FAS CAMPUS SUSTAINABILITY REPORT, FY08

“ The FAS is embracing the values of conservation, the wise use of resources, and the long view of the impact the choices we make today have on those who come after us. We have a unique obligation to engage our faculty and students in solving global challenges…Through innovation and discovery, Harvard can have leverage to make a real and lasting impact .”

Michael D. Smith, FAS Dean
November, 2008








Prepared by the FAS Green Program, partnership between Harvard’s Office for Sustainability and FAS Office of Physical Resources and Planning, January 2008.
For more information visit FAS Green Program website: **www.greencampus.harvard.edu/fas**

FAS ENVIRONMENTAL SUSTAINABILITY

Snapshot FY08

UTILITIES

GHG Emissions

Emissions from recent growth

FY06	1,281 MTCDE*
FY07	6,315 MTCDE
FY08	**12,619 MTCDE**

Overall emissions

FY06	93,888 MTCDE
FY07	94,092 MTCDE
FY08	**97, 974 MTCDE**

* MTCDE = Metric Tons of Carbon Dioxide Equivalent

Energy & Water

kBtu* of Energy per sf

FY06	129.45
FY07	133.07
FY08	**123.32**

Gallons of water per sf

FY06	23.73
FY07	21.42
FY08	**18.41**

* 1 kBtu = 1,000 Btus

Conservation Investments

Investments

FY06	$1,033,217
FY07	$661,423
FY08	**$589,385 (after rebates)**

Annual $ Savings		**and Payback**
FY06	$271,468	3.81 yrs
FY07	$269,401	2.46 yrs
FY08	**$448,626**	**1.31 yrs**

CUSTODIAL

Solid Waste & Recycling & Composting

Single-stream recycling		**1,065 tons**
Compost		**864 tons**
Electronics		**102 tons**
Other (metal, wood)		**462 tons**
Trash		**2,540 tons**
Total refuse	**=**	**5,033 tons**
Recycling rate	**=**	**49.53%**

FY06, FY07

- Residential buildings (Adams, Annenberg, Dunster, Lowell, Mather, Winthrop)

FY08

- Residential buildings
- Office buildings: CGIS café, Herbaria

Green Cleaning

FY06, FY07

- FMO and Unicco transition to green cleaning practices and equipment

FY08

- Several departments switched over to recycled content paper products in their restrooms (Physics, CCB, Peabody Museum, CGIS)
- A few buildings pilot energy efficient hand-dryers (Jefferson, Lyman, Mac)

OTHER

LEED

LEED-CI Renovations

FY06,07	1 project
FY08	**8 projects**

LEED-EB Operations & Maintenance

FY06, 07	0 projects
FY08	**1 project**

Transportation

Public transportation:

FY03	22.8%
FY07	**28%**

Single occupant vehicles (SOV)

FY03	33.8%
FY07	**16.5%**

* FY08 data will be availably in FY09

Occupant Engagement

FAS-wide campaigns

- Green Tips of the Month
- Harvard Sustainability Pledge
- Eco-Competitions

Supporters

- 8 Eco-citizens (Office and Lab buildings)
- 3 Green Teams
- 20 student REPs

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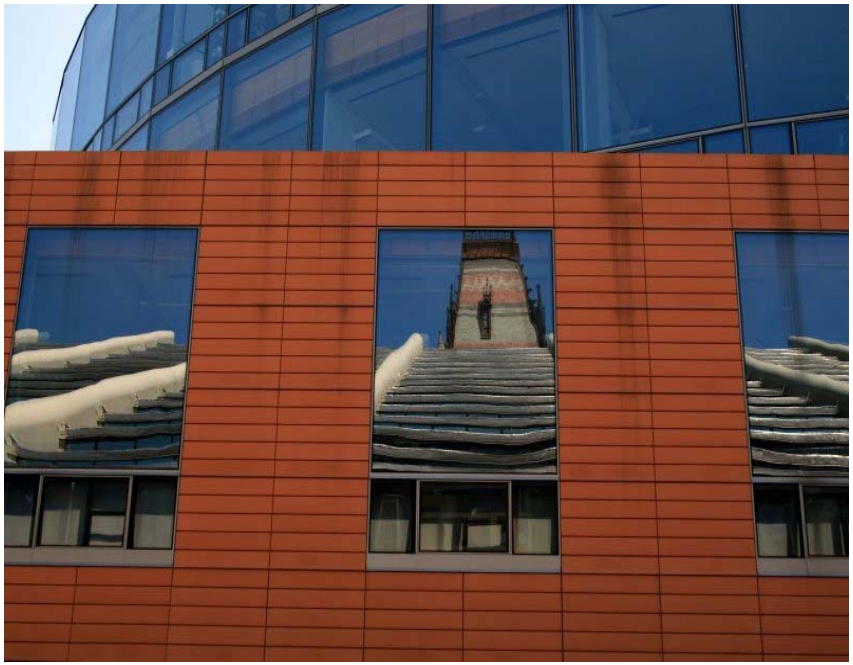
CAMPUS & POPULATION

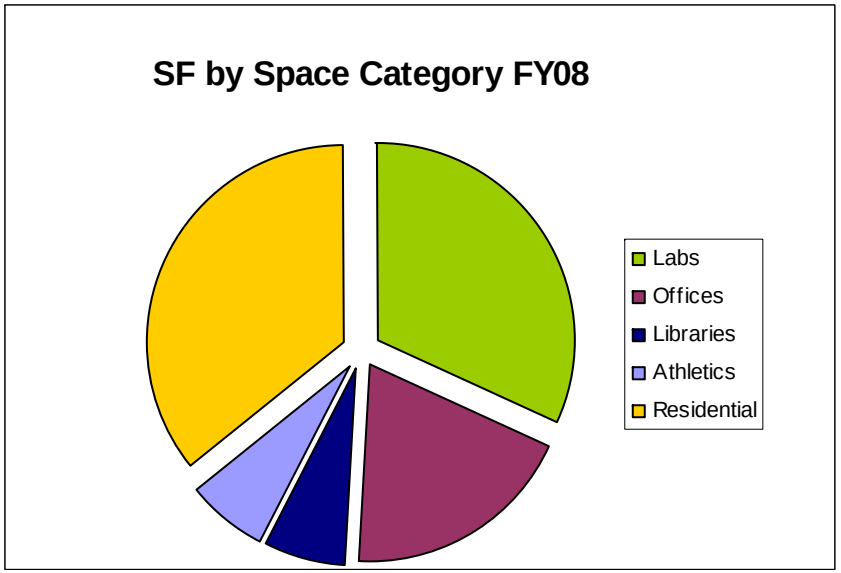
Overview

The FAS campus is located in Cambridge, MA, in the proximity of Harvard Square. FAS comprises several distinct "tub" entities: core FAS labs and offices, Harvard College, Athletics, Harvard College Libraries, Division of Continued Education, Graduate School of Arts and Sciences and School of Applied Engineering and Sciences. FAS campus consists of 260 buildings and have been recently expanding through construction of new buildings in the North campus area (LISE, Northwest, CGIS and BRI).

Close to 50% of FAS populations (college and graduate students) live and study o campus. A large percentage of staff and faculty work in lab buildings that account for over 30% of FAS' square footage.



- Total sf FY98: **7,166,000**
- Total sf FY08: **9,856,000**
- Change in total sf FY98-08: **+ 37.53%**



- Total population in FY98*: **12,722**
- Total population in FY08: **14,867**
- Change in population FY98-08: **+ 18.68%**

* FAS population numbers are based on Harvard Fact Book estimates and include students (undergraduates and graduates), staff and faculty.

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GREENHOUSE GAS EMISSIONS

GHG Planning

The FAS, like most of Harvard University, has experienced significant annual increases in its Greenhouse Gas (GHG) emissions since 1990. In recent years much has been done to decrease emissions in the existing building portfolio. While significant, these reductions have been offset by the impact of campus growth.

In response to these trends and with climate change emerging as a key issue of our time, **88.3% of Harvard undergraduates voted in the fall of 2006 to request that the FAS commit to reduce GHG emissions by 11%** below 1990 levels by the year 2020. As a result, the FAS established a GHG Reduction Advisory Committee and commissioned the Harvard Green Campus Initiative to assist in a consultation and planning effort that provided cost estimation and an overall implementation framework to support the FAS GHG reduction goal.

The University-wide GHG Taskforce utilized the draft FAS GHG Reduction Plan as a guiding document and concluded with the Report of the Harvard University Task Force on Greenhouse Gas Emissions, June 13, 2008. The President formally announced a Harvard-wide GHG Reduction Goal in July 2008. In the wake of this recent University-wide commitment, the FAS GHG reduction goal has been revised to be in full alignment with the University's overall commitment.

Three high-level categories of implementation strategies have been identified to address GHG emissions from **existing buildings**, **known growth** and **committed growth**. Within each of these categories there are three types of strategies:

- Avoidance strategies (A)
- Reduction strategies (R)
- Mitigation strategies (M)

The three strategies **(ARM)** offer a wide-range of opportunities, with different financial impacts (upfront costs and paybacks), different time-lines, and different stakeholder and leadership requirements. The full implementation of the ARM strategies will be essential to achieving our goal.

History

- **Fall 2006:** student referendum "A greener Harvard" calls on the FAS Administration to reduce GHG emissions by 11% below 1990 levels.
- **Winter 2007- winter 2008:** a GHG Advisory Group of FAS faculty, students, administration and HGCI staff works on developing a draft GHG strategic plan for the school.
- **Winter 2008:** Michael Smith, FAS Dean approves the plan.
- **Summer 2008:** the Plan is being revised and aligned with the Harvard-wide GHG commitment.
- **Fall 2008:** FAS GHG Program is officially launched

FAS-wide GHG Reduction Strategies

- **Accountability:** Implement an FAS-wide GHG, utilities, and financial tracking and reporting system.
- **Capital projects:** Implement Harvard's campus-wide "Green Building Guidelines in all construction and renovation projects.
- **Incentives:** Establish an incentive system for FAS departments, buildings and contracted engineers to drive engagement with the plan.
- **Human Resources:** Establish reward and recognition framework for staff performance in relation to GHG reduction efforts to foster a culture of acknowledgement and appreciation for leadership and success.
- **Finance:** Adopt financial and accounting systems that identify and reinvest financial savings from energy conservation into additional GHG reduction activities.

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Energy Conservation Measures (ECMs)

The FAS Energy Team and FAS building managers are working together on implementing dozens of energy conservation measures across the campus.

Typical ECMs include:

- Lighting upgrades
- DDC controls
- Renewable energy pilots
- HVAC upgrades
- Energy audits
- Behavioral campaigns and projects to encourage occupant energy conservation in the buildings.

☐ Annual savings from FY08 ECMs: $448,626
☐ Total FY08 ECM Investment: $589,385

Sample FY08 Energy Conservation Measures	Cost	Annual Savings
BRI—Air Change Reductions: Rebalance facility and reduce air changes in animal holding rooms and procedure rooms from 16 air changes per hour down to 10 Air changes per hour (ACH). (simple payback = .15 yrs)	$45,000	$308,393
Science Center—DDC controls on the Kitchen Hood Reduce hood's exhaust rates when not in use (simple payback = 5.42 yrs)	$42,000	$7,201
WJH—Lighting retrofits & occupancy sensors: (simple payback = 4 yrs)	$8,475	$2,119
MAC—Co-generation unit A 75KW cogen plant that delivers hot water to the pool and domestic hot water assisted by two back up Aerco Boilers. Also, assists with providing electricity. (simple payback = 10.3 years)	$252,895	$24,562
Leverett House— Envelope improvements McKinlock's fireplaces were sealed to prevent introduction of cold air into the building and loosing heated air (simple payback = 2.37 yrs)	$21,672	$9,150

RENEWABLE ENERGY

Alternative Energy Sources

The FAS looks beyond what is possible from demand-side reductions alone (e.g. energy efficiency upgrades, behavioral changes and green renovations) and recognizes the importance of considering the source of energy itself. Renewable energy sources, such as wind, solar, biomass, and geothermal, will be critical in reducing FAS' carbon impacts and over the past few years, the FAS funded several educational projects as part of its investigation into alternative energy sources.

Project Highlights

3 SACRAMENTO STREET SOLAR THERMAL

The solar thermal hot water system was installed on 3 Sacramento Street, an FAS undergraduate co-op dorm, in June 2008. The project was funded as a prize for Harvard's 2007 Sustainability Pledge. For each person that took the pledge, $1.50 was put in a fund for an on-campus renewable energy system and 3 Sacramento's solar thermal system won the funding. The 2 flat plate panels will provide at least 20% of the hot water used by the 20 students who live in the co-op.

HARVARD FOREST PV

In July 2007, the Harvard Forest installed a 10.2 kW, 60 panel photovoltaic array near their garage. The PV array supplies enough energy to run the garage and is tied to the rest of the campus for when it generates excess energy.

SCIENCE CENTER ROOF INTEGRATED PV

In August 2007, FAS installed an 11.9 kW building integrated photovoltaic system on the Science Center roof. The system's performance is available online.

SCIENCE CENTER PV LAMP

In 2006, the Sepco single shoe box lighting system was installed in front of the Science Center. The photo voltaic panel produces 2kWh of electricity per day in summer, and approximately 0.6 kWh in winter to power an exterior light. It prevents 1,170 lbs of CO2 from being released each year.

QRAC GROUND SOURCE HEAT PUMP

The QRAC wells were installed in 2005. The system is composed of 2 wells that are each 1,500 feet deep.

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Water Use

FAS receives water from the Cambridge Water Resources Authority, which supplies water to the entire Cambridge area. Most of the water used at the FAS is for:

- Cooling towers
- Lab practices
- Restrooms
- Kitchens
- Irrigation

Water Conservation Highlight	Cost	Annual Savings
Houses—shower heads re-placements Shower heads were replaced with more efficient low flow fix-tures (simple payback = 1.21yrs)	$90,000	$74,257

For many years, the FAS Energy Team has been investing in upgrading water fixtures and systems in its office, lab and residential buildings. Some of the most notable past projects include:

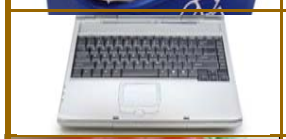
- Water wasted during reverse osmosis/deionization processes is now used for irrigation and quenching hot water discharge (Biolabs)
- Aspirators were replaced with vacuum systems for filtration, solvent removal, evaporation and distilling purposes (Chemistry)
- Low flow shower heads and dual flush toilets were installed in the restrooms of 14+ houses (Houses and Dorms)
- 500 washing machines were upgraded to an energy and water efficient model (Houses and Dorms)
- Rain sensors were installed to prevent irrigation on rainy days (Harvard Yard)

SOLID WASTE, RECYCLING & COMPOSTING

Waste Reduction

Over the past few years, FAS' recycling and composting rates have significantly increased thanks to continued efforts of FAS' occupant engagement programs to improve recycling infrastructure, set up composting programs and raise community's awareness about the environmental benefits of waste reduction. All this in partnership with Harvard's Recycling & Waste Program.
Typical waste reduction campaigns include:

- Recycling infrastructure audits
- Improved signage
- Mt. Trashmore
- Waste audits
- Composting at FAS events

Material	Benefits of Recycling in FY08
	**SINGLE-STREAM RECYCLING** 1,065 tons
	**ELECTRONICS** = 102 tons
	**ANIMAL and FOOD WASTE** (composted) = 864 tons
	**OTHER (Metal & wood)** = 462 tons
Total Recycling & Composting	**49.53%**

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CLEANING

Green Cleaning

FAS' main cleaning contractors, FMO and Unicco have embraced green cleaning principles and are now have transitioning to greener cleaning practices across all FAS buildings. FAS' objective is to reduce the exposure of building occupants and maintenance personnel to potentially hazardous chemical, biological and particulate contaminants, which affect air quality, human health, building systems and the environment. Air quality is further enhanced by installation of high performance filters on air intakes, and also matting systems near building entrances to prevent introduction of particulate matter (see Thayer Hall's LEED-EB case study on the FAS Green Program website).

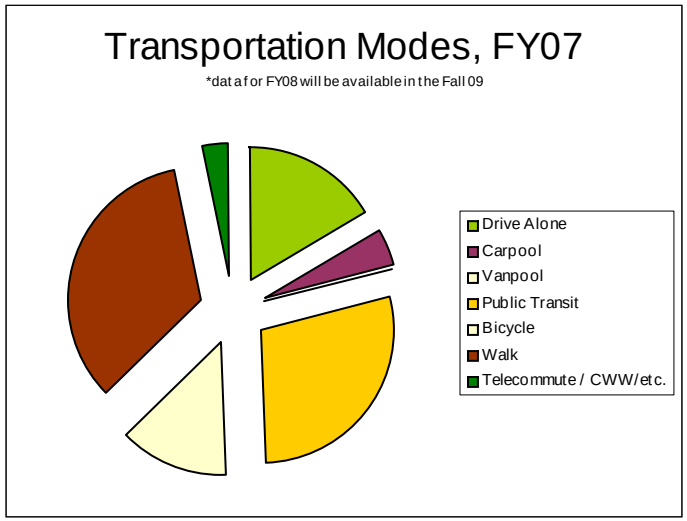
Typical green cleaning practices include:

- High-efficiency, low-noise, ergonomically designed equipment
- Low-VOC, Green Seal Certified cleaning chemicals
- Environmentally friendly foam soaps with no antimicrobial agents
- Recycled content paper products

TRANSPORTATION

Alternative Transportation

To encourage the use of alternative transportation to and from campus , Harvard University offers a wide range of incentives through its CommuterChoice Program, including 50 percent discounts on monthly bus, subway and commuter rail passes, Zipcar discounts and biking programs. In FY08, FAS' EPS (Earth and Planetary Sciences) Green Team signed up for the Departmental Bike program and now has 2 bikes available for staff and students to get around campus.



"EPS acquired two bikes through the Commuter Choice Harvard Departmental Bike Program last fall, for anyone in the department to use. We were inspired by the bike share program in Paris and wanted to offer the EPS community an alternative to walking or driving. So far so good, the bikes are great."

Ben Tobin, Faculty Assistant, EPS Depart-

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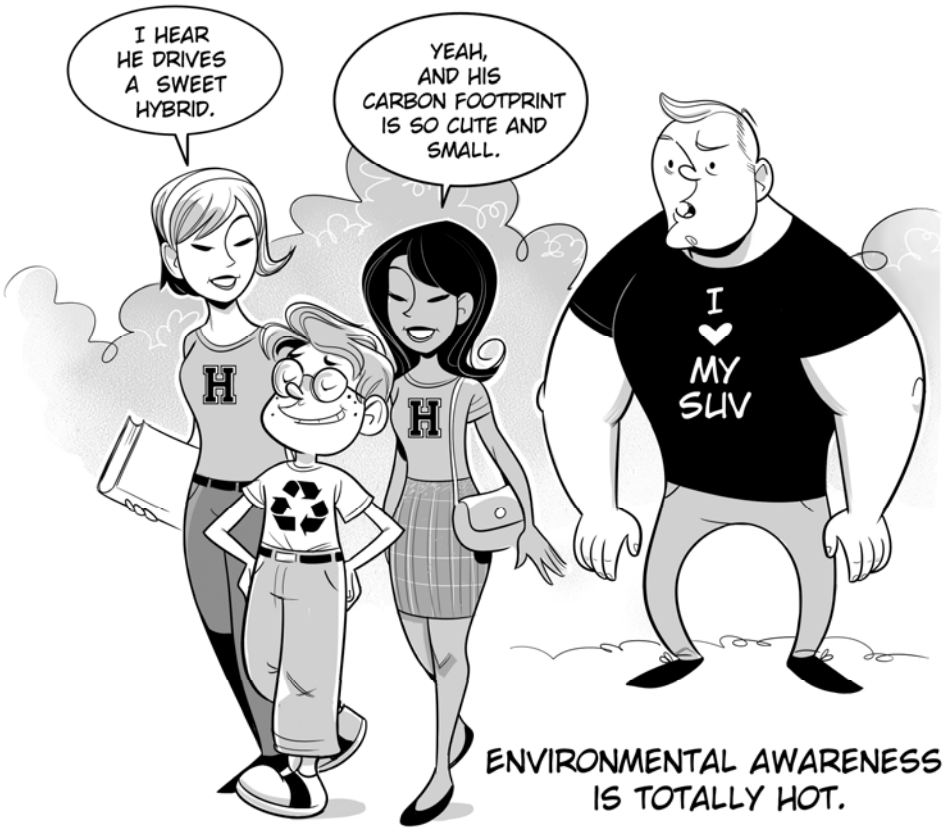
OCCUPANT ENGAGEMENT

Overview

This report is intended to provide a high level view of the environmental footprint of the FAS campus, including its greenhouse gas emissions, energy and water use, waste/recycling volumes and transportation habits. While these areas can be easily quantified, there are several other key sustainable areas where efforts are underway and contribute to lessening the environmental impacts of the school.

The FAS was the first Harvard school to recognize the connection between individual practices of its community and the environmental performance of its campus. Since FY2001, the FAS has partnered with Harvard's Office for Sustainability (formerly called the Harvard Green Campus Initiative) in order to manage campus sustainability efforts, raise awareness and engage FAS community in resource conservation efforts through initiatives such as the…

- Student peer-to-peer education
- Environmental building competitions
- Environmental art contests
- Green TipS of the Month
- Annual Harvard Sustainability Pledge
- "Shut the Sash" campaigns in the labs
- Green Lab Equipment resources
- Earth Day activities
- Green Office starter kits
- Recycling & composting outreach
- Policy development
- Collaboration with FAS environmental student group, Environmental Action Committee



OCCUPANT ENGAGEMENT

CERP (Campus Energy Reduction Program):

- Integrating sustainability into daily practices and operations in FAS' offices and lab
- Formerly "Computer Energy Reduction Program", first "occupant engagement program" at Harvard, created in 2001
- Starting in FY09, CERP got split into 2 separate programs: FAS Green Labs and FAS Green Offices

FAS Green Tips of the Month

Interesting monthly green tips and information are sent out to students and staff

Eco-Competition

The annual competition pits buildings against each other to determine the greenest one

Green Office Program

Green Office workshops and checklists help guide offices to becoming more sustainable

Eco-Citizens and Green Teams

Eco-Citizens and Green Teams work to green their departments

Shut the Sash Competition

Researchers have become aware of the large amount of energy escaping through their open fume hoods and they now close them when not in use

Resource Efficient Lab Products

A "Green Products" section was included in the 2008 *Best Buy Guide* released by VWR and a "Green Product" handout was distributed to dozens of lab groups

Highlights, FY08

- **$72,472 in savings** and **reduction of 230 MTCDE** from the Eco-Competition
- **1,000 pledges** in office and lab building
- **8 Eco-citizens**
- **54 "Earth Day" bags** with environmental office samplers given out to FAS Departments
- **70 CERtoon entries**
- **70% recycling rate** in WJH, and 50%+ in 9 other FAS buildings
- **$130,000 in savings** and **reduction of 350 MTCDE** from the Shut the Sash campaign

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OCCUPANT ENGAGEMENT

REP (Resource Efficiency Program):

- Employs students (REPs) to engage their peers on sustainability issues in their daily lives
- Created in 2002

Pledge Campaign

Close to 50% of college students pledge each year to reduce their environmental impacts.

Green Cup

An annual inter-House competition to reduce heating, electricity use, water consumption and dishware loss. And of course to increase recycling rates.

Mt.Trashmore

REPs collaborate with Harvard Recycling on constructing a Mt. Trashmore each year, in November. The pile represents all the trash generated in one day by Freshmen residences in the Yard and is accompanied by a hands-on waste audit.

Eco-Projects

Students come up with dozens of environmentally themed projects for their Houses, e.g. green cleaning supply store at PfoHo, environmental exhibits, outreach campaigns, etc.

CFL Swapping

At Freshmen Move-in hundreds of light bulbs are handed out along with other materials

Energy Conservation

REPs use heat guns and data loggers to collect data on hot and cold spots in the Houses.

Highlights, FY08

- >**13.8% reduction in electricity** use of dorms by 2007 as compared to 2002
- **>4% reduction in fuel for heating**
- **33% reduction in Food Waste**
- **25% Increase in recycling**
- **>$50,000 annual water savings**
- **>60% reduction in move-out trash**
- **>$75,000/year of reusable items** salvaged and

We live in a messed up world...

Do you part to make it right!
Turn off your lights over break!

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LEED commitment

In support of Harvard's High Performance Building Guidelines, FAS Office of Physical Resources has made it its priority to integrate sustainability components into all major renovations in FAS buildings. This goes well beyond Harvard's current commitment, where only major renovation/ construction projects, above $5 million are required to follow the Guidelines.

The FAS is now engaged in over 10 LEED-CI renovations on its campus! LEED-CI (LEED for Commercial Interiors) is the recognized system for certifying high-performance green interiors that are healthy, less costly to operate and maintain; and have a reduced environmental footprint.

The FAS is also pursuing LEED-EB (LEED for Existing Buildings) certification for Thayer Hall, a residential building in Harvard Yard, with the goal of expanding best operational practices to other FAS buildings.

Project Highlights

WATER CONSERVATION

- dual flush systems and low flow aerators on sinks and showers

GREEN CLEANING

- recycled content paper products and Green Seal soaps
- microfiber cleaning products and energy efficient equipment

ENERGY CONSERVATION

- occupancy sensors and LEDs
- energy audits
- ENERGY STAR equipment

MATERIALS AND WASTE

- diversion of construction waste from landfills
- sustainable, local or recycled content furniture and furnishings

ENVIRONMENTAL QUALITY

- filtration units to mitigate dust
- low or no VOC paints, sealants, carpet adhesives,

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