Tufts Climate Initiative
Miller Hall
Medford, MA 02155
p. 617-627-5517
tci@tufts.edu
www.tufts.edu/tci

Tufts Climate Initiative CO_2 Reduction Strategies

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The Tufts Climate Initiative (TCI)has been in existence for over 6 years and we have planned and implemented dozens of climate change projects in partnership with Tufts Division of Operations and many other departments and organizations at Tufts and beyond. During this time we have accumulated a wealth of experience on how to select and implement projects. The following document summarizes TCI's decision making process in selecting CO2 reduction projects. We hope that this will help other institutions gain insight and make decisions about their own climate change projects.

TCI Goals:
Reduce university greenhouse gas emissions consistent with the goals of the Kyoto Protocol (7% below 1990) and the New England Governors (10% reduction by 2020). Increase awareness of climate change and actions to reduce greenhouse gas emissions at and beyond the university.

The Tufts Climate Initiative was formed in 1999 to help the university reduce its greenhouse gas emissions. TCI focuses on four main areas:

C02 Reductions
Realizing direct and measurable reductions in carbon emissions;

Research and Monitoring
Developing an understanding of the actions needed and the incentives that must accompany them;

Education
Increasing awareness about climate change and the personal and institutional connections to the problem;

Outreach and Events
Helping other institutions to make similar efforts to reduce their own contributions to global climate change and increase their awareness of climate change action.

Of these four focus areas, realizing CO2 reductions at the University has the highest priority. This document therefore focuses primarily on the decision process for CO2 reduction projects.

CO2 Reductions can be achieved through the following strategies:

1. **Increasing Energy-Efficiency**
2. **Fuel Switching**
3. **Decreasing Energy Demand**
4. **Purchasing of Carbon Credits**

1. Increasing Efficiency

1.1 Increasing Efficiency in Buildings

Efficiency gains in buildings can be achieved through smart system design, high-efficiency equipment, insulation, efficient lighting, etc.

1.1.1 Efficiency in New Buildings:

It is relatively easy to achieve high-efficiency in new buildings, especially when energy planning is integrated into the design process very early on. LEED and other certification and benchmarking systems offer Universities guidelines for implementing green building guidelines.

TCI is working closely with Tufts Division of Operations. Improving energy-efficiency in new building is one of TCI's highest priorities.

It is important to keep in mind that even the most energy-efficient building will add emissions to the campus. New construction can therefore not reduce total emissions. (The exception to that would be a building that is a net energy producer. Very few such buildings exist in the US. Lack of financial resources, human capacity and time make such buildings unrealistic for Tufts. Also, very rarely does a new building replace an old structure one to one. Given new ASHRA Indoor Air Quality Standards, even energy-efficient new buildings tend to use more energy than old ones.)

New buildings offer a great opportunity to 'do it right' the first time. At Tufts we try to be involved early on in the design process of new buildings. To ensure the willingness and the technical know-how of the architects and engineers to design a green building, it is very important to encourage the university to hire architects and engineers who not only show an interest in green building but have actual experience in designing such systems. Yet, many other factors play into the decision of which architecture firm is hired. It is not always possible to get architects with environmental credentials (see 'long-range planning.')

At TCI we have found the most successful strategies to be:

- participating in design meetings;
- carefully studying design documents;
- working closely with all decision makers;
- improving communication between the different parties;
- cooperatively working with the designers and engineers on integrating smart design features;
- commissioning;
- fundraising for added green features.

1.1.2 Improving Efficiency In Existing Buildings

Because Tufts' goal is to reduce its total emissions (as supposed to its emissions per student or per square-foot) it is of special importance to focus on improving efficiency in existing buildings.

Improving energy-efficiency in existing buildings is one of TCI's highest priorities.

There is a vast array of energy-upgrades that can make an existing building more energy-efficiency. Some of the simpler changes involve lighting and lighting controls and high-efficiency equipment, such as air-conditioners and boilers.

Yet, many building upgrades are more complicated than simple technology upgrades and require an in-depth knowledge of the building and of systems design. Unfortunately, old technologies in existing buildings often leave little room for improvements and major financial capital is required to address those issues ('technological lock-in').

How do TCI and Tufts prioritize? Which building projects are 'worth the effort'? TCI decides on a case by case basis which projects to pursue. The following questions help us in our decision making process:

- What is the CO2 / $ ratio? In other words, how can we get the largest CO2 reductions with the least financial investment?
- Are the project managers open to input?
- Do energy-efficiency concerns fit into the design process?
- Is the technical know-how available to design a smart system?
- Is the project fundable?
- Is there funding already allocated for other scheduled renovations?
- Will the new system increase or decrease maintenance costs?
- Does the project have high visibility? (This might make up for low CO2 reductions: e.g. solar panels reduce emissions only marginally but help tremendously with raising awareness about a green building.)

At TCI, we also try to bundle projects. Combining energy upgrades with a longer payback with ones that are less expensive can enable the university to make more comprehensive upgrades. We spend considerable time advancing energy at top administrative levels, including: master planning, creating a revolving energy fund, and energy planning and reporting (see blow).

A short term project-by-project approach enables institutions to get things done, to gain experience and to learn from many smaller projects. Yet the risks of a project-by-project approach are the following:

- Difficulty to 'mainstream' design principles: Just because things were 'done right' in one building is no guarantee for them to be done correctly in the next project.
- Lack of developing coherent planning and implementation structures that allow for long-ranging change.
- Being marred down by details.

A project by project approach leaves many of us who are working on improving energy efficiency in large institutions and corporations with the limited option of tinkering at the margins. In other words, we focus on projects that are technically and financially feasible, yet do not reap the greatest CO2 benefits. To address this issue, more long-term planning is required.

1.2 Creating the Infrastructure For A More Comprehensive Approach

At TCI we work with the University on several long-term projects. The benefit of addressing long-term sustainability are clear: only if systems are created that will enable the university to integrate sustainable choices into its decision making process on a regular basis, can an institution move from implementing discrete green projects to becoming a truly green institution. The difficulty of working on these long-term projects, is that they do not reap immediate benefits and might take many years to be implemented.

Long-range Projects

1.2.1 High Level Attention To Energy

TCI spends much time raising energy issues with high level decision makers at the university. TCI communicated with a number of university constituencies, include fiscal, policy, university goals, and planning decision makers. We also help implementers in the Operations Division become more effective at communicating energy needs and problems. Of course this does not lead to measurable CO2 emissions reductions. Yet, fostering relationships and increasing awareness about energy security

and climate change among university decision makers is absolutely vital in creating long term change. ***Improving energy-efficiency and climate change awareness among University decision makers is one of TCI's highest priorities.***

1.2.2 Construction Standards
These standards offer a great opportunity to specify specific green products and design features. The difficulty lies not only in clearly specifying the items but also in making sure that construction standards are actually followed. As with so many projects, it is easier (but not easy!) to write great environmentally sound construction standards than to implement them in a meaningful way.

At TCI, we are currently working with Tufts Operations on integrating green features into the construction standards.

1.2.3 Green Building Standards
Unlike the Construction Standards, the Green Building Standards are more general and do not address specific building practices. Such standards could for example specify that each new building has to meet LEED Silver.

At Tufts we currently do not have such green building standards.

1.2.4 Financing mechanisms: Revolving Loans, etc.
Energy-efficiency measures are often associated with higher up-front cost. Several schools, including Tufts, have established a loan fund to pay for such energy upgrades. At Tufts, energy upgrades with a payback of 3 years or less are financed through this energy fund. The incurred energy savings are fed back into the fund. Tufts has invested $700,000 over the last 4 years. Most of the money was used for lighting upgrades (motions sensors and efficient lighting.)

Such revolving loans are ideal for financing energy projects with a short payback. The down side to limiting the financing to projects with a quick payback is that it will be harder in the future to finance energy upgrades with a higher pay back. Bundling of long-term and short-term projects is more difficult when most of the 'low-hanging fruit' have already been picked. On the positive side, this fund has enabled Tufts to quickly implement projects that have very large financial and CO2 benefits.

1.2.5 Engineering Consultation
It is frequently a lack of engineering knowledge (and not money) that will lead to poor design decisions. At TCI, we have found that it is often helpful to hire consultants, to push (and/or pay) for commissioning or to offer training to operations staff. Building the knowledge of and commitment to green building principles at the university itself will ensure long term success of integrating sustainability principles.

TCI, has organized green building trainings, paid for operation staff to attend sustainable building conferences and has hired outside consultants for technical expertise.

1.2.6 Auditing, Benchmarking and Re-commissioning Buildings and Energy Systems
To gain a deeper understanding of the CO2 reduction potential at an institution, it is very valuable to not only conduct a greenhouse gas emissions inventory but also perform audits of and re-commission all major buildings. In order to be useful, this audit has to be specific and in-depth. The same is true for re-commissioning energy systems.

At TCI, we have worked with Facilities to implement an in-depth building audit. Financing such a project requires a large investment. Yet an audit will not result in immediate carbon savings. We are currently still in the planning phase.

1.3. Increasing efficiency in on-campus steam generation plants:

Efficiency gains in buildings can be achieved through updating or replacing existing plants with new high-efficiency systems such as co-generation plants.

Tufts could easily meet its Kyoto protocol goals, if it would replace its oil-fired steam plant on the Medford Campus with a gas-fired co-generation plant.

TCI has explored this option on several occasions. Yet, although in theory a very elegant solution, it is for the following reason currently an unrealistic option.

Barriers for a co-generation:

- **Financial Investment:** Building a co-generation plant requires a very large financial investment.
- **No summer use for steam:** What makes co-generation plants so efficient is that they produce steam and electricity. Tufts does not have a central cooling loop or technology to use steam for cooling. Therefore, the investment would have to be even larger to make full, year-round use of a co-gen system.
- **Location and permitting issues:** The Medford campus is in an urban setting. The campus is small and has little room for additional buildings. A new power plant would almost certainly trigger neighborhood concerns, even though it would be much cleaner than the old plant. Also the old plant has been 'grand-fathered'. A new plant would have to meet many new stringent clean air standards. Although this is a good thing, having a grand-fathered plant with much more lenient permitting requirement is definitively a hindrance to building a new plant.
- **Stand by charges:** Even if Tufts has a co-gen plant, the utility company would still charge to provide power on a stand-by basis.
- **Switch to high pressure distribution:** Tufts currently uses a low pressure distribution system. A co-generation plant may require a high pressure system, which would add considerable to the cost.

Because of these barriers, co-generation on the Medford campus is currently of low priority for TCI, although we continue to monitor the situation for changes that might make this more feasible.

2. Fuel Switching

2.1 Fossil fuel switch:

Switching from oil to natural gas results in carbon savings of 10-30%. Yet natural gas is considerably more expensive than oil. Nevertheless, over the last few years, Tufts has replaced some of the oil boilers in its smaller buildings with gas boilers because gas boilers require considerably lower maintenance, have lower emission levels, and no oil tanks need to be maintained. These changes happened without TCI's involvement and demonstrate how sometimes carbon savings are accomplished as a side benefit.

In its main steam plant on the Medford campus, Tufts still uses oil. It would be technically feasible to switch to gas, yet it is the high cost of natural gas and the winter supply issues that keep Tufts from switching.

TCI is currently not advocating such a switch because it is not financially feasible. Also, natural gas availability is inconsistent during the winter time.

2.2 Purchasing of electricity produced by renewable sources:

Because of an ever increasing use of electronic equipment, electricity demand is growing constantly. Purchasing green power is a way of avoiding carbon emissions associated with conventional power production.
TCI has collaborated with Tufts students who, in the fall of 2004, initiated a student non-binding referendum to raise student fees by $20 per year to purchase green power. The initiative was approved by over 80% by the student body in the spring of 2005. TCI is working closely with the energy manager and the vice president of operations on exploring the possibilities of purchasing renewable electricity and improving efficiency in response to the student initiative.

The main barriers to green power are higher costs and availability.

Purchasing green power is a medium to high priority for TCI. It is a high priority for Tufts students.

2.3 On campus production of renewable energy: e.g. solar PV, solar water heaters

Tufts has installed several PV panels and hot water heaters. A large 26 kW installation is planned for the new residence hall with is currently under construction.

Solar projects can have very high visibility. ***Yet because of the low carbon benefits, installing solar power and other alternative energy sources on campus is not a very high priority for TCI.***

3. Decreasing Energy Demand

3.1 Demand-side management: Decreasing demand by modified behavior

TCI has initiated many campaigns to raise awareness and encourage energy-efficient behavior, e.g. shutting down fume hoods, computers and lights when not in use.
Changing behavior is very difficult and only rarely leads to large savings. Nevertheless, it is important to keep raising awareness about climate change and energy consumption among students, staff, and faculty. ***Decreasing energy demand though behavior changes is a medium priority for TCI.***

3.2 Decreasing demand through technology:

Efficiency can be increased in many applications (office equipment, vending machines, vehicles). These non-building related efficiency gains are often relatively small and time intensive. For example, it requires much staff time to organize the installation of timers on all water coolers at the university and the CO2 gains, although not negligible, are nevertheless quite small.

TCI faces one of its biggest challenges in deciding which of these smaller energy projects are worthwhile pursuing. The administrative burden of implementing such projects is very large. Because of that ***decreasing energy demand though small scale technologies is a medium priority for TCI.***

4. Purchasing of Carbon Credits

CO2 reduction credits (achieved by other companies through efficiency gains or carbon sequestration -- e.g. tree planting, land use management) can be purchased to "neutralize" one's own emissions. The Kyoto Protocol entered into force in February 2005. Even though the US has not ratified the treaty, CO2 trading systems will become more and more common. Already there are trading systems established in the US.

Tufts is a member of the Chicago Climate Exchange and Tufts received carbon credits in 2004 from International Paper.

A number of other institutions have chosen to buy carbon credits to offset their emissions. ***At TCI, we see buying credits as a last resort, since it does not really move the university any closer to being a sustainable institution.*** Buying credits remains a paper transaction that does not facilitate change at the institution. Also, issues of double counting are difficult to address. In addition, credits that come from carbon sequestration remain questionable because the science of carbon sequestration is marred with many uncertainties when calculating carbon savings through land management and forestation.

5. What we are not doing

Limited resources (financial and human) make it especially important to select projects very carefully. There are many areas TCI currently does actively pursue. The following is a partial list (in alphabetical order.)

Air Travel
Air travel is a major contributor to climate change. Tufts staff and faculty as well as students fly on a regular basis. Yet it is difficult to calculate the Tufts emissions related to air travel. At the moment, TCI does not focus on emissions from air travel.

Biodiesel
Biodiesel is an alternative fuel made from vegetable oils that can replace petroleum diesel. It has an excellent energy balance, with 3.2 units of energy output for every gallon of fossil fuel inputs . It also significantly reduces carbon emissions when compared to petroleum diesel, with 15% CO2 reductions when B20 is used. Because the Tufts fleet is small and contributes only a small fraction to the total emissions, TCI does not currently focus on switching to biodiesel.

CNG
CNG has many environmental benefits, including reduced emissions of NMHCs (Non-Methane Hydrocarbons), CO (Carbon Monoxide), and CO2 (Carbon Dioxide).

But using CNG instead of regular gasoline would increase CH4 (methane) emissions substantially. Methane traps 21 times more heat per molecule than CO2. Small natural gas leaks can therefore quickly off-set any efficiency gains. Our research indicated that using CNG would very likely increase our impact on the climate.
For more information on how we reached these conclusions, go to www.ott.doe.gov/out/field_ops/pdfs/26035.pdf to look at a study done on a Crown Victoria taxicab fleet, or www.fueleconomy.gov (a collaboration of the EPA, USDOE)

Co-Gen: see above

Extensive on-site PV
Tufts has installed several PV panels and hot water heaters. A large 26 kW installation is planned for the new residence hall with is currently under construction.

Solar projects can have very high visibility. Yet because of the low carbon benefits, installing solar power and other alternative energy sources on campus is not a very high priority for TCI.

Fuel switching: see above

Food
The environmental impact of food production is very large. Yet, it is very difficult to quantify CO2 benefits of sustainable agriculture projects. Although we work with the TFAP (Tufts Food Awareness Project) and have a "eat less meat" campaign for students, we do not work on food related issues.

Purchasing
Almost all purchasing has been decentralized at Tufts. Influencing decision making about purchasing is therefore very labor intensive. TCI is continuously working with Tufts Purchasing but does currently not pursue any major purchasing projects.

Purchasing Carbon Offsets
Does not really lead the university towards a path of sustainability. (see above)

6. TCI's Role at the University

TCI sees itself as a catalyst for change. We work in cooperation with many different departments at Tufts. To ensure long-term viability of TCI, we must find a balance between pushing for change and acknowledging the barriers and short-comings every large institution struggles with.

TCI is mostly grant funded and is not part of Tufts Operations. Being an 'outsider' has the advantage of giving us the flexibility to push for solutions or projects and to cross administrative hierarchies within the university.

The disadvantage is that we are of sometimes treated as outsiders (e.g. being excluded from decision processes.) Being grant funded gives TCI more freedom in its decision making process but it also means that a substantial amount of time is spent on fundraising.

7. How Tufts is doing

Tufts was able to level its electricity consumption on its largest campus, thanks to the many energy-efficiency projects. This despite the fact that buildings have been added and every year, students bring more electronic equipment. Overall, energy intensity (BTU/sft and kW/sft) has been lowered.

Unfortunately, more buildings are scheduled to be added, which will make it difficult to lower consumption even further.

Tufts is very likely to purchase a large part of its electricity from renewable sources (40-60% hydro). This will greatly help the University move toward meeting Kyoto.