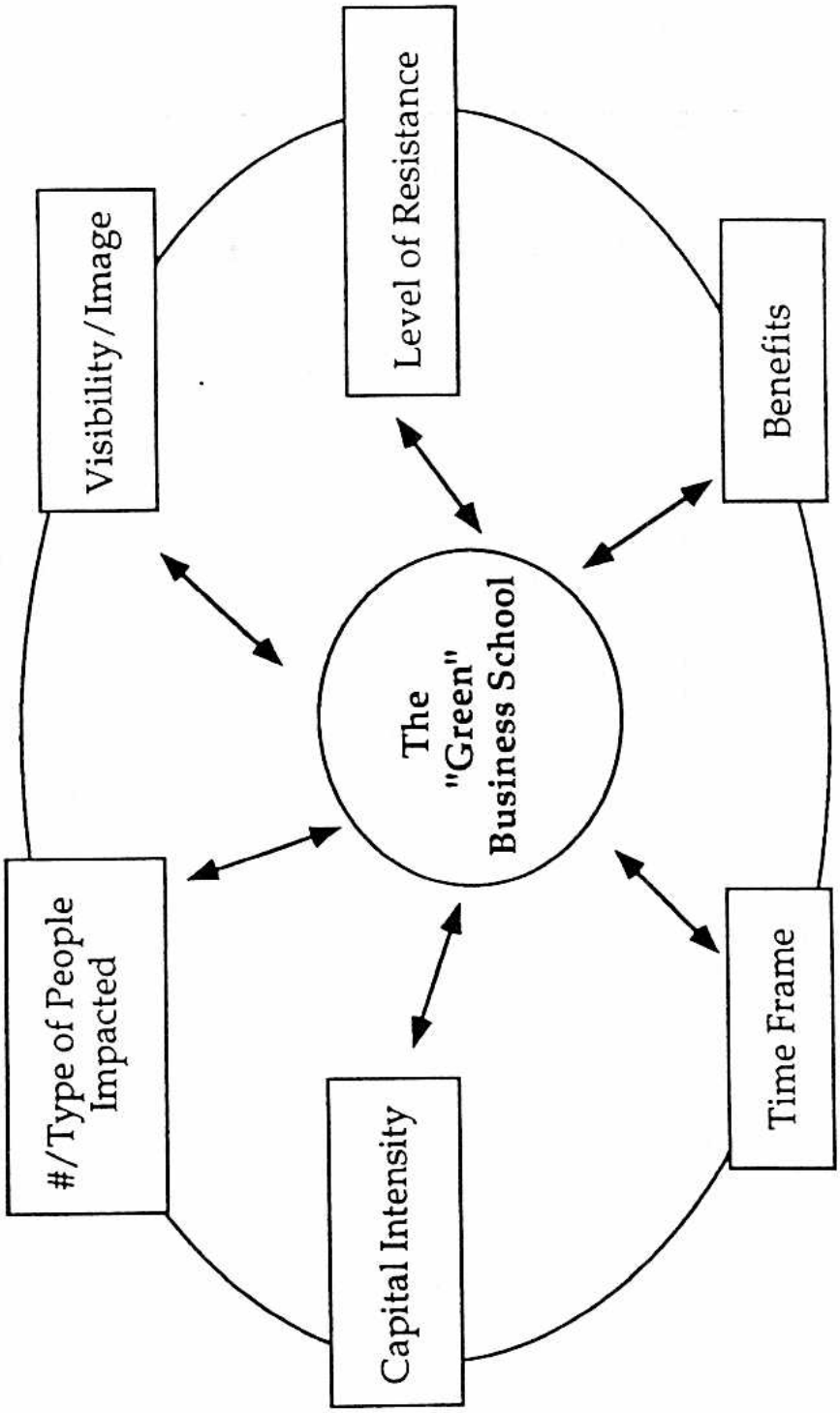
Transportation Services advertises carpool spaces in the *University Record* and in the hospital bulletin in order to boost carpool space sales. In the advertisements, they stress the reserved space and the reduced cost of the parking permit and gas. Since gas prices are currently low, this last tactic has not worked particularly well.

Cleaning

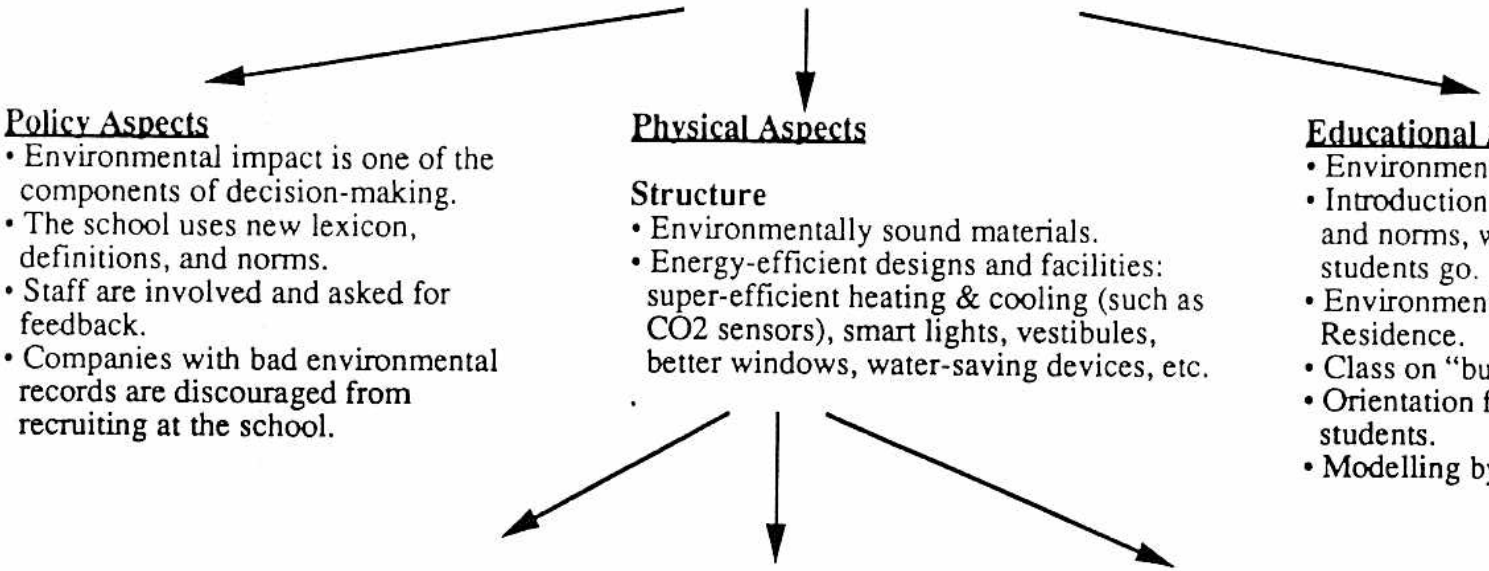
The parking structure is swept, washed and plowed, sanded and salted in the winter. The elevators and stairs are cleaned regularly. During off hours and as spaces empty, the surface is swept and occasionally treated with chemicals that absorb oil and a substance that delays oil absorption.

Appendix III
Initial Business School Models

Michigan Business School Implementation Model: Take 1



A Vision for the School of Business Administration:
"Environmental responsibility is one of the bases for decision-making ... the school is environmentally sound in every aspect of its existence."



Policy Aspects
- Environmental impact is one of the components of decision-making.
- The school uses new lexicon, definitions, and norms.
- Staff are involved and asked for feedback.
- Companies with bad environmental records are discouraged from recruiting at the school.

Physical Aspects

Structure
- Environmentally sound materials.
- Energy-efficient designs and facilities: super-efficient heating & cooling (such as CO2 sensors), smart lights, vestibules, better windows, water-saving devices, etc.

Educational Aspects
- Environmental component in curricula.
- Introduction of new lexicon, definitions and norms, which are carried wherever students go.
- Environmental class in Executive Residence.
- Class on "business and environment."
- Orientation for staff and for incoming students.
- Modelling by all.

Furnishings
- Durable materials
- Replacable parts
- Wood from sustainably managed forests

Operations
- Food: use reusable plates, personal mugs, organic food, and a composting program.
- Offices: make two-sided copies, recycle paper, use post-consumer recycled paper, turn off computers when they are not in use.
- Communication: use an electronic message board and routing slips.

Maintenance
- Use water-based paints.
- Repair things like leaky faucets.
- Use non-toxic cleaners and detergents.
- Practice organic land-scaping.

Appendix IV
Proposal for "Greening" the Business School

Mission Statement (January 8, 1993, draft)

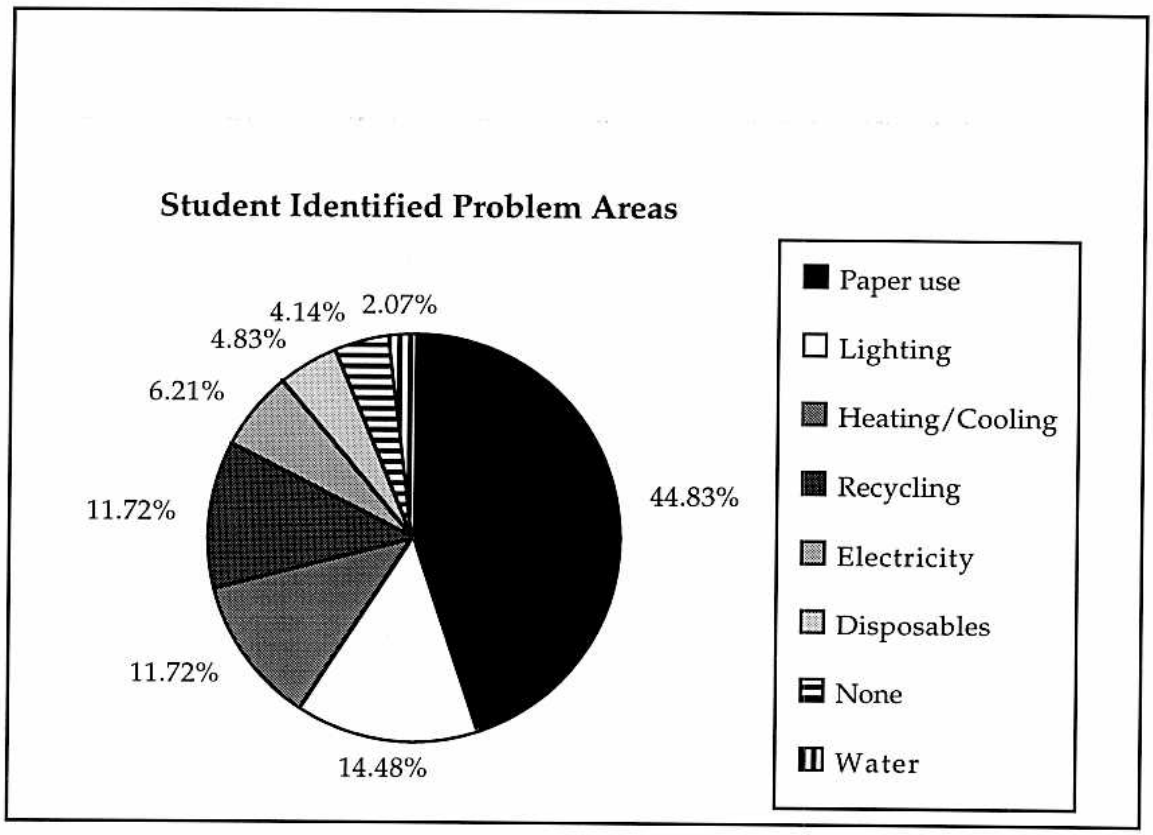
> *"The University of Michigan Business School will become environmentally responsible in every aspect of its operation, including administrative policy, physical operations, and curriculum. The Business School will provide students and executive education participants with direct experience in an environmentally sensitive culture, which will influence their decisions and actions throughout their careers. Other universities and University of Michigan departments will look to this ethos as a model for their own operations."*

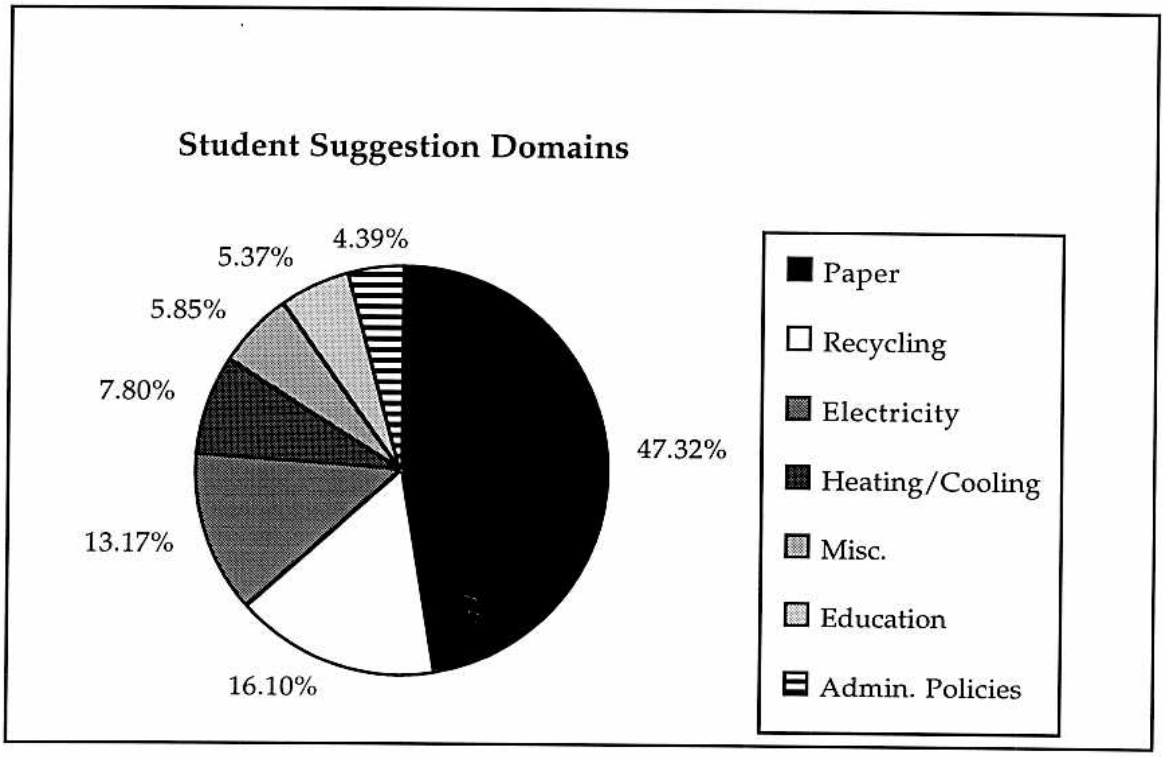
GOALS	STRATEGIES	PROJECTS
Organization and Management		
Students, faculty, and staff will be able to voice concerns and create solutions.	• Gather staff, faculty, and students with expertise or interest in pollution prevention, marketing, and TQM to guide the School in pursuing the environmental-quality mission.	• Survey students and staff about their concerns and ideas. • Create an ongoing "Green Team" within the Business School.
Students, faculty and staff will come to value environmental sustainability.	• Provide experiential opportunities for increasing environmental awareness. • Educate and motivate students, faculty, and staff with informational prompts. • Model environmentally sound behavior and actions. • Recognize progress and innovation.	• Incorporate environmental advocacy into the Global Citizenship programming. • Post "Turn off the lights—conserve energy" prompts. • Use mugs rather than disposable cups. • Report successes in the *Monroe St. Journal*, *University Record*, or departmental reports.

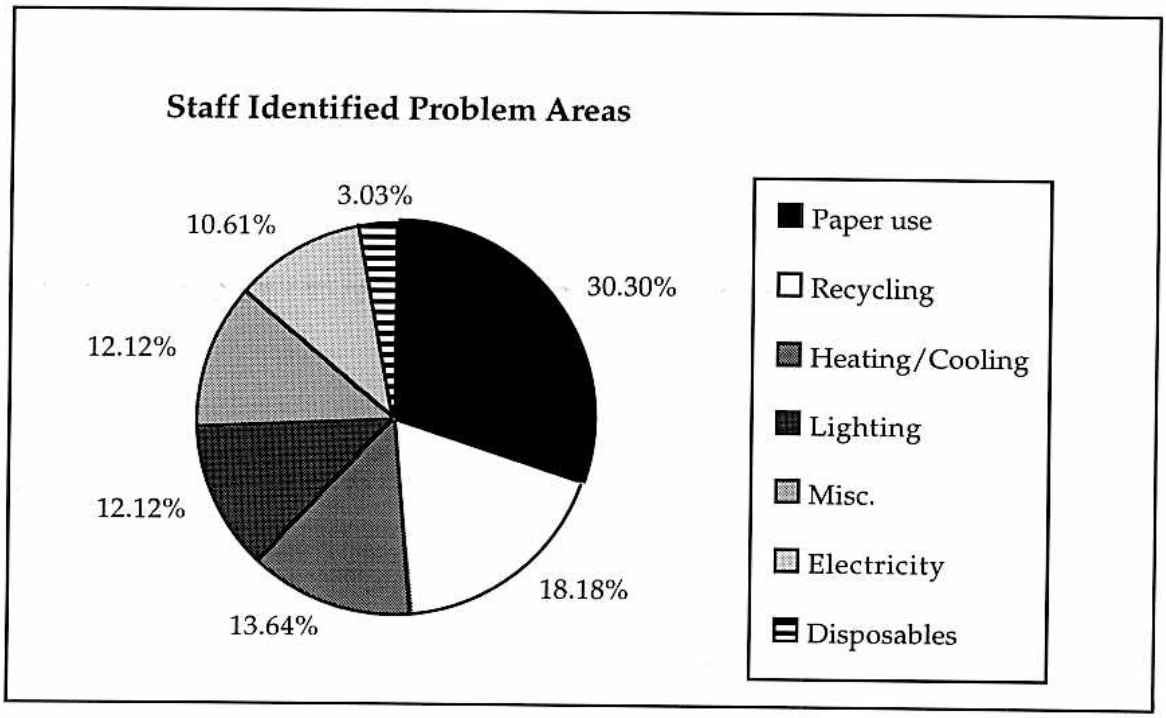
GOALS	STRATEGIES	PROJECTS
Peer schools, key customers, and business publications will recognize the School as the environmental leader.	• Pursue initiatives that build the School's reputation and differentiate it from its competitors. • Publicize the School's innovations and successes. • Cooperate and share knowledge w/other U-M units as well as with businesses and other universities.	• Promote environmental accomplishments in alumni magazine and during recruiting. • Include environmental issues in Global Citizenship pre-workbooks.
Students, faculty, and staff will consider environmental responsibility as one of the main criteria for decision-making.	• Incorporate environmental responsibility as an official part of the "Image of Excellence," as well as the "Substance of Excellence," using the principles of Total Quality Management. • Continually update academic, administrative, and physical operation policies	• Set procurement policies to give price preferences to materials with higher post-consumer recycled content. • Develop energy-efficient building-temperature policies.
Curriculum		
The School will graduate innovative business people who understand and are concerned about the affects of corporate activities on the environment.	• Integrate environmental concerns into the Business School degree programs. • Integrate environmental concerns into the Executive Education programs.	• Integrate case studies, projects, and papers adapted from existing modules and guidelines into curriculum. • Develop curriculum modules. • Increase environmental content of MAP. • Institutionalize GCP project work (e.g., by academic credit for continued community service).

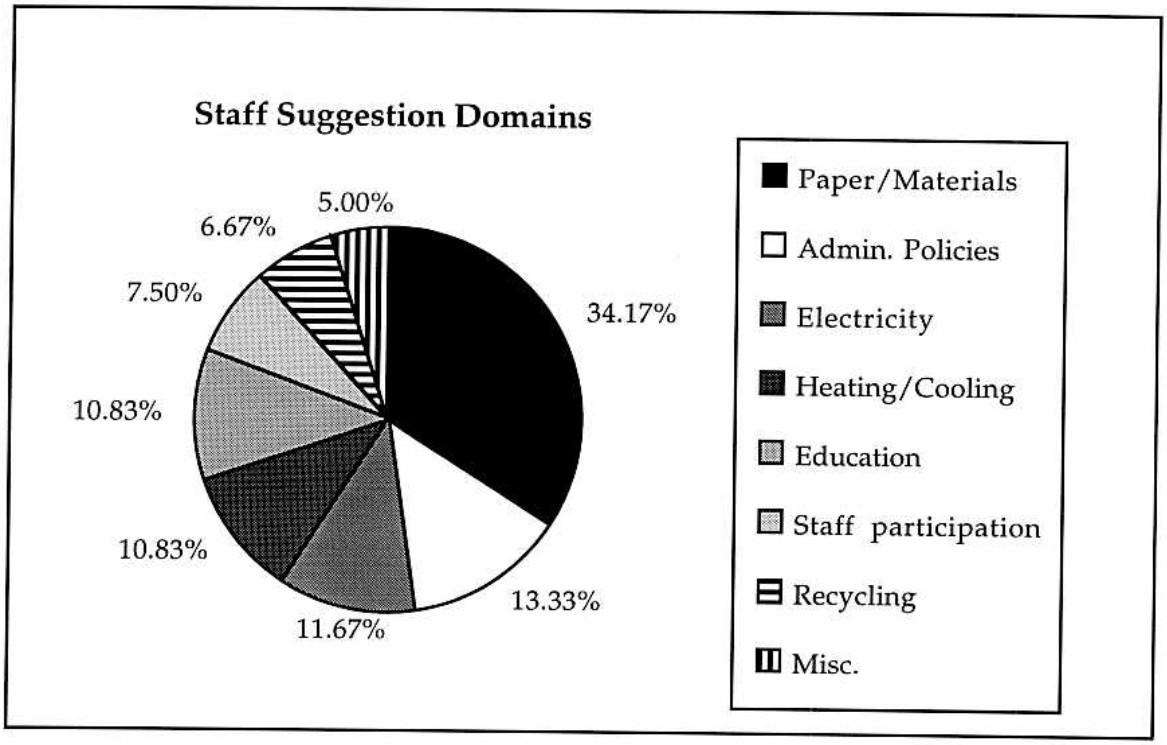
Physical Operations		
The School's structure and operations will be as environmentally sound as possible.	• Minimize use of raw materials and non-renewable energy inputs. • Minimize production of solid, airborne, and waterborne pollutants.	• Use water-conservation technology in Executive Residence. • Implement programs to reduce office paper consumption (e.g., purchase printers and copiers with double-sided printing capability).
The School will continually apply new technology and scientific knowledge to change behavioral norms.	• Consider cost-saving and productivity-enhancing innovations.	• Work with U-M Plant engineers to assess and improve office lighting. • Pursue corporate sponsorship of experimental CO_2 sensors for more efficient air exchange.

Appendix V
Business School Survey Results






Staff Identified Problem Areas
3.03%
10.61%
30.30%
12.12%
12.12%
18.18%
13.64%
Paper use
Recycling
Heating/Cooling
Lighting
Misc.
Electricity
Disposables


Staff Suggestion Domains
5.00%
6.67%
7.50%
34.17%
10.83%
10.83%
13.33%
11.67%
Paper/Materials
Admin. Policies
Electricity
Heating/Cooling
Education
Staff participation
Recycling
Misc.

Staff Responses

Problems Sited. In answer to the question "Have you ever noticed energy or materials being used inefficiently in this building," only one staff member couldn't think of any problems; one said "not too often" and another said "people seem to be environmentally conscious." The other 29 staffers all made suggestions for improvement.

Energy: lighting

7 Lights are left on in empty classrooms, offices, restrooms, meeting rooms (e.g. 3220 and 3254).

1 Some areas are overlit.

"I feel we don't need as many light bulbs in the area where I work."

Energy: heating and cooling

7 Heat is set too high or is not distributed evenly—some windows are open while heat is on.

"Heating/AC units in many parts of the building are ineffective for a good working environment."

"The temperature balance is not right in our section of the building."

"I've noticed some parts of the building are colder than others. Therefore, you find a lot of space heaters being used—ridiculous! A [single] space heater doesn't use that much electricity, but add all the heaters together and what do you get?"

1 Air conditioning makes room too cold in summer.

1 Back doors leading to dock are left open, letting heated or cooled air escape.

Energy: electricity

6 Appliances (computers, adding machines, copiers, TV monitors) are left on when not in use.

"Equipment is not turned off when people are ... out of their office for a couple days"

1 Hobart dishwasher machine's tank heaters left on when machine is not in use.

Solid Waste: paper consumption

16 Too many memos and flyers are distributed to too many people.

"Too much extraneous info sent to too many people."

"[We get] duplicate memos & letters—no strategies mean this kind of thing is recreated constantly"

"Last minute changes in program materials require many materials to be thrown out"

"Why can't memos from the Dean's office be sent by e-mail?"

"Almost all students throw out flyers from the Dean's office because [the information is] of little interest to them"

3 There are one-sided copies of materials which would be appropriate on two-sided copies.

1 Course handouts of overhead transparencies don't use space on page efficiently.

Solid Waste: recycling

8 Paper that could be recycled is being put in trash containers.

"[There is a] lack of recycling done by professors."

"Offices often clean out their files and do not use recycling bins."

"People throw out campus mail [and other] envelopes."

2 Cans and bottles are thrown away instead of being recycled.

2 Some paper is not recyclable.

"Too many glossy brochures."

"Items for outside mail that are sent too late by the originator to warrant U.S. mail ... therefore require faxing or Federal Express."

Solid Waste: disposable items

2 Too many throwaway plastic and paperware supplies used in student lounge.

Miscellaneous Topics

3 Inefficient use of equipment.

"The copying needs of the faculty aren't met by Document Processing...[so] faculty print off laser printers [which are more expensive to run than] copying machines."

"[There is some] careless use of equipment."

3 Remodeling.

"Remodeling that is done around the building [is] a big waste—talk to people who will be using it before implementing plans!"

"Office space [is allocated] inappropriately—departments not centrally located."

1 Landscaping.

"It is ridiculous to plant and replant all spring/summer/fall."

1 Environmental health.

"I worry about the fumes from copiers and printers. "

Solutions Offered. When it came to solutions, the staff had no shortage of ideas for a less material- and energy-intensive environment. Their proposed strategies for communicating and working included education, behavior change, policy change, staff involvement, and better use of technology. The clearest message is that staff really do want to be involved in making the Business School more environmentally responsible. Again and again, they cited the need for education about environmental issues—and staff involvement in solving problems. Perhaps it's best summed up by this quote: *"Thank you for asking, for taking the time and effort to consider our ideas."* Because of their intense interest, staff may well be the Business School's best resource for change.

Solid Waste: reducing paper consumption at its source

8 Whenever possible, use electronic mail or other computer resources for communicating.

"Push for new resources like e-mail."

"Develop electronic applications to replace some paperwork."

"Evolve to a paper-less strategy of sending exams, messages, resumés via electronic means."

5 Don't print or copy as much.

"Students could read more and copy less...and not printed unneeded material from labs."

"Be judicial in use of paper."

4 Print or copy drafts or internal materials on the blank sides of used paper.

"Use [the back side of] reused paper for printing copies that are not for 'customers.'"

4 Before copying or printing, check for mistakes and carefully assess the quantity needed.

3 Post just one copy on a bulletin board where all interested parties have access.

3 Make double-sided rather than single-sided copies.

2 Send one copy of each memo to each office and encourage routing.

"Instead [of multiple copies of paperwork handed out], we could stamp w/a routing list and pass around. Of course, this only works if everyone reads, acts, and passes promptly."

2 Increase and improve use of TV monitors for communicating.

"Use in-house video more effectively."

1 Standardize forms to fight obsolescence.

"[Develop] schoolwide standards for [paper] forms."

Solid Waste: reducing consumption of other paper and plastic goods.

5 Reduce use of disposable items by encouraging use of durable, re-usable items.
"Provide centralized service for washing dishes, utensils, etc., so folks would not use so many paper goods for parties, meetings, etc."
"Encourage ... people to use and re-use 'real' coffee cups."
"Go back to fountain pens."

2 Use fewer plastic refuse bags.
"Do the paper recycling so it doesn't have to be collected in plastic bags."
"Empty trash only when needed—cut down on plastic bags"

1 Find new homes for reusable items.
"Find organizations that can use things (like books and binders) that we throw away."

1 Conserve other materials (such as office supplies?) by limiting their availability.
"[Fewer] materials could be placed in areas rather than the large amounts being currently placed. When such quantities are displayed, people tend to waste."

Solid Waste: improving recycling

5 In general, encourage and increase recycling.

3 Improve the ease/convenience of recycling.
"Set up more recycling areas."
"Put can and bottle recycling containers in more places."
"Use recycle bins more effectively—they are there but need to be emptied more frequently."

Solid Waste: creating new policies

5 Use procurement power to reward "greener" suppliers.
"Purchase post-consumer recycled paper whenever possible."
"Patronize suppliers that use recyclable packing materials."
"Use a copier and laser printer cartridge supplier who recycles them."
"A central purchasing person for the B-School [could get us] volume price discounts."

2 Procure paper that is easily recycled.
"Publish the Dividend *on paper that can be recycled."*

2 Charge students for printing.

1 Force people to recycle.
"Make recycling mandatory for all—professors as well as staff people."

Energy: heating and cooling

6 Fix problems with heating/cooling system—don't needlessly lose heat.
"Rather than opening windows to warm [over-air-conditioned air] or cool [overheated air], pressure maintenance [staff] to take care of problems."
"Get security staff to ... stop doors from being propped open by students."
"HVAC systems should be checked to make sure outside air intake is kept at a minimum in summer and winter. This will substantially reduce our heating and cooling load."
"Fix recurring problems on a permanent level, instead of just for the day. (Example: in the student lounge/3D and 3E areas, [HVAC] hasn't worked right since it was installed seven years ago)."

3 Lower building temperatures in the winter.
"It would help if we dress warmly like pants and sweaters as opposed to business suits."

2 Distribute heat more evenly.

1 Get a better handle on when heat is needed.
"Lower building temperature on weekends."

1 Consider changing schedules to use heat more efficiently.

"I believe students should be in class on Fridays.... all kinds of heat, electricity, etc., are wasted on Fridays when only a minimum of staff work and no students or faculty work."

Energy: electricity

8 Remember to turn off lights when not in use.
- *"Put small signs up to remind people to turn off the lights."*
- *"Use night lights only after building closes."*
- *"[We need] an awareness program.*

3 Use other equipment more efficiently.
- *"Simply turning the tank heaters off when the [Hobart dishwasher] is not in use would save 72,000 kWh of electricity per year. This translates to an annual saving of $5,760."*
- *"Use computers more efficiently."*
- *"Turn off equipment ... when away for a while."*

1 Calculate lighting costs.
- *"How much money does it take to light the [building]? The Business School responds to [financial] data!"*

1 Have more windows and skylights.
- *"More natural light would not only decrease our dependence on Detroit Edison but would also add* greatly *to the environment and the disposition of those sharing it."*

1 Install more efficient lights.
- *"We could set up a group relamping schedule. This increases luminaires and reduces labor (along with cleaning fixtures)."*

Energy: policy and planning

1 Start an energy management program in every department.
- *"The energy management. program should include a formal plan involving implementation of energy management opportunities (EMOs) for at least five years. The formal plan should be annually reviewed and updated. In addition, building personnel should be constantly aware of their responsibility to manage energy."*

General/Miscellaneous Suggestions

1 Landscape more perennials.
- *"Plant bushes/flowers that come back."*

1 Prolong life of equipment.
- *"Don't abuse equipment and surroundings."*

1 Conserve water.
- *""Report problems with water (i.e., in restrooms) more promptly."*

Strategies for Change

13 Educate members of the Business School community about how to conserve materials and energy.
- *"Raise consciousness [with] info on legislation, problems of pollution in Ann Arbor... any info to illustrate great need for conservation."*
- *"Have a 1-2 hour training class on recycling and energy efficiency."*
- *"Educate students as to the necessity of recycling."*
- *"Make everyone aware of the inefficiencies."*
- *"Make [everyone] more aware that this is an environmentally conscious school."*

9 Increase staff participation in decision- and policy-making.
- *"Ask for input from staff and faculty, and listen to it. There is a large amount of experience you're not relying upon."*

"Allow staff to join the Quality Council—those asking to join have a commitment to our School and seek to aide our environment. Allowing passive staff to participate doesn't count—we don't need 'yes' people representing anyone's interest, and it detracts from our responsibilities as a School community without segregation."

"Ask for everyone's help in implementing change."

"Encourage team dynamics."

"How about talking with the users of office space and furniture before making purchases of items that perhaps don't solve the problem?"

6 Improve administrative leadership and modeling.

"We need a firm *statement and example from our Administration outlining acceptable [waste-reduction] practices."*

"Set guidelines and stick to them."

"Reduce/reuse/recycle. Take an attitude of caring for your surroundings, your school, your fellow workers, your university, your planet. People seem to be too busy to care. Make a concerted effort to show others 'the way.'"

"More careful planning or utilization of existing school resources."

"Encourage people to take more pride in facilities or more consideration for their peers."

1 Report on progress.

"[Give] feedback as to good efforts we've done."

1 Reward staff for conservation efforts.

"Tie energy and material savings to incentive programs."

Student Responses

Problems Sited. Six students couldn't think of any; the other 71 respondents all listed something.

Energy: lighting

21 Lights are on in empty classrooms/bathrooms/offices and also when natural light would suffice.

"Nobody seems to want to turn lights off after leaving the room."

"Building lights are on all night."

"Lights in bathrooms are on all *the time—even on bright days."*

Energy: heating and cooling

12 Heat is set too high.

"[Our] buildings are often overheated in winter, especially the classrooms in B and study rooms in K." [Michigan Room and Wolverine Room were also mentioned.]

"On 'warmer' days in the winter, the heat is left going as if it were as cold as normal."

"They don't account for all the people in the room who give off heat!"

3 Heat is not distributed evenly—some windows are open while heat is on.

"[There is] excessive heat in the student lounge and [some] areas of the building. other areas are drafty"

2 Heat escapes.

"[Outside] doors are propped open."

"Windows let in a lot of cold air—could be insulated better."

Energy: electricity

9 Appliances (computers, printers, TV monitors) are left on when not in use.
"Computers aren't turned off after use."
"Sometimes the TV is on when no one is watching it."

Water

3 Some water is being wasted.
"[There are] lots of leaking water faucets."
"Water in the restroom is left running."

Solid Waste: paper consumption

36 Too many memos and flyers are distributed in mail folders and on walls.
"The flyers and poster which grace (or deface) the walls around this place (the lounge and the halls) have reached epidemic proportions."
"The indiscriminate use of fliers and memos here is mindboggling. Student and faculty print these at the drop of a hat, it seems!"
"One flyer for everyone in the school is crazy."
"Every day there are three or four notices, etc., which I immediately toss out."
"We [already] know about events from MSJ and friends."
"The paper in our mail folders [is usually] unnecessary information that could be distributed by computer or mass media."

18 People print and copy more than they need and don't copy enough things double-sided .
"Students ... print out too many rough drafts ... of their reports in the computer lab."
"LaserJets are free in lab—there is no cost to overuse."
"[Too many] single-sided copies [when double-sided would do]."
"We use way too much paper."

6 Course handouts of overhead transparencies don't use space on page efficiently.
"Why can't [professors] print on both sides?"
"Many overhead notes are circulated in classes; these photocopies of slides contain little information. I noticed only one professor who had reduced the slides for the handout."

4 Too much newsprint is used.
"Why are there so many extra copies of the MSJ?"
"The Monroe Street Journal *has unnecessary filler"*

1 The computer room throws away blank sheets of paper.

Solid Waste: recycling

10 Paper that could be recycled is being put in trash containers.

7 Recycling is confusing or difficult.
"How do we recycle colored paper flyers? Since I'm unsure, I often throw all office paper in the trash."
"We were supposed to have bins for newspapers. but I haven't noticed any."
"Recycling bins are located in inconvenient spots."

Solid Waste: disposable items

6 Too many throwaway plastic and paperware supplies used in student lounge.
"Excessive usage of food containers, milk cups, spoons, etc."
"Sometimes snack bar [staff distribute] paper plates unnecessarily, or give too many—oftentimes they go in the trash."

1 Too many paper towels are consumed.
"Paper towels in restroom are stacked on counters leading to using too many"

Solutions Offered. Two respondents said they couldn't think of any solutions; one said that conservation is "not the role" of students, staff or faculty; and one said "I'm not sure. But I think it's cool that you're trying to save energy. I honestly don't spend enough time here to notice." When it came to reducing the paper glut, many students asked for increased use of (and access to) TV monitors and online communication resources. Their other solutions were less technical in nature, focusing mainly on noticeable changes like turning the heat down or turning lights off in empty rooms.

Solid Waste: reducing paper consumption at its source

19 Whenever possible, use e-mail or other computer resources for communicating.
- *"Have messages on a B-School network [instead of on] flyers."*
- *"Distribute the information ... online to targeted students."*
- *"Make MTS more available and use it to disseminate info."*
- *"People* must *use e-mail—make it a requirement."*
- *"We may need ... dedicated terminals ... strictly for e-mail, with time limits."*

17 Post flyers on a few bulletin boards rather than putting a copy in each mail folder.
- *"A simple posted schedule would be sufficient to communicate ... events."*
- *"Develop a set of rules as to posting of flyers."*
- *"Put a special board in the lounge where the flyers that end up in* everyone's *mail folder could be posted there in a single example (saves 400 sheets right there!)."*
- *"Trust that we'll discover B-School [events] on our own."*

12 Increase and improve use of TV monitors or M-Track for communicating.
- *"Make the news monitors more accessible to students."*
- *"[Get students to] quit complaining when a flyer is not placed in their folder and learn to read a damn TV screen."*
- *"The video monitors around the school are helpful. More events should be posted on them"*

10 Encourage professors to use or require less paper in their classes; reuse coursepacks.
- *"Duplex printing of course packs where applicable."*
- *"Provide pre-printed class notes (double-sided): students would use less paper...and would not have to make copies [of] notes on reserve in library,[which] wastes more paper."*
- *"Reuse course cases in different classes to reduce costs and copy fees."*
- *"A more precise selection of class materials could be used."*
- *"Choose shorter readings; select less verbose books.""*

7 Don't print as much in the computer lab.
- *"We won't waste as much [paper] if we have to pay for it."*
- *"Computer lab should stress utilizing 'print preview.'"*
- *"LaserJets could be set to print double-sided."*
- *"Re-program computer so that extra blank copies of paper don't appear between projects."*

7 Don't use as much paper in general.
- *"Encourage/force clubs to cut down on the paper trail: establish some policies to reduce stuff in our mail folders."*
- *"If one office puts out info (i.e., MBA alumni profiles)...then there is no need for another office to reproduce that info and then redistribute it to the B-School population."*

5 Print announcements in the *Monroe Street Journal* instead of on individual flyers.
- *"Print notices/corporate flyers in* MSJ *instead of xeroxing and dropping in every mailbox."*

"Staff and faculty could make better use of MSJ*'s resources."*

4 Use the back sides of paper too before recycling it.
"It's definitely a 'culture' thing. The recycling programs are good—maybe encourage people to reuse the back of paper like this [survey]."
"Use white computer paper as scrap paper—students could do this."

3 Condense information on flyers so each sheet can hold more information.
"Have one leaflet with several pieces of info on it."

2 Only put flyers in the folders of people who would be interested in the information.
"Put flyers only in mail folders of club members or students interested in the information."

3 Miscellaneous ideas:
"Leave a few flyers where interested students can pick them up."
"More info/PR/pressure signs in lounge."

Solid Waste: reducing consumption of other paper and plastic goods

8 Reduce use of disposable items by encouraging use of durable, re-usable items.
"Put cloth towel systems (rotating) in rest rooms."
"[Have an] in-lounge sale of [reusable] cups and [give a] discount for using own cup."
"No styrofoam plates in lounge."
"Conserve paper plates—perhaps use different sizes so multiple plates aren't necessary."
"Replace plastic spoons and food wrapping with reusable plates, knives, forks, etc."
"Stop giving out receipts in the lounge."

Solid Waste: improving recycling

33 In general, encourage and increase recycling; make it easier and more convenient.
"[Put a] paper recycling box by lounge door as well as by mail folders."
"Add a bin for newspapers....more bins in classrooms, lounge, library..."
"Recycle course packs—have a drive or a collection."
"Encourage people to put recycled material where designated."
"Make sure recyclable paper is recycled and not thrown away by maintenance."
"Pay attention more....make recycling more of a priority....run some sort of campaign?"
"We have to make it easy. B-School students don't look for ways to recycle but will likely participate if it is handed to them."

4 Procure recycled paper.
"Only use recycled paper products, including published material."
"Make the use of nonrecyclable glossy flyers against the rules, etc."

Energy: heating and cooling

3 Lower building temperatures in the winter.
"Wear sweaters"

3 Don't needlessly lose heat.
"Close [outside] doors."
"[Build an] enclosed walkway from the Administration Building to Paton."
"[Install] revolving doors to save heat."

10 Control and monitor heat.
"Many times the climate control system is...blowing wrong temperature air"
"Better insulation."
"Better monitoring and response to complaints [about too much heat]."
"Independently controlled climate control in each room."
"More careful monitoring of building temperatures."

Energy: electricity

21 Remember to turn off unneeded lights, or use heat- and motion-sensors to turn lights off.
- *"[Use] heat and motion sensing for lighting of rooms."*
- *"Put lights on timers."*
- *"Everyone should get into the habit of turning [classroom lights] off if no class follows (also in rest rooms!)"*
- *"Have someone around turning off lights."*

1 Increase use of natural light.

5 Use other equipment (computers, TV, overhead projectors) more efficiently.
- *"Don't allow profs to keep their own refrigerators in offices."*

General Strategies for Change

11 Educate and raise awareness of B-School community about conserving materials and energy.
- *"Build awareness of the scarcity of natural resources and the consequences of waste."*
- *"Educate [people about] costs."*
- *"Maybe [have] a class on energy saving in the workplace, or a committee whose job is to find inefficiencies."*
- *"More education—reminders to recycle (on posters or in* MSJ*)."*
- *"Publicize the goals/strategies better—make people aware that it is important."*

5 Improve administrative leadership and modeling; create policies.
- *"[We] need administration commitment to change...instead of just discussing it."*
- *"Create an atmosphere where waste of paper is frowned on.*
- *"[Create] official policy by B-school and [show] commitment to it."*

4 Encourage participation by all members of the B-School community.
- *"Voice more concern to the school—many people have opinions that aren't heard."*
- *"[Organize] a few brain-storming sessions of staff and faculty."*
- *"All should make an effort to deal with this problem."*
- *"[Faculty, staff, and students should] clean up after themselves."*

Miscellaneous Suggestions

6 Energy:
- *"Have Detroit Edition's conservation department do an energy audit to find where the B-School is wasting energy."*
- *"Use alternative sources of energy (i.e., solar, gas)."*
- *"Close down sections of the building when they are not in use at night."*
- *"Stress the importance of energy saving through flyers or posters around the school."*
- *"Report abuses of heat.*
- *"[Install] water misers in restrooms."*

6 Materials:
- *"Make people pay for waste."*
- *"Post waste amounts. Set conservation goals. I think people are just not aware."*
- *"Recycle, reuse, reduce!"*
- *"[Have] surveys such as this to identify waste."*
- *"Think. Act."*

Appendix VI
Completed Business School Surveys

Your Business School: Is It Efficient?

1. Have you ever noticed energy or materials being used inefficiently in this building? Please give examples.

Yes. The heating/air conditioning units in many parts of the building are ineffective for a good working environment. The copying needs of the faculty aren't met by Document Processing, and because of that unmet need, faculty print off of laser printers instead of using copying machines, which are less expensive to run. Computers are left on, as are lights.

It is ridiculous to plant + replant all spring/summer/fall. Plant bushes/flowers that come back.

People do not recycle as much as they should (and they are slobs with the garbage they do have).

→ Remodelling that is done around the building – a BIG WASTE – talk to people who will be using it before implementing plans!

2. What strategies could help the Business School use energy and materials more efficiently?

Ask for input from staff + faculty, and listen to it. There is a large amount of experience you're not relying upon.

Fix recurring problems on a permanent level, instead of just for the day (ex.: our heating/air conditioning hasn't worked right since it was installed 7 years ago – student lounge/3D + 3E areas).

3. What do you think Business School students, faculty, staff, and administrators could do to save energy and materials in this building?

Reduce - Reuse - Recycle. Take on an attitude of caring for your surroundings, your school, your fellow workers, your University, your planet. People seem to be too busy to care.

Making a concerted effort will show others "the way".

Please note if you are ☐ student ☒ staff ☐ faculty ☐ administrator

Thank you!

This survey is printed on 100% reused paper.

Your Business School: Is It Efficient?

1. Have you ever noticed energy or materials being used inefficiently in this building? Please give examples.

Yes - incredible volumes of paper - - many handouts don't need to go into folders.

Also - lighting is efficient, but there are many appliances all over the school

2. What strategies could help the Business School use energy and materials more efficiently?

Don't allow all profs to keep their own refrigerators in offices

3. What do you think Business School students, faculty, staff, and administrators could do to save energy and materials in this building?

Voice more concern to the school - - many people have opinions that aren't heard.

Please note if you are ☒ student ☐ staff ☐ faculty ☐ administrator

Thank you!

This survey is printed on 100% reused paper.

Appendix VII
Green Team Charter

"The University of Michigan School of Business Administration will become environmentally responsible in every aspect of its operation, including administrative policy, physical operation, and curriculum. The business School will provide students and executive education participants with direct experience in an environmentally sensitive culture, which will influence their decisions and actions throughout their careers. Other universities and University of Michigan departments will look to this ethos as a model for their own operations."

A crucial role in achieving this mission will be undertaken by an established committee, or Green Team. Through the on-going process of incorporating structural and policy change, this team will lead the School in its visionary endeavor of working towards environmental responsibility. The team will undertake continuous goal setting based on current waste information, new technologies and organizational change theories; it will then formulate and implement strategies and evaluate the effectiveness of these strategies. Feedback should be provided to the whole school to emphasize the importance of each individual's participation in such change.

Participation in the Green Team will thus allow members to be involved in an innovative project and ground-breaking work. It will create an arena where members can gain experience in topics with which they are unfamiliar. Finally, the team will provide the opportunity for people to initiate ideas and implement strategies which will create positive environmental change.

Structure and Operation

Provisionally, the core membership of the team will consist of 2 faculty members, 2 administrators, 4 staff members and 2 students with at least one staff person from the executive residence. Dean White will serve as an ex officio member and will be invited to all meetings. He will be apprised of the Green Team's progress through e-mail meeting minutes.

Two Options for Operations:

1. At the beginning of each academic year, the core team will solicit and generate ideas for both long and short term pollution prevention projects. Having decided which projects to implement, the team will break into subcommittees composed of at least one core member and other volunteers recruited for the projects.

2. Team will decide to work on projects concerned with one area of pollution prevention throughout the year.

The Green Team should meet once a week from its inception to the end of April. To ensure that a proper transition occurs, these meetings will be held with the members of the Pollution Prevention Master's Project. After April, the Green Team will meet bi-monthly.

Appendix VIII
Proposed Green Team Meeting Agendas

Meeting 1
What is the Green Team?
Importance of equality; equality exercises
Rules of conduct
Our vision of the Green Team
Assignment: generate greening strategies and mission for the green team

Meeting 2
How to make use of us over the next few weeks
Introduction to a contact person
Discuss focus and mission
Survey results

Meeting 3
Suggestions for projects, specifics, types
Rules and tasks; division of functions
Introduction to a contact person
Measurability
Goal-setting

Meeting 4
Introduction to a contact person
Resource binder
Behavior change issues and concepts
Roles, tasks, and functions revisited

Meeting 5
Introduction to a contact person
Loose ends

ELECTRIC AUDIT - SCHOOL OF BUSINESS

DATE: _____

OOM NUMBER _____ HALLWAY _____

LASSROOM _____ OFFICE _____

GHTS:

FLUORESCENT:

	TYPE OF EQUIPMENT	# OF FIXTURES	BULBS PER FIXTURE	WATTS/LAMP	HRS USE/DAY	DAYS/YEAR ROOM IN USE
1						
2						
3						
4						
5						
6						

INCANDESCENT:

	TYPE OF EQUIPMENT	# OF FIXTURES	BULBS PER FIXTURE	WATTS/LAMP	HRS USE/DAY	DAYS/YEAR ROOM IN USE
1						
2						
3						
4						
5						
6						

FFICE EQUIPMENT, APPLIANCES, ETC.:

	TOTAL NUMBER	POWER RATING	HRS USE/DAY	DAYS USED/YR		COMMENTS	
OMPUTER							
YPEWRITER							
OPIER							
AX							
ICROWAVE							
OFFEEPOT							
INDOW AIR COND							
ADIO							

Appendix IX
Lighting Audit Worksheet

Appendix X
February 1, 1993 *Monroe Street Journal* Article

B-school Looks For Cutbacks..in Waste

Should you watch more TV? Many Business School students think you should. However, they are not referring to the one in your living room but rather to those in the corridors of the Business School where upcoming events are listed.

This suggestion was only one of those made in response to a survey conducted to get student and staff input on waste reduction, during the past two weeks One of the overwhelming concerns was the avalanche of memos which descends on mail folders daily. Survey respondents suggested TV monitors as one method of reducing the memo overload.

The survey was conducted by School of Natural Resources and Environment (SNRE) students who have been invited by Dean White to help make the Business School more environmentally responsible. One of the goals of this project is for the Business School to be recognized, as part of its image of excellence, as an environmental leader and to serve as a model for other schools. This innovative model will incorporate environmental concerns into physical, technical, behavioral and policy aspects of school life. "I strongly support this student initiative to make the Michigan Business School a model of environmental responsibility," says Dean White. "I want our students to hear about leading-edge concepts and practices in our classrooms and to see them put into effect here at the

Waste Reduction

continued from page 1

School." Accordingly, the B-School will be the first to make changes which will soon be seen not just as good citizenship, but also as a business imperative.

The survey was a first step to elicit involvement from members of the Business School community in this project. In addition to too much paper, many respondents voiced concern about a lack of recycling bins and unclear information as to what can be recycled, maladjusted temperatures, drafty windows, and lights left on in hallways overnight and in empty rooms. There was also some enthusiasm for a textbook and coursepack exchange system.

The project's next step is to form an advisory committee, a "Green Team" within the school to discover and implement strategies to keep the Business School in the forefront of environmental responsibility.

The SNRE students would like to thank the 150 students and staff members who have answered the survey, and to invite anyone interested in becoming further involved, getting more information or offering suggestions to leave a note in the "ppbiz" folder in the club mail folder section in the student lounge (on scrap paper, please) or, even better, send e-mail to: ppbiz@.um.cc.umich.edu .

Appendix XI
Questions for OSEH's Hank Baier

After reading the materials that you provided us and discussing the development of a chemical tracking project at U of M, we found that there were a number of general questions that we needed to clarify in order to ensure that we focus our energies in the proper direction. We do not expect that you will have answers to all of these questions, but this list will give you a good idea of the direction that we are moving in. We are looking forward to meeting with you on Tuesday, October 6, at 2:00pm.

Background Information

1) How do we obtain information on how many individual labs are using hazardous materials? Do you have any contact names?
2) Can we get access to the list of people to whom Jeff Hacala sent his surveys?
3) How can we get information on purchasing practices for chemicals at U-M?
4) Does one need to be authorized to order chemicals? If so, do you have a list of the authorized users on campus?
5) What are the existing policies governing the use and transport of hazardous materials at U of M? Who currently ships materials and can they go to any site on campus?
6) Does the chemistry department keep track of the amount and type of chemicals used on campus?

Logistical Questions

1) Would it be helpful to focus on the Chemistry Department as a model for the chemical tracking and exchange program?
2) What are the general steps that you envision will have to be taken in order to establish a chemical tracking program at U of M?
3) What steps could we realistically take this semester?
4) What steps do you envision we will need to take to get support from the university community (ie. staff and faculty)?
5) What areas of resistance do you think we will run into?
6) Is there EPA guidance for universities under SARA or other laws?

Appendix XII
Questions for University Interviews

General Questions

Why do you use a chemical tracking system?
Who uses or has access to the chemical tracking system at your university?
When did you start using one?
Does it perform the tasks you anticipated?
What resources in terms of people, computers, etc. are needed to run this system?
What are the benefits of a tracking system?
What are the difficulties?
Did you consider waste minimization as a benefit of using a tracking system?
If you were to proceed differently, what might you do differently?
What other universities do you know of that use a tracking system?

System Specific Questions

Is (ChemTox . . .) well adapted to the needs of a university?
Why did you choose this system?
Did you examine other systems besides (ChemTox . . .)?
What do you wish this system would do that it does not?
What type of training or product support does this company offer?

Chemical Sharing Questions

Do you have a chemical sharing program at your university?
If so, how does it work?
What benefits have come from this program?
What difficulties have been encountered by sharing chemicals?
How do you prevent contamination of chemicals?
Can you include chemicals purchased with different grants?
How does your university publicize it's chemical sharing program?
What other universities do you know of have chemical sharing programs?

Appendix XIII
Pollution-Reduction Project Ideas for Students

Food Waste

Start a food composting pilot in a small residence hall. Make it a joint project between the residence halls' dining services unit and your campus's plant department (or whatever department is responsible for landscaping and waste management). Use the compost to condition soil in landscaping operations. Broadcast the results in the student and staff newspapers. Benefits: cost savings (in hauling trash and procuring mulch); education (about biological cycles and the web of life).

Recycling

Recycling offices are springing up at campuses all over the nation, and most would like to work with student organizations if they have special projects in mind. Perhaps these projects can even satisfy some of your academic requirements. Contact your campus waste-management division.

Computers and Electricity Consumption

Investigate the situation of computers being left on when people are not using them. Many computer consultants themselves do not seem to know if this is the best choice. The argument for it is that it saves wear and tear on the on/off switch and that, supposedly, electronic devices wear out faster when powered on and off more frequently. However, this may be much less important that the skyrocketing electrical consumption due to computer use. Obviously, there is a tremendous need for research on how much electricity would be saved and how much "damage" would actually occur to the computers. Perhaps students in physics or engineering would be especially interested in this project.

Paper

Using the Smallest Amount of Paper Possible

- Avoid double-spacing text.
- Avoid excessive printing of drafts—proofread on the computer screen
- Circulate single copies (of memos, documents, periodicals, and reports) instead of producing or buying a copy for everyone

- Print or copy on both sides of the page—designate one paper tray as "final" and the other as "draft," stocking it with paper that has either been used on one side or is 100% recycled.

- Convert once-used paper into telephone message pads, hanging folder labels, scratch pads, or other small paper items. Small pieces of paper and paper clips can replace Post-It® notes, which are not recyclable.

- If you have an ink-jet type printer, print "draft" copies (which constitute most of what gets printed) on the back sides of outdated letterheads, sheets from obsolete publications, or other items found in your recycling bin.

- Keep customer mailing lists current, or find out if some people want to share copies of your publications

- Save back-up copies of documents on computer disks rather than making extra paper copies.

Reducing the Amount of Paper in Your Mailbox

- If your office or department receives duplicate publications, offer to share subscriptions with other people.

- If you are receiving unwanted publications (anything from magazines to campus flyers), try to get them stopped.

- If you are receiving unwanted advertisements, write to the Direct Marketing Association, Mail Preference Service, POB 3861, New York, NY 10163-3861,
  and request that your name or business be removed from mailing lists. Be sure to include all permutations of your name and address.

Producing Publications That Can Be Easily Recycled

- Choose staples over glued bindings, choose unglossed coverstock, and avoid heavy inking in bold colors as much as possible.

- Avoid glossies, strongly colored paper, paper with plastic strips or coatings, pressure-sensitive glues, and carbon copies.

Other Materials

Using as Little Packaging as Possible

- Ask suppliers and vendors not to overpackage orders.

- Try to order merchandise with minimal packaging, in concentrated form, and in bulk.

- Request that deliveries be shipped in returnable containers.

- Reuse foam "peanuts" and cardboard boxes or give them away. (University Stores will accept some used packing materials for reuse.)

- Repair and re-use wooden pallets, or give them to University Recycling.

- Replace cardboard boxes with durable boxes for shipping on campus.

Being "Environmentally Responsible" With Office Equipment.

- Purchase used or remanufactured office equipment—start with U-M Property Disposition.

- Invest in high-quality, durable, repairable equipment that facilitates source reduction:

  —copiers that easily make two-sided copies

  —computer printers that can handle paper that's already been printed on one side (such as ink-jet printers), or that cut pages wherever the text ends rather than every 11 inches.

  —dishwashing equipment and durable dinnerware

- Use rechargeable batteries.

- Recharge fax-machine and laser-printer cartridges—some local companies return one free toner cartridge for every eight that they pick them up. Investigate having printer ribbons re-inked.

Providing and Encouraging Reusable Items Rather Than Disposables

- Buy envelopes that can be easily re-addressed and re-sealed. As a public-relations measure, have a rubber stamp made that says "The [name of your department] asks you to re-use this envelope."

- Provide, or encourage employees to bring in, reusable mugs and plates and utensils.

- Buy refillable pens and distribute refill cartridges to employees.

Purchasing Recycled Materials

- Ask specifically for products that have been made from post-consumer waste—this "closes the loop" and opens up markets for the paper that you are already recycling. University Stores has a database of "environmentally friendly" products.

Appendix XIV
Conference Presentations

June 2, 1992: Three team members explained Greg Keoleian's materials-flow model (see page 10), the components of our audit, anecdotal results, and plans for the rest of our project at the "Recycling and 'U'" conference held in the Michigan Union.

September 2, 1992: In the Rackham School of Graduate Studies, three team members explained our project's goals and accomplishments at the Advisory Board meeting of the National Pollution Prevention Center. One person gave another update at the next Advisory Board meeting, which was held January 7 in the Business School Executive Residence.

October 1992: One Polprev representative participated in a panel discussion on institutional recycling at the Michigan Recycling Coalition meeting in Lansing, MI.

October 17, 1992: Two team members participated in the regional Student Environmental Action Coalition conference, which was held on the U-M campus. At a workshop on campus environmental audits, they gave tips on planning audits and procuring information from university staff.

November 9, 1992: One PolPrev representative spoke at the weekly meeting of a student environmental group regarding the audit PolPrev conducted, directions in which PolPrev is going and directions for the future.

January 5, 1993: Two PolPrev members presented the project to the Advisory Board meeting of the National Pollution Prevention Center.

February 1, 1993: Three PolPrev representatives made a short presentation to the first-year graduate students in SNRE's masters project planning course. We briefly described our project's goal, listed our accomplishments and plans to date, and "recruited" students for a new masters project for 1993-94.

February 18, 1993: One member of our Business School group gave a presentation in a Corporate Environmental Strategy course comprised of Business School and SNRE students. She described the Business School project and invited Business students to become involved with the Green Team.

April 28–30, 1993: At the Biennial Pollution Prevention Roundtable Conference in San Diego, two PolPrev members spoke about PolPrev as an example of current P2 efforts at universities. Roundtable members include federal and state government officials and industry representatives.

Appendix XV
Annotated Bibliography and Information Clearinghouses

Chapter 1: Introduction

"The Campus and Environmental Responsibility" (1992) *New Directions for Higher Education* Eagan, D.J. and Orr ,D.W. eds. San Francisco: Jossey-Bass Publishers, Inc., #77, Spring, Volume XX, Number 1.

This book is a collection of articles written about pollution prevention activities that have occurred at American universities. It includes articles such as "Campus Environmental Audits: The UCLA Experience" By April Smith and Robert Gottlieb and "Can Brown Be Green? Lessons from One University's Quest for Environmental Responsibility" by James Corless and Harold Ward.

Facility Pollution Prevention Guide (1992) U.S. Environmental Protection Agency Office of Research and Development, Washington, DC 20460, May, EPA/600/R-92/088.

This is a follow-up to the Waste Minimization Opportunity Guide of 1988. This document deals with the multi-media pollution prevention approach and upholds the principles of the 1990 Pollution Prevention Act. It employs a general approach for use by companies in all businesses and geographic areas.

Getting at the Source: Strategies for Reducing Municipal Solid Waste (1991) World Wildlife Fund and The Conservation Foundation Publication, P.O. Box 4866, Hampden Post Office, Baltimore, MD 21211.

This is the final report of the Strategies for Source Reduction Steering Committee. It details the emergence of source reduction for solid waste and various approaches, outlines an evaluation framework for selecting source reduction opportunities, and discusses strategies to encourage source reduction —what we can do now.

Guides to Pollution Prevention: Research and Educational Institutions (1990) U.S. Environmental Protection Agency, Risk Reduction Engineering Laboratory and Center for Environmental Research Information, Office of Research and Development, Cincinnati, EPA/6255/7-90/010, June.

This guide provides an overview of waste generating processes and operations that occur in educational or research institutions and presents options for minimizing waste generation through source reduction and recycling. It includes worksheets and a list of waste minimization options developed through assessments of three research and educational institutions in the Los Angeles area.

McDonald's Corporation and Environmental Defense Fund's Final Report of the Waste Reduction Task Force (1991) April.

While this document does not directly relate to universities, it is the classic positive example of corporations and environmental organizations working hand-in-hand to prevent pollution and is well worth reading.

Resource Integration Systems, Ltd. (1991) *53 Simple Things Universities and Colleges Can Do to Reduce Waste: Case Studies of University Source Reduction, Recycling, and Composting* Prepared for Integrated Solid Waste Management Office, Board of Public Works, Los Angeles, California.

This guidebook is intended to help colleges and universities improve waste reduction and recycling activities on campus. It consists mostly of case studies illustrating how academic institutions have practiced creative waste reduction and reuse. A directory is provided for people looking for more information regarding specific programs.

Starting Points for Action on Waste Prevention (1990) Michigan Office of Waste Reduction Services—Departments of Commerce and Natural Resources, P.O. Box 30004, Lansing, MI 48909, November.

This document is based on 25 in-depth interviews with representatives of companies regarding the issue of waste prevention. The companies represent five manufacturing industry areas. It helpfully outlines reduction opportunities that companies generally consider easy and more difficult to initiate, defines terms, describes conditions necessary to make waste prevention and priority, and discusses gaps in technology and experience. Basic concepts as well as quotes from interviews are presented.

Chapter 3: Theoretical Bases for Demonstration Projects

Arnstein, S. (1969) "A Ladder of Citizen Participation." *Journal of the American Institute of Planners* 35: 216-224.

This article likens citizen participation to citizen power. The author creates an eight rung ladder with each rung corresponding to the citizen's power to effect change. "Manipulation" and "therapy" are the two bottom rungs which describe non-participation designed to "educate" or "cure" the participant. "Informing," "consulting," and "placation" are rungs three, four, and five. These are classified as tokenism by Arnstein because they allow the participants to air their concerns to those in power but do not assure that their concerns will be addressed. "Partnership," "delegated power," and "citizen control" make up the highest rungs of participation and are described as degrees of citizen power.

Aronson, E. and O'Leary, M. (1983) "The Relative Effectiveness of Models and Prompts on Energy Conservation: A Field Experiment in a Shower Room." *Journal of Environmental Systems* 12:3 219-224.

This study was designed to get people showering in a shower room to turn off the water while they were putting shampoo on their hair or soap on their bodies. This study took place during a drought. Large, specific signs induced compliance, however, some people

took very long showers which the authors see as a negative reaction to the signs telling them what to do. Modeling in addition to the sign prompt increased compliance (49% as opposed to 19% with just the sign). Two models increased compliance even more (to 67%). Thus, combination of prompts and modeling is more effective than just prompts.

Becker, L.J. (1978) "Joint Effect of Feedback and Goal Setting on Performance: A Field Study of Residential Energy Conservation." *Journal of Applied Psychology* 63:4 428-433.

The article starts: "one of the best-established findings in psychology is the positive effect of information feedback or knowledge of results on performance". Becker postulates that without feedback, working toward a difficult goal is frustrating, and that without a goal, feedback is useless. This study shows that both, a difficult goal, and feedback on how well people are doing in relation to that goal are important components in achieving high goal-related performance. The combination of goal-setting and feedback makes people more motivated to conserve. Becker brings up the important difference between goal assignment and goal acceptance, but does not fully explore it.

Brown, L.D. (1983) "Organizing Participatory Research: Interfaces for Joint Inquiry and Org. Change." *Journal of Occupational Behavior* 4:9-19.

Cultural factors (e.g., values, beliefs, norms, formal structures such as the division of labor and distribution of power), and technological processes (e.g., procedures for defining problems, designing research, collecting and analyzing data, utilizing findings) combine to shape the interaction of researchers and those being researched in organizational inquiry. Well-developed cultural factors, formal structures, and technological processes from the experimental and survey research traditions in behavioral science are compared with similar patterns from the emerging tradition of participatory research.

Brown, L.D. and Tandon, R. (1983) "Ideology and Political Economy in Inquiry: Action Research and Participatory Research." *Journal of Applied Behavioral Science* 19:277-294.

The article compares action research and participatory research methods, traditions and values. The participatory tradition emerged from work with oppressed peoples in the Third World; it combines social investigation, education, and action in defining and solving a problem. Action researchers emphasize individual, interpersonal, and group levels of analysis in problem solving; participatory researchers analyze problems in terms of community and social structures. Action researchers often work with their clients within the system; participatory researchers must often work against the system.

Checkoway, B. (1991) *Six Strategies of Community Change.* Jerusalem: The Hebrew University.

This paper discusses six different strategies for community organizing. Each strategy can be used in different settings within differing outcomes. Proper assessment of the situation is critical for long-lasting and positive change to occur. The strategies include: mobilization, social action, mandated participation, advocacy, popular education, and local services development. Martin Luther King, Jr. used mobilization effectively in the civil rights movement. Saul Alinsky used social action on the South side of Chicago. Mandated participation works within the system, agreeing with the

tenets of democracy—that equity among people should increase over time. Advocacy involves certain people, who act as advocates, entering the administrative and legislative arenas on behalf of other groups. Popular education brings about change by raising the critical consciousness of people. Finally, in local services development, people provide their own services at the community level. Local solutions to problems are key and often result in psycho-social benefits to community members.

Costanzo, M., Archer D., Aronson E., and Pettigrew T. (1986) "Energy Conservation Behavior: The Difficult Path from Information to Action." *American Psychologist* May, 521-528.

This article starts by explaining why two main theories of behavior change—the economic model and the attitude-behavior model—do not work reliably. People need accurate information about, not just familiarity with, conservation programs in order for those programs to be effective. Different psychological and positional factors interact determining an individual's actions. Psychological factors are: "the information must be perceived, the individual must favorably evaluate the information, the information must be understood, and the information must be remembered." Positional factors refer to a person's situation and things that restrict or facilitate action. Characteristics of the most effective information were that it was vivid, concrete, in the form of a personal story (from an acquaintance), from a credible source, and relevant to the receiver. Studies have also found threat of loss more motivating than promise of gain.

Csikszentmihalyi, M. (1978) "Intrinsic Rewards and Emergent Motivation." *The Hidden Costs of Reward: New Perspectives on the Psychology of Human Motivation* Leppet, M. and Green, D. eds. Hillsdale, NJ: Lawrence Erlbaum Associates.

The author suggests that an open system of behavior, with emergent, or intrinsic, rather than promised, or extrinsic, goals takes advantage of the flexibility humans have historically needed to survive. Intrinsic rewards seem to arise in an environment that "provide(s) information to the person that his or her actions are meeting a set of challenges in the environment," (p. 209), and are decided on by the person receiving them.

DeYoung, R. (1986) "Encouraging Environmentally Appropriate Behavior: The Role of Intrinsic Motivation." *Journal of Environmental Systems* 15:4 281-292.

This paper begins with the perspective that since humans have evolved, now many of our behaviors can be seen in terms of what once helped us survive. Using intrinsic satisfaction as an intervention strategy can tap into that evolutionary development. Intrinsic motivation predicts that much of human behavior can be explained "in terms of goals and rewards that arise out of participation in an ongoing activity," (p. 282). One interesting finding from this article is that conservation and extrinsic motivation were not positively related to each other, which suggests that intrinsic rather than extrinsic rewards will help foster conservation activities.

Eng, E. (1988) "Extending the Unit of Practice from the Individual to the Community." *Danish Medical Bulletin* 6:45-52.

This article discusses the concepts of community participation by using the case study of the isolation of elderly people. The concepts are transferable to any situation in which community participation is desired.

Goeppinger, J. & Baglioni, A.J. (1985) "Community Competence: A Positive Approach to Needs Assessment." *American Journal of Community Psychology* 13:507-523.

These researchers constructed a questionnaire called the Community Residents Survey (CRS), derived from L.S. Cottrell's work (1976) in the area of community competence and elaborated upon by community workers and researchers. CRS was then field-tested in 5 rural communities.

Hayes, S.C. and Cone, J.D. (1981) "Reduction of Residential Consumption of Electricity Through Simple Monthly Feedback." *Journal of Applied Behavioral Analysis* Spring, 81-88.

Because frequent feedback is difficult on a large scale, this study looks at the effect of monthly feedback on consumer's electricity use. Participants were neither volunteers nor did they have specific, easily attainable goals set for the purpose of this study. The feedback consisted of specific information about both, kilowatt-hour use and money spent. The combination of feedback and a difficult goal produced the most behavior change. Interestingly, all study participants returned to higher energy use when the intervention period ended.

Katzev. R. and Mishima, H.R. (1992) "The Use of Posted Feedback to Promote Recycling." *Psychological Reports* 71:259-264.

Information about why and how to recycle often fails to affect widespread participation in recycling programs because this type of information leaves people to function somewhat in a vacuum. People need feedback about how well they are doing and about the consequences of their actions. Feedback acts as information and motivation. Performance-related feedback motivates people to improve their performance. In this study, recycling increased during the feedback intervention period and then dropped to above the baseline level during the follow-up period. Unfortunately, it is difficult to use this study to predict durable behavior change, as both the intervention and follow-up periods were only one week long.

Marti-Costa, S. and Serrando-Garcia, I. (1987) "Needs Assessment and Community Development." *Strategies of Community Organization* F.M. Cox, et al., eds. Itasca: F.E. Peacock, Chapter 20.

This article presents an ideological framework to evaluate and direct needs assessment efforts. The model includes four phases: the first phase is a familiarization with the community — including seeking knowledge of the community's history, structure, and the processes which would facilitate the intervener's entry into the community. Key persons in the community should be identified at this stage. The second phase is characterized by the formation of a core group that must be composed of both key

community persons and interveners. The main task of this group is the direction and coordination of the needs assessment. The core group must take an active role in evaluating the relevance of the different needs assessment techniques particular to their community. The group must then publicize the needs assessments to the community. The third phase is the formation of task groups. Long and short term goals are defined and further action plans are developed. Group tasks should emphasize cohesiveness.

Rosener, J. (1978) "Matching Method to Purpose: The Challenge of Planning Citizen Participation Activities." *Citizen Participation in America* Langton, S. ed. Lexington: D.C. Heath, Chapter 9.

In this article, Rosener discusses how to avoid the pitfalls of meaningless mandated citizen participation. She speaks of the need for public officials not to think of citizens as a "professional hazard." She describes how goals and objectives must be formulated to include citizens in meaningful ways.

Wandersman, A. (1979) "User Participation: A Study of the Types of Participation, Effects, Mediators, and Individual Differences." *Environment and Behavior* 11:185-208.

This article attempts to clarify the meaning of participation by separating it into distinct types and relating each type to evaluation of the environment. The study was a simulation of the process of designing dormitory rooms that contrasted three types of participation while controlling for quality of the design: (1) self planning (sp)—generating alternative plans and choosing one; (2) choice (c) —choosing a design from two alternative designs generated by others; (3) no participation (np). Type of participation was significantly related to reports of how much students would like living in the room. Sp and c subjects liked the rooms significantly more than np subjects. While sp and c subjects did not differ significantly from one another, sp and c subjects reported that participation made them feel significantly more creative, responsible, helpful, and less anonymous than np subjects. Attitudes about the architects were significantly affected by the type of participation.

Yates, S.M and Aronson E. (1983) "A Social Psychological Perspective on Energy Conservation in Residential Buildings." *American Psychologist,* April.

Because environmental problems must be seen as needing human rather than technological solutions, the authors examined ways of affecting conservation-oriented behavior. They discuss the economic model, on which energy policies have been based, and the fact that most people are slow to implement cost-saving devices in their homes. This is attributed to the understanding that human behavior is much more complex than the economic/rational actor theory. The authors find that the way the information is presented—the framing of a problem and potential solutions—is very important in the way people respond to it. The authors also find that to be effective, information should be vivid, specific, and personally relevant. The more effective behavior change strategies allow for participants' involvement and cognitive engagement. Choice and control are also important.

Chapter 5: Case Study in Chemical Tracking

American Chemical Society, Department of Government Relations and Science Policy (1985) *Less is Better: Laboratory Chemical Management for Waste Reduction* Prepared by the Task Force on RCRA.

This bulletin discusses the various techniques that can be employed to develop a "less is better" philosophy of hazardous waste management, as well as the practical benefits that can be gained from implementing such a program. It is composed of five sections that address waste reduction through management techniques such as purchasing control, inventory control, surplus, chemical exchange, reclamation, and recycling.

AT&T Bell Laboratories, Environmental Health and Safety Division (1992) *Chemical Information System* New Jersey.

A bulletin outlining Bell Laboratories' chemical tracking system. Different components of the CTS are discussed: chemical tracking, complying with regulations, bar-code technology, on-line Materials Safety Data Sheet system, and hardware and software.

California Department of Health Services (1988) *Waste Audit Study: Research and Educational Institutions* Los Angeles: Ralph Stone and Co., Inc.

The objective of this study was to conduct waste audits at three diverse educational/research institutions: a large university, a technical research institute, and a small, private, liberal arts college. The audits were performed to determine ways these types of institutions could reduce the generation of hazardous waste.

Hacala, J. (1992) *Strategies for Hazardous Waste Reduction at the University of Michigan* Prepared as a service by the State of Michigan Office of Waste Reduction Services and the University of Michigan.

A study sponsored by the State of Michigan Office of Waste Reduction Services investigating the amount and nature of the University's hazardous waste stream. An audit of the University's waste stream was performed and a survey of faculty and staff was undertaken in order to determine current disposal practices, gauge the level of acceptance that a waste reduction program would receive, and identify problems that might surface in implementing such a program.

Kaufman, J. (1990) *Waste Disposal in Academic Institutions* Chelsea, MI: Lewis Publishers.

This book, containing the papers from the symposium "Waste Disposal in Academic Institutions" held at the Third Chemical Congress of North America in Toronto in 1988, offers specific, practical and cost effective solutions to hazardous waste generation problems found at academic institutions. In addition, legal requirements placed on both secondary and post-secondary institutions are addressed and clarified.

Information Clearinghouses

A Catalog of Hazardous and Solid Waste Publications
RCRA Information Center, U.S. EPA, Office of Solid Waste (OS-305), 401 M Street, SW, Washington, DC 20460, (202) 475-9327

Conservation and Renewable Energy Inquiry and Referral Service
Provides referrals, fact sheets, bibliographies, computer searches, and publications. Advanced Sciences, Inc. (for the U.S. Department of Energy), Box 8900, Silver Spring, MD 20907, (800) 523-2929

Environmental Defense Fund
257 Park Avenue South, New York, NY 10010, (800) CALL-EDF

EPA Films and Video Tape Library
Tapes available on loan, free from EPA; distributed by: FilmComm, 641 North Avenue, Glendale Heights, IL 60139, (708) 790-3300

Institute for Local Self-Reliance
2425 18th Street, NW, Washington, DC 20009, (202) 232-4108

National Pollution Prevention Center for Higher Education
University of Michigan, Dana Building, 430 E. University, Ann Arbor, MI 48019-1115 (313) 764-1412; Fax: (313) 936-2195; e-mail: nppc@umich.edu
The Center's mission is to educate students, faculty, and professionals about pollution prevention; to create educational materials that reflect multi-sector perspectives on pollution prevention; provide students, faculty, and professionals with tools and strategies for addressing relevant environmental problems; and establish a network for the collection and exchange of pollution prevention educational materials. The Center's program activities include education and curriculum development, research, professional education and training, conferences, and internships.

National Technical Information Service
A self supporting agency of the U.S. Department of Commerce providing single source access to over 1.6 million technical reports describing the results of research conducted by government, university, and corporate research organizations and around the world. United States Department of Commerce, 5285 Port Royal Road, Springfield, VA 22161, (703) 487-4650

Pollution Prevention Information Clearinghouse (PPIC)
Contains technical programmatic, legislative, policy, and financial information regarding source reduction and recycling efforts in the U.S. and abroad. Operated by SAIC for the U.S. EPA, 8400 Westpark Drive, McLean, VA 22102. Technical Support Office (703) 821-4800. EPA's RCRA/Superfund Hotline (800) 424-9346

Solid Waste Information Clearinghouse (SWICH)
Components include an electronic bulletin board, a library, and a hotline. Services include document ordering and on-site library access. Manager, Solid Waste Information Clearinghouse, Solid Waste Association of North America, P.O. Box 7219, Silver Spring, MD 20910, (800) 677-9424

Waste Information Clearinghouse

Michigan Departments of Commerce and Natural Resources, P.O. Box 30004, Lansing, MI 48909, (800) 662-9278