

# Environmental Stewardship at the University of Michigan

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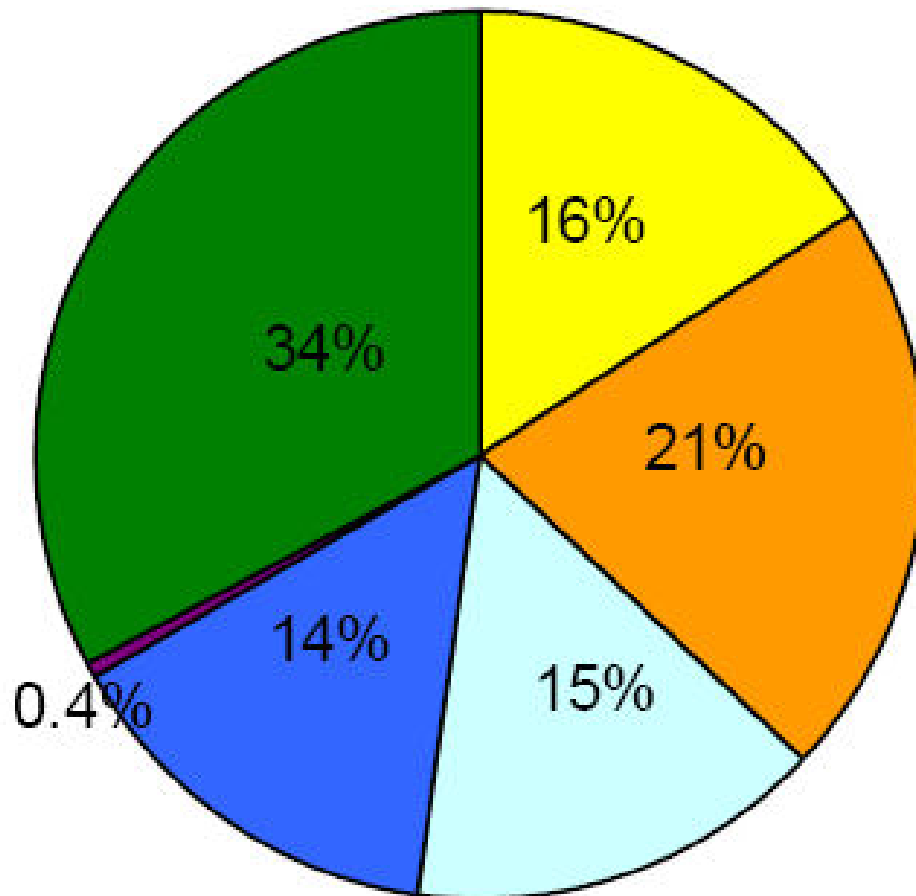


# Demographics – AA Campus

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- 29 Million square feet of building space – 538 major buildings and 1,400 family housing units
- 39,000 Students – 34,000 faculty and staff
- 19 Different Schools and Colleges
- 865 Licensed bed Hospital
- \$753 Million in research last year

## UM AA Land Use



- Campus: Impervious
- Campus: Green
- Other athletics area
- Golf courses
- Natural: Impervious
- Natural: Green

Total: 3,070 acres

# Multi - Faceted

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- Academic
- Research
- Operational
- Infrastructure – “green” building
- Social/Political – Students, City, State, Country
- UM’s Commitment – FTE’s

# Stewardship in Academia

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- ◌ UM offers 10 undergraduate, 11 Masters, 15 Doctoral degrees and 429 individual courses with a sustainability focus.
- ◌ 10,500 students were enrolled in these programs in 2005/2006.

# Major Academic Centers and Academic Programs

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- Center for Sustainable Systems (CSS) at School of Natural Resources and Environment
- Graham Environmental Sustainability Institute (GESI)
- Corporate Environmental Management Program - CEMP
- LSA – Program for the Environment

# Research

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Graham Environmental Sustainability Institute  
Environmental and Water Resource  
Engineering

Atmospheric and Oceanic Sciences

Center for Advancing Research and  
Solutions for Society

Chemical Engineering – Fuel Cell Research –  
Levi Thompson

# Operational Programs

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- ☪ Pollution Prevention
- ☪ Energy Reduction
- ☪ Environmental Design
- ☪ Alternative Fuels
- ☪ Green Purchasing
- ☪ Recycling



# Pollution Prevention

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## ☪ P2 and the University

## ☪ Program Areas

- Fluorescent Bulbs
- Consumer Electronics
- Mercury Elimination
- Chemical Redistribution
- Photographic Waste Recovery
- Waste Minimization/Green Chemistry

# Fluorescent Bulbs

**Universal Waste** – Fluorescent bulbs, HID's, sodium vapor, mercury vapor, neon, and incandescent lamps. Also CRT's.

**Hazardous Material** – Mercury  
**Requirements**

- ☉ Placed in suitable containers
- ☉ Labeled with location, date, number and type
- ☉ Stored in dry area
- ☉ Transferred to pick-up locations

**Annual Totals**

- ☉ 2005
  - 56,255 from campus (\$13,315), 26,377 from UMH (\$5,154)
- ☉ 2006
  - 61,921 from campus (\$15,818), 16,084 from UMH (\$3,933)

# Bulb Trailer



# Consumer Electronics

**Universal Waste** – Any type of equipment containing circuit boards

**Hazardous Materials** – Lead, mercury, beryllium, cadmium, batteries, toner, phosphor compounds, PCBs and brominated fire retardants

## Requirements

- ☉ Transferred to Property Disposition\*
- ☉ Placed in suitable containers
- ☉ Labeled with location and date
- ☉ Stored in dry area

## Annual Totals

- ☉ 2005 – 110,054 lbs (\$30,815)
- ☉ 2006 – 97,372 lbs (\$27,264)

# E-Waste Storage and Transfer



# Mercury Elimination

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**Universal Waste** (If contained in original package/equipment)  
– thermometers, manometers, switches, etc

**Hazardous Material – Mercury**

## **Requirements**

- ☉ Placed in suitable containers
- ☉ Labeled with location, date, number and type
- ☉ Stored in dry area
- ☉ Transferred to MSRB III, A100

# Mercury Thermometer Program

- ☉ Began 10/01
- ☉ 5,402 recycled as of 10/06 (\$12,155)
- ☉ 500 lbs of other elemental containing Hg equipment recycled



# Mercury Thermometer Spill Response

Year	Number of Hazmat Responses
2003 - 2006	13* - average
2002	18
2001	47



# Chemical Redistribution

## Program Specifications

- ☉ Designed to help reduce chemical waste across campus
- ☉ Only unused and unopened chemicals with a maximum volume of 5 gallons will be accepted for donations
- ☉ No biological, radioactive, or highly reactive materials
- ☉ All chemicals stored in Room A100, MSRB III

## Statistics

- ☉ 68 different types
- ☉ 36 requested and 18 donated to program in 2006

# Chemical Redistribution Storage



# Photographic Waste Recovery

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## **Hazardous Material – Silver Requirements**

- ☉ Placed in suitable containers
- ☉ Labeled with location, date, number and type
- ☉ Stored in dry area
- ☉ Transferred to pick-up locations

## **Annual Totals**

- ☉ 2005 – 2017 gals (\$6,051)
- ☉ 2006 – 1436 gals (\$4,308)

# Photographic Waste Transfer



# Waste Minimization/Green Chemistry

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## 12 Principles

1. Prevention
2. Atom Economy
3. Less Hazardous Chemical Syntheses
4. Designing Safer Chemicals
5. Safer Solvents and Auxiliaries
6. Design for Energy Efficiency
7. Use of Renewable Feedstocks
8. Reduce Derivatives
9. Use Selective Catalysis Rather Than Stoichiometric Regents
10. Design for Degradation
11. Real-time Analysis for P2
12. Inherently Safer Chemistry for Accident Prevention

# P2 Summary

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In the end, the P2 program is focused on developing innovative methods for reducing, reusing, or recycling material to reduce the University's overall impact on the environment.



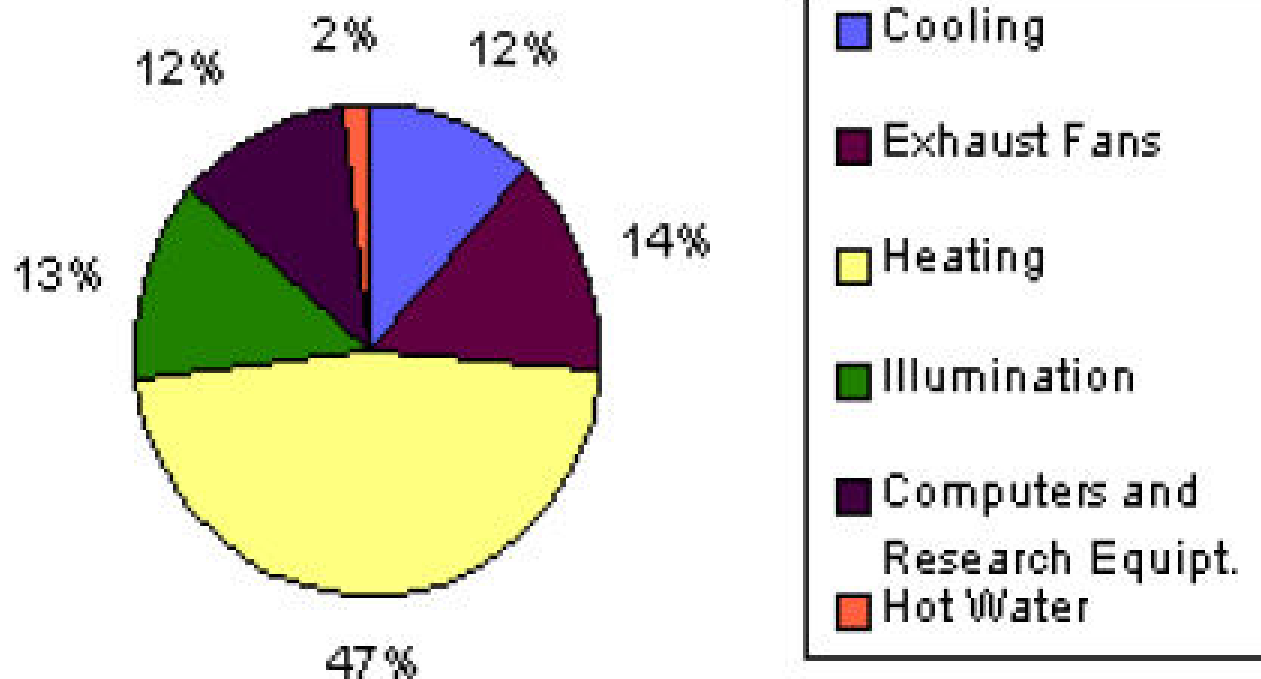
# Energy Management

## UM Central Power Plant



# Energy Consumption

## Energy Consumption Breakdown of a Typical UM Building





# Energy Conservation Efforts

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- ◌ Campus Utilization
  - Utilities Reduction Committee
  - Institute for Social Research (ISR) Study
- ◌ Tuning building mechanical systems
- ◌ Mechanical and lighting upgrades
- ◌ New const. and renovation – materials
- ◌ Challenge: Growth

# Alternative Fuels

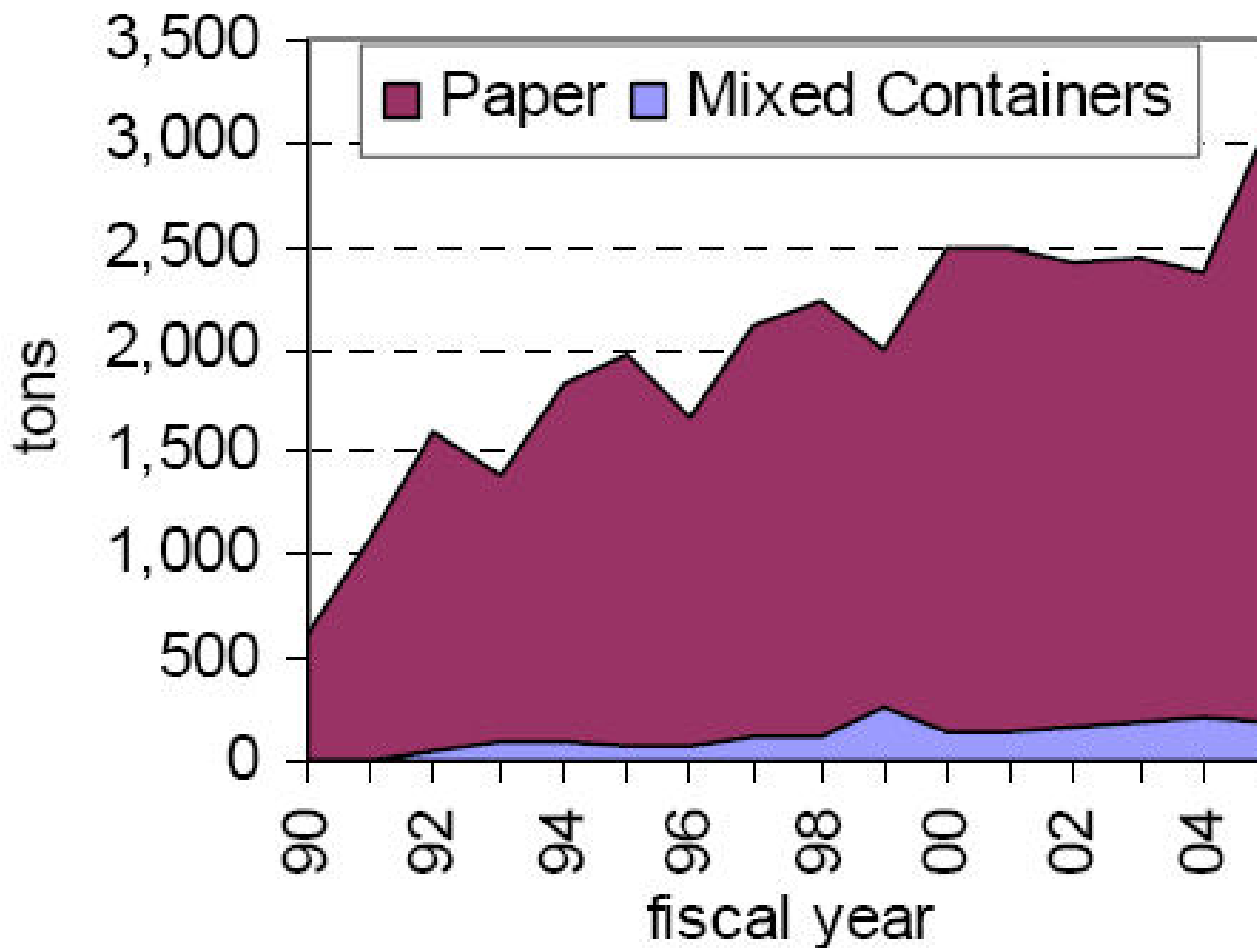
## Largest Operating Alternative Fuel Fleet in State

- 102 vehicles running on ultra low sulfur bio-diesel
- 410 vehicles running on ethanol
- Hybrid electric vehicles



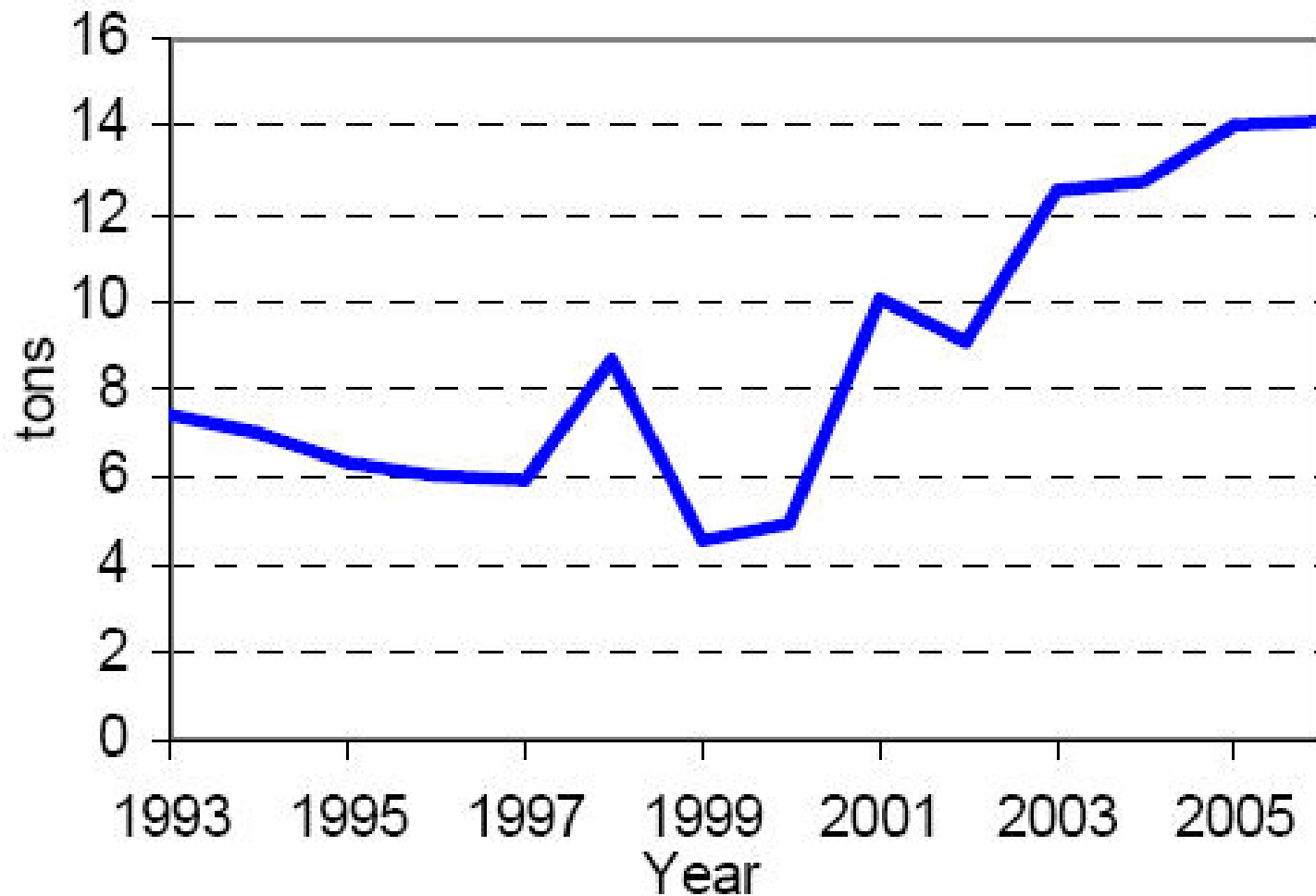
# Recycling

**Materials Recycled by WMS**



# Student Move Out Program

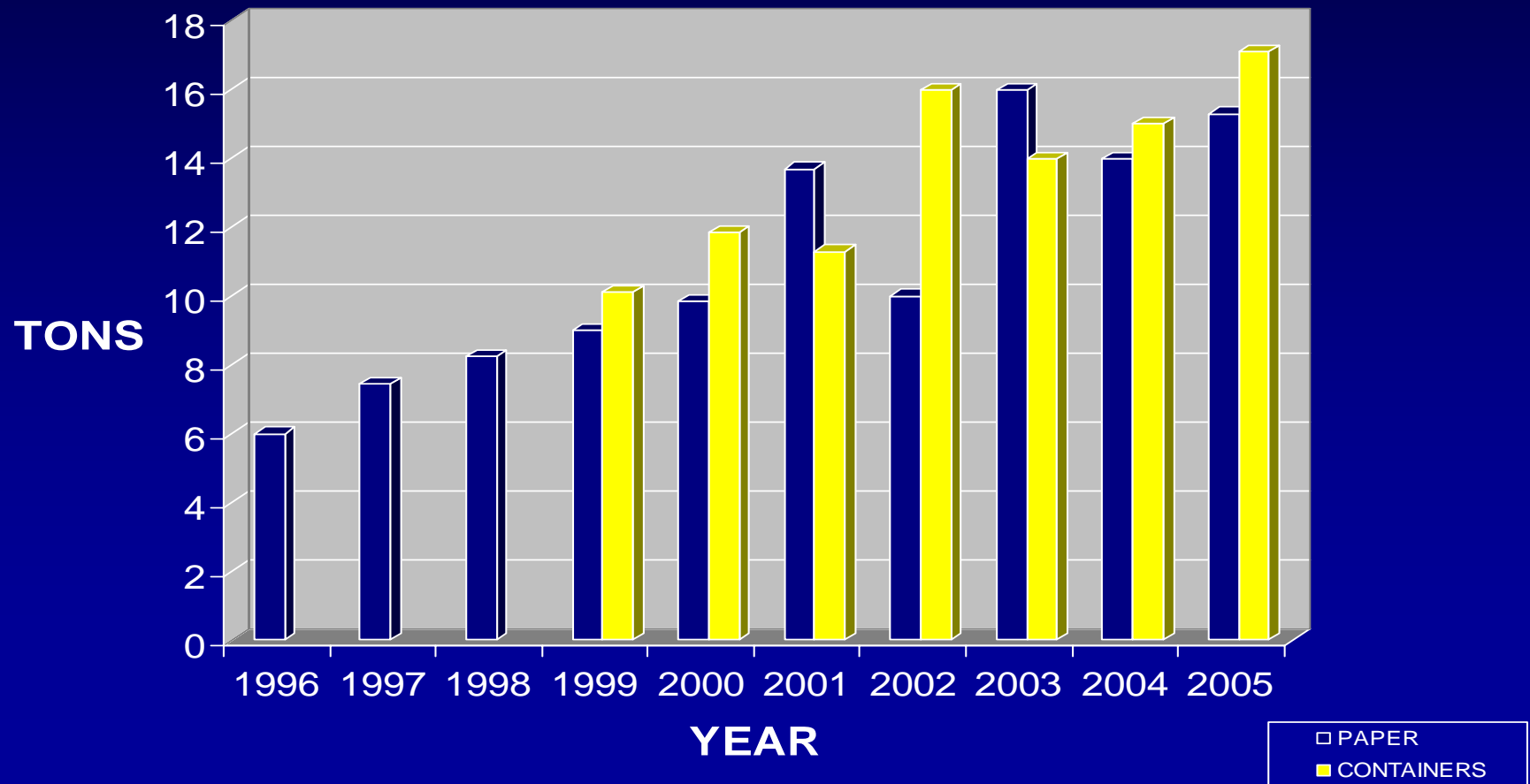
**Student Move-Out Collection**





# Football Recycling Program

## MICHIGAN STADIUM RECYCLING



# Solvent Recycling in Chemistry

- ☉ Acetone
- ☉ 1,500 Gallons / yr
- ☉ \$53,000 / yr disposal
- ☉ \$19,000 Capital Investment
- ☉ 1 Year Payback





# University of MICHIGAN

## Purchasing Services

Purchasing

M-Stores

Aux Svcs



### "BUY RECYCLED" SUPPORT THE UNIVERSITY'S SUSTAINABLE INITIATIVES

The Purchasing Department supports and encourages University of Michigan Departments to buy products that are made from recycled or remanufactured materials. Listed below are the products available through M-Stores, Prime Vendor, and Campus Wide Vendors that support the University's sustainable initiatives.

### **Prime Vendors & Campus Wide Vendors Offer Recycled Products**

#### **Mercury-Free Alternative Thermometer Program**

In an effort to reduce the risk of environmental contamination, human exposure, and costly clean-up activities associated with accidental thermometer breakage, the Department of Occupational Safety and Environmental Health (OSEH) has established a Mercury Thermometer Elimination Program.

Purchasing Se



# Environmental Design

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- ◌ LEED Standards - Master Design Guidelines
- ◌ All Renovation and New Construction
- ◌ LEED Certification
- ◌ DANA School of Natural Resources – Gold Rating
- ◌ Mott's Women's Children's Hospital

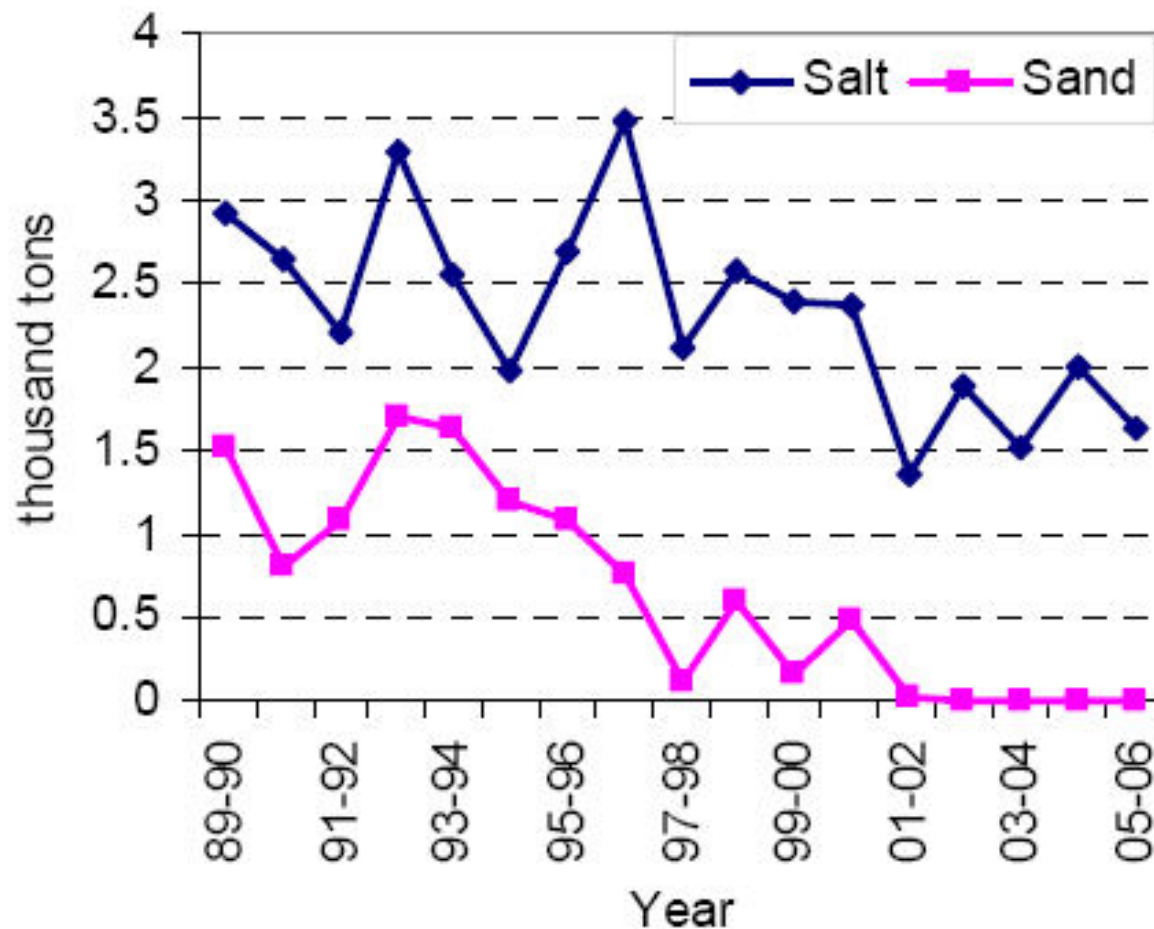
# Storm Water Management



Concrete is poured in the storm water detention basin. August 2001

# Huron River Watershed

## Road Salt and Sand Use







## Transforming Dana

### Historic Renovation - The Ultimate Recycling

The Dana Building was constructed in 1903 for the School of Medicine, anchoring a corner of Michigan's historic central campus "Diag". Recycling Dana preserves both the material fabric of the building, a "contributing structure", and the cultural landscape of Michigan's Central Campus, a designated historic district.



### Staying In Place/Expanding In Place

SNRE kept its prime location at the heart of the campus by expanding Dana by more than 25% - an "umbrella" of steel framing was erected in the central courtyard, providing additional space on four existing floors and adding a partial fifth floor suspended over the existing building.



### Transforming Daylight: Courtyard into Atrium

The open courtyard was converted into an enclosed Atrium with skylight - lab and computer spaces needing reduced glare are clustered around the Atrium where appropriate indirect-daylight filters in.

# "The Greenest Building is One That is Already Built"



## Conserving Material & Cultural Resources

### Harvesting Material Resources

The deconstruction of portions of the original building yielded valuable material for re-use: harvested roof framing yielded 11,000 board-feet of old-growth pine used for furniture and architectural features like the Atrium balcony railing.

### Capturing Embodied Energy

Conserving 100% of existing masonry walls captured the equivalent of 135 tanker trucks of embodied energy - more than 60 times the annual energy savings calculated in the whole building energy simulation which modeled the performance of high-efficiency energy-consuming systems engineered into the Dana Building renovation.



## University of Michigan Greening of Dana School of Natural Resources & Environment

QUINN EVANS | ARCHITECTS  
in association with  
William McDonough + Partners  
University of Michigan



## Green Technologies as Preservation Strategies



### Radiant Panel Cooling

Designed to leverage the physical properties of water, Dana is cooled using ceiling panels that "radiate" cooling - most spaces do not require suspended ceilings, restoring Dana's high ceilings and tall windows.



### Green Materials

Industrial ecology is a focus of study at SNRE. Dana is a laboratory for green materials - incorporating materials that are salvaged, recycled, contain recycled content, natural, rapidly renewable, certified sustainable wood, from local sources or that contain low or no VOCs.

### Photovoltaic Panels

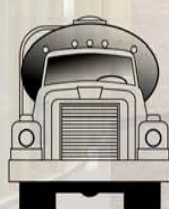
On roof areas that are not visible from the protected views of the historic campus setting, two arrays of photovoltaic panels demonstrate renewable energy technologies. The PVs generate a maximum output of 33 kilowatts.

### Water Efficiency

Dana is a laboratory for water-conserving technologies: water efficient landscaping requires no irrigation, low-flow fixtures, proximity sensors on faucets, waterless urinals and composting toilets.

## Sustainability Facts

Dana Building	Renovation
Location	Ann Arbor, MI
Year	2008
LEED-NC Rating	Gold
Team	Quinn Evans Architects, William McDonough + Partners, University of Michigan
Client	University of Michigan
Program	School of Natural Resources & Environment
Area	200,000 sq ft
Energy	100% Conserved
Water	100% Conserved
Materials	100% Conserved
Indoor Air Quality	100% Conserved
Transportation	100% Conserved
Waste	100% Conserved
Greenhouse Gas Emissions	100% Conserved
Water Consumption	100% Conserved
Land Use	100% Conserved
Ecology	100% Conserved
Community	100% Conserved
Health & Safety	100% Conserved
Cost	100% Conserved



Existing Walls  
Conserved (in red)

Embodied Energy  
Conserved by Renovation

Annual Energy  
Conserved by high-  
efficiency HVAC system







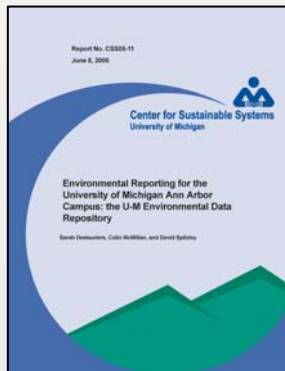
# Evolution of Environmental Reporting at the University of Michigan



**Economicology Conference (April 1999) -**  
University environmental reporting framework conceived



**Examining Our Progress (June 2002) –** Master's project produces prototype sustainability report for the University



**Environmental Data Repository (June 2005) –** Campus wide environmental data management system developed to support reporting



**Environmental Task Force (April 2004) –** Advisory report to President Mary Sue Coleman on the selection of environmental indicators

# 59 Performance Indicators and Operational Metrics

- Energy: Buildings and Transportation (15)
- Water Use (5)
- Land Use: Built and Natural Spaces (8)
- Emissions: Air and Water Pollutants (6)
- Material Use and Solid Waste (22)
- Cross-Cutting and Emerging Issues (3)

General Category	Indicators, Metrics, and Normalizations (units)	2004 Results
Energy - Buildings and Transportation	Total Energy Consumption (Bbl/person)	18.0
	Total Energy Consumption (Btu)	7.58001E+12
	Total Energy Consumption (Btu/person)	104,254,208
	Percentage Renewable Energy	0.29%
	AATA Bus Ridership	851,000
	Bicycle Ridership (Number of bike racks)	3,366
	Building Energy (Btu)	7.47911E+12
	Building Energy (Btu/ft2)	270,419
	Building Energy (Btu/ft2/person)	3.72
	Building Energy (Btu/person)	102,866,443
	Bus Energy Consumption (Btu)	35,211,327,293
	Bus Energy Consumption (Btu/passenger)	7,488
	Campus Bus Ridership (Total passengers)	4,702,261
	Generated Electricity Consumption (MWh)	238,248
	Purchased Electricity from Renew. Sources (MWh)	1,066
	Purchased Electricity (MWh)	242,176
	Fleet Vehicles Energy Consumption (Btu)	65,688,938,409
	Renewable Percentage for Transportation Energy (%)	18%
	Transportation Energy Consumption (Btu)	1.009E+11
	Transportation Energy Consumption (Btu/person)	1,387,765
	Van Pooling (Passenger miles)	3,094,729
	Van Pooling (Vehicle miles)	471,210
Water Use	Purchased Electricity from Renew. Sources (%)	0.44%
	Generated Electricity from Renew. Sources (%)	0.00%
	Total Water Use (gal)	1,237,461,853
	Total Water Use (gal/person)	17,020
	Building Specific Water Use (gal)	1,016,409,438
	Building Specific Water Use (gal/person)	13,980
	Total Discharge to Sewers (gal)	902,032,593
	Total Discharge to Sewers (gal/person)	12,406
	Total Irrigation Water (gal)	149,195,063
	Total Purchased Water (gal)	1,202,643,703
Land Use - Built and Natural Spaces	Total Purchased Water (gal/person)	16,541
	Total Irrigation Water (gal/acre green space)	213,472
	Total Impervious Surface Area (% of campus area)	20%
	Total Impervious Surface Area (acres)	415
	Deck Parking (# of deck parking spots)	9,492
	Deck Parking (% of parking spaces that are parking decks)	41%
	Maintained Green Space (% of campus area)	35%
	Maintained Green Space (acres)	725
	Total Building Area (ft2)	27,657,452
	Total Building Area (ft2/person)	380
	Total Green Space (% of campus area)	80%
	Total Green Space (acres)	1,672
	Total Land Area (acres)	2,087
	Tree Population	14,954
	Unmaintained (Natural) Green Space (% of campus area)	45%
	Unmaintained (Natural) Green Space (acres)	947

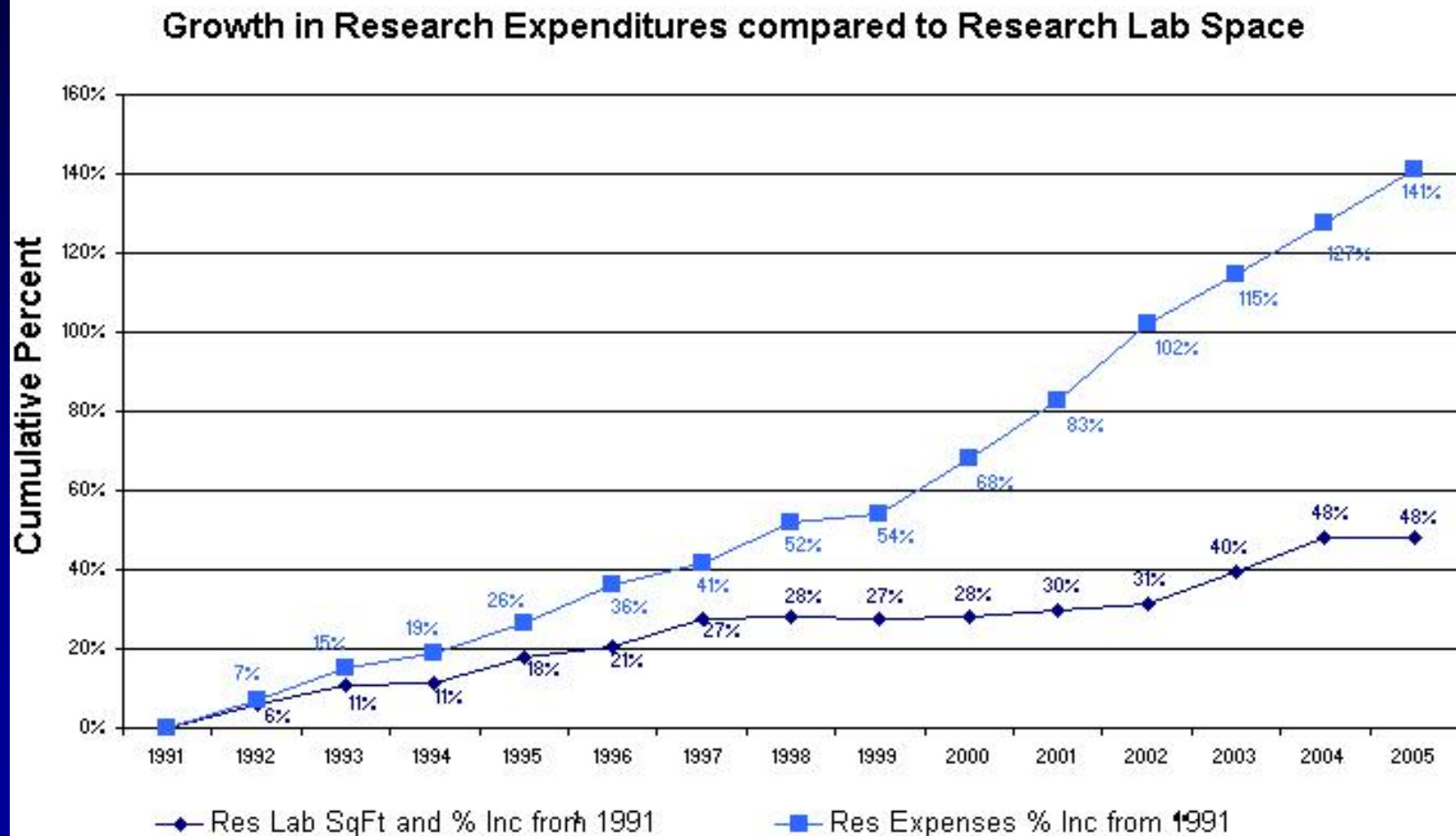
# Student Groups

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- ◌ ENACT – Env. Activism
- ◌ MSA – Environmental Issues Commission
- ◌ Green Greeks
- ◌ Student Animal Legal Defense Fund
- ◌ Students for Pirgim (Public Int. Group MI)
- ◌ Transformers – Sustainable Planet



# Conclusion - Challenges



# Challenges - Continued

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- ⌈ Continued Growth
- ⌈ Annual Changing Population
- ⌈ Decentralized
- ⌈ University Integrated within the City
- ⌈ Poor Geographic Area for Alternative Fuel Availability