



**MITEi**  
MIT Energy Initiative

## MITEI Campus Energy Program

### Giving Opportunities:

- MIT Campus Energy Conservation Investment Fund: \$14 million
- Campus Energy Education Opportunities Fund for programs to support faculty, undergraduate and graduate student research and experiments on campus energy efficiency: \$1.25 million over 5 years to include:
  - Graduate fellowships to develop Campus Energy Efficiency Framework jointly led by faculty of Sloan, Architecture, Mechanical Engineering, and others
  - 12 campus energy UROP's
  - 20 student campus energy projects

### For More Information:

[web.mit.edu/mitei/campus](http://web.mit.edu/mitei/campus)

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## Innovating and leading by example: MIT tackles its own campus energy challenge

*It is our institutional responsibility to address the challenges of energy and the environment....Tackling the problems that energy and the environment present will require contributions from all our departments and schools...bringing scientists, engineers and social scientists together to envision the best energy policies for the future.*

Susan Hockfield, President

The MIT community has embraced with passion and commitment the challenge of improving sustainable energy practices on campus, particularly energy efficiency. The Campus Energy Program of the MIT Energy Initiative (MITEI) has been the catalyst for an unprecedented partnership between students, faculty and staff of the Institute. A number of strategies to reduce MIT's energy use have been the result of research and collaborative projects involving students and faculty from all five schools at MIT and staff from administrative units, such as facilities management, information technology, housing, travel, and environment, health and safety.

### The Opportunity at MIT

The MITEI Campus Energy Program has three goals:

- ❖ Reduce MIT's energy consumption and associated greenhouse gas emissions economically
- ❖ Enhance student energy education and learning by using our campus operations as a living laboratory for discovery and innovation
- ❖ Serve as a model of intelligent, effective actions to reduce energy consumption and greenhouse gas emissions: a model that could be used by others in the US and worldwide

The path and strategies to meet those goals are not clear and discovering and developing a reasoned, robust framework and suite of meaningful and sustainable actions is needed. Through its multi-disciplinary and collaborative expertise and its fact-based analysis for decision making, MIT is well positioned to identify, model, and share effective strategies.

**Successful Examples of the Campus Energy Program**

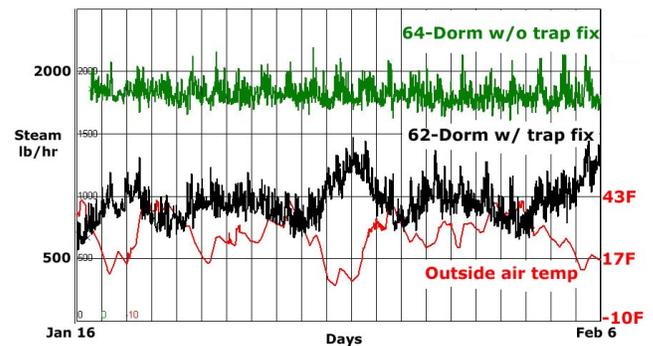
Two complementary areas of focus with initiatives designed and developed during the first year of the MITEI Campus Energy Program illustrate MIT’s unique approach to the campus energy challenge.

**MIT Energy Conservation Investment**

Students in a recent Sloan School of Management course (Laboratory for Sustainable Business or “S-Lab”) partnered with the Department of Facilities and other campus units to identify investments in improved campus energy efficiency and to rank them in terms of return on investment, payback, and impact on greenhouse gas emissions. A \$14 million portfolio of investments with a three-year payback has been identified.

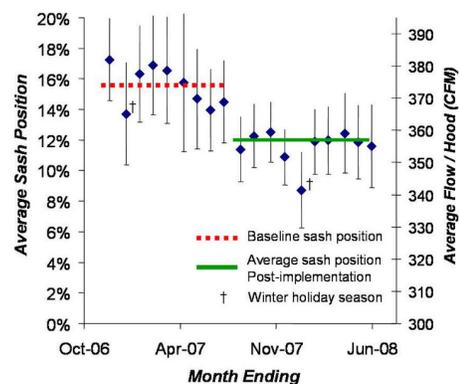
As a result of this work, MIT has launched the pilot phase of the **MIT Energy Conservation Investment Fund** with \$500,000 of seed capital provided by the MIT Treasurer to fund these investments in energy efficiency across campus. Initial pilot projects include retrofitting light fixtures, adding and adjusting motion sensors, monitoring buildings to gauge energy use, and automating laboratory fume hood controls. Each project will be carefully monitored to determine the actual energy savings and return on investment as part of student research projects.

One of these pilot programs involves the replacement of steam traps in the heating systems of our older buildings. Steam traps are valves that purge unwanted water and air in radiators, while conserving the energy-intensive steam. If they malfunction, the loss in energy from wasted steam can be large. To test this program, MIT Facilities personnel conducted a controlled experiment on the two East Campus parallel dorms. The results demonstrated conclusively that such investments produced measurable improvement. The accompanying graph displays the difference in energy efficiency from steam trap replacement in one of the dorms.



A dramatic increase in energy efficiency was demonstrated after steam traps – devices to regulate steam use - were replaced in one of two identical dorms. Steam use in Building 62 (indicated by the black line) was reduced by nearly 50% and was responsive to changes in outside temperatures.

A pilot program to reduce energy use through promoting better chemical fume hood practices in MIT’s Department of Chemistry has also resulted in improved energy efficiency. Through a series of measured interventions including training, performance feedback, and awareness efforts - all with student participation, fume hood sash positions (a key determinant of energy use) were reduced by almost 30% as indicated in the chart below. Replicating this program institute-wide is a priority of the Campus Energy Program.



MIT is seeking to raise an additional \$14 million to fund the MIT Energy Conservation Investment Fund to execute the identified projects. Savings realized from the investments would be reinvested in a subsequent round of energy saving programs on campus. Given the anticipated average 33% return on investment of this first \$14 million of projects, we expect funding to result in a high multiplier impact on MIT's energy footprint. The first \$14 million of investments would reduce MIT's expenditures on energy by an estimated 9% and significantly reduce our campus greenhouse gas emissions.

### Education Investment

The Campus Energy Program offers an unmatched opportunity for students to learn while helping change MIT's energy footprint. Through project-based independent activities, undergraduate and graduate theses, UROPs, and courses that focus specifically on the energy and environmental challenges our campus faces, students embody MIT's motto *mens et manus* (mind and hand) under real world conditions.

Hands-on experience developing sustainable solutions for our campus energy systems provides an ideal opportunity for students to grapple both with the relevant technologies while considering the economic, organizational, and behavioral issues that must be addressed whenever new technologies are deployed. Multidisciplinary teamwork on challenging problems develops crucial skills in formulating, planning, and carrying out an innovative project that can lead to realistic solutions.

Hallmarks of this student work are that it is most often multidisciplinary and requires and is enriched by close cooperation between members of the academic and administrative arms of the Institute.

There is considerable excitement among MIT students, faculty, and staff about engaging in actions on campus that make important contributions to our own energy

efficiency. Projects that use the MIT campus as a living laboratory for student education offer fourfold value: tangible infrastructure improvements, frequent cost savings, increased capacity and momentum for student-staff-faculty collaboration, and perhaps most importantly, exporting knowledge on energy efficiency with graduating students. Examples of current student campus energy projects include:

- ❖ A team graphically mapped campus energy use and intensity by building.
- ❖ An undergraduate surveyed the sources of energy inefficiency in Building 18 and highlighted the major energy losses associated with improper fume hood operation. Each hood left open used as much heating energy as a single family home in Boston.
- ❖ A PhD student is developing a new generation control and monitoring system based on a new internet protocol. He is carrying out a demonstration of its impact on energy efficiency and comfort in Building N42.
- ❖ Several student groups are developing methods to encourage behavioral change through energy efficiency awareness campaigns focused on motivating people to use revolving doors, turn off lights, use computer power management features, and print double-sided.
- ❖ Students are hosting a dorm electricity conservation contest. To support this effort, another student group has developed and is installing an inexpensive system to monitor real-time energy use in each dorm.

Examples of future research projects for graduate research assistants include:

- ❖ A careful evaluation and analysis of the performance and cost aspects of initial campus energy investments followed by a development of future scenarios.
- ❖ A joint technology, management and economic study of long range planning and optimization strategies to develop a comprehensive framework for addressing the campus sustainability challenge. The project would develop a framework to guide MIT's efforts, but would also be applicable to the broader college and university community. The study would identify the guidelines to develop the best mix of technical options and means to overcome organizational barriers.
- ❖ Development of advanced technologies for daylighting, controls, and cooling of buildings and computer centers.
- ❖ Virtual building design tools to aid the integrated design process.

We are seeking funding to support undergraduate involvement in these types of projects through Undergraduate Research Opportunities (UROP's), student project support funds and support for graduate research assistantships over a five year period.

### **MIT's impact on carbon mitigation beyond the campus**

The Institute's ability to cut carbon emissions extends far beyond the borders of the campus. Our students will take skills and knowledge gained here into a range of careers. Their future endeavors — whether in industry, government, academia or elsewhere — will in many cases apply lessons learned in campus energy projects. Together with the innovations developed at MIT that ultimately find a place in the broader marketplace, our graduates' efforts could dramatically advance the world's quest for energy sustainability and a reduction in greenhouse gas emissions.