2010

Sustainability and Climate Action Management Plan (SCAMP)

SMITH COLLEGE

Committee on Sustainability

March 15, 2010

In ways I might not have predicted even five years ago, a commitment to resource stewardship and preservation has emerged as a powerful organizing principle in Smith College's operational and curricular development and a vivid manifestation of the college's responsibilities to the nation and the world.

Our community has developed a 20-year plan to reduce the college's environmental impact. The "Sustainability and Climate Action Management Plan," or SCAMP, defines the resource-use benchmarks Smith has publicly pledged to achieve under the American College and University Presidents Climate Commitment, to which Smith was an early signatory.

Not surprisingly, Smith's greatest carbon impacts arise from its mission as a residential college: heating, cooling, and lighting student houses and other facilities; operating an extensive dining program; and maintaining grounds and buildings that date from the nineteenth century. Even absent a public pledge, Smith is among a handful of colleges and universities that achieved significant declines in greenhouse gas emissions over the last decade. Our 2009 emissions levels trailed those of 1990 by more than 10 percent. Our early infrastructure investments are already reducing our carbon footprint, and their payoff will be realized over decades to come.

A more complex challenge is changing behaviors. Our students, who live in a variety of houses, lead student competitions to shut off power to idle appliances and campus-wide drives to put computer monitors to sleep when not in use. As we install visible energy monitors in the public areas of houses and other buildings so everyone can easily see their utility usage in real time, we hope to raise awareness of the impact each of us has through our personal decisions.

Signing the Presidents Climate Commitment also dedicates Smith to ensuring that issues of climate neutrality and sustainability are part of every student's educational experience. CEEDS – our new Center for the Environment, Ecological Design and Sustainability – is uniquely positioned as a nexus of faculty and student research initiatives and a link among such programs as environmental science and policy, landscape studies and engineering. In gathering the necessary technical data for many environmental projects and for this plan, our students and faculty worked together to provide the college with new information that is essential to our progress.

As a global college with an established, thriving study-abroad program, one of our greatest challenges is reducing the environmental impacts of transportation, particularly air travel. Some institutions are investing in carbon offsets – credits by which they compensate for their environmental impacts through investments in alternative energy enterprises or technologies – to counteract their air-travel effects. Our community continues to discuss whether offsets represent a responsible strategy, given the lack of regulation in that trading market. Similarly, while we assume that biofuels will play some role in our long-term sustainability strategies, we recognize that they may never be available in sufficient quantity or derived from a source that is truly sustainable when all effects are taken into account.

As we grapple institutionally with unfolding knowledge about climate change, we are giving our students the experience of shaping and observing the evolution of their college as it addresses the major issue of this century. I am pleased to submit this collaborative and evolving plan developed with the help and support of so many members of our campus community. It will guide us through years of evolving technologies and new challenges that we hope to assess and address wisely on behalf of our local, national, and international communities.

Sincerely,

Carol T. Christ

Carol T. Christ, President

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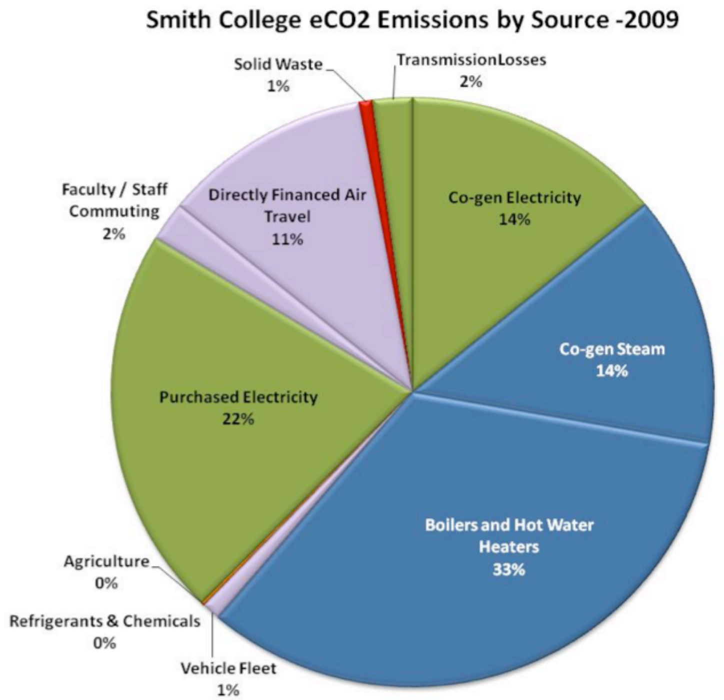
This plan and other information about sustainability at Smith College may be found at

http://www.smith.edu/green/.

1.0 Introduction

The Smith College Sustainability and Climate Action Management Plan (SCAMP) is a roadmap to reducing resource use and associated impacts. Our goal is institutional culture change. The future will be best served by a community of students, faculty and staff who make individual and collective choices consistent with our goals to use fewer resources and choose wisely what we use. The SCAMP reviews current environmental performance, establishes priorities and, identifies metrics to measure progress.

By signing the American College and University Presidents' Climate Commitment (ACUPCC), Smith committed to becoming carbon neutral. The SCAMP charts a path for reaching carbon neutrality with a deadline of 2030. To understand the goal, we must establish where we begin. The chart provides a snapshot of Smith's greenhouse gas emissions for fiscal year 2009. Most of our emissions are the result of creating heat and hot water (blue areas), and using electricity (green areas) and transportation (purple areas). Together, these categories comprise 99 percent of Smith's greenhouse gas emissions.



It was clear to Smith's Committee on Sustainability that the plan needed to include environmental and resource issues that have limited greenhouse gas implications (e.g. water) or are not now measured as part of our emissions (e.g. purchase of goods). Therefore, the plan includes water, buildings and energy, transportation, purchasing and solid waste, landscape management, climate action, and academic and co-curricular integration.

Each section reviews current resource use and, to the extent we have data, trends over time. We identify performance metrics, outline potential projects and describe improvement targets and timelines. We assume readers understand the value of each resource and of performance improvement. While each section includes aspects of climate action, a separate section on that topic sums up efforts and incorporates carbon-specific strategies, such as carbon offsets. Each section lists projects appropriate for student or faculty research. A section on academic integration describes Smith's efforts to support sustainability education in academic and residential life.

This plan is a starting point. While we hope and expect that many of the strategies outlined here will be further explored and implemented, we also expect that some will prove unwise, not cost-effective, or otherwise unattainable. The plan provides an initial roadmap; over time, new technologies and information will allow us to refine and expand our efforts to create a more sustainable future for Smith and our students, who will become leaders in their communities and the world.

Smith College Committee on Sustainability 2009-2010

Professor Judith Cardell, Engineering, Chair
Professor Elisabeth Armstrong, Study of Women and Gender
Ruth Constantine, VP, Finance and Administration
Kate Etzel, Director of User Support, ITS
Camila Fierro '10
Ann Finley, Area Manager, Dining Services
Professor Nathanael Fortune, Physics
Carole Fuller, Senior Donor Relations Officer
Etta Grover-Silva '10
Lauren Kaelin '10
Professor Thomas Litwin, Director, Clark Science Center
Professor James Lowenthal, Astronomy
Kenneth Person, Asst. Director, Facilities Management
Professor Tom Riddell, Associate Dean of the College
Professor L. David Smith, Environmental Science and Policy
Dano Weisbord, Environmental Sustainability Director
Elisabeth Wolfe '10

2.0 Water

2.1 Overview and goals

Smith College used 45.6 million gallons of potable water in 2009. This is enough to provide 222 glasses of water every day to 4,400 students, faculty and staff or to fill the Smith swimming pool 177 times. More than half of this water is used in houses by students and dining services. Other significant sources of consumption are the cooling plant (9%), the sciences (6%), the heating plant (5%) and irrigation (5%).

Goals:

- Reduce potable water consumption by 11.8 million gallons (~24%) by 2015

  19% through efficiency

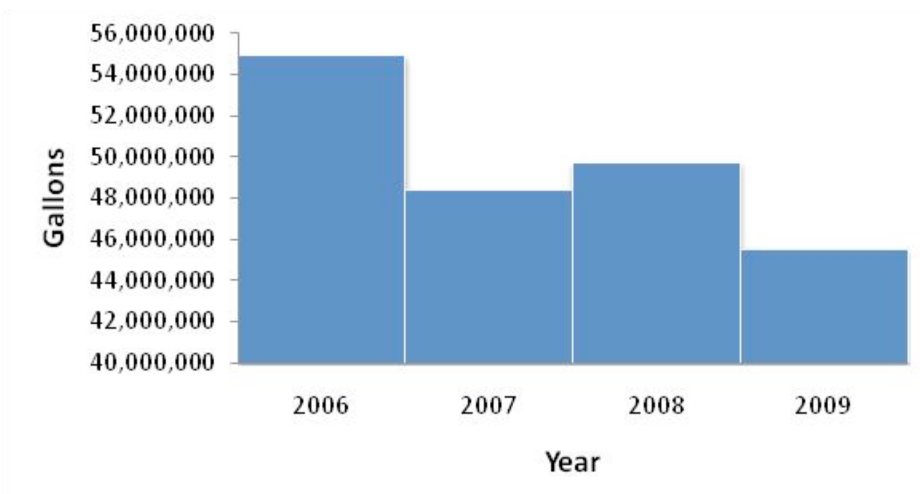
  5% through behavior change
- Eliminate use of potable water for irrigation by 2015
- Reduce thermal demand associated with heating water by 3,384 MMBtu's and GHG emissions by 328 MT eCO2 per year by 2015.
- Reduce potable water consumption by an additional 1.5 million gallons between 2015 and 2030

2.2 Current use and trends

Smith obtains its potable water from the City of Northampton Water Division, a municipally owned and operated public water utility. Water is currently metered on a building-by-building basis every quarter. Historical usage data is available since 2006. Water consumption was 16% lower in 2009 than in 2006 (Graph 2.1). Campus consumption depends on a number of variables including weather. For example, more water will be used for cooling and for irrigation in a hotter, dryer summer. Therefore, while the data below suggests that Smith is using less potable water, it is not possible to attribute the decline strictly to conservation measures.

Graph 2.1
Total Annual Water Use
2006-2009

Year	Total Usage (Gallons)
2006	54,938,288
2007	48,368,913
2008	49,742,332
2009	45,556,993



Smith uses water in almost every building for domestic and research purposes. In addition, the largest single (behind a single meter) use is associated with the cooling towers on the central chilled-water plant, which account for approximately 4.2 million gallons per year—9.2% of total. On the athletic fields on the west side of the Mill River, Smith uses Paradise Pond as a source for irrigation water. On the east side of the Mill River (the primary campus area), municipal water is used for irrigation. The Facilities Management Department estimates that landscape irrigation uses approximately 2.1 million gallons per year of potable water. Residence hall and

Table 2.2: Sources of Water Consumption FY 2009

uses	gallons per year	% total
Houses and Dining	26,483,214	58%
Academic / Administrative	6,987,271	15%
Cooling Plant	4,204,041	9%
Sabin-Reed	2,586,797	6%
Heating Plant	2,103,517	5%
Irrigation	2,100,000	5%
Gyms	1,092,153	2%
Total	**45,556,993**	

dining use is approximately 26.5 million gallons per year. Sabin-Reed, the primary "wet laboratory" building, uses approximately 2.6 million gallons of water per year or 5.7 % of the total consumption (Table 2.2). By analyzing meter data for students in those houses that do not contain dining halls, we estimate that each student uses an average of 27.4 gallons per day.

2.3 Metrics

- Total annual potable water consumption
- Total annual house and dining consumption
- House water consumption per student.
- Total annual water use for landscape irrigation (when available)

2.4 Strategies

Measurement

While Smith water consumption data exists on a building-by-building basis, this data is collected by the City of Northampton and is only available on a quarterly basis.

Installation of advanced metering that will provide real-time feedback will enhance operational management and conservation efforts.

Currently, landscape irrigation on the east side of the Mill River uses municipal water supplies, sourced from several campus buildings. Developing a water metering system for landscape irrigation will provide better data for managing that system as well as for the buildings that currently provide irrigation water.

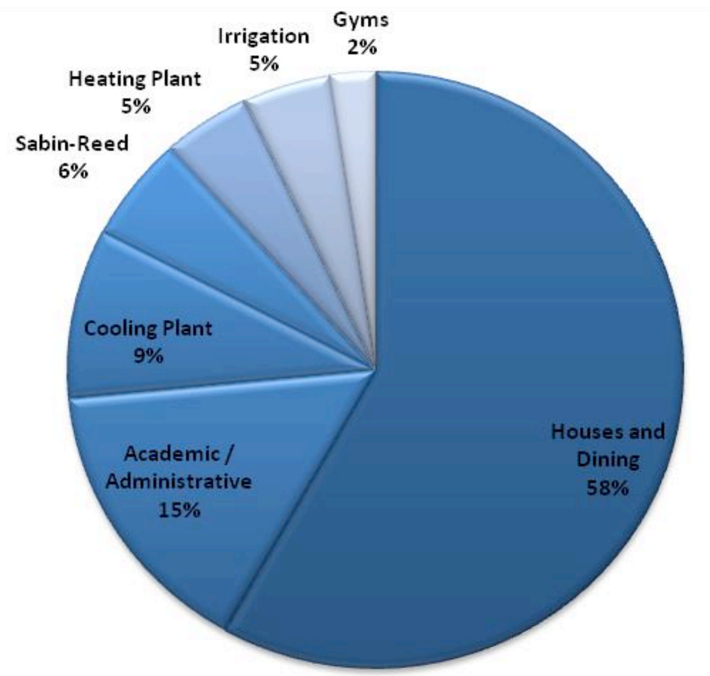


Chart 2.3: Sources of Water Consumption FY 2009

Efficiency

A variety of efficiency projects will reduce potable water consumption; specific projects are listed in the table below.

A project with significant impact is a transition to using the Mill River for all landscape irrigation. This would save approximately 2.1 million gallons of potable water per year at a minimal impact to that water system. The Grounds Department continues to upgrade the irrigation infrastructure. New automated systems will be "smarter," i.e., sensors will indicate the need for increased moisture in the soil and lawns will be watered only as needed. Shifting the irrigation source water to the Mill River will save potable water, and improvements to the irrigation systems will reduce use of water generally, regardless of its source.

Consumption can be reduced by approximately 6 million gallons (14%) through deployment of a number of water-saving efficiencies such as low-flow showerheads and sink aerators.

Behavioral Conservation

Chart 2.3 shows that almost 60% of potable water use is student domestic use and use by dining halls and kitchens. This data suggests that behavioral changes focused on student housing could have significant impact. This plan targets saving 1.5 million gallons of water through behavioral change by 2015 and an additional 1 million gallons by 2030. We expect that this effort will be augmented by a) upgrading metering infrastructure, allowing students to see real-time water consumption data by house and b) launching house-to-house competitions to reduce water use.

Table 2.4: Water Strategies

	Water Strategies 2010-2015
	Measurement
A	Install advanced water metering as budgets allow. Focus on residential houses and sciences.
B	Develop metering system for landscape irrigation
	Efficiency
C	Replace 550 showerheads with 1.5 GPM standard models
D	Replace 1500 lavatories with 0.6 GPM standard model aerators
E	Replace 100 systems with reduced-flow flush systems (20 toilets/year)
F	Irrigation w/ non-potable water from the Mill River
G	Irrigation metering and controls
	Behavioral Conservation
H	Raise awareness by distributing posters on conservation methods, providing contact information if a condition is discovered that requires repair, and participating in conservation competitions between houses
	Water Strategies 2015-2020
I	Replace 300 systems with reduced-flow flush systems (20 toilets/year)
J	Behavioral Conservation

2.5 Financial Implications

We expect many efficiency projects proposed in this section to be cost-effective, particularly if they save hot water. The initial stages of measurement projects are currently funded within existing budgets. Although metering does not provide a direct return on investment, it is essential to targeting operational efficiencies and will vastly improve the yield on behavioral conservation initiatives that have minimal costs associated with implementation.

2.6 Climate Implications

Providing hot water for domestic use (showering, hand-washing, laundry etc.) has a climate impact because water on campus is heated either through the central steam system or by independent gas (or occasionally electric) hot-water heaters. Reducing hot water use will reduce the associated release of greenhouse gasses to the atmosphere. The measures proposed here would reduce thermal demand associated with heating water by 3,384 MMBtu's and GHG emissions by 328 MT eCO2 per year by 2015.

2.7 Potential Student Involvement

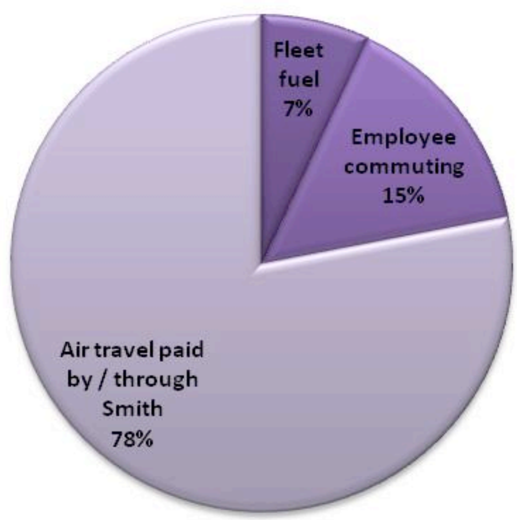
- Development of survey instruments or other methods for analyzing student water use
- Analysis of water use within specific buildings or departments
- Development of communication and/or educational materials on water use
- Development of social marketing campaigns within student housing
- Review of existing report on environmental impacts of using the Mill River for irrigation
- Development of cost benefit analysis of proposed irrigation project
- Environmental life-cycle analysis of proposed irrigation project

3.0 Transportation

3.1 Overview and goals

Transportation-related emissions associated with Smith College are responsible for approximately 4,113 MT of eCO2 per year. This is about 15% of the college's total GHG footprint of 28,000 MT eCO2. The emissions come from three categories of travel. Air travel paid by the college (~4.1 million miles) accounts for emissions of approximately 3,210 MT eCO2 per year —11% of the college's total emissions and 78% of the travel-related emissions (see Chart 3.1 below). Faculty and staff commuting (~1.5 million miles) accounts for 2% of college emissions and 15% of transportation emissions (about 620 MT eCO2). Fuel use in college-owned fleet vehicles (~31 thousand gallons) produced 285 MT eCO2 or about 1% of college emissions and 7% of transportation emissions.

Chart 3.1: Total Transportation-related MT eCO2 Emissions FY2009



The transportation section is divided into three-sub-sections:

1. Fleet vehicle use
2. Faculty, staff, and student commuting
3. Air travel

These areas of transportation were selected because they are required reporting categories for the Presidents' Climate Commitment. In our GHG inventory, we are not yet able to report accurately emissions associated with college-reimbursed automobile mileage, study-abroad air travel or student travel to and from the college.

However, the last two areas of travel are discussed within the air travel section because they represent significant additional sources of college-related greenhouse gas emissions.

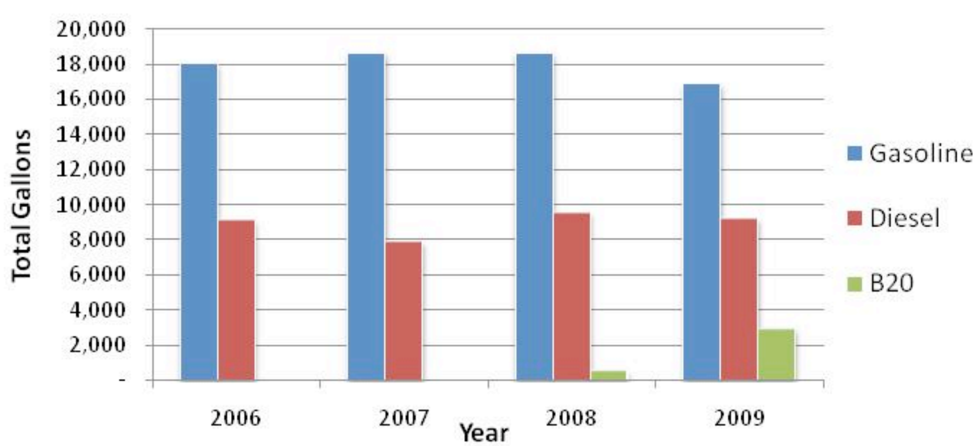
This section establishes the following goals:

- Improve fleet-weighted average EPA estimated fuel mileage from 16 mpg to 25 mpg by 2015 - Will reduce fuel use in college fleet vehicles by 33% (10,000 gallons saved, 85 MT eCO2 eliminated).
- Reduce single-occupant personal vehicle use for commuting from 69% of trips to 59% of trips by 2015 (167,405 miles or 69 MT eCO2)

3.2 Current Use, Trends and Practices

3.2.1 Fleet vehicles

Graph 3.2: Consumption of fuel by type 2006-2009



In 2009, fleet vehicles used approximately 30,000 gallons of fuel and produced 250 MT eCO2, less than 1% of college emissions. While currently contributing a relatively small portion of emissions to the college total, Smith can exert the most influence over this aspect of transportation.

Smith College currently owns 99 pieces of equipment that burn gasoline or diesel fuel. For this discussion, we divided the equipment into two categories: the “service fleet” and the “passenger fleet.”

The service fleet includes gasoline, diesel and electric-powered pick-up trucks, box trucks, waste trucks, lawnmowers, golf carts, weed-whackers and chain saws. Facilities Management operates nearly all service fleet vehicles. 2009 was the first year in which mileage was collected for the service fleet, which traveled about 94,000 miles. The service fleet has an average estimated weighted gas mileage of 12.5 mpg.

The passenger fleet is operated by five different campus organizations: facilities management (13 vans/busses and one car); SGA (9 vans); SOS/Chapel (5 vans); and the education department (one van). 2009 was the first year in which mileage was collected for the passenger fleet, which traveled 160,500 miles. In the future, we will collect mileage data from all road-legal vehicles in both fleets so that an exact calculation of all college-owned vehicle miles traveled is available. The passenger fleet is estimated to have an average weighted gas mileage of 19 mpg.[1]

Emissions from this category were calculated by adding:

- the amount of gallons of gasoline, diesel, and bio-diesel purchased for the tanks located on the Smith College campus, plus
- the amount purchased through college gas cards provided to vehicle users.

Smith’s use of bio-diesel increased from 517 gallons in 2008 to 2,930 gallons in 2009 (Graph 4.2). Overall, Smith purchased a combined total of 31,185 gallons of fuel in 2009, which accounts for approximately 285 MT eCO2 or 7% of the total transportation emissions.

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1 19 MPG does not reflect actual gas mileage. The EPA’s “combined” estimated mileage was used for each vehicle and “weighted” by how many miles a particular vehicle was driven in FY 2009.

Strategies currently in place that help to reduce the fleet transportation emissions:

- B20 bio-diesel, a mix of 20% bio-diesel and 80% petroleum diesel fuel, has been used since 2007. B20 reduces GHG emissions because, under current carbon accounting protocols, bio-diesel is considered "carbon-neutral" being derived from plants that removed CO2 from the atmosphere during their growth and would have released it again upon dying and decomposing. Fossil fuels contain CO2 that was sequestered millions of years ago but is returned to the atmosphere when combusted. Bio-diesel also reduces engine wear and produces less carbon monoxide, particulate matter, unburned hydrocarbons and sulfur emissions.
- Purchase of a Honda Civic hybrid which gets an EPA-estimated 42 mpg in combined driving. Introduction of smaller, more fuel-efficient vans such as the Toyota Sienna, which get an EPA-estimated 19 mpg in combined driving.

Finally, the college expends significant resources to reimburse faculty and staff for fuel or mileage in private vehicles used for college business. We intend to collect this data for future versions of this plan.

3.2.2 Faculty, Staff, and Student Commuting

Smith employs approximately 1,200 faculty and staff. In 2009, commuter trips by car totaled 1,466,000 miles, accounting for 618 MT eCO2 or 15% of college transportation-related emissions.

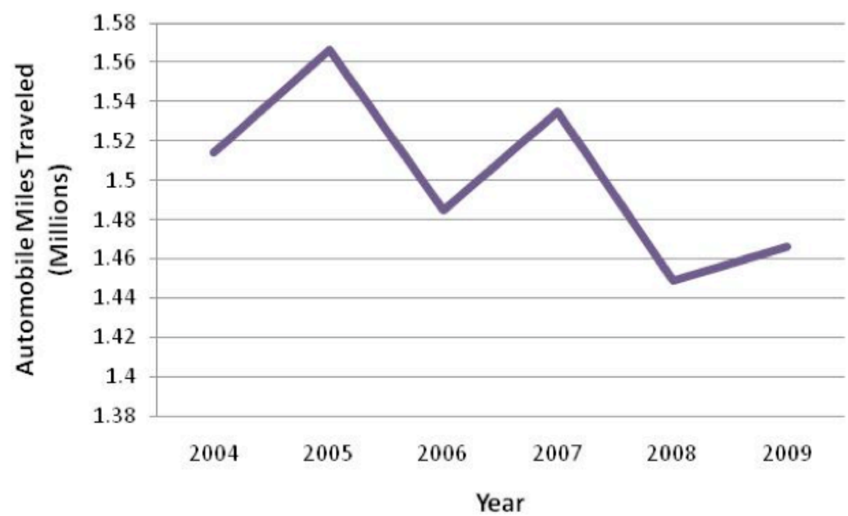
We calculated faculty and staff commuting behaviors using data from a biannual commuting survey required by the Massachusetts Department of the Environment. This provides the:

- average number of days per week faculty and staff commute to campus
- distance each group commutes on average
- mode(s) of transportation used
- number of days per week carpooling
- number of days per week using other modes of transportation (i.e. bus, bike, walk)

Survey data is available for fiscal years 2004, 2006, and 2008.

Over this time period, there was a slight downward trend in faculty and staff commuting mileage (Graph 3.3).

Graph 3.3: Faculty and staff commuting, 2004-2009

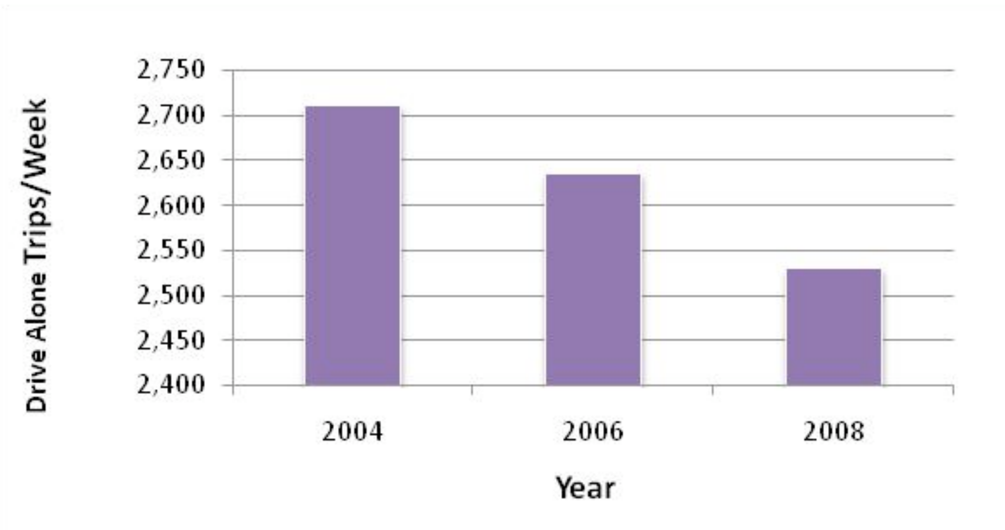


The surveys also suggest that the number of commuting days per week by single-occupant vehicles ("drive alone" or SOV) has decreased by 6.7% since 2004 (Graph 3.4). This decrease appears to be the result of employees choosing to walk, bicycle, take public transit or carpool to get to campus. Since 2004, the number of days per week walking to campus has increased by 13%, while carpooling has increased by 27% (Graph 3.5).

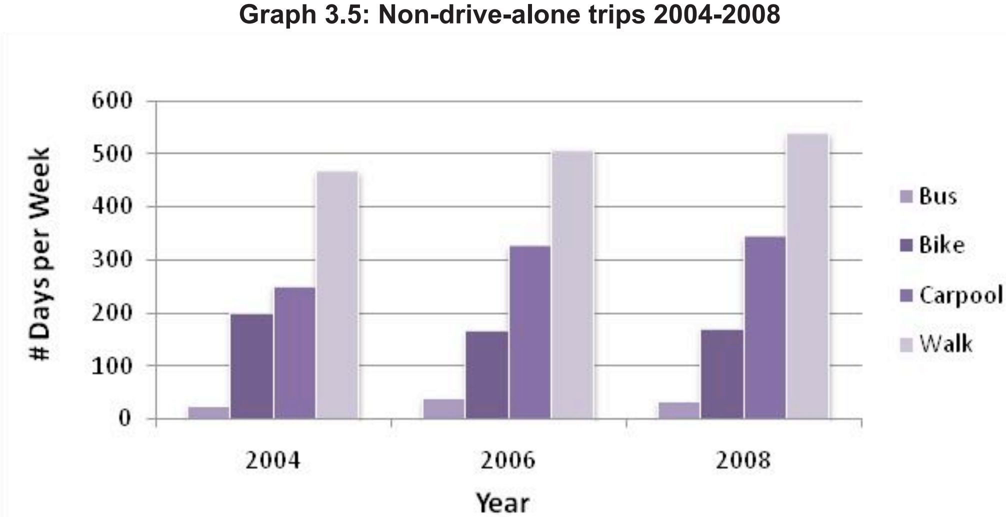
While the data suggests a promising trend, the changes are still very small. An improved survey tool and methodology is one of our suggested strategies. Nearly all undergraduate students are required to live on campus; therefore, student commuting does not play a significant role in Smith's overall transportation emissions and is not currently reported in our GHG inventory.

To encourage sustainable commuting, Smith offers a number of Transportation Demand Management (TDM) programs to its faculty, staff, and students. TDM is the selection of "strategies that result in more efficient use of transportation resources." These include:

Graph 3.4: Drive-alone trips 2004-2008



Graph 3.5: Non-drive-alone trips 2004-2008



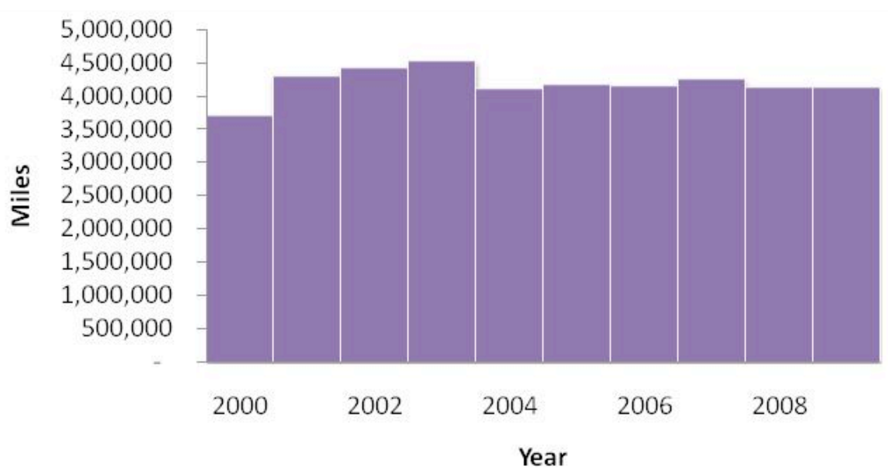
- **Five College bus system.** Smith provides financial support to the UMass Transit/PVTA bus system, which provides fare-free travel to Smith students and staff on the “Five College” system nine months of the year.
- **UMass Rideshare Program.** A free carpool assistance program is available to any Five College employee or off-campus student. It lists schedules and routes of carpooler participants and allows easy access to ride matching.
- **MassRides Ride Matching and Emergency Ride Home (ERH) Program.** A carpool program allows participants to find carpools and/or find an emergency ride home in the event of personal or family illness, unscheduled or unexpected overtime, or carpool driver emergency.
- **Zipcar.** Faculty, staff, and students may join the popular car-sharing club for $35 a year and have 24/7 access to Zipcars located on the college campus. This reduces overall vehicle miles traveled compared to using individual private vehicles.
- **Smith’s Bicycle Kitchen.** A student-run organization provides Smith College students with bicycle rentals for $15 a semester and a weekly “Bike Fix’n” service that offers free bike maintenance education. The Bike Kitchen currently holds more than 40 bicycles, all of which are rented out each semester.
- **Smith Opt-Out Parking Program.** A program pays eligible Smith employees not to drive single-occupant vehicles (SOV) to campus. This encourages participants to find alternate modes of transportation such as car-pooling, walking, biking, or public transit. 2009 payment rates are $150 for those living within one mile of the center of campus and $400 for those living farther than one mile from campus. The Opt-Out program, initiated in 2008, has enjoyed a 6.4% participation rate in its first year and an 8.4% participation rate in 2009.
- **Pedestrian safety.** Initiatives are currently underway to further enhance pedestrian and bicycle safety and access around campus, including traffic-calming measures along Elm Street.

3.2.3 Air travel

Paid by the college

In 2008, Smith paid for 4.1 million miles of air travel, which accounts for 3,210 MT eCO2 per year, 78% of the total transportation emissions tallied (Graph 3.6), and 11% of all college emissions. These air miles include all faculty and staff travel for research, conferences (even if the conference was funded by an outside grant and paid through the college), fundraising, and any travel that was reimbursed by the college to non-employees, e.g. trustees, guest speakers etc. We calculated mileage by determining how much the college spends on air travel in a given year and then converting this expenditure to mileage using the Annual Passenger Yields published by the Air Transport Association< www.airlines.org/economics/finance/PaPricesYield.htm>. This is the method promoted by the Presidents’ Climate Commitment, despite some potential for inaccuracy. In the strategies section, we have listed a number of ways Smith can improve these data.

Graph 3.6: Air miles Paid Through or By Smith College 2000-2009



Note: FY 09 calculations for air travel were not complete publication. Graph uses FY 08 data for FY 09.

Study abroad

Smith students study abroad and enter internships throughout the United States and many other nations. 269 students studied abroad in FY 2009 and traveled approximately 2.7 million miles, accounting for 2,100 MT eCO2. These emissions are not currently included in the college's emissions inventory because the Presidents' Climate Commitment does not require it. However, emissions associated with study abroad are equivalent to 7.5% of the college's total emissions.

Students traveling to/from Smith

Smith's GHG inventory does not calculate or report emissions from student travel to and from the college throughout the year. Smith's diverse student body hails from all 50 states and more than 60 other countries. Many students have no practical alternative to air travel. We hope that students will find ways to offset their travel to and from Smith, and we propose strategies to encourage using train and bus travel whenever possible. At the same time, we estimate that the amount of GHG emissions associated with student travel to and from Smith is roughly 1,850 MTeCO2 per year, which would increase our current estimate of total transportation-related emissions by 45%. [2]

3.3 Metrics

- Total annual eCO2 emissions associated with transportation and college-owned internal-combustion engines
- Total annual airline miles paid for by or though the college (not including study abroad travel)
- Total annual airline miles traveled by students for study abroad (excluding student travel to/from Smith)
- Total emissions from faculty and staff commuting
- Total number of commuter miles by faculty and staff
- Modal split of commute trips:
  - drive alone
  - bus
  - carpool
  - bike
  - walking trips
- Percent (of total faculty and staff) of parking opt-out participants
- Number (of faculty and staff) of parking opt-out participants
- Number of parking decals purchased
- Price of faculty/staff parking decals
- Number of campus parking spaces available
- Annual fleet eCO2 emissions
- Fleet miles traveled per year
- Average Fleet MPG for service fleet
- Average Fleet MPG for passenger fleet

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[2] Assumptions: 300 international students flying 8,000 miles round-trip once per year, 600 US students not from New England or Mid-Atlantic flying 6000 miles round-trip twice per year, and 1300 US students from New England or Mid-Atlantic driving 500 miles round-trip twice per year; air travel assumes 80 passenger mpg; automobile travel assumes 20 mpg; 20 lbs CO2 per gallon fuel.

3.4 Strategies

Strategies in this section are divided into three sub-sections: fleet, commuting and air travel.

Fleet

Both passenger and service fleet vehicles are a highly visible aspect of college operations. As such, they represent an area where Smith can demonstrate efficiency. Given the fragmented management of college fleets, significant efficiencies may be possible. The most important strategies are collecting additional data (strategies A and B) and centralizing fleet management (strategies D and E).

Commuting

To continue the positive trends associated with faculty and staff commuting behaviors will require TDM strategies to be better marketed across the campus and better integrated with parking management. Creating a position to market strategies (strategy N and O) is essential to these efforts. This position could be partially funded through modest phased increases to the parking permit fee. This may also be an area in which five college cooperation would be beneficial.

Air travel

Not only is air travel the most significant source of transportation-related college emissions, it is a function of many departments on campus and arguably the most de-centralized in purchasing. Data collection is important, but it is essential to identify ways to reduce air travel that do not restrict operations such as recruitment and fundraising on which the college depends. This will require a college-wide analysis and consideration of ways to reduce air travel.

Table 3.7: Fleet Strategies, Section A

	Fleet Strategies 2010-2014
	Measurement
A	Initiate collection of use and behavior data on passenger fleet: vans, buses, cars
B	Initiate collection of annual mileage of "road legal" vehicles in passenger and service fleets
C	Collect data on number of miles reimbursed by college for private vehicles
	Management
D	Consider merger of SGA, SOS and Facilities Management van fleets
E	Create a staff position to market transportation demand management, manage parking and possibly passenger fleet operations
F	Analyze data from passenger fleet to determine whether fleet reductions are possible
G	Develop and adopt policies that encourage efficient use of passenger fleet vehicles
H	Develop a passenger fleet vehicle acquisition plan to improve fuel efficiency
I	Assess service fleet needs and existing fuel economy and propose a plan for meeting needs and improving fleet economy via electric and/or hybrid vehicles (Facilities Management)
J	Convert one diesel fleet vehicle (mower) to run on grease waste by 2014

Table 3.7: Fleet Strategies, Section B

	Transportation Demand Management 2010-2014
	Measurement
K	Revise faculty, staff and student commuting surveys for 2010
L	Study bicycle use on campus e.g. what % of students have one? How many have a bike and a car? What incentives would keep students from bringing cars to campus?
	Management
M	Create a staff position to market transportation demand management, manage parking and possibly passenger fleet operations
N	Establish an ongoing TDM and parking committee staffed by above
O	Conduct full accounting of true cost to Smith of building, maintaining, and enforcing each parking space
P	Consider adopting policies that set parking rates for students, faculty, and staff that reflect true cost of providing that parking.
Q	Initiate annual increase for parking permit fee.
R	Increase/modify parking opt-out incentive until participation rates reach 50% w/in 1 mile and 25% w/in 3 miles.
S	Develop a tiered parking permit system (permits for higher demand lots cost more). Consider a salary based component
T	Offer prime parking spaces for carpoolers and those who use high efficiency vehicles to commute
U	Establish frequent and reliable day- and night-time shuttle service to perimeter parking lots to encourage their use over neighborhood streets.
V	Evaluate a policy change to allow only juniors and seniors to bring cars to campus
W	Enhance incentives to choose low-emission (compact, hybrid, or electric) vehicles over traditional vehicles for those who must drive to and from campus, e.g., establish lower parking rates or more convenient parking spaces
X	Provide 50% subsidy for transit passes for faculty and staff on non-Five College PVTA bus routes.
Y	Increase Smith presence in the PVTA management and oversight directly or via Five-Colleges Inc.
Z	Improve the walking and bicycling environment on and around campus. Maintain communication with City's Transportation and Parking Commission and Bicycle and Pedestrian Committee. Implement traffic calming measures on all major roads on and around campus.
AA	Expand Smith's Bicycle Kitchen: Find more central location, increase the amount of bikes available, increase kinds of bikes available to include bike trailers and industrial trikes, increase the frequency and length of the Bike Fix'N service, and allow faculty and staff to participate
BB	Adopt a new campus standard for bike racks.
CC	Upgrade 33% of campus racks with new standard; improve placement to better serve needs of bicyclists. Construct a centrally located covered bike parking area
DD	Allow Zipcar to expand fleet as much as they are willing in at least two locations around campus
EE	Enhance the second mortgage program to be "location efficient", i.e. to favor locations closer to the Smith campus, which will directly reduce commuting by car and parking demand

Table 3.7: Fleet Strategies, Section C

	Air Travel 2010-2014
	Measurement
FF	Conduct anonymous survey of faculty and staff air travel to determine capacity to reduce total air travel.
	Management
GG	Market the existing video conferencing room. Add rooms at various locations on campus for video conferencing as needed.
HH	Encourage rail and bus travel rather than air travel for trips under 500 miles. Investigate possibility of discounted fares on Amtrak, Peter Pan.
	Project Strategies 2015-2030
II	Upgrade 66% of campus bicycle racks with new standard; improve placement to better serve bicyclists. Install additional covered racks

3.5 Financial implications

The strategies proposed in this section involve a mix of those that will ultimately save money and those that add cost. Air travel is the single largest aspect of transportation-related emissions and represents a significant expense for the college. Any reductions of air travel would yield direct savings, although reducing travel may conflict with strategic initiatives of admission, alumnae relations, and development. Possible reductions will need to be weighed in light of their potential effects.

Many of the TDM measures represent expenses to the college, some of them substantial. However, it is possible that some of these, such as the cost of a TDM/Parking Coordinator, can be self-funded by other planned strategies. Ultimately, reducing the need for on-site parking will have associated savings.

Management and consolidation of the fleet should yield fuel and possibly other vehicle related savings.

3.6 Climate Implications

Achievement of fleet, commuting and air-travel goals included in this report will yield carbon reductions of 152 metric tons of eCO2.

3.7 Potential student involvement

- Upgrading the biannual transportation survey to improve response rate and data quality.
- Survey students on car/bike usage at Smith

4.0 Material Purchasing and Waste Management

4.1 Overview and Goals

Like all institutions, Smith purchases, uses and disposes of a wide variety of goods, such as 36 acres of paper napkins and 6,300 miles of bathroom tissue each year.

Material purchasing and waste management are addressed together in this section to make the connection between what we purchase and what we dispose of on campus.

In the past, Smith paid substantial attention to waste disposal and recycling without considering how the purchase and use of materials affects our solid waste stream, the climate or the environment. At the same time, many purchases occur in a decentralized fashion. As a result, there is no single source of data available about what the college purchases, from whom and in what quantities. We have less information about the "front end" of material life on campus than about solid waste.

As a signatory to the Presidents' Climate Commitment, Smith uses a methodology that accounts for emissions associated with solid waste, but not those from the production and transportation of goods to the college. The emissions from these activities are considered "Scope 3" emissions (emissions from sources not owned or controlled by Smith College). From a national perspective, 42% of United States climate emissions are from provision of goods and food (see Chart 4.1). We do not track most Scope 3 emissions; however, this plan proposes a number of goals and strategies focused on developing data on institutional purchase of goods. With this data, we can begin to understand not only what we consume on campus, but the Scope 3 emissions associated with our purchasing choices. Ultimately we hope to identify ways to make "Scope 3" reductions that are consistent with our climate goals if not actually measured in our current carbon accounting system.

This section establishes the following goals:

- Increase the amount of local food purchased by 10%, to 30% of total food budget by 2014
- Increase amount of "environmentally beneficial" food purchased by 3%, to 10% of total food budget by 2014, e.g., organic, hormone or antibiotic free
- Increase amount of "humane" food purchased by 3.5%, to 4% of total food budget by 2014, e.g. cage-free or fair trade
- Develop data on institutional purchasing patterns; identify the highest value and most frequently purchased goods
- Identify areas of purchasing which have the greatest environmental/climate impact
- Develop policies that cover 50% of purchased goods by 2015
- Reduce campus printer fleet from 700 to 450 by 2020
- Reduce landfill solid waste by 20% (147 tons) by 2015
- Compost all pre- and post-consumer food waste produced by Dining Services by 2012
- Increase recycling rate to 34% of solid waste by 2015
- Increase recycling rate to 50% of solid waste by 2025
- Reduce GHG emissions by 72 MT eCO2 though composting and solid waste reduction by 2015

Chart 4.1: U.S. Greenhouse gas Emission by System

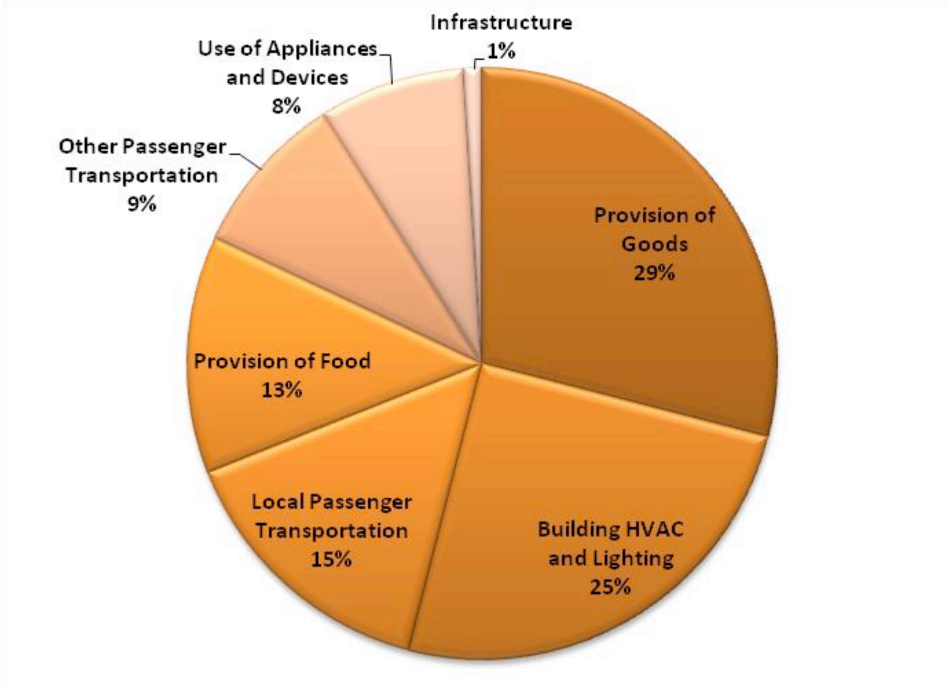


Chart is based on calculations from US EPA Office of Solid Waste and Emergency Response. “Opportunities to Reduce Greenhouse Gas Emissions through Materials and Land Management Practices.” September 2009.

4.2 Current use and trends

4.2.1 Purchasing

For purposes of this plan, we selected three categories of goods as “indicator goods.” These provide a sense of the magnitude of purchasing. By studying these, we hope to develop a sense of how to shape policies and practices for other purchasing decisions. These indicators are food, paper and electronic peripheral devices (printers, fax machines and scanners). We selected these categories because they are:

- generally purchased centrally or by single departments, making estimated consumption data more available; applied policies would affect most of the products on campus;
- categories for which environmentally preferable choices are available, and
- used ubiquitously by students, faculty and staff; this high visibility means that they have educational value for the campus community.

Here are current purchasing practices.

Food

Almost all food on campus is purchased by Dining Services. In FY 2009, Smith spent $2.8 million on food. In that same year, Dining Services began tracking food purchasing in three categories:

- Locally grown or processed (within 150 miles – although locally grown foods come almost exclusively from the three county/Pioneer Valley area)
- Environmentally beneficial (e.g. organic, hormone or antibiotic free)
- Humane (e.g. cage-free or fair trade)

Note that some food purchases fall into multiple categories; these are counted twice.

Locally grown or processed

21% of the food budget was spent on foods that were grown or processed locally (within 150 miles). Smith purchased $375,292 of food (13.4% of the total budget) from 25 local farms or growers. Foods grown or raised locally include: vegetables, fresh fruits, goat cheese, honey, maple syrup, yogurt, milk, turkey and roast beef. Smith purchased $439,423 of food (15.7% of the total budget) from 17 local processors. Foods included: milk and dairy products, tofu, soy milk, rice milk, salad dressings, breads, coffee, sodas, chocolates, pasta and meat. Note that percentages stated above add up to greater than 21% because some foods are locally grown and locally processed (e.g. milk).

Environmentally beneficial

Smith spent approximately $200,000 (7%) on foods deemed environmentally beneficial including: organic coffee, yogurt, soy milk, rice milk, some produce, and hormone and antibiotic-free milk and yogurt. Sixty percent of seafood purchased meets the Monterrey Bay Aquarium Seafood Watch Northeast Seafood Guidelines.

Humane

Smith spends approximately $15,000 (0.5% of budget) on foods in this category. Most of the budget is dedicated to purchasing 100% fair-trade coffee. In addition, small quantities of cage-free eggs and confinement-free poultry are purchased for special events. A small quantity of grass-fed beef is also purchased for special events.

Paper

Printer and copier paper

Smith College purchased about 11 million sheets of printer/copier paper in FY 2009. This includes paper used by students in libraries and computer labs, but not paper purchased directly by students.

Napkins, Paper Towels and Bath Tissue

In FY 2009, Smith purchased about 6,000 rolls of paper towels, 60,000 rolls of bathroom tissue and 440 cases of napkins. All bath tissue meets EPA Commercial/Industrial Sanitary Tissue procurement guidelines (100% recycled content with post consumer content between 20%-60%). All roll paper towels are Green Seal certified (100% recycled content with postconsumer content of at least 40%).

Electronics

In FY 2009, there were approximately 700 printers on campus and as many as 400 fax machines and scanners. These devices use significant quantities of electricity. In addition, recent University of Toronto research has shown that office users who need to stand up to collect paper from printers actually print less and use less paper. Measures to address the quantity of electronic peripheral devices are suggested in the Energy and Buildings section.

The college follows a policy under which all campus-standard computers purchased by ITS and sold by the Smith College Computer Store meet the ePEAT (Electronic Product Environmental Assessment Tool) Gold standard, the RoHS (Reduction of Hazardous Substances) standard, and the Energy Star 4 standards.

4.2.2 Solid waste management

Solid waste is managed in four categories: routine trash, recyclable materials, compostable materials and waste reduction. A number of terms are used within this section to describe various categories of waste. Briefly these include the following:

- solid waste" is all materials discarded by the college with the exception of those that flow into the sanitary sewer system
- "routine trash" is a subset of "solid waste." It is material typically discarded by faculty, staff, and students from offices, classrooms, residence halls, and common areas of campus (i.e. the typical trash found in dumpsters). It does NOT include: construction and demolition wastes, bulky wastes (such as furniture, equipment, scrap metal, and pallets) landscape wastes, computers and electronics, sewage, specialized wastes from areas" such as a the equestrian center or hazardous or medical wastes.

Routine Trash

Routine trash is currently transported to the City of Northampton municipal landfill for disposal. Annual data has been tracked since 1994. Prior to FY 2009, Smith generated an average of 900 short tons of routine trash each year (approximately 500-600 lbs. of waste per student per year). (Figure 4.2).

In 2009, Smith generated 735 tons of routine trash (less than 500 lbs. of waste per student per year). This is the lowest quantity in recent history, a reduction primarily due to the college's aggressive approach to composting food waste (see Compost section below) and the secondary effect of the economy on overall purchasing.

Recyclable Materials

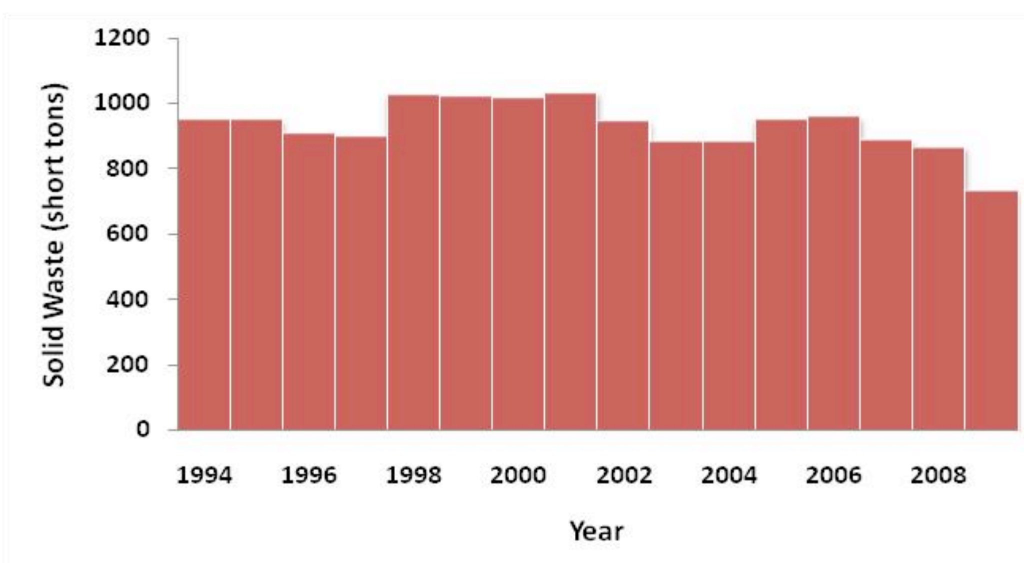
In the past three years, Smith has recycled an average of 290 tons of paper, cardboard, bottles, and cans per year or about 195 pounds per student per year. That is an average of about 25.6% of the routine waste generated over that period.

In the past, Smith's "Earth Rep" program has provided education about recycling and implemented competitions among residential houses to increase recycling rates.

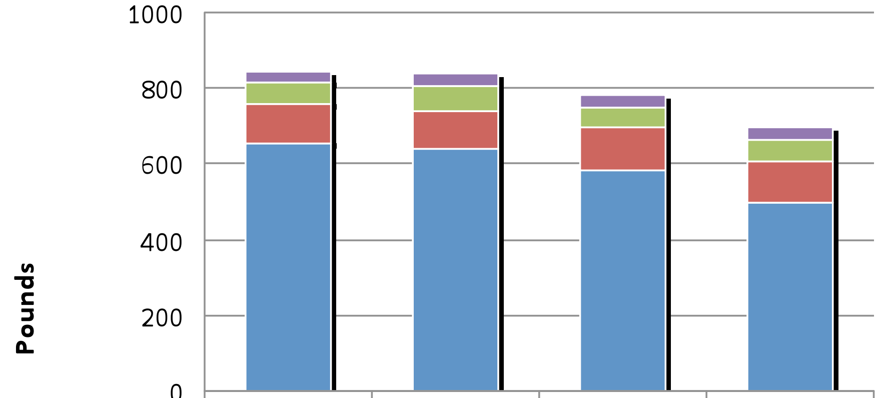
Bottles and cans are taken to the Materials Recycling Facility in Springfield, MA. Paper is shipped to Northstar, a recycling broker in Springfield, MA.

Smith also recycles a variety of other materials including computers and electronics, batteries, cell phones, fluorescent bulbs and printer cartridges.

Graph 4.2: Routine Trash 1994-2009



Graph 4.3: Routine Trash and Recycling – Pounds per student 2006-2009



	FY2005-06	FY2006-2007	FY2007-08	FY2008-09
Bottles & Cans	27.49	34.55	35.06	33.36
Cardboard	56.18	66.65	53.6	56.18
Paper	104.17	100.2	110.01	106.63
Routine Trash	654.57	639.25	584.58	498.43

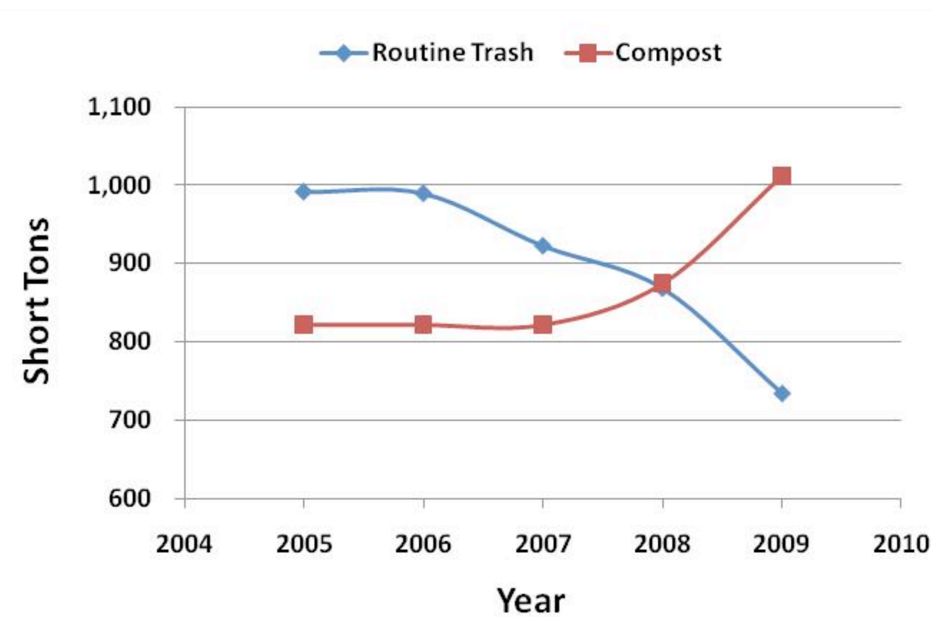
Compostable Materials

The college handles compostable material according in three ways:

1. Food waste composting from participating dining halls and manure and bedding from the equestrian center are taken to local farmers.
2. Leaf and grounds waste are taken to Fort Hill for composting on campus.

In FY 2009, Smith composted approximately 1,011 tons of material from these categories. Food waste composting programs were active in five dining halls in FY2009, an increase from two dining halls the previous year.

Bolstered by this new food waste composting effort, over the last year the college has seen an increase in composting and a decrease in routine trash (see Graph 4.4). This effort has been largely responsible for a 30% decrease in the amount of waste sent to the landfill by the college.



Graph 4.4: Total Routine Trash Vs. Compost 2005-2009

Waste Reduction

Smith currently works to reduce the amount of routine trash in the following ways:

- faculty are encouraged to distribute class information electronically and to accept "papers" and projects electronically via Moodle software
- many departments have adopted processes that reduce paper use, e.g., student payroll is completed electronically instead of by paper forms, and Human Resources collects and tracks employment applications electronically
- computer labs and libraries charge a fee for pages printed
- at the end of the academic year, there are specific programs to reduce and/or donate clothing and furniture unwanted by students moving out; these programs have been in place for a number of years
- students are encouraged to "buy less" when they come to Smith through the "Shop Green" tips provided to entering students in their entrance packets

4.3 Metrics

- Percent of food budget spent on locally (w/in 150 miles) grown or processed
- Percent of food budget spent on environmentally beneficial foods
- Percent of food budget spent on humane foods
- Sheets of copier/printer paper purchased by college
- Number of "impressions" executed by multi-functional devices
- Number of printers, scanners, fax machines and copiers on campus
- Total annual routine trash generated
- Annual routine trash per student
- Total annual compost generated
- Total annual routine recycled material
- Annual routine recycling generated per student

4.4 Strategies

Strategies for this section are divided into three sub-sections: food and dining, material acquisition and use, and solid waste.

Measurement

Purchasing

At this time, there is no single source of data available about what the college purchases, from whom and in what quantities. We assume that purchasing choices have variable environmental implications. For this reason, our plan proposes a number of measurement activities intended to help us understand what is being purchased and the environmental implications of purchases.

Solid waste

Solid waste mitigation strategies are significantly tied to purchasing. We intend to develop better data on what is being purchased and disposed of by developing a process of systematic waste and recycling audits. This data will help drive smarter purchasing, material reduction and recycling efforts.

Management

Purchasing

All strategies are listed below in Table 4.5. With regard to food purchasing, the primary focus is increasing purchase of local foods, particularly produce and meat that are available during the winter. In addition, Dining Services expects to increase the portion of their budget spent on humane and environmentally beneficial foods.

With regard to other goods, once we better understand our current behaviors, we can develop environmental purchasing policies or programs that insure that goods are purchased in environmentally preferable manner, especially where this practice has the highest impact and/or can reduce the total amount of purchasing.

Data are not yet available to quantify the transportation emissions impacts of purchased goods deliveries. As future procurement policies are developed, emissions impacts of source distance will be considered and re-evaluated.

Solid waste

Much of solid waste management involves changing behavior. Solid waste audits will allow us to develop data that can provide the campus community with more feedback on their performance. Improving campus infrastructure will also enhance recycling diversion rates.

Table 4.5: Purchasing and Solid Waste Strategies

	Purchasing 2010-2015
	Measurement
A	Assess the climate/environmental impact of leading categories of purchases (by volume and cost)
B	Evaluate purchasing certifications such as Underwriter's Laboratory "UL Environment", Energy Star, etc.
C	Conduct department-by-department assessment of paper use (largest users and process analysis)
D	Conduct assessment of student paper use, e.g., look at effect of online readings, mailroom advertising/communication
E	Evaluate use of Clean Air-Cool Planet Real Food Challenge and other rubrics for measuring the impact/benefit of food purchasing choices
F	Assess post-consumer waste and student option about "grab and go"
G	Investigate reduced and “no waste” packaging potential for food deliveries
H	Complete an analysis of potential cost savings due to elimination of bottled water and water coolers
	Management
I	Develop a searchable database of all purchasing activity. Identify priority areas for attention by value and frequency of purchase.
J	Establish purchasing policies (or adopt the use of external certifications for product categories e.g. Energy Star) that encourage acquisition of products that minimize waste, have high recycled content, use environmentally responsible production methods, and demonstrate maximum durability or biodegradability, reparability, energy efficiency, and non-toxicity.
K	Develop an environmental preferable purchasing "decision tree" a.k.a. a Smith "users guide" to purchasing
L	Establish an Energy Star purchasing policy
M	Establish paper purchasing policy for all printer and copier paper - at least 30% post-consumer waste

Table 4.5: Purchasing and Solid Waste Strategies, continued

N	Increase portion of budget spent on locally grown, locally processed, ecologically sound and humane foods
O	Develop either container reuse or composting strategy for "grab and go"
P	Add a student sustainability intern to Dining Services to aid in education and resource reduction
Q	Establish bottled water policy that eliminates bottled water in residential housing and catering operations and limits brands for sale on campus to those sourced within a 500-mile radius
	Solid Waste 2010-2015
	Measurement
R	Re-establish house-to-house recycling competitions
S	Develop a trash sampling program for all routine waste to ID sources and types of waste
T	Target purchasing identified by audits
U	Initiate house-to-house accountability program based on audits
V	Initiate building-to-building accountability program based on audits
	Management
W	Establish a campus standard for recycling containers and upgrade existing units to this standard
X	Further develop a campus office materials "freecycle" program in residential houses
Y	Improve recycling infrastructure as houses are rehabbed
Z	Develop paper reduction plan and targets associated with results of assessments

4.5 Financial Implications

Purchasing

Food

Environmentally preferable foods may carry a price premium of 15-20%. Smith is committed to increasing the percentage of these foods purchased and will do so in a phased approach and within financial constraints.

Other goods

While some areas of environmentally preferential purchasing may carry a cost premium, this is not always the case. In addition, some products may cost more initially but save energy in the long run. For example, some “Energy Star” rated appliances carry a small initial premium that pays for itself through reduced operating costs, compared to similar unrated products. As part of policy development for specific categories of goods, we will consider financial implications.

Solid waste

Smith currently pays $70/ton to dispose of solid waste. Any waste that can be diverted from waste disposal for a lower cost (e.g. by recycling, reusing or composting) saves on disposal costs. However, any new initiatives cannot ignore the fact that adding new waste streams or managing waste in a more labor-intensive manner will also carry a labor cost and must be evaluated with this aspect in mind.

4.6 Climate Implications

As a signatory to the Presidents’ Climate Commitment, Smith currently measures two areas of climate impact associated with material use and waste management: a) solid waste that is thrown away releases landfill gas consisting of both methane and CO_2, and b) we can take an emissions “credit” for waste that is composted because an aerobic composting process significantly reduces the amount of GHG gasses that would have been emitted from decomposition of organic waste.

The purchase of goods generates a significant amount of Scope 3 GHG emissions (emissions from releases that are owned and controlled by entities other than Smith College) from production and transportation. While we do not track these emissions now, we intend to explore projects that help us understand the Scope 3 emissions associated with our purchasing choices.

4.7 Potential Student Involvement

- Assist with the identification of purchasing certifications
- Conduct department-by-department assessment of paper use (largest users and process analysis)
- Assess post-consumer waste and student option about "grab and go"
- Assist with house-to-house recycling competitions
- Assist with developing a trash sampling program for all routine waste

5.0 Landscape Ecology

Smith's landscaped campus, designed by Frederick Law Olmsted in 1893, is a source of pride for the college and surrounding community. However, the original plan assumed an availability of labor that has become cost-prohibitive in the 21st century, and landscape architects could not have envisioned the current number and size of buildings for which the original plan has been altered.

The campus is maintained and managed by two entities. The grounds department of Facilities Management maintains all turf areas and trees. The Botanic Garden staff manage plantings around buildings and all formal gardens

The Landscape Master Plan completed in 1995 did not include environmental issues in its charge, and the college does not yet have a comprehensive policy to address sustainability in the overall maintenance of the campus landscape. Given the lack of information available regarding the impact of current practices, this section does not establish quantitative goals. However, it is clear that research and data development are critical to understanding this important area of campus management.

5.1 Current Use and Trends

Both departments that manage Smith's landscape share Smith's growing sense of responsibility to develop sustainable practices, including new approaches to landscape care. The desire to preserve key elements of the Olmsted plan and cultural expectations for what a New England liberal arts campus should look like have been significant drivers of landscape care. The care and maintenance of Smith's landscape has an impact to the environment most directly through:

- the amount of water used in irrigation
- the fuel used for machines to mow, blow, plow, fertilize, and apply chemicals to turf and beds, and
- the amounts of fertilizer, herbicides and pesticides used

Irrigation

Irrigation consumes approximately 2.1 million gallons of potable water per year. (See Section 2.0 Water, for details and goals for irrigation.) The grounds department plans to replace more sprinklers with "smart" systems that take ground moisture content readings into account rather than watering "by the clock". Athletic field irrigation has been converted from manual irrigation to a more efficient automated system.

Turf Management

With the development of new information, new products and expanded environmental knowledge, the issues surrounding campus landscape maintenance are becoming more complex and more amenable to improvement. The grounds department is continually researching and planting new grass seed varieties that are more drought, pest and disease resistant.

A variety of chemicals is used in turf management: pre-emergent herbicides, growth regulators for turf, and fertilizers. Records are kept of all applications of herbicide, pesticide, and growth regulator.

Herbicides are generally applied once a season in spring or early summer to control broad-leaf weeds. Pesticides are applied at the same time as herbicides; however, consistent with Smith's integrated pest management (IPM) practices, pesticides are only applied where needed. Under these practices, turf areas are inspected for pests regularly. If pests are suspected, hands-on inspections are conducted. If pests are present in densities that are likely to become problematic for turf quality, turf is treated in a localized area.

Fertilizer is applied three times each year between April and October. Fertilizer quantities are determined through the use of regular soil tests which document soil nutrient levels. In 2008, the college used 25,000 pounds of synthetic fertilizer and 3,500 pounds of organic fertilizer.

Growth regulators are applied to very limited areas of turf which present unique challenges to mowing. The regulators reduce the need for frequent mowing on hazardous locations.

All mowers are equipped with mulching blades which leave grass clippings at the sight of cutting, providing nutrients and eliminating the need for disposal.

Snow and Ice

"Ice B Gone," a substance derived from an agricultural byproduct, is added to salt for melting snow and ice. This product "reduces the levels of sodium and chloride ion exposure to vegetation ground and surface water and eliminates the need for sand, a major source of phosphorus and fine particulate air contamination." [3]

5.2 Metrics

- Acres of grass
- Lbs. of fertilizer/acre
- Total acreage
- Acres of impervious surfaces

5.3 Strategies

There is potential for developing new strategies in the following areas:

Fertilizers, soil amendments and compost. Synthetics are derived from fossil fuels, but are timed-release, will not wash away in rain and therefore require lower quantities of application. Although organics are derived from organic sources (through a process which mitigates greenhouse gas emissions), application quantities are generally greater, so more emissions are created via transportation and application. Clarifying the answers to this question in a life-cycle context will be beneficial.

Right plant, right place. Choosing a plant that is well suited to its site creates far less disturbance and requires less maintenance than trying to modify the site to suit the needs of the plant. Using plants native to our area produces a naturally low-maintenance landscape. Some work has been done to emphasize native plants and remove invasive species from Smith beds and hillsides.

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3 See [http://www.seaco.com/index.htm]

Limiting lawns. Lawns, even organically managed ones, are high-maintenance areas in a landscape. A smaller lawn is less costly to maintain, easier to care for, and better for the environment. Appropriate and attractive low-maintenance lawn alternatives include low-growing native grasses and wildflowers mixed in a meadow; no-mow grass mixes; or ground covers, shrubs, trees and perennials, according to the conditions. The Botanic Garden has information on areas that could benefit from lower-maintenance groundcovers as a substitute for turf.

Integrated Pest Management (IPM). The best weapon is prevention. A plant suited to its site and growing in soil that contains sufficient organic matter and nutrients will be a healthy plant, less prone to disease and pest problems. A landscape in which the soil is covered with desired plants or mulch is less hospitable to weed germination and growth. Regular monitoring of the landscape by those in regular contact with it can identify problems early, allowing targeted use of organically approved materials. Smith practices integrated pest management and reviews its practices. One of the strategies incorporated into this plan is to develop these practices into a written policy.

Table 5.1 Landscape Management Strategies

	2010 - 2015 Landscape Management
A	Map turf areas
B	Identify areas of use intensity
C	Identify opportunities for turf reduction
D	Identify areas for landscape study/experimentation e.g. low maintenance "mini ecosystems", water sensitive landscapes or advantageous plantings for heating and cooling
E	Cultivate academic cooperation for long-term ecological study areas
F	Develop a written Integrated Pest Management Plan
G	Continue investigation of evolving technology in pesticides/herbicides

5.4 Climate and Financial Implications

The move toward organic products, protein-based fertilizers, and IPM is not based solely on the desire to reduce use and exposure to chemicals. Healthy soils are ultimately more cost-effective than depleted soils that have been stripped of microbes and subjected to bursts of chemical fertilization. A healthy soil foodweb provides disease suppression, nutrient retention, nutrient recycling, and decomposition of plant residues and plant-toxic compounds. Organically managed soils hold water more effectively, require less irrigation, and nourish turf grass all year long. All these benefits affect our use of machinery, chemicals and water.

Some institutions have gradually shifted to greater use of organics and lowered the level of maintenance required in some areas by changing plantings and reducing closely-mowed turf areas. Such a shift requires considerable research and discussion in the campus community, as well as public education about why such changes are being made that affect the appearance of the campus.

Fortunately, there is an increasing body of information available from institutions and soil biology programs. An added benefit is the educational opportunity afforded students in helping to create and implement a different approach which relies on science, engineering and an understanding of landscapes to succeed.

In 1999, The Connecticut and Massachusetts chapters of the Northeast Organic Farming Association (NOFA) formed the Organic Land Care Committee, a mix of technical experts, practicing organic land care professionals, and activists, to create the Organic Land Care Program. In 2001, they wrote Standards for Organic Land Care, used by universities and Cooperative Extension Services across the region in educational programs about organic practices and recognized by national groups as a model for development of organic standards across the country.

5.5 Potential Student Involvement

In 2006, a student completed a retrospective assessment of progress on the Landscape Master Plan, and described the college's progress on itemized lists in each area of concern.[4] She found that although some work has been completed by both Botanic Garden staff and Buildings and Grounds, significant work outlined in 1996 remained to be done. Students under the supervision of faculty have also developed an Evaluation and Action Plan for Lyman Pond Renovation; Tree Health/Hazards Survey; Identification, Removal, and Replacement of Invasive Species; and Use of Paved Paths and Groundcovers to Reduce Foot Traffic and Garden Maintenance.

Smith has a signature program in Landscape Studies and recently approved a major in Environmental Science and Policy. The new Center for Environment, Ecological Design, and Sustainability (CEEDS) brings together faculty, staff, and students from engineering, the natural sciences, social sciences and humanities to pose questions and address problems related to the environment and sustainability. Interdisciplinary work among these departments and programs has already enriched opportunities for student research and hands-on learning. We fully expect these opportunities to continue and are working to fund their expansion.

6.0 Energy and Buildings

6.1 Overview and goals

Smith College has 111 buildings which encompass more than three million gross square feet of floor area or 75 acres of indoor space. Buildings require heat, hot water, cooling and electricity. In FY 2009, the college used approximately 22.8 million kilowatt-hours (kWh) of electricity, 308,000 dekatherms of natural gas, 86,000 gallons of #6 fuel oil, and 10,000 gallons of #2 (home heating) oil. This consumption accounted for 23,800 MT eCO2 emissions or 85% of all college emissions, making building energy use the top priority for carbon reduction efforts.

This section considers energy use in two sub-sections:

- Efficiency measures, both mechanical and associated with building envelope improvement
- Conservation through systems management and behavioral measures

This section establishes the following goals:

- Reduce electrical consumption 19% through efficiency projects (4.4 million kWh) by 2015 and by an additional 9% (2.1 million kWh) by 2030
- Reduce electrical consumption through behavioral conservation programs by 10% (2.3 million kWh) by 2020
- Reduce thermal demand by 20% (48,000 MMBtu) by 2015 and by an additional 8% (15,000 MMBtu) by 2030
- Reduce eCO2 by 29% (7,700 MT) by 2030

6.2 Current Use and Trends

Smith supplies heat to 75% of its buildings (representing 85% of the gross square feet on campus) from a central heating plant via an underground steam loop system. The balance of buildings have individual heating systems. Smith produces some of its own electricity with a natural gas-fired combustion turbine, the heart of a cogeneration system that also supplies steam to the central heating system. The cogeneration system

[4] Jamie Duncan AC '07

represents the largest single energy efficiency upgrade to Smith's infrastructure and will yield significant energy savings and carbon reduction.

In buildings served by the central heating plant, water is heated for domestic use by steam in winter months. Individual gas or electric hot water heaters serve those buildings for the rest of the year, as well as in buildings not served by the central system.

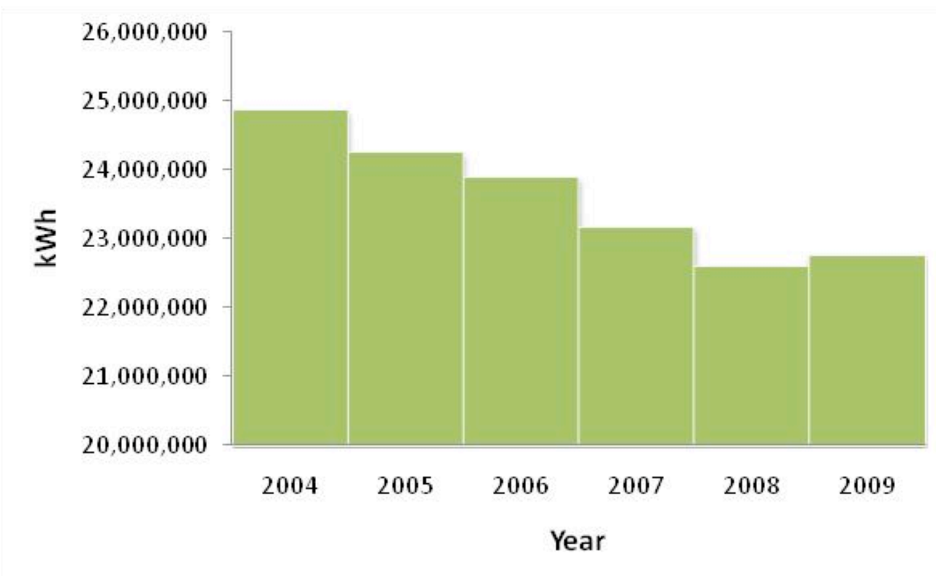
Cooling is provided by a central cooling plant and chilled water distribution system to 18 campus buildings on campus or 45% of the gross square feet. The central cooling system uses highly efficient electric-driven chillers and pumps that circulate chilled water through underground pipes to individual buildings.

Approximately 19 other buildings, representing 15% of the gross square feet, utilize distributed cooling (window air conditioners or electric whole-building systems - a.k.a. "DX" units). The remaining buildings are not cooled.

Electrical Efficiency

Since 2004, 18 campus buildings representing 18% of maintained building space have had state-of-the-art lighting installed as part of a comprehensive renovation or stand-alone retrofit. These upgrades include LED exit signs, occupancy sensors, T8 and T5HO fluorescent technology, and de-lamping with use of reflectors and/or new fixtures. Smith's total electricity consumption in 2004 was 24.6 million kWh, total. By 2008, it had been reduced to 22.4 million kWh—a 9% reduction (see Graph 6.1).

Graph 6.1: Electricity Consumption 2004-2009



- **Cogeneration plant:** A new cogeneration plant went online in October 2008. The heart of the system is a 3.5-megawatt natural gas-fired turbine that will eventually generate about two-thirds of our total electrical power. The system is estimated to cut energy costs by approximately $650,000 per year and significantly reduce carbon emissions. The cogeneration plant will increase the efficiency of energy utilization from 45% for conventional power generation systems (burning fossil fuel in boilers and buying electricity from the grid, as we did previously) to 70% or greater.
- **Replaced bulbs:** Almost all screw-in incandescent bulbs have been replaced with compact fluorescent bulbs in campus buildings, including individual offices and student rooms.
- **Building Metering and Dashboard:** Currently, the Smith campus is monitored by a single utility electric meter. Facilities Management is installing state-of-the-art sub-metering of gas, electric, steam, water

and chilled water. All new meters will report data in “real time,” allowing us to install building “dashboards” to display that information. Metering will help the facilities department manage buildings for greater efficiency. The added data will provide a valuable educational tool, and the systems will allow us to sponsor house-to-house energy and/or water reduction competitions. We expect to install comprehensive metering suites in eight buildings during 2009-2010, including seven residential houses and the Campus Center.

Electrical Conservation

- Many light switches that do not have occupancy sensors have a green sticker on them that reads “Smith conserves. Save energy. Please turn out the lights when leaving.”
- All window air conditioning units are tagged “Smith conserves. Save Energy. Please turn off when leaving. Even though this unit is already installed, we are requesting that you delay using it until June 1 and then maintain minimum setting of 76 deg. We thank you for your cooperation.”
- The Clark Science Center, comprising all of Smith’s science buildings, adopted the following policy which we hope to use as a model for other buildings and departments on campus:

  Clark Science Center Indoor Lighting Policy

  Approved by Science Planning Committee March 26, 2009

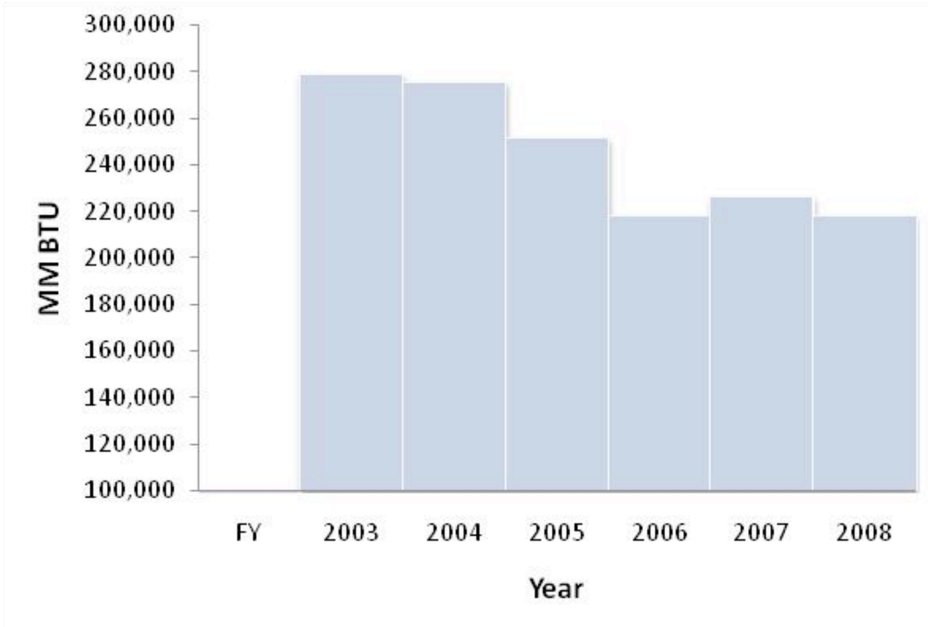
  - All classroom, restroom, and other indoor Science Center lights apart from hallways and stairwells should remain off when not in use. Both faculty and staff should be responsible for implementing the policy. Custodians should be informed of the policy and their aid enlisted in implementing it. Department heads should share the policy with the rest of their department members.
  - Except when used for continuous functions, hallways and stairwells should generally be lit with the minimum level required for safety and should use the most energy-efficient mode (e.g. fluorescent rather than incandescent) whenever a choice is available.
  - If safety code allows, lights in hallways with direct natural light (e.g. McConnell Foyer) should remain off by default during daylight hours.
- The “Green Team” (an informal coalition of students, faculty and staff) has run a number of awareness campaigns including “Sleep Is Good” competition that encouraged everyone to set computers to go to sleep. A competition was run between houses (dorms) to determine the house that had the highest rate of pledges. Pizza parties were awarded to houses with highest participation.

Thermal Efficiency and Conservation

Smith’s peak annual fuel use for heat and hot water was in 2003 (278,993 MM Btu). In FY 2008, the college used 218,361 MM Btu. When adjusted for winter temperatures, this represents a reduction in thermal demand of 12% (see Graph 6.2). We speculate that this reduction is a function of the following:

- Beginning in 2006, the college began a “vacation setback” program in which the entire campus is closed and thermostats in many residential, academic and administrative buildings are lowered between Christmas and New Year’s Day.
- A number of improvements have been made to major heating and ventilating systems in the Neilson Library, Ainsworth Gym and Bass Hall.
- Renovation projects have improved thermal envelopes through addition of insulation and new, more efficient windows.
- The steam system has had some missing insulation replaced on valves and expansion joints in steam tunnels.
- The steam trap replacement and repair program has been accelerated.

Graph 6.2: Heating Fuel Consumption 2003-2008



Renewable Energy and Fuels

Renewable energy and fuel play a role in the college's environmental performance, although its use is in a nascent stage.

- Since 2006, diesel fuel dispensed and used on campus is 20% biodiesel (derived from soy oil).
- In 2007, the Smith Physics Department installed an experimental solar array that consists of one flat plate collector, one evacuated tube collector and one 580-Watt photovoltaic collector. In 2009, it produced 15,303 MBtus used to provide most of the hot water needed for McConnell Hall.
- The Engineering Department has one 240-Watt photovoltaic collector.

6.3 Metrics

- Gross square footage of building space
- Total electricity use (kWh)
- Fuel consumed on site for heat, hot water and electricity production in MMBtu
- Total energy use (electricity + thermal) in MMBtu
- Total energy use per ft. sq. (kWh+MMBtu/campus gross sq.ft.)
- Total energy use per capita (undergraduate students)

6.4 Strategies

Measurement

Smith heat and electricity consumption data is only currently available for the campus as a whole, not on a building-by-building basis. As a result, we have minimal data about the relative efficiency of different buildings on campus, and we have no means of directly gauging the effect of efficiency or conservation measures. Installing advanced metering that provides real-time feedback will enhance operational management and conservation efforts. Facilities Management is currently engaged in a process to install comprehensive metering in some buildings.

Electrical Efficiency

We have analyzed and evaluated a wide range of electrical efficiency projects as part of this plan. We have identified projects we believe have an estimated savings of a total of 4.3 million kWh for the period 2010-2014. Projects include retro-fitting the lighting in the Indoor Track and Tennis facility (estimated 250,000 kWh per year savings) and the Neilson Library as well as retrofitting motors and drives within HVAC systems; retro-commissioning buildings to improve heat and electrical performance; and “virtualizing” servers in the Information Technology Department to enable data to be aggregated, reviewed, and shared throughout campus.

Thermal Efficiency

Strategies for improving thermal efficiency target two areas: HVAC systems and controls and our buildings’ thermal envelopes. We estimate that cost-effective efficiency improvements to HVAC systems may yield a reduction of at least 31,000 MMBtu.[5]

Improving the thermal envelope efficiency of Smith’s buildings is imperative to decreasing our energy use and carbon footprint. An analysis of most buildings on campus[6] demonstrates that by improving the thermal envelopes of most of Smith’s buildings by sealing air leaks, insulating attics and walls where possible, and replacing windows where needed, the college can reduce thermal demand by more than 21,000 MMBtu per year. Most of these improvements can meet current standards for cost-effectiveness. Window replacement is a significant exception, although the study assumed that it would be beneficial to replace windows as part of planned renovation or maintenance.

Most Smith buildings are not metered for heat or electricity. This lack of data and the diverse architecture of the Smith campus create an extremely complicated problem when attempting to estimate the energy value of improving the thermal envelope.

To develop an estimate for thermal efficiency, 79 of 111 campus buildings were chosen for a modeling exercise which targeted thermal envelope improvements. A few of the selected buildings were eliminated from the study because they were new structures (such as the Campus Center), unique historic buildings (such as the Lyman Plant House), or were being assessed as part of another renovation project (such as Sabin-Reed and Burton Halls).

The chosen buildings were categorized according to construction type (wood frame, load-bearing masonry, or masonry veneer) and current insulation levels in attics and walls (none, some, and sufficient). Once categorized, EQuest, a DOE building energy modeling program, was used to create a template for each of the building categories. Categories were modeled using an “ideal building” for each of the construction types (wood frame, load-bearing masonry, or masonry veneer) to show the total potential for energy reduction.

After potential reductions were determined for each building type, a feasibility analysis was completed to determine a realistic expectation for total energy reduction. Finally, a financial analysis was completed for each measure.

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5 This is based on analyses conducted for the college by the engineering firms of R.D. Kimball and Sebesta-Blomberg Inc.

6 Conducted by Assistant Professor of Engineering Denise McKay and Etta Grover-Silva ’10

Table 6.3: Buildings and Energy Strategy

	2010 – 2014 Buildings and Energy		
	Measurement		
A	Install advanced electric, steam, and chilled water metering as budgets allow. Focus on residential houses and sciences.		
B	Conduct administrative, academic and residential building audits and provide feedback to occupants		
	Efficiency	**kWh Saved**	**MMBtu Saved**
C	Electrical efficiency projects including cooler, servers, office equipment, lighting, chiller plant and building HVAC upgrades	4,301,667	
D	Thermal efficiency and conservation, including envelope upgrades, steam-system insulation, retro-commissioning.		39,497
	Conservation	**kWh Saved**	**MMBtu Saved**
E	Reduce building footprint by 150K sq. ft.	1,172,000	13,300
F	Behavioral conservation projects, including house energy competitions and residential, academic and administrative building policy development/ education e.g. refrigerators, vampires etc.	1,000,000	
G	Audit and adjust set-points		TBD
	2015 – 2030 Buildings and Energy		
	Efficiency	**kWh Saved**	**MMBtu Saved**
G	Electrical efficiency projects	1,125,000	
H	Thermal efficiency projects		28,500
	Conservation	**kWh Saved**	**MMBtu Saved**
I	House Energy Competitions	1,300,000	
J	Residential, academic and administrative building policy development/ education e.g. refrigerators, vampires etc.		
K	Electrical Conservation		

6.5 Financial Implications

Whether they are behavioral (encouraging students to forego refrigerators in their rooms) or operational (reducing our total building footprint), conservation measures are the least expensive actions we can undertake. All of the potential electrical efficiency projects used to establish our efficiency goal are very cost-effective with simple paybacks in the range of two to seven years. All of the thermal efficiency projects have similarly short paybacks, with two notable exceptions: window replacement has a simple payback on the order of 10 years, and air-sealing (caulking, gap-filling etc) has a short payback on the order of one year.

6.6 Climate Implications

85% of campus greenhouse gas emissions are associated with buildings. Future energy efficiency and conservation measures will be our first action to advance the reduction of GHG associated with the campus. Improving building envelopes will reduce our GHG inventory by 14% or 4,233 MT eCO2. Electrical efficiency and conservation together will reduce our inventory by 11% or 3,257 MT eCO2. Reducing our building footprint by 5% will reduce our inventory by 4% or 1,200 MT eCO2. By 2030, reductions in energy use will provide a 29% reduction (7,700 MT) of eCO2.

Energy efficiency is one of the most significant and cost-effective strategies for significantly reducing our GHG emissions.

6.7 Potential student involvement

- Energy audit of College Hall
- Design/implementation of conservation programs
- Campus-wide and house-to-house energy competitions
- Continued maintenance, validation and improvement of the building energy model portfolio

7.0 Climate Action

7.1 Overview and goals

In November 2007, Smith President Carol Christ signed the American College and University Presidents' Climate Commitment (ACUPCC). Signing the commitment pledges the college to:

- measure our greenhouse gas emissions, and
- create a climate action plan with a target date for becoming a carbon neutral campus.

Carbon neutrality is defined by ACUPCC as "…having no net greenhouse gas (GHG) emissions, to be achieved by eliminating net GHG emissions or by minimizing GHG emissions as much as possible, and using carbon offsets or other measures to mitigate the remaining emissions." [7]

This section establishes the following goals:

- Achieve carbon neutrality by 2030
  - By 2015 reduce emissions to 22,330 MT eCO2 or 29% below the 1990 level (22% below 2009).
  - By 2030 reduce emission to 8,480 MT eCO2 or 73% below 1990 levels.
- Add 3.5 million kWh of on-site renewable electricity generation and 4,500 MMBtu of solar thermal energy by 2030 to replace fossil fuel use
- Evaluate and replace boiler fuel consumption with a sustainably harvested, domestically produced and/or recycled biofuel by 2020
- Evaluate and replace cogeneration turbine fuel consumption with a sustainably harvested, domestically produced and/or recycled biofuel by 2030
- Revisit and revise these assumptions on a regular basis

This section reviews the sources of greenhouse gas emissions associated with college operations, outlines opportunities for mitigating those emissions, and articulates a plan of action.

7 http://www.presidentsclimatecommitment.org/about/faqs#10

7.2 GHG Emissions and Sources

In 2009, Smith College GHG emissions were 27,976 MT eCO2. This is 11% below 1990 emissions of 31,526 MT eCO2.

A Smith student first calculated institutional GHG emissions in 2005. The inventory was updated by other students in 2007 and by the Office of Environmental Sustainability in 2008 and 2009. GHG emissions sources are generally divided into three categories or "scopes." These are:

- On-site GHG sources. There are considered "Scope 1" sources and include combustion of fossil fuels, farm animals, releases of refrigerants and application of fertilizer.
- Purchased electricity. This is considered a "Scope 2" source.
- All other sources associated with college operations. These are considered "Scope 3" sources.

Smith's inventory includes all Scope 1 and Scope 2 sources, and we have included the following Scope 3 sources consistent with ACUPCC guidance: student, faculty and staff commuting, air travel paid through or by the college, and solid waste disposal.

GHG emissions are measured in units of "metric tons CO2 equivalent" (MT eCO2). There are a number of different gasses responsible for climate change. Using equivalent or "e" CO2 is a convention for standardizing measurement of gasses with disparate properties such as methane (CH4) and nitrogen-oxide (NOx).

Chart 7.1 shows the proportion of college emissions attributable to different sources. Heating and hot water production (blue sections) are the largest contributors at 47% of all emissions. Electricity consumption (green sections) represents 38% of our total emissions. These two categories represent emissions that are a function of building use. Together, the heat and hot water (blue) and electricity (green) sections of the chart total 85% of college emissions. The remaining 14% are almost entirely transportation-related emissions. Air travel paid through or by the college accounts for 11% of GHG emissions, faculty and staff commuting constitute 2% of total emissions, and fuel used by campus vehicles 1% of emissions. Solid waste disposal also constitutes 1% of emissions. The combination of emissions from horses stabled on campus, loss of refrigerants and use of fertilizers add up to less than 1% of emissions.

This section discusses sources of reductions of eCO2 emissions. The previous sections of the SCAMP have identified sources of reduction as summarized below in Table 7.2. These reductions total 8,990 MT eCO2 or 32% of 2009 emissions.

Chart 7.1: 2009 eCO2 Emissions

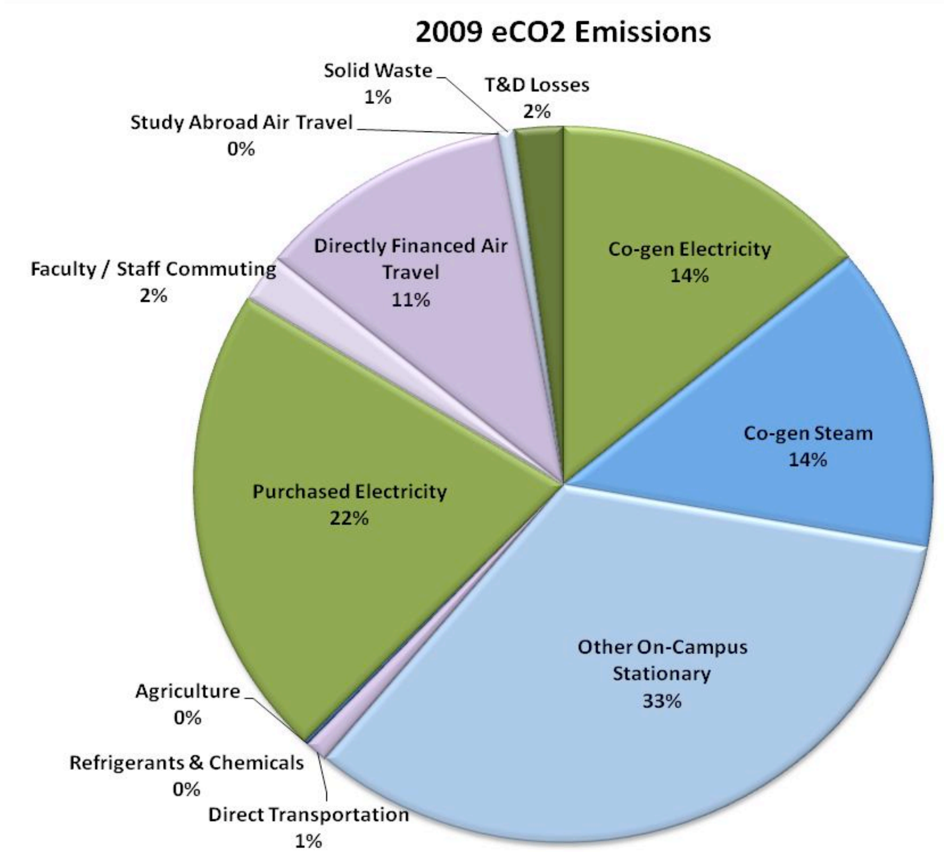


Table 7.2: eCO2 Reduction Sources

Emissions Reduction Strategy	*MT eCO2*	*Percent of 2009 emissions*
Thermal Efficiency	4,233	15.1%
Electric Efficiency	2,284	8.1%
Space Reduction	1,200	4.3%
Electric Conservation	973	3.5%
Water Efficiency/Conservation	179	0.6%
Transportation	152	0.5%
Solid Waste Management	53	0.2%
Total	9,074	32.4%

7.3 Sources of reduction

There are a number of additional sources of GHG reductions with varying degrees of viability at Smith.

Renewable Power and Fuels

Biofuels

The vast majority of Smith buildings are heated by medium-pressure steam produced by the central heating plant. The plant uses three boilers that are currently fueled mostly with natural gas from a pipeline and by #6 oil delivered to underground storage tanks on site. The #6 oil is used during peak demand periods when natural gas is unavailable or occasionally when there is a significant economic advantage. Smith's new cogeneration (or combined heat and power (CHP)) plant uses a combustion turbine to produce electricity and steam. It is currently fueled by natural gas, but it has the capability to burn #2 oil. However, the facility does not have the infrastructure to support liquid fuel delivery to the turbine. Natural gas burns with lower greenhouse gas emissions (as well as lower levels of NOx, and SO2) than #2 or #6 fuel oil.

Running some or all of this central plant with biofuels is one way to achieve carbon reductions under existing carbon-accounting protocols. For the purposes of this plan, we considered biofuels that:

- have comparable properties to the current fuels used (i.e. heating value),
- are expected to be readily available to meet energy demands, and
- can be stored on site.

These criteria preclude using wood chip combustion because, among other considerations, this approach would require significant new infrastructure and operating space.

Recent history shows that decisions about biofuels are more complex than they once seemed. Production of corn-based ethanol requires more energy to produce than it yields as fuel. Some biofuels, such as palm-oil and soy-based diesel fuel divert important food sources to fuel use and/or could encourage deforestation. Biofuel production methods and technology are quickly evolving. As a result, we sought to identify fuels that were more sustainable according to these criteria:

- they do not require long-distance transportation and
- they do not compete with food, land, or water resources

Applying these criteria leaves us with three options available to the college in the future: biodiesel or yellow grease made from waste food-based oils; cellulosic ethanol biofuel, a second- generation biofuel produced from the stalks and stems of plants rather than the sugars and starches used for corn ethanol; and algae biodiesel, a third-generation biofuel processed from a fast-growing plant matter. Literature review and discussion with industry experts suggests that these fuels will be available in sufficient quantity and quality, and at a competitive price, to allow their integration into Smith's operations in the future. Specifically, our research suggests:

- it is unlikely that yellow grease will be available in sufficient quantity to be considered;
- there is some likelihood that a cellulosic ethanol biofuel that falls within the category of #2 heating oil will be available in sufficient quantity at a competitive price by 2020;
- there is some likelihood that a cellulosic ethanol or algae biodiesel will be available in sufficient quantity at a competitive price by 2025.

Hydropower

A 1979 feasibility study details the potential for 120 kW of hydropower, delivering 570,000 kWh per year, by using the existing dam on Paradise Pond. Recent studies on other local dams (Mount Holyoke College) indicate that although relatively low-cost modular systems are available in this size range, simple payback is around 20 years at present electrical rates. The Paradise Pond dam is like many in New England, so one potential opportunity would be to seek funding for study and construction of an environmentally-sensitive hydropower retrofit of the Smith dam as a model for others in New England that might also be used effectively.

Solar power

Solar power is one of the most likely candidates for future development of renewable power on the Smith campus. There are two primary types. Solar thermal refers to installations that produce hot water for domestic use and/or for heat. Photovoltaic (PV) refers to installations that produce electricity. Thermal systems are much more efficient (produce more energy per area) than PV and have a simple payback that is currently in the 7-10 year timeframe. Without any existing subsidies, PV systems have a simple payback of 15 years or longer. Given these two factors, the college is more likely to pursue thermal systems on an institutional level over PV systems. In fact, Conway House and Park House have plumbing that was installed during construction and renovation in preparation for accepting such systems.

To determine a realistic figure for solar potential on campus, the Smith student chapter of Engineers for a Sustainable World conducted an assessment to determine the solar thermal and PV availability. For this assessment, 96 campus buildings were considered. Of these, 37 were identified as un-shaded, 45 were partially shaded and 14 were fully shaded. Shading was determined by observing any obstructions around the south-facing roof (i.e., trees, nearby buildings, or roof obstructions). Suboptimal roof conditions were also noted (i.e., steep tilt angles and/or poor orientation).

Once roof shading was determined, students calculated solar potential for unshaded buildings only. The assessment assumptions were:

- Monthly average solar insolation (exposure to the sun's rays) was 100% for these buildings.
- All panels are at the optimal tilt of 37 degrees.
- Un-shaded residential buildings would be equipped with solar thermal installations
- All other buildings would receive PV.
- For thermal installations, 25% of the roof area would be covered with panels,
- For PV systems 50% of the roof would be covered.
- Efficiency for PV is 12%.
- Efficiency for thermal systems is 60%.

If solar energy systems were deployed according to the above assumptions on all non-shaded buildings, the total amount of power available would equal 2.9 million kWh/year for the PV systems and 4,500 MM BTU for the solar thermal systems.

7.4 Metrics

- Total net emissions eCO2 (ACUPCC required components)
- Total scope 1 and scope 2 emissions
- RECs purchased
- Carbon offsets purchased
- Greenhouse gas emissions (metric tons eCO2)
- Portion of campus electricity from on-campus renewable sources
- Portion of campus energy from on-campus renewable thermal sources

Wind Power

Smith College does not own any land or buildings that are sufficiently windy to develop wind energy.

Geothermal Energy

Ground-source heat-pump systems (sometimes called shallow geothermal) would not be a cost-effective approach to energy development at Smith given the presence of the existing central boiler/cogen system. These systems consume significant electrical energy, and do not necessarily reduce source-energy, GHG emissions or operational cost when providing heat.

There is some possibility that the Pioneer Valley is an area where high heat regions of the earth's crust are closer to the surface than in many locations. As a result, there is some speculation that the region could support "deep geothermal" power in which a medium is sent down a hole five to ten miles deep, returns in a gaseous form, and is then used to create electricity. This is an unproven technology, but one that bears watching for the future.

Carbon Offsets and renewable energy certificates (RECs)

Offsets and RECs are financial vehicles which allow entities to balance the effect of their emissions through the purchase of an emission reduction in another location. RECs apply to the reduction of emissions from electricity consumption. Offsets may be applied to all other sources of emissions.

Renewable energy certificates (RECs)

RECs are an attribute of power that has been produced from a renewable source.[8] For example, when a wind turbine makes a kilowatt-hour of electricity, it is providing power that is consumed by interconnected customers. That kilowatt-hour is also identified as coming from a wind-power source. The electricity and the source of the electricity are often marketed separately. This makes it possible for institutions to purchase "green power" without actually producing it on their site or being directly connected to the source.

Since 2005, Smith has been purchasing RECs. Beginning in 2009, these RECs will be assigned to Ford Hall, the new building for the sciences and engineering, thus making Ford Hall "powered" in part by wind energy for at least two years. When calculating our GHG inventory, we subtract the number of kWh of RECs purchased from the total consumed. The result is a reduction in our GHG inventory. A history of Smith REC purchases is shown in Figure 7.4 below.

It is unlikely that RECs will play a significant role in Smith's overall carbon reduction strategy. This is because we are currently working to maximize the use of the cogeneration facility (which creates a significant reduction in GHG emissions by itself). Because cogen combusts fuel on site, electricity generated by the cogen unit could not be offset using RECs, which do not apply to onsite combustion of fuel for electricity.

Table 7.3: Renewable Energy Strategies

	2010 - 2030 Renewable Energy		
	Measures	kWh Replaced	MMBtu Replaced
A	Solar Thermal		4,500
B	Solar and/or hydro renewable electricity	3,347,000	
C	Contract for pilot photovoltaic system on Campus Center using a producer price agreement (PPA)	30,000	

8 See EPA Green Power Partnership http://www.epa.gov/grnpower/gpmarket/rec.htm

Carbon offsets

A carbon offset is a financial instrument aimed at a reduction in greenhouse gas emissions. Carbon offsets are currently sold by many for-profit and non-profit organizations. Current prices range from $10 to $20 per MT eCo2. At $15/MT, Smith could be carbon-neutral for one year for a cost of approximately $405,000. The future price and quality of offsets are very uncertain. The source of the carbon mitigation can come from diverse group of entities, and the actual impact of the reduction is seldom verifiable. In the U.S., carbon offsets are not specifically regulated, nor are they part of any larger regulatory framework. As such, they pose a number of potential issues. One of these is “leakage,” which is discussed in this quote from a report of the United Nations Intergovernmental Panel on Climate Change: [9]

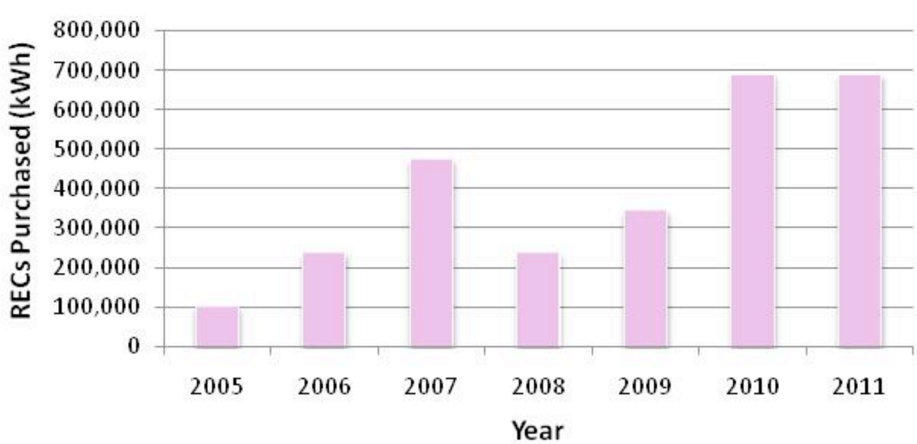
> *A potentially serious problem with carbon offsets is that there may be carbon leakage. Leakage refers to the situation in which a carbon sequestration activity (e.g., tree planting) on one piece of land inadvertently, directly or indirectly, triggers an activity which, in whole or part, counteracts the carbon effects of the initial activity. It can be shown that most of these types of problems arise from differential treatment of carbon in different regions and circumstances, and the problem is not unique to carbon sequestration activities but pervades carbon mitigation activities in the energy sector as well.* [10]

Given the numerous potential pitfalls associated with offset production and purchase, one promising trend in higher education is the development of local offsets. Typically these are investments in energy efficiency made by a college or university in the properties of low-income homeowners. Two examples are Yale University’s experimental “Carbon Fund” and POWER, a non-profit organization started in Oberlin, OH, whose mission is *“to increase energy efficiency of homes in Oberlin, Ohio. POWER seeks to:*

1. *Make low-income individuals more financially secure in the face of rising utility costs*
2. *Improve the quality of life of residents by creating a more comfortable home*
3. *Reduce the amount of pollution and CO2 emitted by Oberlin housing*
4. *Provide a way for the community to take responsibility for unavoidable CO2 emissions”* [11]

Finding a way to create offsets in a way that is verifiable and helps Smith’s local community would be an optimal solution for offsetting remaining emissions of eCO2 associated with the college’s footprint.

Graph 7.4: Renewable Energy Credit Purchases Past and Future 2005-2011



9 Intergovernmental Panel on Climate Change. www.ipcc.ch

10 Intergovernmental Panel on Climate Change. Working Group III: Mitigation http://www.ipcc.ch/ipccreports/tar/wg3/174.htm

11 http://www.oberlin.net/~power/about.html

7.5 Climate Action Plan

Smith's overall plan for carbon neutrality emphasizes reducing our footprint as much as we can through efficiency projects and conservation methods. The expected reductions associated with these efforts are shown in Table 7.5, Chart 7.6 and discussed in Sections 3.0 – 7.0 of the SCAMP.

We cannot reach carbon neutrality through efficiency and conservation alone. Renewable fuels, renewable power and offsets have to be part of our plan. Graph 7.7 provides an overview of our GHG emissions since 1990 as well as our plan for the future.

The portion of the graph (everything under the red line) to the left of the dashed line labeled "2009" is our actual past emissions history.

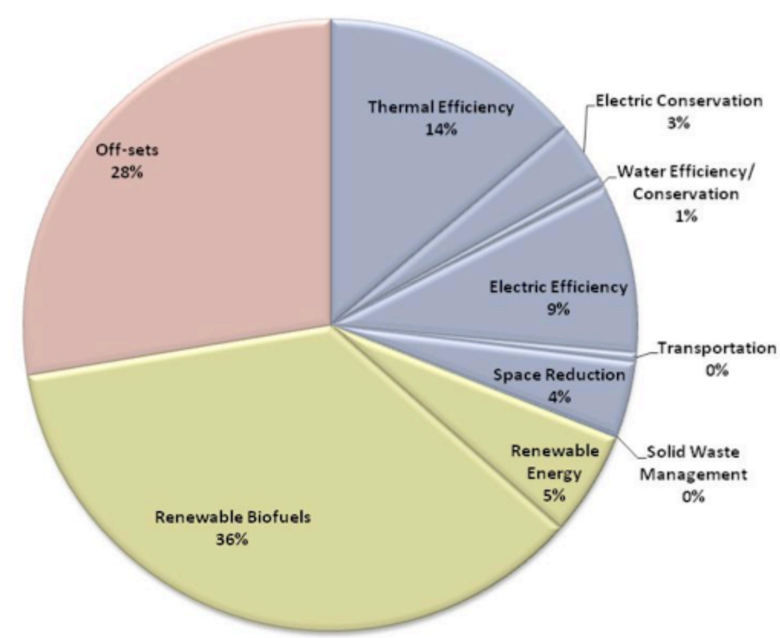
The portion of the graph to the right of the dashed line labeled "2009" is a projection of our carbon emissions if we did nothing (the red line on an upward incline from 2010 to 2030). The "do nothing" case assumes that we will not build any new buildings or achieve any efficiency. It assumes that heat and hot water loads will stay the same, but that electricity and travel will increase at rates of 1% per year.

Table 7.5: Overview of Carbon Neutral Strategy

SCAMP Section #	*Emissions Reduction Strategy*	*MT eCO2*	*Percent of 2030 emissions*
3.0	Water Efficiency	117	<1%
3.0	Water Conservation	62	<1%
4.0	Transportation	152	<1%
5.0	Solid Waste Management	53	<1%
7.0	Space Reduction	1,200	4%
7.0	Electric Conservation	973	3%
7.0	Electric Efficiency	2,718	9%
7.0	Thermal Efficiency	4,233	14%
8.0	Renewable Energy	1,700	5%
8.0	Renewable Biofuels	11,005	36%
	Total Reductions	22,213	72%
	Target Year (2030) Emissions	30,254	
8.0	Remaining to offset	(8,041)	28%

As a result of the "do nothing" case, Smith's GHG inventory would be 30,254 MT eCO2 in 2030—almost what it was in 1990. The emissions reduction strategies shown in Table 7.5 were imposed on the "do nothing" case. These are the various color bands in Graph 7.7. This shows that we can achieve a 73% reduction below 1990 emissions level by employing these measures. We would reach carbon neutrality by offsetting the balance.

Chart 7.6: Proportional Reductions from 2030 Emissions



From this analysis, we have set a target of 2030 reaching for carbon neutrality. Renewable biofuels and offsets play significant roles in this strategy—36% and 28% of our mitigation respectively. (These reductions as portions of our total projected 2030 emissions are shown in Chart 7.6).

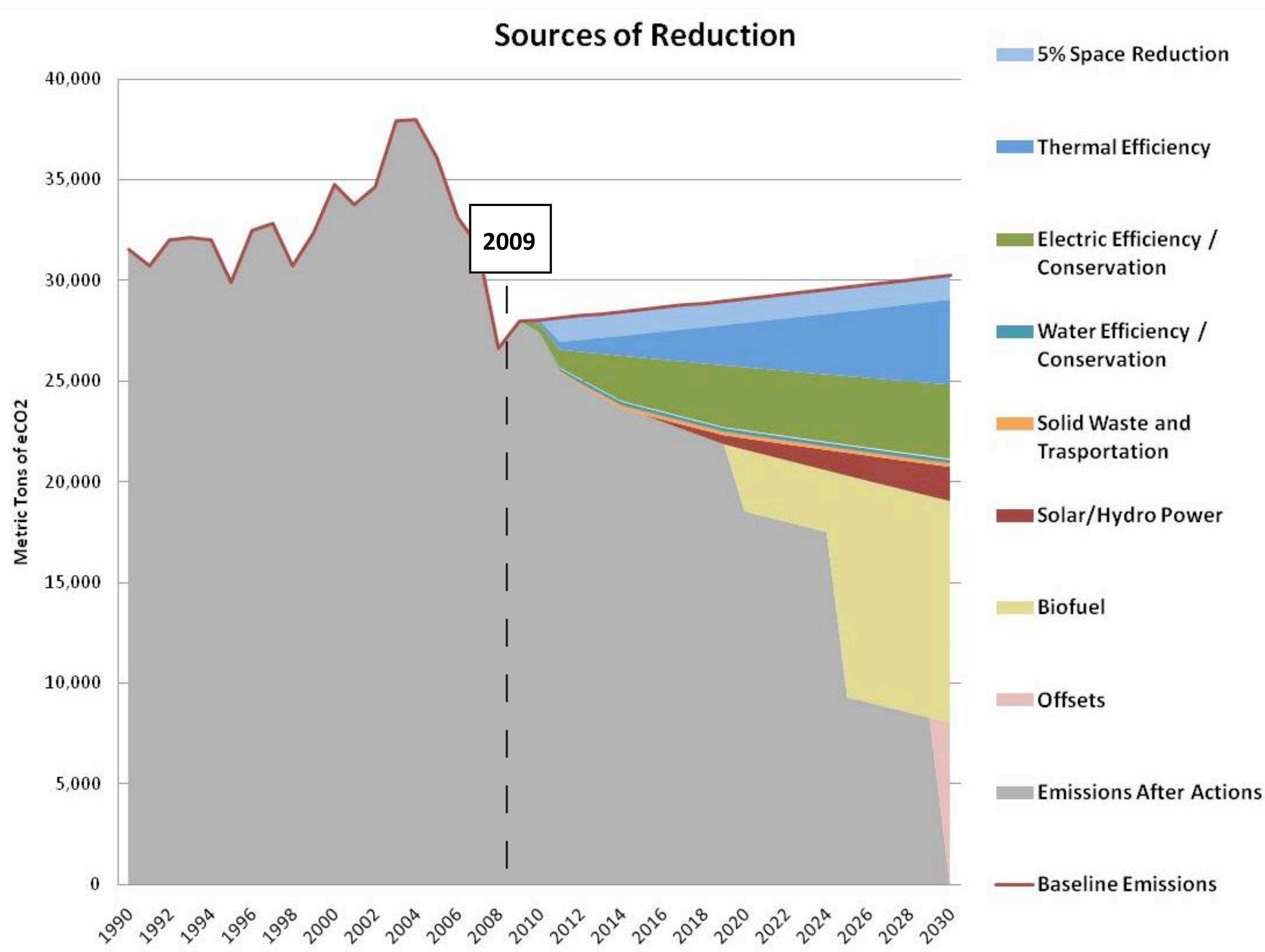
If our existing infrastructure (boiler plant, cogeneration facility) is to play a role in our climate action strategy, we must consider biofuels; however, we do so with some concern. Current carbon accounting protocols allow use of biofuels to be counted as "zero emissions," but methods for determining the true environmental cost of alternative fuels are being disputed because previous calculations have assumed that the source of biofuels is land with no other use or value.

Several researchers and the EPA have calculated that clearing land for the purpose of growing biofuels would release significant sequestered carbon, increase deforestation (with its attendant impacts), and probably increase hunger as land is removed from food production.

Given concerns over biofuel production and its impact, we hesitantly propose use of biofuels in this plan. This is a significant limitation because they play the single largest part (36%) of our current proposed reduction.

We have very good opportunities to reduce our carbon emissions through conservation and efficiency measures in the near term. In addition, we expect solar thermal power production to be viable in the not too distant future. We hope that, long before 2030, new technologies, increasing efficiency in the production process or other ways to create biofuels will address current drawbacks. These developments will positively alter the path articulated here.

Graph 7.7: Baseline Emissions with Sources of Reduction 2010-2030



7.6 Financial Implications

According to this analysis, in 2030 Smith would have 8,480 MT eCO2 remaining to offset (see Table 7.5). At 2009 prices, this would cost approximately $127,000. There is significant uncertainty with regard to future prices for offsets. Similarly, experts assert that biofuels will be cost-competitive with fossil fuels within ten years. Despite challenges, we observe that the cost of renewable energy is becoming competitive. Solar thermal installations currently have a simple payback of 7-10 years, PV has a simple payback of about 15-20 years, and small-scale low-head hydropower development has approximately a 20-year simple payback.

7.7 Potential student involvement

- Assessing solar potential among buildings
- Conducting policy research with regard to permitting hydropower

8.0 Academic and Co-Curricular Integration

8.1 Overview and Goals

Institutions of higher learning should lead the way toward more effective environmental stewardship by promoting environmental literacy; cultural and scientific appreciation of the natural world; and sustainable practices in their curricula, campus designs and operations, and interactions with the broader world. The plan below outlines steps Smith College will take to accomplish these objectives.

Near-term goals by 2015:

- Establish a major in Environmental Science and Policy (ES&P) with 20-30 majors graduating each year
- Strengthen the existing Landscapes Studies minor with 15-20 minors graduating each year
- Create a fully funded and operational CEEDS
  - Create an environmental concentration under the auspices of CEEDS
- Provide adequate staffing in ES&P and LSS to support these initiatives
- Expand environmental offerings throughout the curriculum
  - Create environmentally-oriented courses in all three academic divisions
- Increase student-faculty environmental research collaborations
- Promote the MacLeish Field Station as a site for experiential outdoor teaching and research
  - Increase the number of courses utilizing the field station
  - Support research projects that focus on the area
- Increase study-away opportunities
  - Increase the number of students participating in environmentally oriented study abroad experiences (programs, internships)

Long-term goals:

- Increase demand for Smith graduates by environmental organizations
- Enhance Smith College's reputation as a place to study the environment
- Establish Smith College as a national presence in the media, policy and among non-profit and research organizations

8.2 Current Programs and Organizations

Smith currently supports student learning, investigation and campus engagement related to the environment and sustainability by offering minors in Environmental Science and Policy, Marine Science and Policy, and Landscape Studies; environmental tracks in several majors; and co-curricular opportunities that range from study-abroad experiences to an active Earth Representative program in student housing, student organizations, and intern opportunities within the Office of Environmental Sustainability. These programs and initiatives are described here briefly.

Environmental Science and Policy Program

Smith's Environmental Science and Policy (ES&P) Program seeks to produce future leaders in the environmental field by offering two minors: Environmental Science and Policy and Marine Science and Policy <http://www.science.smith.edu/departments/esp>. More than 25 faculty members from over a dozen departments teach courses in the program. Their research interests span a broad range of fields in the environment, including marine ecosystems, environmental education, global climate change, development and population, international environmental politics, watershed health in North and Central America, political ecology, conservation biology, environmental economics, environmental engineering, and global marine policy. A director and coordinator run the program with support from an advisory committee of faculty.

The minor in Environmental Science and Policy encourages students to define, understand and address complex environmental problems through the application of science and policy. The minor in Marine Science and Policy permits students to pursue interests in coastal and oceanic systems through an integrated sequence of courses in the natural and social sciences.

The Spatial Analysis Lab (SAL), housed in the ES&P Program, provides support and training in geospatial technologies and promotes spatial thinking and geographic literacy. A full-time GIS specialist operates SAL.

The ES&P Program reaches beyond the classroom. Many students are engaged in field research in internships, with faculty or independently. A Smith student may pursue her research project further through a special studies project. Students may also choose to spend a semester or a year studying the environment at affiliate schools abroad or in the U.S. During the summer, students can participate in the unique interdisciplinary Coral Reef Ed-Ventures program (in its 11th year) or the National Oceanic and Atmospheric Administration (NOAA)-Smith internship program, both coordinated by ES&P. The Program regularly hosts lectures from environmental leaders, including Smith alumnae, and promotes sustainable practices on campus. There are also a number of active student environmental groups on campus.

Landscape Studies Program

Smith's program in Landscape Studies is the first of its kind in a liberal arts college. A multidisciplinary exploration of our environment that bridges the arts, literary studies, sciences, and engineering, it is rooted in a long history of architecture and landscape architecture at Smith. The curriculum for the study of the built environment draws from several disciplines to provide a comprehensive perspective: American studies, architecture, art history, biological sciences, comparative literature, engineering, environmental science and policy and urban studies. As part of the Five College consortium, Smith easily accesses the offerings of the University of Massachusetts and Hampshire College for added courses in architecture, regional planning, and permaculture, and alumnae in relevant professions have also been active as guest lecturers, student mentors, and internship supervisors.

The minor offers 6-7 courses per year that focus on the built environment, and the number of graduates has risen steadily since the program's creation in 2002. Landscape Studies students attend graduate schools in the U.S. in architecture, landscape architecture, planning, industrial design, medicine, teaching and doctoral programs.

The Picker Engineering Program

The existence of the innovative Picker Engineering Program (established in 1999) positions Smith uniquely among its peer liberal arts institutions. Viewing engineering a "profession in service to humanity," the Picker Engineering Program is committed to environmental sustainability. Housed in the LEED-certified Ford Hall, the program offers courses in ecohydrology, atmospheric processes, risk communication, engineering and global development, water resources, and fuel-cell design. Students in an introductory engineering course design and build models of sustainable homes that employ passive and active technologies for heat and power. The senior capstone experience, in which student teams work on real projects with industry and governmental partners, regularly provides opportunities for environmentally sustainable design. Examples include:

- Treatment of milkhouse washwater for small dairy farms in Massachusetts
- Solar-powered irrigation for an organic farm
- Geothermal heating and cooling for Stop and Shop, a national supermarket chain
- Nitrogen reduction at Northampton's wastewater treatment plant
- Green building innovations for Habitat for Humanity
- Restoration of tidal flow to a salt marsh in Dennis, MA

Many graduates have pursued careers in environmental fields, and a new bachelor of arts (BA) degree offered by the Picker Engineering Program brings these courses and experiences not only to future engineering professionals but to all Smith students. Additional information on the Picker Engineering program is at *www.smith.edu/engineering.*

Other Curricular Offerings

Tracks within majors

The Department of Geosciences created an Environmental Geosciences track within the major in 2009. The Department of Biological Sciences has proposed a Biodiversity, Ecology, and Conservation track within its major that emphasizes the natural environment and its conservation.

Five College Coastal and Marine Sciences Program

The Five College Coastal & Marine Sciences Program <http://www.fivecolleges.edu/sites/marine/> offers an interdisciplinary curriculum to undergraduate students enrolled in the five colleges. Through field trips and active affiliations with some of the nation's premier centers for marine study, students engage in hands-on research to complement course work. Many students who participate in the program go on to advanced study or professional work in various areas of marine science.

Co-Curricular Opportunities

Student Orientation

Introducing new students to Smith is a key opportunity to send a message about Smith's commitment to sustainability and our expectations for student participation. These messages are communicated through the following venues during orientation at the beginning of every academic year.

- Sustainability content is included in the new student orientation booklet and is provided to admitted students' on a "Moodle" page where, for example, entering students can look up an environmentally friendly back-to-school shopping list.
- Orientation leaders are educated to promote key sustainability messages.
- Environmental Sustainability Director addresses first-year students when they first meet as a group.

- During 2009-2010, first-year students participated in a sustainability scavenger hunt designed to promote student interaction and basic understanding of the Smith campus and surroundings. The hunt featured challenges with specific sustainability themes, such as energy consumption, carbon footprint and local agriculture.
- An intensive two-day orientation program open to 40 first-year students called "Sustainability and Ecological Literacy" has been offered by the director of the Environmental Science and Policy program since 2007. This program exposes students to local ecological and geographical features, local transportation options, and where the college gets its heat and electricity. Guest speakers from facilities, dining and elsewhere introduce students to efforts the college is making towards sustainability and take students on tours of our heating and cogeneration facility.

Internship Opportunities

There are a variety of on-campus internship opportunities available for students who want to gain further exposure to sustainability issues including:

- Green Team student coordinator, three sustainability representatives
- Research interns in the Office of Environmental Sustainability
- Interns in the Environmental Science and Policy Program office
- Botanic Garden internships
- Gaia Praxis Internships
  - The Praxis program allows every Smith student one internship funded by the college. The Gaia internship specifically supports environmentally oriented opportunities.

Student Organizations

There are a variety of student organizations related to sustainability efforts on campus, including:

MassPIRG, a group of students working together as grassroots activists on issues that they're passionate about. Through a waivable semester fee, students accomplish their goals on major environmental campaigns by pooling their resources to hire campus organizers, scientists, and lawyers who provide support to student campaigns and assist them in their endeavors.

The Community Garden, whose mission is be a practical academic tool, engage the Smith community, and serve as a model of sustainability. This student-operated garden revives the historical tradition of the student victory garden and allows students to practice sustainability.

The Bike Kitchen teaches students basic bike maintenance skills for safe riding. They also rent bikes to students for $15/semester or for work exchange time at the Bike Fixin' workshops. They talk to administrators at Smith about improvements such as covered bike racks, offer safety classes for new cyclists, and provide ways to reduce car traffic on campus. Additionally, they provide the space for people with a common interest to gather in get-togethers, group rides and film screenings.

Engineers for a Sustainable World (ESW) is a nonprofit organization with a network of professionals and students working to reduce poverty and improve global sustainability. Through domestic and international development work, education, and public outreach, ESW mobilizes engineers to address the challenges of global poverty and sustainability.

The Green Team

The Green Team is a coalition of faculty, staff, and students dedicated to fostering sustainability at Smith. The Green Team works to educate and support the campus community and the college's sustainability committee in the efficient use of finite natural resources. Their work touches many areas of Smith's operations, including construction, transportation, purchasing, materials use, energy use, and waste management.

Committee on Sustainability (CoS)

Four students appointed by the college president participate in this committee along with representatives from the faculty, staff and administration. The COS develops and guides college sustainability policies.

Earth Representatives

Earth Reps are volunteers in each residential house who help promote positive environmental behavior on campus and beyond.

Originally conceived as a program to promote recycling, the program is being expanded so that Earth Reps provide basic information on electrical use and HVAC details of their particular building. Earth Reps also maintain an Earth Board of information about recycling and environmental information in each house, help maintain their house's recycling sites, and provide other recycling education by hosting teas, making announcements at dinner, etc.

Earth Reps are assisted by three paid Sustainability Reps whose primary role is to support and coordinate the activities of the Earth Reps. They also propose, initiate and oversee recycling projects in student areas of campus.

8.3 Metrics

- Enrollment in environmental/sustainability related courses
- Number of courses or modules within courses in departments and programs not traditionally focused on the environment and sustainability
- Number of majors and minors in
  - ES&P
  - LSS
- Relevant tracks within other academic programs
  - Certificates
  - Concentrations (see below)
- Number of research opportunities and projects (class-based projects, special studies, Honors theses, summer fellowships)
- Number of courses utilizing the MacLeish field station
- Number of students participating in environmentally oriented study abroad experiences (programs, internships)
- Number of successful applicants to environmental graduate programs
- Number of successful graduating job seekers
- Number of 5-year alumnae in environmental fields
- Number of 5-year alumnae who completed the environmental concentration and articulate clearly the benefits of their integrative education as key to personal fulfillment
- Number of matriculating students who indicate that they are attending Smith because of its environmental resources and education
- Number of applicant inquiries that indicate interest because of environmental programs
- Smith news mentions with respect to environmental issues

8.4 Strategies

Smith is launching an Environmental Science and Policy major in academic year 2010-2011 and the Center for the Environment, Ecological Design and Sustainability in 2010. Each of these programs will build on existing strengths and provide new opportunities for students to engage issues in sustainability and climate change from both academic and co-curricular perspectives. These initiatives are detailed below.

Major in Environmental Science and Policy

The curriculum combines existing courses from the natural and social sciences and engineering with four new courses that are explicitly integrative and developmental in nature. The four integration courses form the intellectual and organizational core of the major. Each brings together frameworks, skills and information from natural and social sciences in an explicitly integrative fashion to explore and analyze important environment-related topics at local, regional, national and global levels.

The major consists of 14 courses. All majors will take:

- 4 integration courses
- 3 introductory courses in the Natural Sciences with 2 labs;
- 2 introductory courses in Social Sciences/Humanities (from different departments);
- 1 course in Statistics;
- 4 electives that create a coherent sequence with a clear environmental focus.
- One semester of independent study (EVS 400) or credit toward an Honor's thesis may be substituted for 1 elective. Internships, study abroad, or Praxis experiences are strongly encouraged.

Center for the Environment, Ecological Design and Sustainability

Smith's strategic plan, the "Smith Design for Learning," outlines an integrated, multidisciplinary approach to key areas of study that are particularly important to students living and working in a global society. One of multidisciplinary approaches is the Center for the Environment, Ecological Design and Sustainability (CEEDS).

CEEDS is intended to foster collaborations that bridge the natural and social sciences, arts and humanities; advance environmental literacy in the Smith community; address environmental problems through interdisciplinary research and educational outreach; facilitate collaboration and synergies among environmental interests on campus; and identify Smith as a model for the study of environmental policies and stewardship.

The CEEDS mission is to graduate women who excel at integrating knowledge in support of environmental decisions and actions.

Initiatives

These initiatives are not goals in and of themselves. Rather, they support the larger mission of the Center and should be viewed as fluid and changeable. The following list is not exhaustive, but highlights some initial ideas for what the center may do.

- Environmental Concentration
- Interdisciplinary projects
- Use of MacLeish Field Station for research, education and contemplation
- Environmental monitoring, data collection and dissemination

  - MacLeish Field Station meteorology, atmospheric chemistry, stream biomonitoring, permanent vegetation plots, etc.
  - Avery Brook flow-monitoring
  - Campus energy and material flows for the buildings on Smith's campus
- Connecting Smith operations with the academic program
- Communication on environmental topics on campus and beyond
- Developing productive partnerships

Office of Environmental Sustainability

Sustainability Plan Implementation

This plan identifies many opportunities for student research, analysis and policy development associated with reducing our operational impact. In cooperation with CEEDS, ES&P and other academic departments, these projects will become integral to student learning.

Five College collaborations

We believe there is value in increased coordination among environmental programs and sustainability initiatives in the Five Colleges. We will continue to investigate and explore the opportunities for new programming or cooperation.

Acknowledgements

One of the central benefits of developing a plan such as this one is that the process of development brings some basic questions into focus for participants in the system. Understanding "how much" and how we know "how much" are critical to understanding how we will collaboratively chart a future that does not compromise future generation's ability to thrive on the planet.

True to this spirit, the development of this plan was truly a collaborative effort. The SCAMP received a warm reception as the committee presented across campus. Many people offered their support, ideas and questions. Thank you all for your input. Specifically, I would like to thank the following for their essential contributions to this effort.

Facilities Management staff know that much of implementation of this plan will fall on their shoulders. Even though they are aware of it, they allowed me to take up an inordinate amount of time in successive meetings of the Facilities Management Operations Group. Many of the group's members as well as other Facilities Management staff gave substantial additional time to assist with the plan. They include:

- John Shenette, Executive Director
- Ken Person, Assistant Director
- Karl Kowitz, Business Operations
- James Lucey, HVAC/Carpentry
- Bob Domkowski, Grounds
- Chuck Dougherty, Cogeneration Plant
- Frank Perman, Plumbing
- Diane Benoit, Building Services
- Hank Horstmann, Electrical
- John Robinson, Capital Projects Manager
- Charlie Conant, Project Manager
- Gary Hartwell, Project Manager
- Cheryl Obremski, Capital Projects
- Jennifer Marcotte, Systems
- Linda Hiesiger, Purchasing
- Brett McGuinness, Building Services

Dining Services has been a leader in campus sustainability; when it came to providing data for the SCAMP and planning for the future, Dining staff really put their collective shoulder to the wheel. Thanks to:

- Kathy Zieja, Director
- Ann Finley, Area Manager
- Patrick Diggins, Purchaser

The Public Safety and the Finance offices have been essential to understanding our transportation behaviors and impacts. Thank you:

- David DeSwert, Budget and Grants
- JoAnn Furman, Public Safety

The Office of Environmental Sustainability staff was essential to SCAMP development. Thank you:

- Roger Guzowski, Five College Recycling Manager
- Todd Holland, Five College Energy Manager

The following students collected data, researched policy, proofread drafts, made charts and graphs, and conducted analysis. Thank you:

- Katherine Clark '10
- Etta Grover-Silva '10
- Katherine MacKenzie '11
- Wiley Reading '10
- Kerry Valentine A '10
- Elisabeth Wolfe '10

Finally, Professor David Smith, Environmental Science and Policy Program, Professor Denise McKay of the Engineering Department, Professor Andrew Guswa, Director of the Center for the Environment, Ecological Design and Sustainability, and Carole Fuller of Development were each instrumental in bringing this plan into being in very different but essential ways. Many thanks to all of you.

Dano Weisbord, Environmental Sustainability Director
March, 2010

Appendix A: Glossary of Terms

#6 oil: also called heavy fuel oil or residual oil and is used for industrial fuel. It is a viscous liquid with a higher boiling point than gasoline, diesel and home heating oil. Chemically, residual oil is a hydro-carbon chain that is relatively long (20 to 70 carbon atoms). As a result, it is much more "carbon rich" per Btu than other liquid fuels.

academic integration: incorporating sustainability principles and projects in the academic curriculum

ACUPCC: American College and University Presidents' Climate Commitment, a high-visibility effort to address global climate disruption undertaken by a network of colleges and universities that have made institutional commitments to eliminate net greenhouse gas emissions from specified campus operations, and to promote the research and educational efforts of higher education to equip society to re-stabilize the earth's climate.

behavioral conservation: saving resources by changing human behavior to less wasteful practices

biofuel: liquid fuels derived from renewable resources such as plant or animal materials

Btu: a traditional unit of measurement that refers to the amount of energy needed to heat one pound of water one degree Fahrenheit. One Btu is approximately the heat output by a kitchen match.

carbon offset(s): a credit purchased from a carbon brokerage to compensate for the use of fossil fuel. Individuals, companies, institutions, or governments purchase carbon offsets to mitigate their own greenhouse gas emissions from transportation, electricity use, and other sources. For example, an individual might purchase carbon offsets to compensate for the greenhouse gas emissions caused by personal air travel. Offsets are created by supporting projects that conserve or create green energy.

DOE: United States Department of Energy

efficiency: use of mechanical or technical means to reduce use of a resource while providing a constant level of performance. Examples include installing low-flow showerheads to save water or replacing old lighting with lower-wattage lighting that provides the same amount of light.

EPA: United States Environmental Protection Agency, a federal agency

GHG: greenhouse gas can be any number of chemicals that serve to increase the insulating value of the earth's atmosphere. They include carbon dioxide (CO_2), nitrous oxide (N_2O), methane (CH_4), and industrial gases hydrofluorocarbons (HFCs) perfluorocarbons (PFCs)and sulfur hexafluoride (SF_6)

GPM: gallons per minute

Green Seal certified: a certification that uses a life-cycle approach, which means they evaluate a product or service beginning with material extraction, continuing with manufacturing and use, and ending with recycling and disposal. Products only become Green Seal certified after rigorous testing and evaluation, including on-site plant visits.

HVAC: heating, ventilation, air conditioning

IPM: Integrated Pest Management programs use current, comprehensive information on the life cycles of pests and their interaction with the environment. This information, in combination with available pest control methods, is used to manage pest damage by the most economical means and with the least possible hazard to people, property, and the environment.

KWh: A kilowatt-hour is a unit of energy: the expenditure of one kilowatt of power for one hour. A toaster running for an hour will use about this much energy. The average US home uses 900 kWh per month.

MMBtu: one million Btu's or British Thermal Units. One Btu is approximately the heat output by a kitchen match. The average Massachusetts home uses 112 MMBtu per year for heat.

MT eCO2: metric tons of carbon dioxide equivalent; although other gases are measured, their equivalent in carbon dioxide is used for ease of comparison measurements. Smith's indoor track and tennis facility could hold approximately 116 metric tonnes of CO_2.

PV: photovoltaic; solar panels that produce electricity

T5HO: a high-output fluorescent lamp

Appendix B: Table of All Metrics Performance

Metric	Quantity (FY 2009)	Unit
2.0 Water		
Total annual potable water consumption	45,556,993	gallons
Total annual house and dining consumption	26,483,214	gallons
House water consumption per student	27.4	gallons/day
Total annual water use for landscape irrigation	2,100,000	gallons
3.0 Transportation		
Total annual eCO2 emissions associated with transportation and college-owned internal-combustion engines	4,113	metric tonnes
Total annual airline miles paid for by or though the college (not including study abroad travel)	4,134,690	miles
Total annual airline miles traveled by students for study abroad (does not include student travel to and from Smith)	2,703,512	miles (est)
Total emissions from faculty and staff commuting	620	metric tonnes
Total number of commuter miles by faculty and staff	1,466,000	miles
Modal split of commute trips by faculty and staff:		
drive alone	2,637	trips/year
bus	42	trips/year
carpool	330	trips/year
bike	169	trips/year
walking	508	trips/year
Percent (of total faculty and staff) of parking opt-out participants	8.4	percent
Number of faculty and staff participating in opt-out	95	participants
Number of parking decals purchased	2,192	decals
Price of faculty/staff parking decals	50	dollars
Number of campus parking spaces available	1,560	spaces
Annual fleet eCO2 emissions	250	metric tonnes
Fleet miles traveled each year	254,500	miles
Average fleet MPG for service fleet	12.5	mpg
Average fleet MPG for passenger fleet	19	mpg
4.0 Material Purchasing and Waste Management		
Percent of food budget spent on locally (w/in 150 miles) grown or processed	21	percent
Percent of food budget spent on environmentally beneficial foods	7	percent
Percent of food budget spent on humane foods	0.5	percent
Sheets of copier/printer paper purchased by college	11,000,000	sheets
Number of “impressions” executed by multi-functional devices	TBD	
Number of printers, scanners, fax machines and copiers on campus	~1,100	units
Total annual routine trash generated	735	short tons
Annual routine trash per student	498	pounds
Total annual compost generated	1,011	short tons
Total annual routine recycled material	292	short tons
Annual routine recycling generated per student	198	lbs

5.0 Landscape Management		
Acres of grass	41	acres
Lbs of fertilizer/acre	695	lbs/acre
Total acreage	147	acres
Acres of impervious surfaces	TBD	
6.0 Energy and Buildings		
Gross square footage of building space	2,894,811	sq ft
Total electricity use	22,800,000	kWh
Total electricity produced on site	8,349,096	kWh
Fuel consumed on site for heat, hot water and electricity production	322,754	MMBtu
Total energy use (electricity + thermal)	372,032	MMBtu
Total energy use per capita (undergraduate students)	142	MMBtu
Total energy use per ft. sq. (kWh + MMBtu/campus gross sq. ft.)	122,588	Btu/sq ft
7.0 Climate Action		
Total net emissions eCO2 (ACUPCC required components)	27,976	Metric tonnes
Total scope 1 and scope 2 emissions	23,873	Metric tonnes
RECs purchased	345,000	kWh
Carbon offsets purchased	0	Metric tonnes
Greenhouse gas emissions (metric tons eCO2)	27,976	MT eCO2
Portion of campus electricity from on-campus renewable sources	0	percent
Portion of campus energy from on-campus renewable thermal sources	15.3	MMBtu

Appendix C: Stakeholders Comments

Water

- What's the difference in carbon emissions from pond pumping vs. using Northampton water?
- What will be the impact to Northampton from Smith reducing its water consumption?
- Water is not seen as issue in NE, but delivery, treatment, and maintenance of the system does have a carbon footprint.
- What are the impacts of using potable water for irrigation?
- Rain barrels/collection tanks should be used for watering plants/trees.
- Grey water systems should be used in buildings.

Transportation

- How do we reconcile necessity of air travel with huge emissions it produces?
- Re-examine the opt-out structure.
- Add more bike parking (covered, dispersed).
- Reimburse offset purchases for air travel (or split costs).
- Provide 5 college park and ride.
- Incentivize car pooling (even for part time car poolers).
- Improve public transport.
- Assign parking spaces to stop "cruising."
- Create a tiered parking fee structure.
- Install bike lockers.

Purchasing and Waste Management

Purchasing

- Increase duplex page printing.
- Purchase local barramundi (fish).
- Is there a better(less wasteful) way to distribute peanut butter, jelly and other "portion controlled" food items?
- How do we manage (overcome) budgetary constraints on purchase of vehicles that could use biofuels or other alternative fuels?
- More group van trips for sustainable shopping (thrift stores w/ reusable bags).
- Default to double sided printing in computer labs.
- Provide instructions for printing multiple pages per sheet.
- Prioritize purchase of low-energy computers.
- Print double-sided/on the back of recycled/reused paper.

Waste

- Recycle milk containers.
- Yogurt containers need better recycling promotion.
- Increase awareness of composting in residences and dining.
- Increase late meal hours to reduce waste.
- How can the Green Team help with composting?
- End of year waste:
  - Can the house free box carry over from year to year?
  - Tell students they don't need furniture at central check-in
- Create a list of items in rooms
  - Increase space for storage or storage containers
  - College should provide hangers
  - Trunk rooms could be better organized
- Reuse trash for art.
- Place compost bins in student kitchens.
- Create a student "composer" job in dining rooms.
- Collaborate w/ faculty to reduce paper use e.g. reuse reading packets.
- Is there a "greener" way to handle laboratory waste?
- Bottle and can recycling is needed in SSW offices.
- Get the word out about composting and other recycling measures.
- I'm involved in the laboratory sciences and animal quarters at Smith College. How can we reduce waste there? Equipment, chemicals, cleaning products etc. are so wasteful or have such a short lifespan. Can we do more green chemistry?
- Some of the dining halls still are not compost houses, and in the ones that are, more could be done to advertise the need to compost and encourage students to make use of the facilities that are in place. Organic waste is the worst kind to dispose of, and there is no good way to do so other than to compost. This is even more important than recycling. Perhaps compost bins could be available in the houses? I understand the logistics would be difficult, but it might be worth figuring out. Possibly wormeries--bins of special composting worms that turn the food placed in the bin into very fertile soil--could be put in the houses? They are very cheap and require no maintenance other than dumping food in them and occasionally removing the soil from the bottom bin. My house is already looking into the possibility.

Landscape Ecology

- Prioritize areas for lawn and transition some other areas to low maintenance non-grass plantings.
- How to do we evolve the image of what a liberal arts college should look like? Why do we still have "19th century England" lawns?
- Transition/evolve the image of a liberal arts college – this is not England in the 1800's
- In Cambridge, there is a city-wide ban on leaf blowers. This can save Smith some CO_2.

Energy and Buildings

- Smith is known to have more building space per student than comparable institutions. This space costs large amounts of energy, money, and resources to maintain. The Smith College of the future should be more compact, more efficient, and better utilized. To achieve this, an objective standard for measuring space usage should be developed and applied across the campus. This could be person-hours of occupancy per 100 square feet, for example. Underutilized space should eventually be reconfigured for other uses or decommissioned. Exceptions would be necessary; however, they should be well justified and made with full and open disclosure.
- The next new building or major renovation on Smith campus should meet or exceed the Architecture 2030 standard (more than 50% reduction in energy use as compared with similar existing buildings). Ford Hall would not meet this goal because of its north-facing glass atrium and extremely high air exchange rate. The Campus Center is another example of inefficient architecture; its glass roof alone loses more energy than many entire buildings in the winter and greatly increases the air conditioning load in the summer. We can ill afford any more inefficient buildings. Our priorities and decision making process both need to change.
- Heat is either “all on” (hot) or “all off” (cold) in houses. Windows are being used to control temperature.
- House common areas such as lounges and living rooms could have efficient overhead lights instead of lots of floor and table lamps.
- Offices are too cool in summer and lack local control.
- Windows are really drafty.
- There are electric space heaters in many offices which waste electricity but provide local control of heat.
- Replace or retrofit cardio machines with ones that produce energy – at least enough to power the TVs.
- Add light sensors in corridors and stairwells which are over-lit.
- Install and/or adjust lighting sensors or timers in kitchenettes and bathrooms.
- First floors are cold, 4th floors are cold.
- No adjustment for heat in rooms.
- Increase use of sleep mode on computers.
- Provide treadmills or pedals in the fitness center which generate electricity.
- Make available the campus metering data to students, faculty, and staff

Climate Action

- Students should research various offset programs, who runs them, is the “pricing structure” rational, where does the money actually go? Should smith establish its own offset program?
- What kinds of biofuels would we consider using? (asked many times)
- Have we planned for budget impact of using biofuels and/or buying offsets?
- Provide deeper insight to the tradeoffs between natural gas and biofuels

Academic Integration

- Student research on offset programs (e.g. Terrapass).
- Create and environmental blog.

- Engage 2,3,4th yr students.
- Identify better/easier ways for students to get involved.
- Provide an outlet for environmental news on campus.
- Include more courses/curriculum in different departments related to conservation.
- I was pleased to learn that engineering students did the study of buildings for the climate action plan.
- Integrate courses, or course projects on the environment with psychology.
- Include environmental economics in economics intro classes.
- Including psychology would be very beneficial and help add another perspective. Could help educate not just about environmental sustainability but also how to effect change e.g. "the psychology of environmental sustainability."

Implementation

- As new initiatives are developed, the impact on the environment should be assessed and openly reported. For example, the new focus on global leadership could significantly increase the amount air travel being done by our student body. The greenhouse gas emissions due to this new initiative should be estimated (roughly, but including both fuel and air transport infrastructure), compared with existing energy use at Smith, and reported as a percentage increase.
- College-funded activities that are highly energy intensive should be assessed for their impact on the environment and the results considered when evaluating funding priorities. The largest of these energy-intensive activities likely include athletics (facilities, operation and travel) and college-funded travel for fundraising, outreach, recruitment, research, and courses. Other energy-intensive activities should be evaluated as they become apparent.
- How do we educate the campus community in a productive way?
- Support the community garden (funding/location) to support its use as an educational tool/initiative.
- Make environmental initiatives more public and wide-spread.
- I feel like the way I can contribute to achieving the goals outlined in the plan by increasing awareness among my peers.
- Just talking about it is pretty effective in many cases. Also, a commitment to promoting environmentally friendly practices in many house and/or work places should help.
- Fixing and taking care of things. Changing the way we live on a day to day basis. Sustainable use of water, electricity.
- Look at Donella Meadows work on how to change systems by motivating the community – 10 points for how to change systems (Solutions Magazine).
- Generate a list of research questions that can be used as projects in an introductory statistics course, preferably requiring some data collection as well as analysis.
- Create an organized, central list of data needs and desires.
- Make available a list of projects that students, across the disciplines, could get involved with
- Offer more short-term projects on the campus sustainability plan. Probably shorter than two-days, perhaps an afternoon, with some modest incentive to bring new faces to the table. Objectives would be to connect faculty across disciplines and to make them more aware of the campus and its operations.
- Put signs, labels, and information throughout the campus that raises awareness of consumption patterns: energy use, material flows, etc. Include carbon and economic costs when appropriate.

- Advocate that a share of any cost savings that result from behavioral changes be returned to the target group (students, faculty, staff).
- Make a priority list of operational strategies for faculty to implement with a clear articulation of the expected benefit (in dollars, carbon, etc.).
- In addition to a centralized list of potential student projects, also provide an effective information management system for making the results of such projects readily available to students, staff, and faculty.
- Figure out a way that students, faculty, and staff (in particular, those associated with horticulture and the greenhouse) can be allowed access to the green roof on Ford Hall.

Appendix D: List of Outreach Presentations

December, 2009

- Senior Administrative Staff
- Dining Services Mangers and Chefs

January, 2010

- Committee on Mission and Priorities
- Advisory Committee on Resource Allocation
- Faculty Council
- Senior Staff
- Kahn Institute Project on Sustainable Operations
- Liberal Arts Lunch

February, 2010

- Library Staff
- Student Government Association Cabinet
- Facilities Management Operations Group
- House Presidents
- Campus Committee on Community Policy
- Open Campus Forum – 80 participants from around the college
- Smith College Museum of Art staff meeting
- Office of Admission staff meeting
- Student Government Association Senate

March, 2010

- The Board of Trustees
- Information Technology Services
- Sigma Xi
- Residential Life Staff

Scheduled

- Advancement
- Alumnae Association

Cover photo credits:

The Bike Kitchen and coordinator, Elizabeth Wolfe ’10, organized a demonstration of pedal power at the Smith Campus Center, photo courtesy of Environmental Science and Policy
Smith College Co-gen system, Judith Roberge
Ford Hall building for the sciences and engineering, Jim Gipe
Marine science and policy students at Pemaquid Point, ME, courtesy of Professor David Smith

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Dano Weisbord, Environmental Sustainability Director; Professors L.David Smith (ES&P) and Denise McKay, (Engineering); Carole Fuller, Sustainability Committee; students Katherine Clark ’10, Etta Grover-Silva ’10, Katherine MacKenzie ’11, Wiley Reading ’10 Kerry Valentine AC ’10 and Elisabeth Wolfe ’10

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Northampton, Massachusetts

This plan and other information about sustainability at Smith College may be found at

http://www.smith.edu/green/.