international sustainable campus network

novatlantis
Sustainability at the ETH domain

April 24, 2008 – Zurich

North-American Best Practices

MIT Engaging Students in Campus Greening: Local Action, Leadership, Global Change

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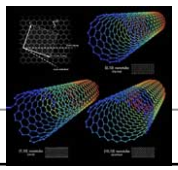
MIT Campus: A Microcosm of Our Global Challenge

- MIT targeting energy and climate issues
- Aligning research, education, walking the talk
- A learning laboratory for local & global change
- Students play key role in all aspects
  - Pushing the envelop on all frontiers

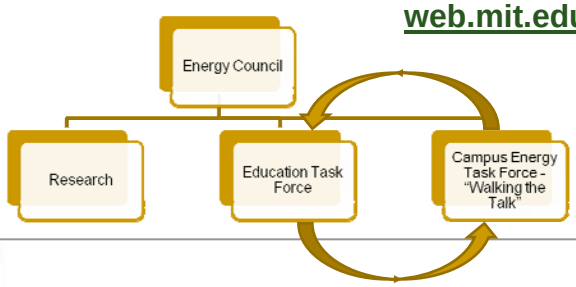



MIT Energy Initiative

MITei MIT Energy Initiative

- **Energy Initiative**: President Hockfield's signature research initiative
  - A call to action for MIT to tackle the global "energy crisis":
    - *"The need for workable energy options is perhaps the greatest single challenge facing our nation and the world in the 21st century"*
    - The gist: how to meet growing energy demand without destroying our world's resources = sustainable energy

web.mit.edu/mitei



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MIT Energy Initiative: Walking the Talk on Campus

- Extending research impact by demonstrating sustainable energy practices on campus and integrating education opportunities
- Leading and educating by example: MIT taking action to reduce its own campus energy foot print through:
  - Making a commitment
  - Investing in energy conservation
  - Increasing energy efficiency
  - Applying advanced energy technologies
  - Embracing sustainable design
  - Applying innovative financial strategies
  - Opening our campus as a learning laboratory
  - Creating campus-focused energy research and education opportunities

- Using greenhouse gas emissions & student engagement as some metrics of our progress

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Setting the Stage at MIT

- 130 academic buildings
- 11.5 million sq feet academic space
- 153 urban acres in Cambridge
- 20,000 person campus population
- Over 2,000 research labs
- District steam, chilled water & electricity
- Utilities purchased for FY06 $49M (FY07 $60M)
  - $31.7M natural gas (2.9 million mmbtu)
  - $9.4M electric (80 GWh of 200 GWh total)
  - $3.8M oil (0.4 million mmbtu)
  - $4.2M water and sewer
- Building energy intensity
  - Campus average 373 kbtu/sf/year
  - Typical wet lab 1200 kbtu/sf/yr
  - Bldg 39 2600 kbtu/sf/yr
  - Typical dorm (unairconditioned) 150 kbtu/sf/yr
- Historical 1M sq ft of new space/decade

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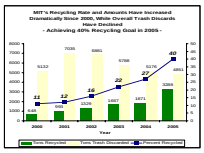
MIT's Sustainability Challenge



- MIT uses 350 million gallons of water annually
- Generates nearly 16,000,000 lbs of trash per year
- …and over 270,000 lbs of lab chemical waste per year
- Produces thousands of cu/ft of other regulated lab waste waste annually
- 25% of MIT community drives to campus alone
- But 75% take the T, carpool, bike, walk, etc. versus 45% nationally
- Of over 100 campus vehicles, only 3 use alternative fuel
- Energy, energy, energy…

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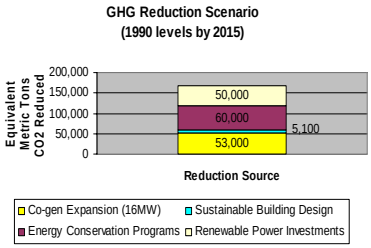
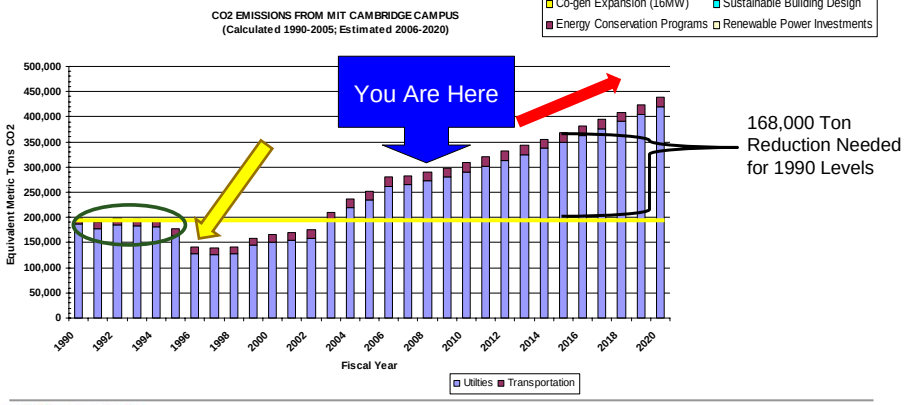
Massachusetts Institute of Technology Community Solar Power Initiative

Our GHG Challenge

- Building consumption 90%
- Transportation (including commuting) 9.5%
- Solid waste 0.5%





168,000 Ton Reduction Needed for 1990 Levels

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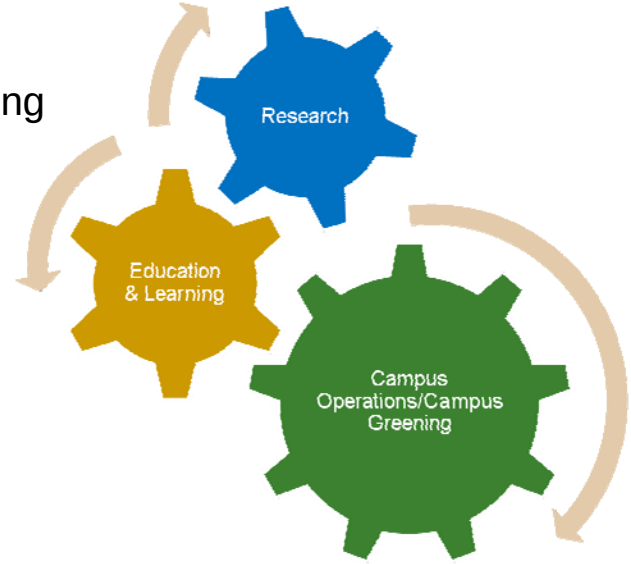
Avenues for Student "Education" in Sustainability

- Researching
- Learning
- Doing
- Leading
- Driving



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Students Embrace the Campus as a Learning Laboratory

- ✓ Student interest in on-campus energy and environmental performance has skyrocketed
- ✓ Driven by desire to:
  - ➢ Walk the Talk on campus and affect change in their community
  - ➢ Create a unique space to apply MIT-honed creative problem-solving skills
  - ➢ Develop and test emerging leadership abilities
  - ➢ Build collaborative bridges across academy and administration
  - ✓ Lead the way on campus for win-win solutions:
    - ✓ Reduce energy use and costs
    - ✓ Educate the community (and themselves)
    - ✓ Minimize MIT's climate footprint
    - ✓ Create smarter, more efficient campus

How We Engage Students On Campus (and Get Engaged by Them)

- "Formal" education channels
  - Course curricula
  - Class projects (5.92, S-Lab)
  - Special modules (FPOP DEEP)
  - Faculty-sponsored research (CS-UROPS)
- "Informal" education channels
  - Explosion of volunteer activities & internships
    - Student clubs: SAVE, SfGS, Sloan EE, Energy Club
    - MIT Generator
    - MIT Pledge
- Campus as a learning laboratory

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Classwork – Undergraduates

Energy, Environment & Society (5.92)

- First Year Students
- Project-Based Learning
- Interdisciplinary

Key Lessons

- Freshman exceed expectations
- Meaningful results for partners
- Sufficient guidance is key
- Bring new students into network

Projects

- MIT Wind Capacity
- Waste Heat from MIT Nuclear Research Reactor
- Renewables Capacity at Cambridge High School

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Classwork – Sustainability Lab (S-Lab)

MIT Carbon Mitigation Matrix

MITSloan MANAGEMENT

Carbon Mitigation Projects Matrix

Key columns

Totals			132,164		52.27%		$103,721,140	$16,284,745
Project category	Project description	ROI	Reduction MTCO2e/yr	NPV per MTCO2e	MIT CO2e 2003	# of Units	Installed Cost	Energy Saving $
Fac Eff	Cogen. Plant Expansion 16MW, 300,000 pph	8%	53,086.13		21.00%		$78,000,000	$6,500,000
Fac Eff	Window Film Application	40%	110.98	$148,647	0.04%	2,400,000	$10,000,000	$4,000,000
Fac Eff	Retrocommission Six Buildings	233%	16,776.82	$503	6.64%	6	$600,000	$1,400,000
Fac Eff	Lighting Occupancy Sensors	63%	5,026.04	$992	1.99%	9,867	$1,609,820	$1,006,933
Fac Eff	Laboratory Fume Hoods Upgrade & VAV Controls	19%	4,274.88	$267	1.69%	500	$4,000,000	$750,000
Fac Eff	Continuous Commissioning of Buildings W35 & 18	302%	12,522.20	$244	4.95%	2	$165,000	$499,102
Fac Eff	Continuous Commissioning of Four More Academic	133%	10,017.76	$229	3.96%	4	$300,000	$400,000
Fac Eff	Re-Lamp / Re-Ballast Campus-Wide	16%	1,570.64	$133	0.62%	50,000	$2,500,000	$390,000
Fac Eff	Steam Trap Retrofits	119%	8,184.59	$248	3.24%	3,000	$302,000	$360,000
Fac Eff	Add Heat Recovery to Building 13	11%	9,093.98	-$43	3.60%	1	$2,000,000	$225,000
Fac Eff	Air Handler Low Drop Filters and Coil Cleaning	100%	604.09	$1,366	0.24%		$150,000	$150,000
Fac Eff	Underground Steam Pipe Insulation	35%	4,546.99	$117	1.80%	1,800	$400,000	$140,000
Fac Eff	Add Heat Recovery from Lab Exhaust Systems	13%	4,092.29	-$11	1.62%	5	$750,000	$100,000
Fac Eff	Incandescent Light Bulbs to CFL Retrofits (Task Lighting)	70%	212.04	$1,269	0.08%	5,000	$75,000	$52,650

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FPOP DEEP@MIT

Pre-freshmen get DEEP into energy and environment

- Freshmen Pre-Orientation Program = Discover Energy & Environmental Programs
  - Leading faculty presentations on global climate issues, research, classes
  - Calculation of own “carbon footprint”
  - Learning about MIT’s own energy use & CO2 emissions
  - Dorm building audit: heating loss, water & electricity use, trash and recycling
  - Leads to sets of recommendations for improvements
- New addition to programs on literature, engineering and outdoor adventures

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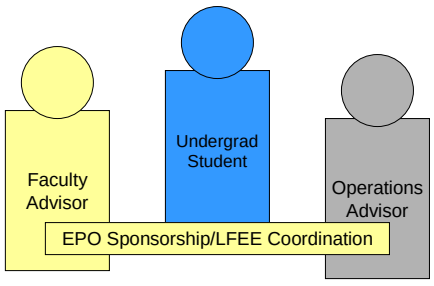
Campus Sustainability UROPs

laboratory for energy and the environment

UROP = Undergraduate Research Opportunity Program

- >80% of MIT undergraduates do at least one



Project Examples

- Green Building Feasibility Analysis
- Benchmarking Analysis of Green Funding Mechanisms
- Recycling Systems & Communications Analysis

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Campus Sustainability UROP Guidelines

- Both student and campus learning essential
- Integrated supervisory team: faculty, facilities/operations, UROP coordinator, sometimes graduate students
- Timeline for deliverables including presentation and report

Architectural Model of New MIT Graduate Dorm, NW-35

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Graduate Thesis or Independent Research

A Methodology for Assessing MIT's Energy Use and Greenhouse Gas Emissions

by

Tiffany Amber Groode

B.S., Mechanical Engineering
University of California, Los Angeles, 2002

Submitted to the Department of Mechanical Engineering in Partial Fulfillment of the Requirements of the Degree of Master of Science in Mechanical Engineering

at the

Massachusetts Institute of Technology

May 2004

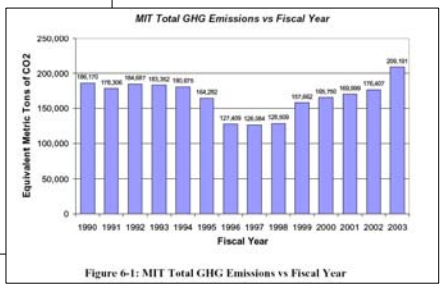

Figure 6-1: MIT Total GHG Emissions vs Fiscal Year

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MIT Generator

Students walking the talk on energy and the environment

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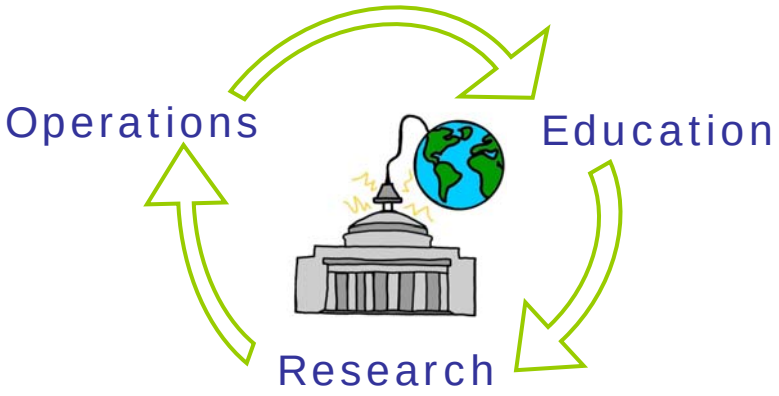
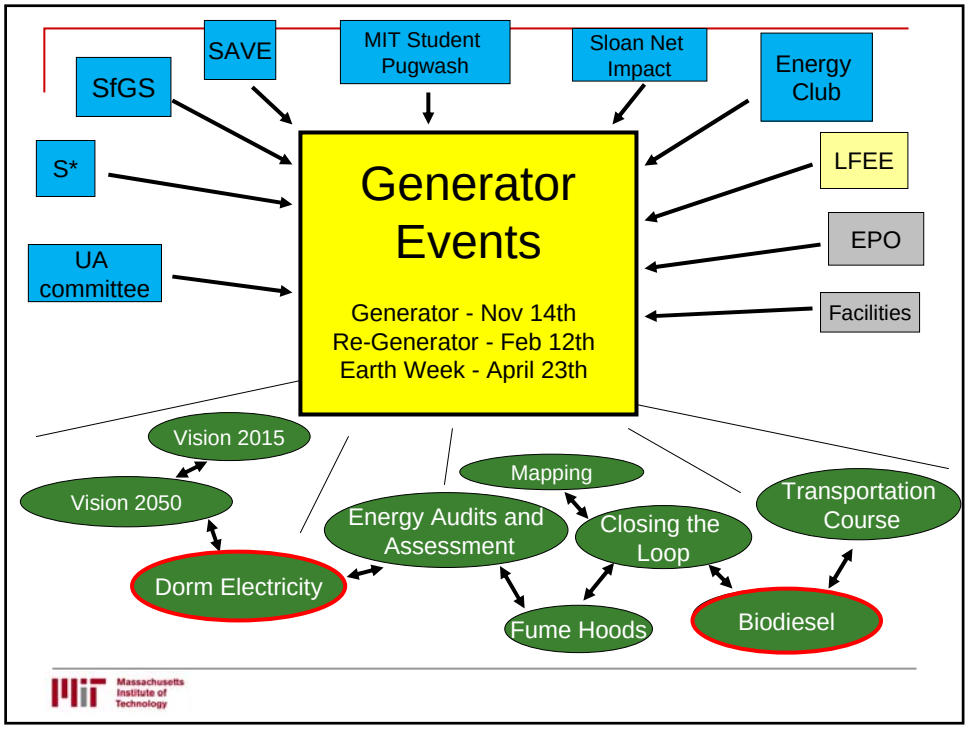
The MIT Generator exists to unite and catalyze student groups working on local energy, environment, and sustainability projects with a campus focus



Our vision is for MIT to be a living laboratory, where the campus itself is a development site and proving ground for student leadership and innovative policies, practices, and technologies

MIT Generator: Students Walking the Talk on Energy and Environment

- A coalition, an event series, a community, working groups
- Alliance through joint action
- Distributed innovation… under one roof



Behavior Change Measures

- Behavior change measures essential
- Require different set of skills and programs
- Students well suited to advance these

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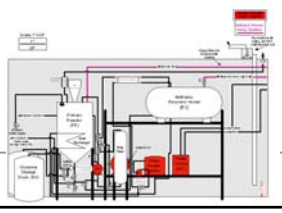
- ✓ This student team really wanted to get their hands dirty and make a difference
- ✓ Setting the gold standard for student leadership, commitment and organization
- ✓ Created whole new campus community
- ✓ Established new model for bringing change
- ✓ Leading faculty member: “Don’t let these proposals gather dust!”

The Boston Globe

MIT group strikes oil, wins "eco-grant"

A plan to turn used cooking oil into biodiesel fuel has won a group led by MIT students a $25,000 "eco-grant" and a concert to be headlined by Angels & Airwaves.



Student Campus Energy Project Grants

Wind Turbine Competition

Energy Mapping Project

MIT Generator

UA Campus Energy and Environment Pamphlet

Campus Climate Awareness Project

Revolving Door Behavioral Change Campaign

Appliance Use Energy Audits and Case Studies

http://mit.edu/mitei/news/opportunities/index.html

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Benefits of Student Engagement

- Enthusiasm
- Brainpower
- Creative problem solving
- Change agents – presses us further
- Better outcomes
- Community building
- Leadership creation
- Multiplier effect – local to global

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Lessons to Share

- Student learning is optimized through a mix of informal and formal opportunities for learning and leadership
- For academics and educators, knowing the rhythms of operations is critical
- Aligning operational goals with core academic and educational mission increases its power
- Persistence, vigilance, and constant connecting are key to keeping the threads together in an “emergent” process
- Building awareness, community, empowerment, lasting change

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We’re doing lots, but need to do more

- Environmental policy
- Environmental goals
- EHS management system
- Sustainability staff
- Co-Generation & heat recovery
- Solar power systems
- Green building standards
- Diesel pollution control retrofits & alternative vehicles
- Transportation demand programs
- Recycling, waste minimization & pollution prevention
- Energy and water conservation programs

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