

## CHAPTER 1

### Campus Sustainability Assessment

Over the past year, Green ROUTES has been working to develop a Campus Sustainability Assessment (CSA) by researching and looking at important topics that the school could eventually implement in order to green the campus. While measuring sustainability is not easy, a growing number of institutions are attempting to quantify the added value of their initiatives using a CSA to develop benchmarks and chart progress across time. According to the National Association of College and University Business Officers as many as 250 new CSAs of widely varying depth and focus are being produced each year by North American colleges and universities.<sup>1</sup>

This section of the project report contains the results of the CSA. It includes a *Priority Level List* of more than thirty recommendations of specific actions Colby-Sawyer College can take over the next few years to improve the sustainability of campus operations. These recommendations were prioritized based on their importance, and the amount of time and money the Green ROUTES team estimated would be required for implementation. The priorities levels are as follows:

- Level I: changes which could be implemented within one year
- Level II: changes which will require one to three years
- Level III: changes which will require more than three years

#### Level I:

- Focus the Nation
- Grounds
- Invasive Species
- Investments
- Labs
- Light Bulbs
- Orientation
- Refrigerators
- Sustainability Coordinator
- Sustainability Day
- Tree Inventory
- Vending
- Windows
- Zip Car

#### Level II:

- Green Building Design
- Green Fund
- Insulation
- Motion Sensors
- Paper: 100 % recycled
- Pool Cover
- Printers: Double-Sided
- Printers: Energy Star
- Recycling
- Water

#### Level III:

- Carbon Footprint
- Composting
- Dining Services
- Double Doors
- Impervious Surfaces
- Solar Energy
- Wind Energy

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<sup>1</sup> National Association of College and University Business Officers. (2005). "The Payoffs of Planet-Friendly Initiatives." <http://www.nacubo.org/x6330.xml>

## ***Level I Priorities***

### **Focus the Nation**

Global warming solutions for America

**Alexa FitzGerald**

#### **Green ROUTES Recommendation Level : I**

**Introduction:** Focus the Nation is an organization that was established for the purpose of educating students and community members on the issues of global climate change. The Project Director, Eban Goodstein, is a professor of Economics at Lewis and Clark College in Oregon and is an avid advocate for action against global climate change. The advisory board members for Focus the Nation is made up of politicians, professors, business professionals, and a congressman and was founded on the idea of bringing educational institutions together for an event one big event. Since the beginning they have incorporated participation from business organizations as well as religious groups in a hope to involve as much of the community as possible. Their goal is to spread awareness as far as possible in the hopes that this will spark action.

This is a great thing because the issue effects people all across the world and yet there are people in the United States (and surely in our college) who have absolutely no idea about what is going on. By holding this conference and this awareness event that will happen on January 31, 2008, Eban and his colleagues, as well as the businesses and institutions that have signed on in an agreement to participate in the event, hope to open the eyes of people who are uninformed and teach them about what is going on in terms of environmental issues in the world right now, namely global climate change. This will also give community members a chance to voice their opinion and speak with politicians about what they are planning to do to address the issue on a political level. This is vitally important because they represent us and make decisions for us.

**Objectives:** A few members of the Green ROUTES team attended a conference at Middlebury College this spring. The conference was called Focus the Nation. It focused on about global climate change issues and the consequences of irresponsible human actions. Some of the objectives of Focus the Nation are as follows:

- Spreading awareness of global climate change
- Taking responsibility and action against greenhouse gas emissions
- Assigning a day for awareness (January 31, 2008)
- Get as many people and institutions involved as possible
- Get local politicians involved to take action on our behalf

#### **January 31, 2008:**

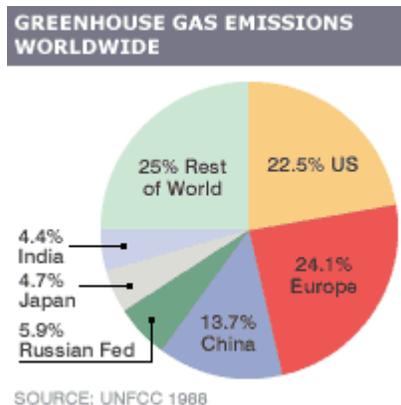
Over one thousand colleges, universities and high schools as well as political leaders and businesses, faith and civic organizations will participate in a nation-wide, non-partisan discussion on critical policy choices for the next decade.

“Focus the Nation provides an exciting model opportunity to create, for one day, a true national community of scholarship bridging traditional disciplinary boundaries.”

**Recommendation:** It would be great to get Colby-Sawyer involved in this initiative. This can be done by pledging support on the Focus the Nation website. When a new university or institution signs up, a flag is put on the website map where it is located to represent your commitment to participate in the event, to take action and make change in our community. This pledge also means that Colby-Sawyer and Green ROUTES will plan an event for January 31, 2008 that will bring community members and students together to speak with local and state politicians about Climate Change. It would be a wonderful community service for Colby-Sawyer to host the event, or collaborate with Dartmouth College to put something on together.

By engaging the public and the politicians, who ultimately make decisions for the entire country on a global level, this gives people the chance to ask questions to the politicians of what is being done in the government, and also gives the politicians a chance to see and hear how concerned the public is regarding these environmental issues.

**Related Items:** Kyoto Protocol – Conference held in 1997 in Kyoto, Japan by the United Nations Framework Convention on Climate Change (UNFCCC), it was named “an international and legally binding agreement to reduce greenhouse gases emissions world wide.” After it entered into force in February 2005, countries around the world ratified the agreement and began taking action. Although the United States is largely responsible for much of the greenhouse gas emissions every year, we are not a part of the Protocol. It was signed in 1998 by Al Gore, but with out the support of the U.S. Senate (who voted unanimously, 95-0 against), the Protocol was not ratified. On March 29, 2001, the Bush Administration withdrew the United States entirely from the 1997 Kyoto Protocol on Climate Change.



The World Resource Institute’s webpage states that, “In terms of historical emissions, industrialized countries account for roughly 80% of the carbon dioxide buildup in the atmosphere to date... Annually, more than 60% of global industrial carbon dioxide emissions originate in industrialized countries, where only about 20% of the world’s population resides,” (2007).

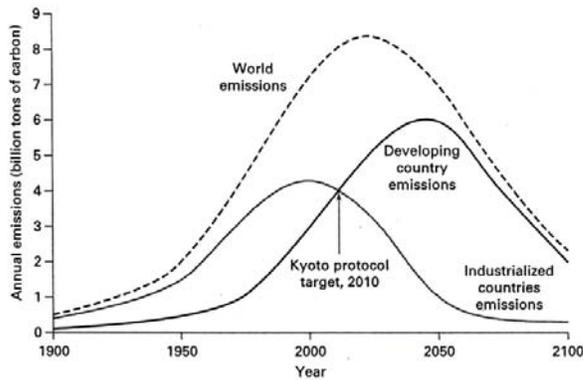


FIGURE 23.1 Stabilizing CO<sub>2</sub> Concentrations at 450 ppm  
Source: Bernow et al. (1999). Used with permission.

This Graph explains the annual emissions of carbon (in billion tons), released at three different levels: Developing country emissions, industrialized country emissions and world emissions. It also shows what the emissions would look like if the Kyoto Protocol were put into place.

### Websites/Links:

- Focus the Nation  
<http://www.focusthenation.org/>
- Real Climate  
<http://www.realclimate.org/>
- NASA  
<http://www.nasa.gov>.
- Union of Concerned Scientists  
<http://www.ucsusa.org/>
- Clean Air – Cool Planet  
<http://www.cleanair-coolplanet.org/>

## **Grounds**

The creation of wildflower meadows throughout campus will create more scenic views and relive some of costs and pressure of lawn maintenance

### **Green ROUTES Recommendation Level: I**

**Brian L. Valle**

**Introduction:** Lawn maintenance is a time consuming endeavor. Seeding, fertilizing, watering, and regular maintenance are all labor intensive and time consuming jobs. The implementation of a wildflower meadow is relatively easy and low maintenance. Along with bringing native flower species to areas where they may have once flourished, they also create natural habitat and corridors for wildlife. Perhaps the most rewarding aspect of a wildflower meadow is the aesthetic value it brings to any backdrop.

**Objectives:** The objective of the wildflower meadows is to bring native flower species back to Colby-Sawyer College campus while at the same time reduce current maintenance costs. The use of chemical fertilizers, water and maintenance vehicles for a wildflower meadow is only a small proportion of a manicured lawn.

**Methods/Procedures:** Some target low traffic areas have been identified where the implementation of wildflower meadows would create a beautiful visual seen without obstructing foot traffic routes throughout campus. These areas, such as the grassy hill between the Sawyer Fine Arts Center and Best hall, are referred to as priority one (see attached map) The reason this area is first priority, is due to the low foot traffic, slope of the land which also creates time consuming maintenance. Priority one should be planted and maintained for one to two years to ensure that the wildflower applications are affective. The second priority (see attached map) is larger low traffic areas, which also incorporate an aesthetic view. These areas should be considered for the amount of maintenance the manicured lawns need. Priority two incorporates five parcels totaling 13.5 acres with largest parcel being 7.2 acres. This 7.2 acre parcel that surrounds the tennis courts is the largest maintained grass area that is not a playing field throughout Colby-Sawyer College campus excluding the area around Kelsey fields. The Converting this area to wildflower meadows does not need to incorporate all 7.2 acres. The area surrounding the courts should be maintained for spectators use. Finally, priority three, totaling 5.5 acres with five parcels, are all the low traffic manicured grass areas around the campus which have the potential to be converted into wildflower meadows.

**Lawn Maintenance:** Colby-Sawyer College's manicured lawn areas are maintained by the facilities department and subcontractors. Applications of broadleaf weed control, pre-emergent crabgrass control, and fertilizer are applied seasonally. Also, there are many treatments which are done to the athletic fields starting around April through November. The application of: Thatch X 5-2-10@1 lbN weed spray on both the baseball warming track and the infield dirt, 5-2-10 @ 1lbN 100% organics deep tine- aeration, 32-0-10 @ 1

lbN 75% SCU deep tine aeration, 21-3-21 @ 1 lbN 50% slow, palletized lime@ 10 lb, and 16-0-31 @ 1 lbN 50% sop scu slice-aeration. These applications are subject to change depending on the proprietor, and the labor associated cost. Therefore, an accurate cost calculation can only be attained by receiving estimates from particular proprietors.

**Findings/Graphs Meadow Calculations:**

Three ways to plant	Lush Stand	Average Display	Meadow Look
1 pound plants up to:	1,500 sq. ft.	2,000 sq. ft.	4,000 sq. ft.

**For Lush Standing Meadows:**

- **Meadow Priority 1**  
Total acres= .61 (one parcel)  
Seed pounds = 17.777  
Seed cost = \$426.65
- **Meadow Priority 2**  
Total acres= 13.469 (five parcels)  
Seed pounds =391.158  
Seed cost = \$9387.78
- **Meadow Priority 3**  
Total acres= 5.523 (nine parcels)  
Seed pounds = 160.375  
Seed cost = \$ 3,848.99

**For Meadow Look:**

- **Meadow Priority 1**  
Total acres= .61 (one parcel)  
Seed pounds = 6.666  
Seed cost = \$159.99
- **Meadow Priority 2**  
Total acres= 13.469 (five parcels)  
Seed pounds = 146.682  
Seed cost = \$3,520.37
- **Meadow Priority 3**  
Total acres= 5.523 (nine parcels)  
Seed pounds = 60.139  
Seed cost = \$1,443.35

For a lush, almost solid flower look, the cost per acre is \$696.95. For a meadow look, the cost per acre is \$261.35. This does not include labor, which would consist of spreading the seeds. The seed price is based on the Wildflower Seeds: Northeast Mix sold at [www.americanmeadows.com](http://www.americanmeadows.com)

**Wildflower Seeds: Northeast Mix** ([www.americanmeadows.com](http://www.americanmeadows.com))

(It is important to note that Colby-Sawyer College has had a problem in the past with Dandelion (*Taraxacum*), and therefore the facilities department has asked that this variety be omitted from any wildflower mix applied to the campus grounds.)

<b>Common Name:</b>	<b>Scientific Name:</b>
Cornflower,	<i>Centaurea cyanus</i>
Siberian Wallflower,	<i>Cheiranthus allionii</i>
Ox-Eye Daisy,	<i>Chrysanthemum leucanthemum</i>
Shasta Daisy,	<i>Chrysanthemum maximum</i>
Lance-Leaf,	<i>Coreopsis lanceolata</i>
Plains Coreopsis,	<i>Coreopsis tinctoria</i>
Sulphur Cosmos,	<i>Cosmos sulphureus</i>
Wild Cosmos,	<i>Cosmos bipinnatus</i>
Wild Larkspur,	<i>Delphinium ajacis</i>
Sweet William,	<i>Dianthus barbatus</i>
Purple Coneflower,	<i>Echinacea purpurea</i>
California Poppy,	<i>Eschscholzia californica</i>
Perennial Gaillardia,	<i>Gaillardia aristata</i>
Baby's Breath,	<i>Gypsophila elegans</i>
Wild Annual Sunflower,	<i>Helianthus annuus</i>
Dame's Rocket,	<i>Hesperis matronalis</i>
Rose Mallow,	<i>Lavatera trimestris</i>
Scarlet Flax,	<i>Linum grandiflorum rubrum</i>
Blue Flax,	<i>Linum perenne lewisii</i>
Perennial Lupine,	<i>Lupinus perennis</i>
Baby Blue Eyes,	<i>Nemophila menziesii</i>
Red Poppy,	<i>Papaver rhoeas</i>
Mexican Hat,	<i>Ratibida columnaris</i>
Gloriosa Daisy,	<i>Rudbeckia hirta gloriosa</i>
Black Eye Susan,	<i>Rudbeckia hirta</i>
None-so-Pretty,	<i>Silene armeria</i>

**Kentucky Bluegrass Planting Rates:**

([www.seedland.com](http://www.seedland.com))

**Lawns:** New: 1-3 lbs. per 1000 sq. ft.

Recommended planting rate: 3 lbs. per 1000 sq. ft for new lawns.

One acre requires 45-135 lbs. acre.

(110-330 lbs.@Hectare)

**Over-seeding:** Apply at about 1/2 rate - 1½ lbs. per 1000 sq. ft.

**Cost:** About \$3.00-4.00 per pound. This is an average cost derived from the average of all the available brands and costs located at [seedland.com](http://seedland.com).

## **Wildflower Meadows: Environmental Impact Statement**

### **Advantages:**

- *Aesthetic view:* Colby-Sawyer College has many beautiful views which could be enhanced by the incorporation of natural wildflower meadows throughout campus.
- *Minimal maintenance:* The maintenance of a wildflower meadow compared to a manicured lawn is minimal. The wildflower meadow, depending on the stand which is to be achieved, only needs to be cut once a season. The process of cutting the wildflower meadow will help to reseed and enhance the meadow for the next year. It may take two or three passes to fully cut the meadow down. Compared to cutting a manicured lawn once a week, the maintenance is far less.
- *Creation of Natural Corridors:* The popularity of manicured lawns and the increase in property division over the years has depleted the natural corridors and buffers of forest. These buffers are the areas of high grass and small shrubs and trees which line the forest. This is a habitat in its self that provides shelter and cover for the smaller animals, while linking forested areas together. The transition from manicured lawns to wildflower meadows will recreate corridors and habitats for small animal, and insects. These corridors give protection to the native species.

### **Disadvantages:**

- *Attracts insects and small animals:* Although the wildflower meadows are quite beautiful there is the chance that they could bring in unwanted insects and small animals within close proximity to the residence halls. Although this normally does not present a problem in a residential setting, the close proximity and amount of individual trash receptacles may attract the insects into the residence halls.
- *Conversion:* There are many different ways to plant a wildflower meadow. All the different methods of planting come to the same end product; that there are usually three different types of meadows. The first, is a scattered handful of flowers per then square feet. The second is almost complete flowers per then square feet. The final stand is lush flowers throughout the fields. Although the first two options sound desirable the presence of long grass may dictate the want to cut the wildflower meadow defeating the purpose and killing the flowers for the season.

**Alternatives:** The alternatives to the implementation of wildflower meadows are to keep the manicured laws as they are. There are many different ways of maintaining lawn areas, perhaps the college can look into alternative mowing plans.

**Recommendations:** The attached map identifies areas of desirable wildflower meadows locations. These areas were chosen by identifying low traffic areas with a slope. The first priority area is located between Sawyer Fine Arts Center, and Best Hall. This area is a steep slope which is rarely utilized by students and difficult to maintain. This are is about .61 acres. It would take about 18 pounds of seed to create a lush wildflower stand, costing about \$426.65 in seed. The same area would cost about \$159.99 for a meadow look. Once this area is converted to a wildflower meadow it should be monitored for one to two years. This monitoring period will determine how the meadows adapt to the campus and will determine the savings in overall lawn maintenance. This area is less than one acre.

The hope is that the implementation of this wildflower meadow will bring an aesthetic value as well as savings to Colby-Sawyer College

**Websites/Links:**

- Meadow calculations  
<http://www.americanmeadows.com>
- Creation and maintenance  
<http://www.lincstrust.org.uk/factsheets/meadow/index.php>

**Related items:**

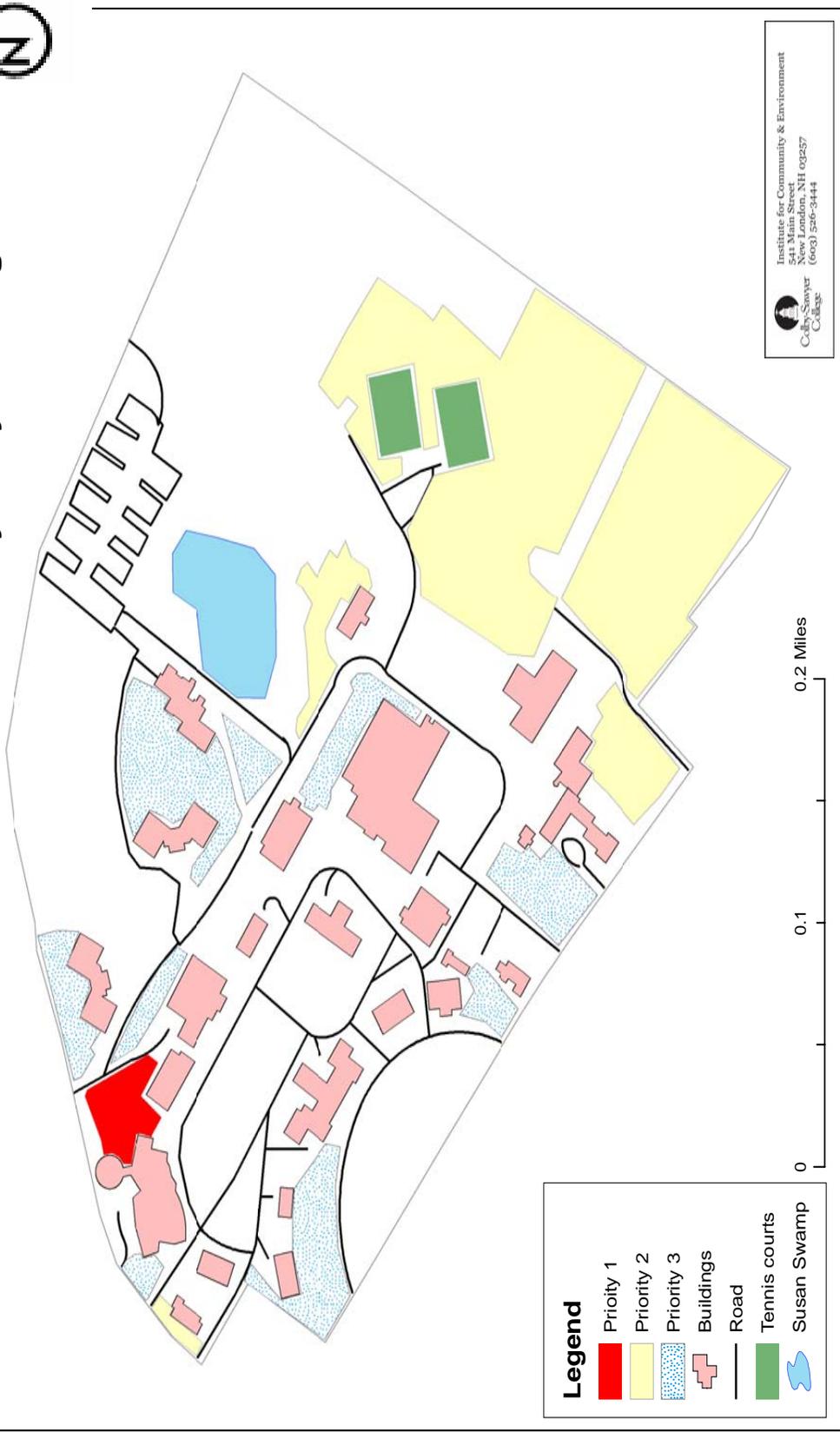
- Composting
- Native/Invasive Species
- Tree inventory
- Sapling Tree Farm



[www.outdoorphotoop.com](http://www.outdoorphotoop.com)



**Wildflower Meadow Priorities for Colby-Sawyer College**



## **Invasive Species**

Eradication of invasive plants and implementation of a native plants policy throughout campus

**Brian Valle**

### **Green ROUTES Recommendation Level : I**

**Introduction:** Invasive species are types of plants that are not native to the area in which they reside. They have no natural competitors so it is relatively easy for the species to spread, crowding species native in their environment. The invasive species can spread to different places through people planting them in different spots, and through natural reproduction. An invasive species is defined as “a species that is 1) non-native (or alien) to the ecosystem under consideration and 2) whose introduction causes or is likely to cause economic or environmental harm or harm to human health.” Such species may include plants which are currently sold as ornamentals such as Burning bush, *Euonymus alata*. It is important to understand how each species affects surrounding native species and how the invasive affects the overall habitat of an area. Eradication and education of such invasive plants, throughout Colby-Sawyer College is the amine objective of this research.

**Objectives:** The invasive species objectives are three fold, education, eradication, and replacement. Understanding how invasive species spread uncontrollably, and out-compete native species is vital. Invasive species can spread in many ways whether it is by animal transporting the seeds, or the rotes of the invasive plant networking throughout a shallow substrate producing new plants. These same plants usually flourish in their new habitat causing rapid growth and high fecundity. Invasive species tend to overtake native plants out competing them for light and water, causing the native plants to wilt and die. The removal of invasive species is imperative to the preservation of the native species throughout our campus. Species such as Oriental Bittersweet, *Celastrus orbiculata thunb.* plague Susan’s Swamp. The Oriental Bittersweet is an invasive that is slowly spreading throughout our campus; however, the eradication of this invasive from the campus is tangible. The removal process for such species is quite intensive, but essential to the health of the campus’s native plant species.



In addition, the removal of other invasive species throughout campus, such as Burning bush, *Euonymus alata* require replacement plants. The implementation of new native plants throughout campus should consult the tree wish list of native species for the campus compiled by the Green Routes group.

**Methods/Procedures:** Specific removal techniques for Oriental Bittersweet, *Celastrus orbiculata thunb.* can be found on the Green ROUTES website under Project Activities. Also, the creation of New Hampshire House Bill 1258, affects the removal process invasives. Additional details on House Bill 1258 can be found in the Environmental Policy section. A tree inventory has been conducted, locating and listing all the tree species throughout the campus. This list along with the tree wish list can be used to create a plan to integrate native plant as species that need to be replaced. The large Norway maple *Acer platanoides* surrounding the Loop and the interior of the campus are invasive trees and as these trees need replacing. Native species should be considered. For example, the Kelsey forest is becoming scattered with Norway maple *Acer platanoides* saplings, which can easily be removed. The removal of these saplings contributes to the health of the forest, by preventing the spread of invasive species. Although this effort may not visually affect the forest, or be seen by many members of the community, it is the responsibility of Colby-Sawyer College as good environmentalist to do what is necessary to preserve the health of our surrounding ecosystem.

**Invasive Species List:** The following list of plant species is considered invasive according to New Hampshire House Bill 1258. This bill is effective as of January 1, 2007.

### **New Hampshire Prohibited Invasive Plant Species**

\* Denotes that the sale of these species shall be prohibited as of January 1, 2007

<b>Common Name:</b>	<b>Scientific Name:</b>
Norway Maple *	<i>Acer platanoides</i>
Tree of Heaven	<i>Ailanthus altissima</i>
Garlic Mustard	<i>Alliaria petiolata</i>
Japanese Barberry *	<i>Berberis thunbergii</i>
European Barberry	<i>Berberis vulgaris</i>
Oriental Bittersweet	<i>Celastrus orbiculatus</i>
Black Swallow-Wort	<i>Cynanchum nigrum</i>
Pale Swallow-Wort	<i>Cynanchum rossicum</i>
Autumn Olive	<i>Elaeagnus umbellata</i>
Burning Bush*	<i>Euonymus alatus</i>
Giant Hogweed	<i>Heracleum mantegazzianum</i>
Yellow-Flag Iris	<i>Iris pseudacorus</i>
Blunt-Leaved Privet	<i>Ligustrum obtusifolium</i>
Showy Bush Honeysuckle	<i>Lonicera x bella</i>
Japanese Honeysuckle	<i>Lonicera japonica</i>
Morrow's Honeysuckle	<i>Lonicera morrowii</i>

Tatarian Honeysuckle	<i>Lonicera tatarica</i>
Japanese Knotweed	<i>Polygonum cuspidatum</i> / ( <i>Fallopia japonica</i> )
Common Buckthorn	<i>Rhamnus cathartica</i>
Glossy Buckthorn	<i>Rhamnus frangula</i> / ( <i>Frangula alnus</i> )
Multiflora Rose	<i>Rosa multiflora</i>

**New Hampshire Prohibited Aquatic Invasive Plant Species:**

<b>Common Name:</b>	<b>Scientific Name:</b>
Fanwort	<i>Cabomba caroliniana</i>
Variable milfoil	<i>Myriophyllum heterophyllum</i>
Purple loosestrife	<i>Lythrum salicaria</i>
Common reed	<i>Phragmites australis</i>

**Other Recommended Invasive species**

(Watch list for the New Hampshire Invasive species committee)

<b>Common Name:</b>	<b>Scientific Name:</b>
Oriental Bittersweet,	<i>Celastrus orbiculata thunb</i>

(Highlighted plants are found on Colby-Sawyer College campus)

**Watch List:**

<b>Common Name:</b>	<b>Scientific Name:</b>
Spotted Knapweed	<i>Centaurea maculosa</i>
Canada thistle	<i>Cirsium arvense</i>
Crown vetch	<i>Coronilla varia</i>
Russian olive	<i>Elaeagnus angustifolia</i>
Wintercreeper	<i>Euonymus fortunei</i>
Sweet reedgrass	<i>Glyceria maxima</i>
Common Privet	<i>Ligustrum vulgare</i>
Amur Honeysuckle	<i>Lonicera maackii</i>
Moneywort	<i>Lysimachia nummularia</i>
Japanese stilt grass	<i>Microstegium vimineum</i>
Reed canary grass	<i>Phalaris arundinacea</i>
White Poplar	<i>Populus alba</i>
Kudzu	<i>Pueraria lobata</i>
Black Locust	<i>Robinia pseudoacacia L.</i>
Siberian Elm	<i>Ulmus pumila</i>
Porcelain-berry	<i>Ampelopsis brevipedunculata</i>

**Invasive Species: Environmental Impact Statement**

**Advantages:**

- Aesthetic: The removal of invasive species will open an area for native plants to grow.

- Lead by example: Invasive species are a growing concern throughout many communities; however, the debate over what is invasive and what is not invasive can create animosity amongst community members and local organizations. The removal of invasive species, such as Oriental Bittersweet, also allows for animals to pass through the under story. Monitoring and removing invasive species such as Norway Maple, that have spread from Colby-Sawyer College campus across Seaman's road to the Kelsey fields will help show the environmental stewardship of the College.

**Disadvantages:**

- The disadvantages to the removal of invasive species like Oriental Bittersweet are quite severe, perhaps resulting in the loss of the native host species. The host species is the native species on which the invasive species uses to benefit, while unfortunately out-competing the host over time. In the manual removal technique, it is in the application of the pesticides to the roots of the invasive species which may result in the destruction of the native host species. Moreover, high climbing vines can pose a threat to the person removing the vines from the native host species. Some of the vines can grow in excess of thirty feet. This height poses a threat to any person doing work in a tree.
- Removing invasive species can be costly both in time and money. A full eradication of a certain species, like Oriental Bittersweet, may take many years, treatments and close attention.
- The replacement of invasive species with native species is also expensive. With such invasive species as Norway maple *Acer platanoides*, Japanese barberry *Berberis thunbergii*, and burning bush *Euonymus alatus* as of January, which at one time were considered ornamental species, their replacement will take time. Many of the Colleges roads are lined with Norway maple and the front of buildings with burning bush.

**Special Concerns:**

- Amount of Land Affected:
  - The area that is affected is undetermined because of the vast amount of invasive species and their sporadic growth. One area of special concern is around Susan swamp and "K" Parking lot.
- The classification of invasive species will need to be modeled off of a stat organization, and perhaps tailored to the priorities with problematic species found on campus. The removal priority of the invasive species should incorporate the growth rate of the species, the seed spread and its fecundity, along with the resistance of this plant to natural predations.
- The topic of invasive species is very controversial throughout many communities. It is important that Colby-Sawyer College recognizes the problem of invasive species and the importance of native species.

**Alternatives:**

- No alternatives, just a continuation of growth and spread of invasive species throughout campus and bordering land parcels.

**Recommendations:**

- Identify all invasive species on campus which are considered to be invasive, as classified by a predetermined list. New Hampshire House Bill 1258, chapter 88, and President Clinton's Executive Order 3112 are two laws that have been created on behalf of the eradication of invasive species.
- The creation of an invasive species management plan for the future of the college will help bring more native species and slowly replace the planted invasive species throughout campus.

**Removal recommendations:**

1. In the Kelsey Athletic Fields it is apparent that Norway maple *Acer platanoides* has spread from the main campus to the fields. Management of the invasive species throughout the Kelsey Forest is essential to the preservation and health of Colby-Sawyer College campus. The removal of Norway maple saplings from the Kelsey fields is the first removal recommendation.
2. The area around Susan's Swamp and K lot is covered in Oriental Bittersweet, *Celastrus orbiculata thunb.* This invasive species is taking over the native plants and physically out competing them for sun light. The removal of Oriental bittersweet is a long and arduous process that takes many years for a full eradication of the species.
3. Although a costly replacement the burning bush in front of many buildings throughout campus should be removed as soon as possible. The reason for this is because as people walk around our campus they see the invasive burning bush everywhere. Ideally native species will line the entrances of our buildings and residence halls.
4. As planted invasive species throughout Colby-Sawyer College die off, they should be replaced with native plants from the tree wish list. (See invasive species)

**Invasive found throughout campus:** (see attached map)

- Norway Maple *Acer platanoides*  
Total locations: 24
- Japanese Barberry *Berberis thunbergii*  
Total locations: 1
- Burning Bush\* *Euonymus alatus*  
Total locations: 20
- Multiflora Rose *Rosa multiflora*  
Locations: surrounding Susan Swamp
- Purple loosestrife *Lythrum salicaria*  
Locations: surrounding Susan Swamp
- Oriental Bittersweet, *Celastrus orbiculata thunb.*  
Total locations: 3

**Related items:**

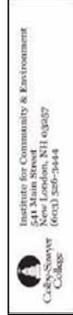
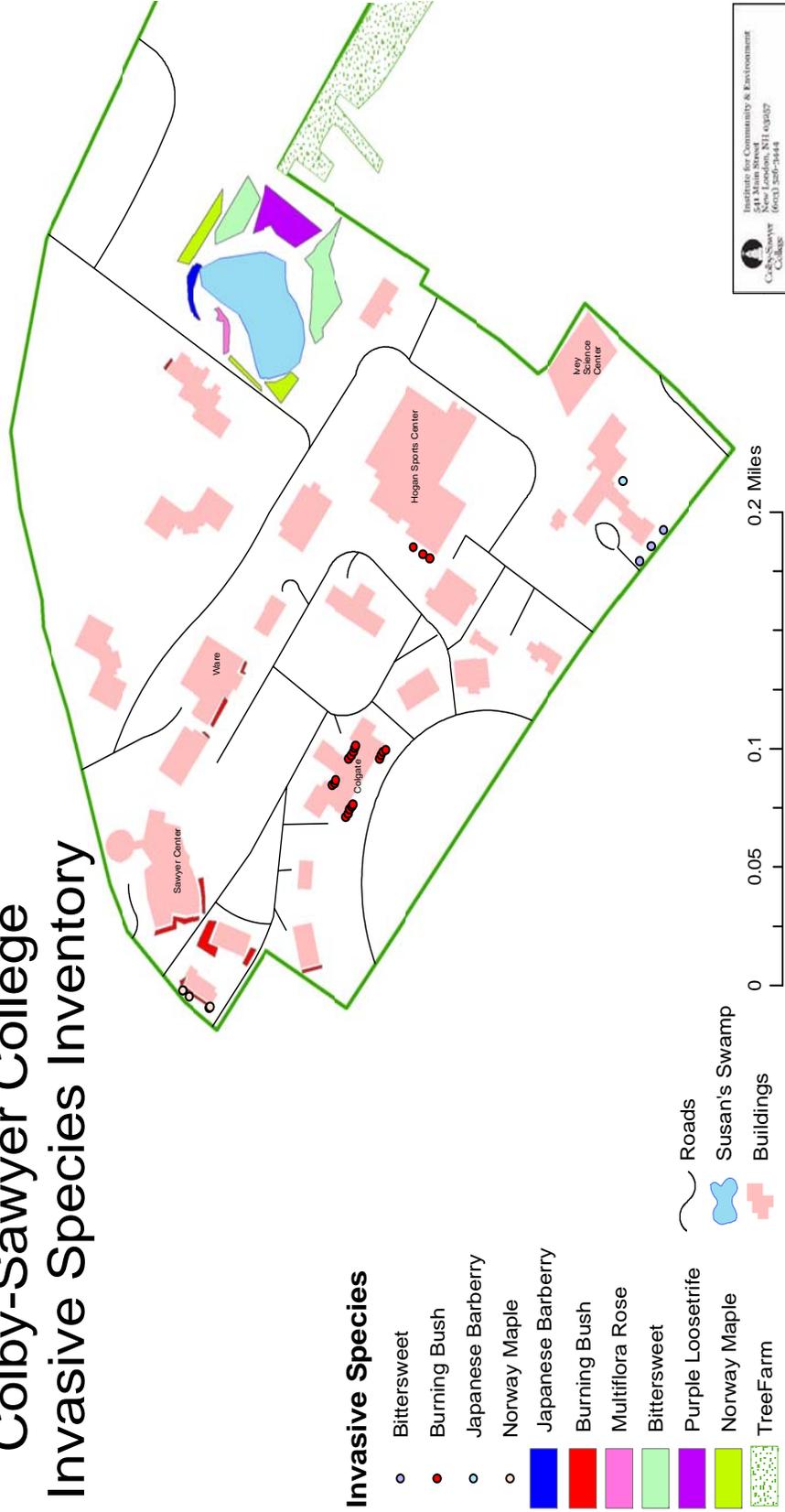
- Tree Inventory
- List of native plants “Tree wish list”
- Wildflower Meadows
- Sapling plantings

**Websites/Links:**

- Weeds Gone Wild  
<http://www.nps.gov/plants/alien/>
- New Hampshire Invasives Fact Sheet  
<http://www.nashuarpc.org/envplanning/invasiveplants.pdf>
- Colby-Sawyer College Virtual Herbarium  
<http://www.colby-sawyer.edu/academic/ces/herbarium/index.html>
- NH State Forestry Nursery  
<http://www.dred.state.nh.us/nhnursery/>



# Colby-Sawyer College Invasive Species Inventory



## **Investments**

Greening Colby-Sawyer through investments

**Chris McClellan**<sup>2</sup>

### **Green ROUTES Recommendation Level: I**

**Current Investments:** Currently the college has no environmental screening criteria for investments. Some of the dirtiest companies the college now invests in include:

1. Exxon
2. General Electric
3. PepsiCo
4. Carolina Group
5. FedEx

**Socially Responsible Investing:** Investing in companies which meet a set of criteria, including:

- Governance and director independence and diversity
- Environmental policy and management
- Workplace environment, health and safety
- Regulatory compliance
- Product safety and integrity
- Community relations and social contributions

### **Winslow**

Invests in companies which are Clean or Green

- "Green" companies are solving or addressing an environmental problem.
- "Clean" companies are not focused on an environmental need, but are responsibly managing their environmental impacts.

### **Calvert**

Looks for companies that practice innovative pollution prevention or natural resource conservation

- Place responsibility for environmental performance
- Disclose sources of environmental risk and liability

### **PAX**

Investment criteria include a company's...

- Air and water emissions
- Waste reduction
- Use of clean and renewable energy
- Climate change initiatives
- Sustainable development programs

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<sup>2</sup> This analysis was originally completed by students in BUS/CES 321: Organizations and their Environment, Fall 07.

### Winslow Green Small Cap

**Average Annual Return 2002-2006: 19.25%**

	Fund	Return 02-06
Green	Winslow Green Small Cap (15%)	600,748
Current CSC	Buffalo Small Cap	661,329
GAIN/LOSS		<b>(60,581)</b>

### Calvert Large Cap

**Average Annual Return 2002-2006: 11.54%**

	Fund	Return 02-06
Green	Calvert Large Cap (11.5%)	1,293,681
Current CSC	Harbor Cap. Appreciation	357,071
GAIN/LOSS		<b>935,608</b>

### Calvert International Equity

**Average Annual Return 2002-2006: 8.13%**

	Fund	Return 02-06
Green	Calvert Int. Equity (10 & 13%)	1,478,601
Current CSC	International Equity Fund	1,644,645
GAIN/LOSS		<b>(166,044)</b>

### PAX World Balance Fund

**Average Annual Return 2002-2006: 6.40%**

	Fund	Return 02-06
Green	PAX World Balance	1,068,352
Current CSC	Multi-Strategy Bond Fund	959,256
GAIN/LOSS		<b>109,096</b>

Total gain had four comparable mutual funds the college currently invests in been replaced with four green funds from 02-06	<b>\$ 818,078</b>
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**Results/Conclusions:** Green investing can be a drastically impactful way for the college to reduce its environmental impact, without having to alter its construction or policies. Green investing is an essential step in the complete greening of an institution.

## **Labs**

Colby-Sawyer's labs and the disposal of hazardous material

**Geoff Pushee**

### **Green ROUTES Recommendation Level: I**

**Introduction to subject:** The goal of this project was to look into Colby-Sawyers different labs, whether they are for art or science purposes and see how green the college's labs are. Labs can have many different types of substances that are very harmful for people and especially the environment. This area of concern is important because if these materials are not disposed of correctly Colby-Sawyer could have a hugely negative impact on the environment, causing harm to not only humans but all of nature. All colleges should have some type of plan for how they dispose of their toxic substances and they should have all of these substances clearly marked, both for disposal and for storage. With the correct laboratory program for storing and disposing of hazardous material Colby-Sawyer could feel confident that everyone will stay safe on the campus and that our impact on the environment will be significantly lower.

**Objectives of Work Plan:** The main objectives of this project was to make sure that Colby-Sawyer was disposing of and properly storing and labeling the toxic substance from our laboratories. By doing this it would be made sure that Colby-Sawyer is not having a hugely negative impact on the environment because of reckless disposal and storage practices of hazardous materials, thus keeping their labs more green. The main focus would be on the Sawyer Center because these laboratories are the biggest area for concern on the campus.

### **Methods/Procedures:**

- An audit of the laboratories in the Sawyer Center.
- Develop a plan to correctly dispose of and label the hazardous material for the future.
- Properly dispose of any old material that may be lying around.
- Look at and implement the laboratory practices in the Curtis L. Ivey Science Center into the Sawyer Center.



**Findings:** The findings of this project were that in the past the Sawyer Center did problems with the disposal of and labeling hazardous materials. In addition, the college faced the threat of fines for not having plans in place. Loretta Barnett, chair of the Fine and Performing Arts Department developed and implemented a plan to managing hazardous materials. As Professor Barnett had already been working on this topic for over a year, Green ROUTES determined that this topic did not need further attention the work plan.

**Recommendations:** It is necessary for the college to continue to properly store label and dispose of laboratory materials. It is necessary that they stay on top of the situation so that the college does not fall behind again like what happened in the past. It will be important as the Sawyer Center is redesigned that they look into the laboratories in the Curtis L. Ivey Science Center and implement many of the things that are being done there. This is both a short term and a long term priority. It is necessary to continue what is being done now and into the future.

**Benefits:**

- Helps in teaching the student body.
- Allows for the teaching of proper disposal practices.
- Allows for everyone to learn about Hazmat and how it should be taken care of and used.
- Provides a controlled environment.

**Disadvantages:**

- Dangerous to the health of the community.
- Dangerous to the environment if not disposed of properly.
- It's a very serious matter and so everyone around the labs or hazmat can not be messing around.
- Liability for the school.

**Special Concerns:**

- Making sure that Colby-Sawyer continues to properly manage their labs and hazmat.
- Are we doing everything we can in order to make sure our management programs are top notch/or as good as they can be.
- Are we doing everything we can to keep ahead of the game so that we do not fall behind.

**Conclusion:**

At Colby-Sawyer it is very important that we keep our labs top notch in order for the college to keep their environmental impact low. Labs are a great place for learning but there are also many materials and substances within them that could have a huge impact on the environment if not properly taken care of. There are many laws for labs that the school must follow because if they do not they could not only be putting the environment in harms way but also the students, faculty, and staff at the school. This is why it is a huge liability because if somebody were to get sick or the surrounding environment were to be harmed because the school was not properly following all the regulations for labs then they could have a huge lawsuit on their hands. This is a huge reason for the school to properly manage their labs if the environmental impacts are not enough of a reason.

Colby-sawyer as of right now is doing a pretty good job with managing their labs and taking the proper precautions and steps to make sure that they keep their environmental impact low. It is necessary that the school continues to do this and keep our labs top notch. We need to also look into and see if we are doing everything that we can in order to make sure we are not falling behind and keeping our labs up to par. It would be good if we could actually stay ahead of the game and even do things that are not required. If the school can continue to do what they are doing and maybe even do some other things to further help decrease their environmental impact with labs and hazardous material then they will be able to feel confident that they are doing all they can and more to help make sure that our campus and the surrounding community is as green as possible.

**Websites/Links:**

- Labs for the 21<sup>st</sup> Century  
<http://www.labs21century.gov/about/index.htm>
- MIT Green Labs  
<http://web.mit.edu/newsoffice/2005/epa-0608.html>



## **Light Bulbs**

Bringing compact fluorescents to Colby-Sawyer College

**Anna Clark**

### **Green ROUTES Recommendation Level: I**

**Introduction:** Some of the goals set by Green ROUTES are to promote green initiatives and to encourage people to conserve resources and minimize waste. One of the ways that Colby-Sawyer Facilities has contributed to making Colby-Sawyer College more environmentally friendly is through replacing incandescent bulbs, which are inefficient, with much more efficient compact fluorescent light bulbs.

**Findings:** There is a difference between compact fluorescent light bulbs and incandescent light bulbs. Making it a policy to have compact fluorescent light bulbs a part of Colby-Sawyer College campus is very important in decreasing the size of our ecological footprint. Light bulbs have already been replaced in several campus buildings; the Susan Colgate Cleveland Library Learning Center, the David L. Coffin Field House, and the Dan and Kathleen Hogan Sports Center Pool.

**Benefits @ Colby-Sawyer College:** Within the first year, changing the light bulbs in the Susan Colgate Cleveland Library Learning Center resulted in a 75% reduction in energy and a cost savings of \$9360.00. 350-65 watt light bulbs were replaced with 13 watt fluorescent bulbs. Another benefit of converting to fluorescent light bulbs is that incandescent light bulbs rarely convert more than 5 % of the energy taken in into light. Approximately 95% of the energy is converted to heat!



**Results/Conclusions:** In 2005, Colby-Sawyer College Facilities department received an energy efficiency award from Public Service of New Hampshire for converting incandescent bulbs to compact fluorescent bulbs in the Susan Colgate Cleveland Library Learning Center and in the Dan and Kathleen Hogan Sports Center.

- **Disadvantages @ Colby-Sawyer College:** Some of the disadvantages that would come from the process changing over to compact fluorescents is handling the disposal of the bulbs at the end of their useful life. This is because compact fluorescent light

bulbs have a small amount of mercury in them. Therefore the method of disposal needs to be clarified. It is bad for the environment to simply throw them away.

- **Disposal of Compact Fluorescent Light Bulbs:** There is a very simple solution to the disposal of light bulbs. The New Hampshire Department of Environmental Services provides recommendations and programs for proper disposal of compact fluorescents. See websites below..

**Websites/Links:**

- New Hampshire Department of Environmental Services  
<http://www.des.state.nh.us/PIC/>  
<http://www.des.state.nh.us/factsheets/hw/hw-7.htm>

## **Orientation**

Preparing new students for a more environmentally friendly transition to  
Colby-Sawyer College

**Anna Clark**

### **Green ROUTES Recommendation Level: I**

**Introduction:** Through implementing a policy that suggests students should have some green initiatives in their dorm rooms, Green ROUTES is educating those that are unaware of their environmental impact. Also, asking that students plan ahead for their dorm rooms and consider their impacts on the environment with every purchase they make.

**Objectives:** To provide students with an education to emphasize the relationship between humans and the environment. There are many ways in which students can “green” their dorm rooms... Some of the goals set by Green ROUTES are to promote green initiatives and to encourage people to conserve resources and minimize waste.

**Methods/Procedures:** By developing a policy where students have opportunities to make contributions to Green initiatives it allows for Colby-Sawyer College to make a difference in its environmental footprint and impact. It spreads the word that changes need to be made to conserve our resources and to minimize the waste that being produced.

**Findings:** New American Dream helps Americans consume responsibly to protect the environment, enhance quality of life, and promote social justice. They work individuals, institutions, communities and businesses to help conserve natural resources, counter the commercialization of our culture and promote positive changes in the way goods are produced and consumed. This organization can help Colby-Sawyer College make a difference within the dormitories and around the campus.

#### **A few ideas to help make a contribution to conserving our natural resources...**

- Buy local/ Support organic growers
- Change to compact fluorescent light bulbs
- Recycle / Use Recycled materials

Post-consumer recycled and tree-free papers help preserve forests, cuts paper-manufacturing pollution, and reduce solid waste. A totally-chlorine free paper reduces emissions of dioxin, a known human carcinogen linked to endocrine, reproductive, nervous and immune system damage.

- When purchasing appliances, Chose **ENERGY STAR**



**These are some of the tips which Colby College gave to their students that should apply here at Colby-Sawyer College as well.**

- Buy goods with some recycled content; this creates a market for recycled material.
- Consider the lifetime of a product: Try to reduce your use of disposable items (razors, dishes, coffee cups) and items with excessive packaging.
- Use a reusable mug for those cold winter days.
- Edit documents on the computer screen as much as possible to avoid printing multiple drafts, Do not print unless you have to.
- Minimize water use: Do only full loads of laundry; don't run water constantly when brushing your teeth or shaving; and limit your shower time.
- Close storm windows and windows you see open during cool months. Educate yourself about the heating system with the dorms so you do not waste heat.
- Turn off light that are not in use. Change to Compact Fluorescent light bulbs.
- Find new uses for old things. For example, recycle products, appliances, grocery bags, and dishware.
- Give unwanted appliances, clothing, and furniture to the Drop and Swap at the end of the year so that they can be recycled and remain out of the waste stream.
- Several different campuses' around the nation are focusing on Green Initiatives and have started to change for a Greener Campus. These were some of the responses to questions asked in relation to bringing the students closer to environmental sustainability.

**Websites/Links:**

- New American Dream  
<http://www.newdream.org/buy/bts/index.php>
- TreeHugger.com  
[http://www.treehugger.com/files/2006/09/green\\_your\\_dorm.php](http://www.treehugger.com/files/2006/09/green_your_dorm.php)
- US Environmental Protection Agency – Energy Star  
<http://www.energystar.gov/>

Below is a flyer that was prepared for new students coming to Colby-Sawyer College.



During the 2006-2007 academic year, Project Green ROUTES (Redirecting Our CampUs Towards Environmental Sustainability) completed the first Campus Sustainability Assessment for Colby-Sawyer College. This work was conducted as part of CES 301/302: Community-Based Research Project I & II. The goal of Project Green ROUTES is to raise awareness of environmental issues on campus and create a plan to ensure greater sustainability for years to come.

Students play a critical role in improving campus sustainability. This flyer is intended to provide suggestions on items you can bring to campus that will help the environment.



The *US Environmental Protection Agency* has a great site for finding energy efficient appliances called Energy Star. It even helps you find stores in the area that sell EnergyStar labeled products.

<http://www.energystar.gov/>

*The Center for the New American Dream* offers tips for going back to school in style – Green Style!

<http://www.newdream.org/buy/bts/index.php>



*TreeHugger.com* offers loads of tips for greening your dorm room.

[http://www.treehugger.com/files/2006/09/green\\_your\\_dorm.php](http://www.treehugger.com/files/2006/09/green_your_dorm.php)

Visit the Green ROUTES site to learn more about being green at Colby-Sawyer - follow the link to "What You Can Do"

<http://www.colby-sawyer.edu/academic/ces/greenroutes/Index.html>

***During orientation you will get more information on being green at Colby-Sawyer College. If you have any questions, contact***

***[GreenROUTES@colby-sawyer.edu](mailto:GreenROUTES@colby-sawyer.edu)***

## Refrigerators

Do we need common refrigerators in the residence halls?

**Stephanie Goggin**

### **Green ROUTES Recommendation Level: I**

#### **A Waste of Energy...**

**Objectives:** To determine if the communal refrigerators in the dormitories are used by the students who live in that dorm. The experiment was designed to show the lack of use of the refrigerators and therefore the amount of energy being wasted. We also wanted to show that when the refrigerators are used, it is mostly for condiments and or liquids and very rarely any substantial food.

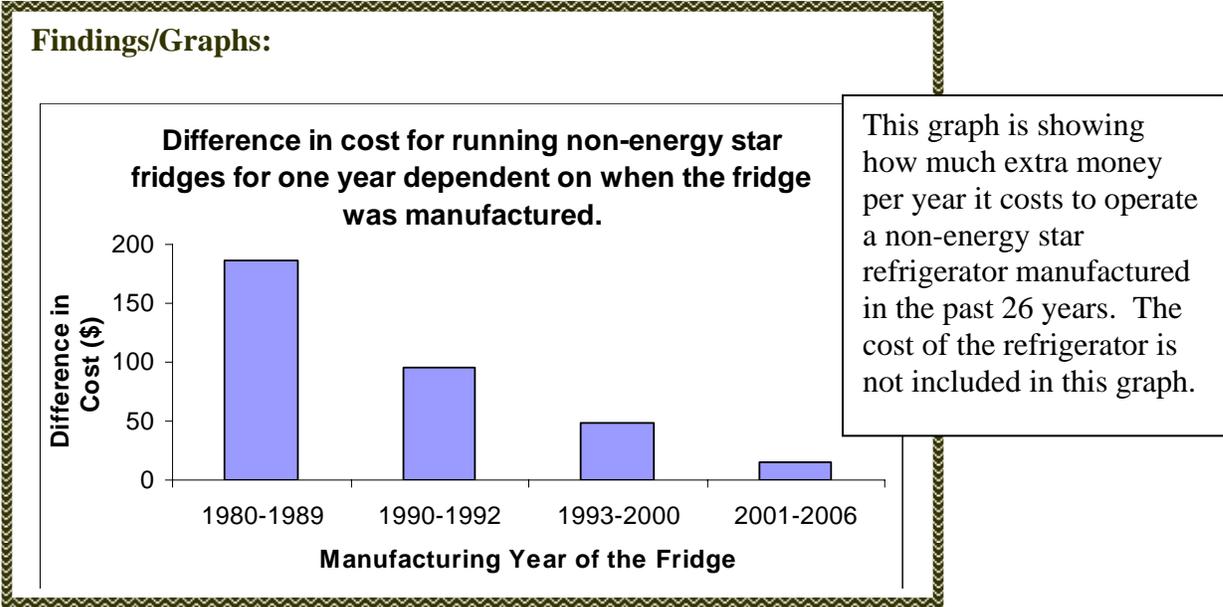
**Methods/Procedures:** By performing two audits of the schools refrigerators, the necessary data was collected. On the first audit pictures were collected of each of the refrigerators in each dorm to show how empty they were. On the second walk through data was collected concerning the brand and model number and the number and types of items in the refrigerators. The model numbers collected did not turn up in the Energy Star database, so the numbers calculated were done using a general refrigerators based on size and type. Energy Star is a joint program with the EPA and the US Department of Energy that helps promote energy conservation and provides certification for energy efficient appliances.

**Energy Star Refrigerators:** Energy Star refrigerators are readily available these days from all refrigerator vendors. On average it would cost the school \$54 per refrigerator to operate an Energy Star refrigerator for one fiscal year. While this is only a savings of \$15 from non-energy star refrigerators manufactured today, the energy saved is substantial. The average Energy Star refrigerator uses only 407 KWh per year, while the non-Energy Star refrigerator uses on average 527 KWh per year.

**Recommendations:** Create a policy that states that all new refrigerators bought for the school will be Energy Star certified.



<http://www.energystar.gov/>



**Survey Results:** 53% of Colby-Sawyer students and faculty, and 50% of staff agree with removing common room refrigerators in dorms.

**Results/Conclusions:** The audit showed that of the six dorms that had refrigerators, one was not plugged in, while three of the remaining five were sparsely used, and only two were determined to be effectively used. The timing of our second audit could have played a hand in this however, since it was right before thanksgiving and Abbey Hall was planning a hall thanksgiving and therefore the refrigerator was stocked with all sorts of foods for this event. The other refrigerator that had substantial use was the one in Lawson Hall.

Below are two proposed plans for the refrigerators:

**Alternative A:** Remove refrigerators from dorms due to lack of use which will result in a savings of \$345/year in operating costs, since there will be no more refrigerators to pay for. However this may result in an increase in personal refrigerators in dorm rooms which could increase total energy consumed.

**Alternative B:** When time comes to replace refrigerators, replace with Energy Star certified ones. This would result in a savings of \$75/year in operating costs.

**Environmental Impact Statement:**

Removing Refrigerators:

- The disposal of the unused refrigerators could pose environmental impacts, especially if placed in a landfill.
- Chemicals (Freon and compressor oil) must be removed before a refrigerator is disposed by federal regulations

- Possible cost to dispose of refrigerator
- The disposal of the community refrigerators could create a larger demand on campus for mini- refrigerators in dorm rooms.
- Shredded insulation foam releases harmful chlorofluorocarbons into the atmosphere.

Replacing Refrigerators with Energy Star Refrigerators:

- Recycling of old refrigerators, 98% of refrigerator material can be re-used
- Should refrigerators be placed in the buildings where they are not currently in use?
- Should mini- refrigerators in rooms be banned to encourage use of community refrigerators?

## Sustainability Coordinator

Staffing sustainability

John Callewaert

### Green ROUTES Recommendation Level : I

**Introduction:** The National Association of College and University Business Officers (NACUBO) reports that each year more than 250 campus sustainability assessments (CSAs) such as Green ROUTES are completed. In the corporate world sustainability assessments can cost upwards of \$50,000 and require hundreds of staff hours. Campus projects can be more economical utilizing student and staff time, but any sustainability assessment should be viewed in terms of value, not cost. A well-done and successfully implemented CSA can save an institution thousands, if not millions, in operating expenses over several years (NACUBO, 2005).

**Objective:** Adequate staffing is a key issue for campus sustainability efforts. While student enthusiasm can often get such initiatives off the ground, institutional commitment in terms of staffing is critical for long term success. Over the past few years many colleges and universities have established sustainability coordinators. These coordinators assume the responsibility for a wide range of sustainability initiatives and ensure proper coordination.

**Recommendation:** Colby-Sawyer College should create a position of **Campus Sustainability Coordinator**. This position could start as a half time position and be paired with another half time position – perhaps something in Residence Life or a pro-rata faculty position. Based on the data below from AASHE, a salary estimate for a half time sustainability coordinator would be approximately \$20,000. The Campus Ecology Program of the National Wildlife Federation has a planning guide for creating a sustainability coordinator position (see link below).

#### Data:

##### Without Advanced Degrees:

Years of Experience	# Individuals	Average Salary	Standard Deviation
0-5	8	\$34,000	\$6,200
6-10	3	\$48,700	\$3,800
11+	5	\$52,000	\$12,500

##### With Advanced Degrees (MS, MBA, JD, PhD):

Years of Experience	# Individuals	Average Salary	Standard Deviation
0-5	5	\$41,500	\$8,900
6-10	5	\$51,500	\$10,200
11-20	6	\$81,800	\$26,400
20+	4	\$52,000	\$13,400

**Related items:**

- Barlett, P. F. and Chase, G. (eds.) (2004). *Sustainability on Campus: Stories and Strategies for Change*. MIT Press.
- Creighton, S. H. (1998). *Greening the Ivory Tower: Improving the Environmental Track Record of Universities, Colleges, and Other Institutions*. MIT Press.
- Farrant, R. and Silka, L. (eds.) (2006). *Inside and Out: Universities and Education for Sustainable Development*. Baywood.
- Newport, D. and Litten, L. (2005). The Payoffs of Planet-Friendly Initiatives. NACUBO.

**Websites/Links:**

- Association for the Advancement of Sustainability in Higher Ed  
<http://www.aashe.org/>
- National Wildlife Federation Sustainability Coordinator Profile  
<http://www.nwf.org/campusEcology/files/coordinator.pdf>



## **Sustainability Day**

Creating awareness on campus through a variety of events

**Stephanie Goggin**

### **Green ROUTES Recommendation Level: I**

#### **Schedule of Events:**

##### **Food Waste: Battle of the Sexes**

Thursday April 12th - Tuesday April 17th

Measure food waste against the opposite gender to see which gender produces more food waste.

##### **Light Bulb Replacement**

Thursday April 12th -- Tuesday April 17th

Green ROUTES team members will be coming around and swapping out your standard light bulb for energy efficient compact fluorescents

##### **Reset Your Computer**

On Webpage

Learn how to set your computer to maximum energy efficiency settings

<http://www.colbysawyer.edu/academic/ces/greenroutes/Index.html>

##### **Reusable Coffee Mugs**

Tuesday April 17th – end of the school year

The dining hall will be distributing reusable coffee mugs

##### **Green ROUTES Recycled Art Contest**

Tuesday April 17th at 3:00 – 4:00pm –Alumni Lounge

Using only recyclable materials create a piece of art:

The first 25 entrants receive a prize for signing up

Prizes are \$75, \$50 and \$25 to College Café/ Snyders

- Judging done by GreenRoutes on creativity, variety of recyclable materials and ability to be recycled after contest

##### **Lights Out Candlelit Dinner**

Tuesday April 17th

Come to dinner to experience the dining hall lit only by candles!

##### **Earth Day Poetry Contest**

Tuesday April 17th at 7:30 – Lethbridge Lodge

Poetry must be environmentally themed and prizes will be awarded



**Survey Results:**

**51%** of Colby-Sawyer students, **60%** of faculty and **77%** of staff feel that all students should be required to take an Environmental Literacy Course at the College.

**53%** of students, **70%** of staff, and **64%** of faculty are willing to get involved in the implementation of new ideas toward creating a green campus.

**Recommendations:** Hold a Sustainability Day or Days every year at Colby-Sawyer College. Incorporate some of the events featured here and create new events every year! Continue to raise awareness about sustainability on campus!

Food Waste Challenge: Battle of the SEXES		
During Lunch	Men (food weight)	Women (food weight)
Day 1	27.8 lb (156 men) Per person = 2.8oz	55.2 lb (301 women) Per person = 2.9oz
Day 2	40.2lb (142 men) Per person = 4.5oz	46.6lb (246 women) Per person = 3.0oz
Day 3	27.6lb (164 men) Per person = 2.7oz	48.4lb (268 women) Per person = 2.9oz
Day 4	38.0lb (162 men) Per person = 3.7oz	41.0lb (307 women) Per person = 2.1oz
Total:	<b>133.6lb</b> (624 men) Average = 33.4lb Per person = <b>3.4oz</b>	<b>191.2lb</b> (1122 women) Average = 47.8lb Per person = <b>2.7oz</b>



## **Tree Inventory**

The trees at Colby-Sawyer College

**Alexa FitzGerald, Chris McClellan, Kris Ramsay, Brian Valle**

### **Green ROUTES Recommendation Level: I**

**Introduction:** An inventory of trees on the Colby-Sawyer campus was completed to determine the number and location of native tree species compared to the number of cultivated species. It was important to gather this information as the Community and Environmental Studies (CES) program uses the campus as a laboratory for plant identification. Knowing where to find native species campus will help future CES students by showing them examples of native species in this region of New Hampshire.

The inventory revealed a surprising number of transplanted, non-native trees growing on campus. It would be wonderful if in the future Colby-Sawyer could be a model for planting native tree species. This could be accomplished by replacing dead trees with native species where possible. In doing this, it will be important to consider the habitat that the trees are going to be planted in to make sure that the area makes ecological sense for the tree species.

Two tree species which are not native but would do very well in this environment: blue spruce and douglas fir. Although these are western species, they are commonly planted species that grow very well here and are not invasive. It would be preferable to plant native species, but these two are also good alternatives and common nursery stock.

Another alternative would be the American Chestnut. This species used to be a dominant native species in New England that nearly went extinct in the early to mid 1900s when a blight, of Asian origin, spread rapidly through them. Because the native Chestnut trees had little resistance, they were quickly wiped out. There are very few left and scientists are back breeding them in order to bring back the species with a resistance to the killer blight. It would be great for Colby-Sawyer to take part in reintroducing these trees to New England.

**Related items:** The American Chestnut tree is predicted to be ready for planting blight-free seedlings by the year 2006. Colby-Sawyer should plan for some space to plant when they are ready, and in the meantime, work with seedlings in the conservatory. Colby-Sawyer can purchase these trees from The American Chestnut Foundation in Bennington, Vermont, who is working to back-breed the species in order to safely reintroduce them into their native habitat.



**Annual Tree Plantings:** Starting in 2005, Professor Nick Baer, initiated a program to plant native trees to commemorate Earth Day and the graduating Community and Environmental studies and Biology classes. The native sugar maples are located in front of Colgate Hall lining the loop. The trees were planted in the spring and were donated by the college. To continue the annual tree planting, the implementation of a small scale tree nursery on campus is a good use of our open space. The proposed nursery area is north of the Kelsey Tennis Courts, this area is low traffic and bordered with trees. Plastic tubes will be needed to keep out unwanted wildlife that may dine on the saplings during their first few years. As the trees mature they can be planted around campus according to our proposed tree planting plan.

**Sapling plantings:** Are available through the New Hampshire State Forest Nursery's planting program. "We exist under authority of [RSA 227-H:2](#) to raise and sell seedlings to '...persons who desire to plant them'. Our goal is to provide customers with the highest quality, bare-root seedlings for forestry, conservation and education purposes at attractive prices"(ww.dred.state.nh.us/nhnursery). In conjunction with the annual tree planting and the "tree wish list" a small area could be converted in to a tree nursery which would provide trees for the annual planting. The saplings provided by the New Hampshire State Forest Nursery, rang in age from 1-5 years depending on the type of tree or shrub. These plants are sold when they are able to be planted outside.

In conjunction with the Green fund potential, the sapling program could fund the annual tree planting conducted by professor Nick Baer. The cost of trees depend on the age and type; however, if the college was to plant 25 saplings each year in the potential tree nursery, within the next few years, the saplings would be ready to plant. The sugar maples which were planted in the past have been purchased locally from Spring Ledge Farm in New London New Hampshire. The trees cost about \$250.00 with a diameter of about 2-2.5 inches.

**Tree saplings from New Hampshire State Forest Nursery:( [NH State Forest Nursery](#) )**

<b>Common Name:</b>	<b>Scientific Name:</b>	<b>Price from NH State Forest Nursery:(NA= sold out no price)</b>
Silver maple	Acer saccharinum	2 years old, \$15.00 per ten plants
Sugar maple	Acer saccharum	2 years old, \$NA per ten plants
Blue spruce	Picea pungens	3 years old, \$NA per ten plants
Douglas fir	Pseudotsuga menziesii	2 years old, NA per ten plants
Scotch pine	Pinus sylvestris	2 years old, \$NA per ten plants, \$15.00 per twenty-five

**Trees from [www.naturehills.com](http://www.naturehills.com)**

(Naturehills.com is an online nurseries that sells and ships plants all around the United States.)

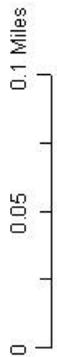
<b>Common Name:</b>	<b>Scientific Name:</b>	<b>Calculations:</b>
Silver maple	Acer saccharinum	4ft trees, 4 + plants= \$12.28 each, Total = \$49.12 25+ plants = \$10.84 each, Total = \$271.0
Sugar maple	Acer saccharum	4ft trees, 4 + plants= \$17.87 each, Total = \$71.48 25+ plants = \$15.71 each, Total = \$392.75
Blue spruce	Picea pungens	12in trees, 4 + plants= \$6.95 each, Total = \$27.80 25+ plants = \$5.21 each, Total = \$130.25
Douglas fir	Pseudotsuga menziesii	10in trees, 4 + plants= \$5.91 each, Total = \$23.64 25+ plants = \$5.21 each, Total = \$130.25
Scotch pine	Pinus sylvestris	10in trees, 4 + plants= \$5.91 each, Total = \$23.64 25+ plants = \$5.21 each, Total = \$130.25



# Colby-Sawyer College Tree Inventory



- Tree Species**
- Sugar Maple
  - Norway Maple
  - White Oak
  - White Ash
  - American Elm
  - ▲ White Walnut
  - White Pine
  - Eastern Hemlock
  - Norway Spruce
  - Red Spruce
  - Gray Birch
  - ◆ Red Maple
  - ◆ Balsam Fir
  - ◆ Cedar
  - ◆ White Birch
  - ◆ Pin Cherry
  - ▲ Apple
  - ▲ Blue Spruce
  - ▲ Speckled Alder
  - ▲ Red Birch
- Roads  
 ■ Buildings  
 Susan's Swamp

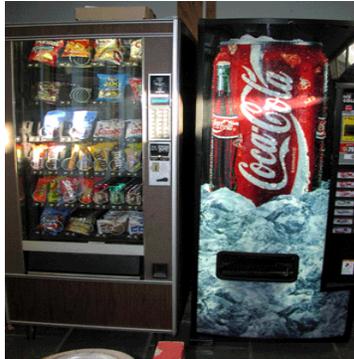


## Vending Machines

Vending machines are located all over campus, and are constantly consuming energy

Sean Wheeler

### Green ROUTES Recommendation Level: I



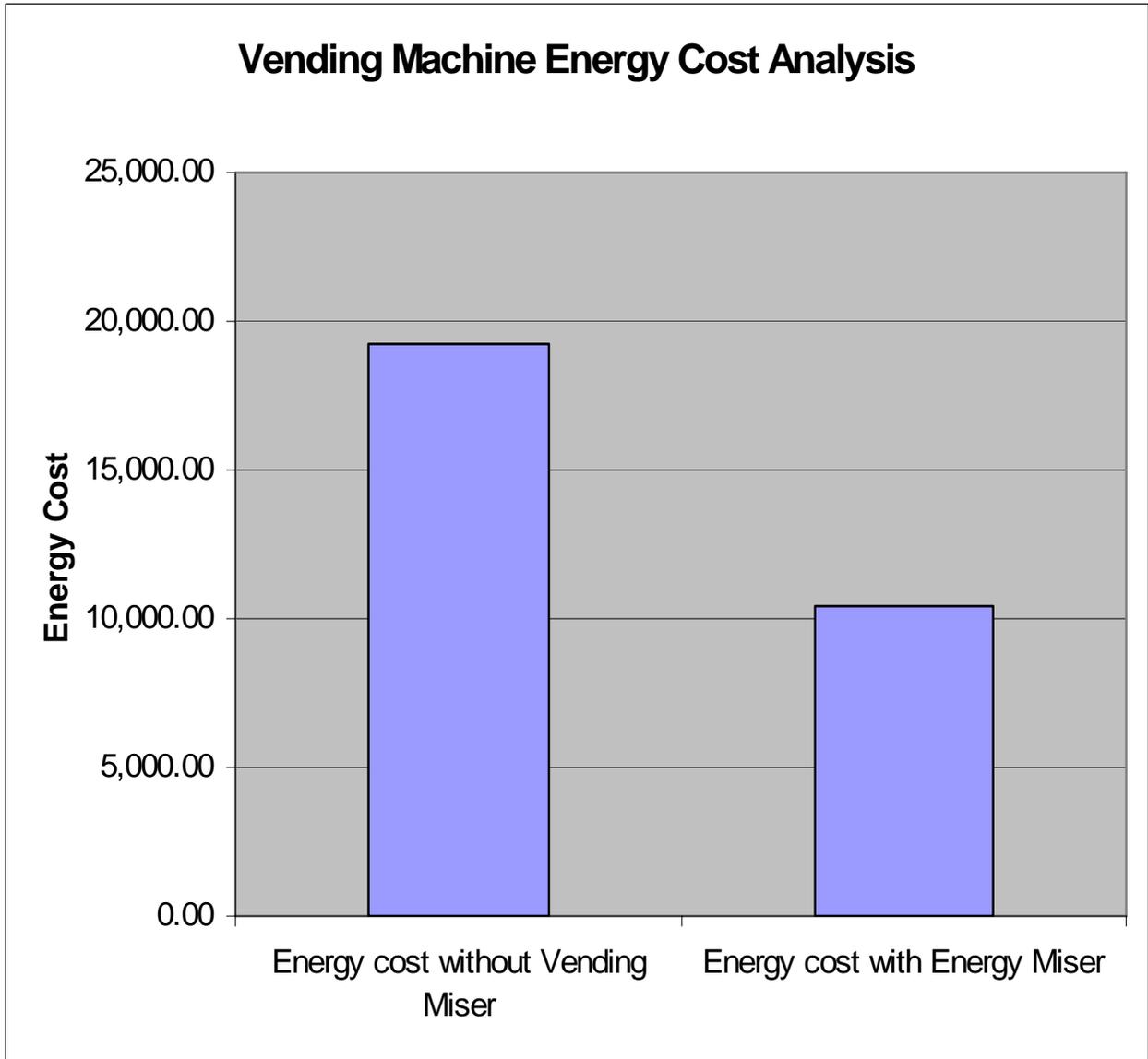
**Introduction:** On the Colby-Sawyer campus there are vending machines in almost every building. This makes it very convenient for people to get late night snacks, but the machines also use a large amount of energy. The lights are always on and the refrigerators are always running. This causes the non-Energy Star vending machines to cost the school about \$1.88 per machine per day. This does not sound like a lot, but when you count the 29 vending machines located on campus and multiply that by the 365 days a year that they are on and the numbers get much larger. It is estimated that to run all of the vending machines all year round costs the school \$19,265.

**Objectives:** The objectives of this work plan were to assess the vending machines that are currently located on campus and find a way to make them more energy efficient. By looking into different energy saving devices such as Energy Star Machines or a device called the Vending Miser the school could cheaply and easily take a step toward lessening their carbon footprint.

**Findings:** By doing research into vending machines and energy efficient alternatives, this information can now be taken to the vending machine company for discussions about alternatives and ways of switching. There are other vending companies, for example the Middlebury vending company which offers the energy saving alternatives to the school for free.

**Findings/Graphs:** After looking into energy saving devices for vending machines it seems that the best option for the college to look into would be the Vending Miser product. This product claims to reduce energy consumption by 46%. The Miser product costs \$179 for cold beverage machines and \$79 for snack machines. Between the cost to switch all of the machines and the energy savings, the project would break even in roughly two and a half years. After this the energy savings would be saving the school

around \$8,861.76 if the 46% savings that the company claims is accurate. This switch would not only help the college financially, but it would help us reduce our carbon footprint. Based on occupancy and information from the U.S. Environmental Protection Agency, Colby-Sawyer could reduce CO<sub>2</sub> emissions by 2,200lbs and reduce our Nox by 3,600 grams.



**Websites/Links:**

- US Environmental Protection Agency, Energy Star  
<http://www.energystar.gov>

**Results/Conclusions:** Contact has been made with the Newmont Vending Company, and a message was left with the owner stating the objectives of this project. The call was not returned but the contact is: Mr. Black (the owner), Newmont Vending, 603-543-3305.

**Disadvantages:** There are a few initial costs to buy and install the vending miser. The drinks in the machines would not be ice cold, but just cold. The vending miser sticks up out of the top of the machine so it is possible that people would find it esthetically unpleasing.

**Special Concerns:** Most of the vending machines are placed in high traffic areas where people walk by them all the time, if they were kept in these areas the motion sensors would keep being tripped by people walking by, this could cause the vending machines to be on for almost as long as they would normally be, so this would cause the energy savings to be lessened. If the machines were to be placed in lower traffic areas but still were easily accessible to students to use, the savings would be higher and would also help them pay for themselves quicker as well.

**Related items:** The idea of motion sensors is something that could work not only on vending machines, but with out lighting systems, in places like bathrooms where the lights do not need to be on all day.

## Windows

Comparison of older and newer windows

**Stephanie Goggin**

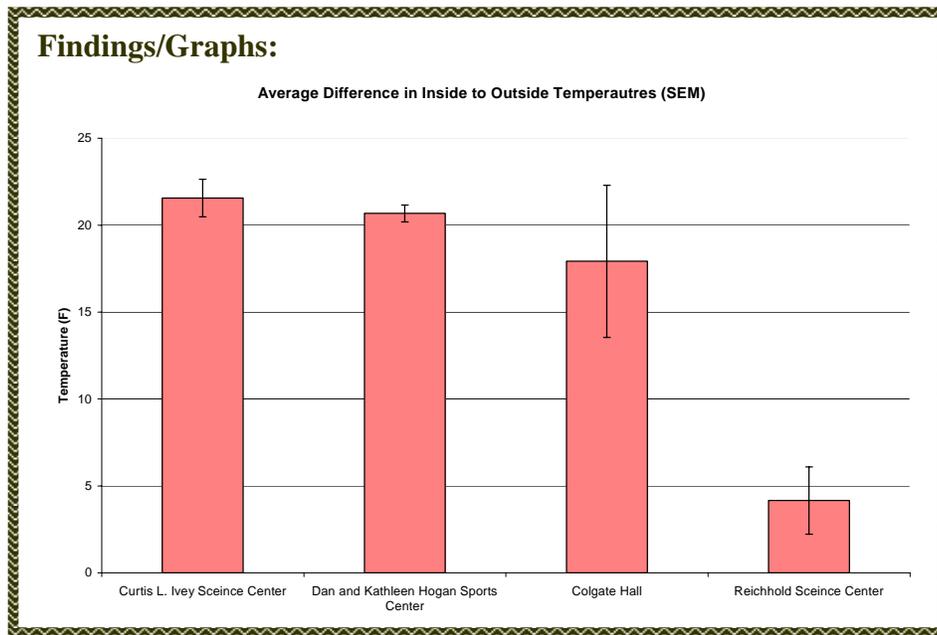
### **Green ROUTES Recommendation Level: I**

**Introduction:** In order to determine the benefits of replacing the older windows around campus, an experiment was conducted to estimate how much heat was being lost through the windows around campus.

**Objectives:** By measuring the temperature of both the inside and the outside of the windows, the average difference was calculated between the two types of windows to determine how much heat was being lost through them. The purpose of this experiment was to determine the benefit in replacing the old single pane windows with the new airlock double pane ones which hold more heat in the buildings.

**Methods/Procedures:** Using a heat gun, the inside and outside temperatures of the windows were measured, five windows in each of four buildings, two newer buildings (Curtis L. Ivey Science Center and Dan and Kathleen Hogan Sports Center) and two older buildings (Colgate Hall and Reichhold Science Center). Next, the average difference between the inside and outside temperature was calculated and also the standard deviation and the standard error of the mean in order to determine which buildings had efficient windows and which did not.





**Results/Conclusions:** The two newer buildings both showed very little variance in the data, and both also had a high difference between the inside and outside temperatures leading to the conclusion that the windows are holding the heat well. The two older buildings both showed very different results. Colgate Hall showed a relatively large difference between the inside and outside, however had a large variance, possibly due to the multiple uses of the building. Reichhold Science Center showed very little difference between the inside and outside temperatures, possibly due to the age of the windows.

**Environmental Impact Statement:**

Replacing Old Windows with more Heat Efficient Newer Ones

- New windows are double paned and will hold heat inside of buildings better than old single pane windows
- Will save the College on heating costs
- Cost of disposing old windows in a safe manner
- Heat loss while replacing windows, replacement should take place on warmer days when buildings are not being heated and therefore no heat loss will occur during replacement

**Recommendations:** Replacement of old windows on campus is currently being preformed by the facilities staff. There are plans for the remaining buildings which do not have new windows to receive them within the next year.

**Websites/Links:**

- Marvin Windows  
<http://www.marvin.com/>

## Zip Cars

"Wheels when you want them" through car sharing

**Stephanie Seavy**

### **Green ROUTES Recommendation Level: I**



**Introduction:** Zip Car's on campus car-sharing program can provide faculty, staff and students an alternative to the costs and hassles of keeping a privately-owned car on or near campus. Zip Car began testing its cars-on-campus concept at MIT in 2002. Today it has rentals at 18 east coast colleges. Zip Car charges students a \$25 membership fee; drivers then pay rates starting at \$8.50 an hour or \$65 per day, which includes gas and insurance. Zip Car reservations can be made within minutes or up to a year in advance through a user-friendly web-based reservation system or automated phone.

**Objectives:** Like many other colleges, Colby-Sawyer College has a limited amount of parking spaces. Due to a lack of public transportation in the area, many students are forced to bring their own vehicles to campus. If enrollment increases and more students want to bring cars, the college may be forced to either restrict some students (possible freshman) from bringing cars to campus or Colby-Sawyer College may have to build an additional parking lot which will be costly and aesthetically unpleasing. In order to combat this likely future problem Zip Car, provides students who cannot or do not want to bring a privately-owned car to school, the opportunity and freedom to travel off campus to attend interviews, run errands or take a weekend trip.

### **How it Works- As explained by Zip Car:**

**Join:** Students, faculty and staff apply online. It only takes a few minutes. Once they're approved – by you and Zip Car – they get their own Zipcard.

**Reserve:** Reserve a car online or over the phone – for a couple ours or the entire day. A wireless signal is sent to the car with the reservation info.

**Unlock:** The driver walks to the car, and then just holds the Zipcard to the windshield. The doors will unlock, and it's ready to drive!

**Drive:** Drive away... and then return to the same reserved parking spot at the end of the reservation. Gas, parking and insurance included. It's simple!

**Zip Car Provides:**

- Zip Car(s) – CSC can chose from a list of over 20 makes and models, including hybrids
- Insurance for all approved drivers ages 21+
- Gas- Drivers just fill up with the Zip Car gas card
- Application process- Zip Car makes sure all drivers meet safe driving standard
- Custom online reservation system
- Easy view billing view usage to see who is driving & when
- Marketing materials and communication plan to promote the service
- Zip Car membership and Zip Card for each driver
- Unlimited access to live support center
- Roadside assistance 24/7

**Colby-Sawyer must provide:**

- Reserved parking for the Zip Car
- Administrative contact

**What Colby-Sawyer College students, staff and faculty said in the 2007 Green ROUTES survey :**

Although the Green ROUTES 2007 Survey did not have any questions specifically addressing the issue of Zip Cars, individual students, staff and faculty members made reference to the subject in the section of the survey that asked for additional comments.

For example, one student suggested that Colby-Sawyer College, “restrict the number of people who can have cars on campus, therefore supporting carpooling and interaction with others.”

The idea of carpooling and the desire to reduce the amount of cars on campus was also shared by numerous staff and faculty members at Colby-Sawyer College. A staff member wrote, “A car pool or ride share area in the community discussion board of Blackboard would be great for our college community.”

Having a Zip Car program at Colby-Sawyer College may also attract prospective students who will not be bringing a car to college. Prospective student, Adam D., from NY remarks, “since I won’t be bringing a car to campus, if Colby-Sawyer College has a Zip Car program it would make it much easier for me to get around off campus.”

## **Environmental Impact Statement for Zip Cars at Colby-Sawyer College:**

### **Advantages:**

#### **Reduced Demand for On-Campus Parking:**

The Zip Car website claims that each Zip Car replaces over 20 privately owned cars. Having Zip Cars at the Colby-Sawyer College could reduce the amount of cars that the student body brings to campus each year.

- A reduced number of on-campus cars on campus will free up parking spaces on campus. “Green space is preserved as fewer parking spaces are required to meet the driving needs of the same number of people.”

#### **Zip Cars at Colby-Sawyer College will strengthen the school’s relationship with the community:**

- Fewer student cars means less competition for on-street parking and reduced traffic congestion
- The community will also be able to use the Zip Car’s offered at CSC, which will provide the community with the many benefits that the Zip Car program offers.
- The Zip Car website states, “we promote a deeper sense of community as members within a small geographic area share a common resource and the money saved, reported by members to be over \$5,000 per year, gets spent locally.

#### **Reduction of Air Pollution from the Zip Car Program:**

- Older cars are replaced with new ones that have more stringent pollution controls.
- Lower fuel consumption means fewer greenhouse gas emissions and particulates.

#### **Low Cost Transportation for Colby-Sawyer College students:**

- Will allow students who do not personally own cars, or who can not afford cars, the opportunity to drive themselves to an interview, the pharmacy, etc.
- A ZipCar program at CSC will enable students to choose not to bring a private personal car to campus

### **Disadvantages:**

#### **Air Pollution**

Although a Zip Car program can help to reduce Colby-Sawyer’s CO<sub>2</sub> emissions, the Zip Cars are still powered by gasoline, a non-renewable energy source that is contributing to the progression of global climate change.

#### **Scheduling Conflicts**

At some points the one or two Zip Cars that Colby-Sawyer College will have may be both in use at the same time. This may cause conflict among student and/or community drivers who both want to use the car at the same time.

**Possible unreliable transportation:**

There would always be a possibility that one Zip Car renter may return the Zip Car late, which could cause problems for the next scheduled user. For example, if someone rented the Zip Car for 1 -2 PM and another person was supposed to rent the car from 2 – 3 PM, if the first renter got stuck in traffic, or had an accident it could cause the second renter to miss their meeting, or doctors appointment that they had, had scheduled for 2 -3 PM.

**Zip Car University Partners to date:**

Harvard University

M.I.T.

Simmons College

Boston College

Boston University Medical Center

Berkley College of Music

Northeastern University

Tufts University

Wellesley College

University of North Carolina

Columbia University

Princeton University

Stevens Institute of Technology

George Washington University

Georgetown University

American University

Catholic University

Howard University

George Mason University

**Websites/Links:**

- Zip Car  
<http://www.zipcar.com>

## ***Level II Priorities***

### **Green Building Design**

Leadership in Energy and Environmental Design (LEED)

**Alexa FitzGerald**

#### **Green ROUTES Recommendation Level : II**

**The Importance of Green Buildings:** The United States alone is responsible for about ¼ of global greenhouse gas emissions. Given the fact that buildings are responsible for over 49% of these CO<sub>2</sub> emissions, sustainable “green” building designs are becoming a more and more attractive alternative to traditional building designs. Green building design is a smart thing for Colby-Sawyer to consider and invest in because it would greatly decrease the college’s environmental footprint and at the same time, it would provide huge long-term savings.

**Objectives:** Green building is an opportunity for Colby-Sawyer to use its resources efficiently while creating healthier buildings to live in and work in. The main benefits of green building designs are as follows:

- Health
- Productivity
- Efficiency
- Energy savings
- Decrease environmental footprint

US. Green Building Council established a program called Leadership in Energy and Environmental Design (LEED). This program was established to help private builders and corporate builders learn about sustainable designs and give them the necessary “tools” to work with. These “tools” could be of great use and value to Colby-Sawyer’s campus. Right now the college suffers major financial losses because of high energy loss and bad overall building efficiency. Using ideas from LEED to renovate old buildings and build new buildings in the future would be great for the college’s finances and also for cutting back on its emissions and energy wastes.

**Methods/Procedures:** Different LEED sustainability requirements:

- Sustainable sites – i.e. site development, light pollution reduction
- Water Efficiency – i.e. use reduction, landscape efficiency
- Energy and Atmosphere – i.e. on-site renewable energy
- Materials and Resources – i.e. reuse of buildings, regional materials
- Indoor Environmental Quality – i.e. increased ventilation, daylight
- Innovation and Design Process – i.e. innovation in design

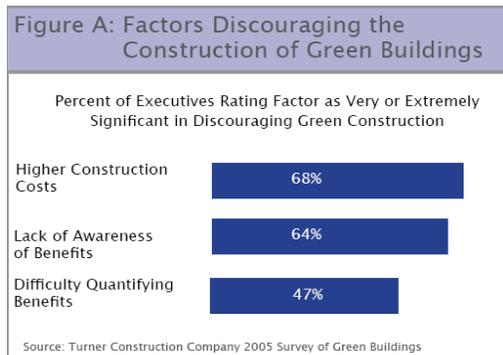
Some initiatives around sustainability are being acted on right now, for instance changing windows in dormitories and changing light bulbs around campus. Already the light bulbs alone are creating large savings; imagine if we took sustainability to another level! With more natural lighting and better ventilation, productivity of staff and students could greatly increase and make this institution an overall better and healthier place to learn.

**Why Certify?**

LEED-certified buildings:

- are leading the transformation of the built environment
- are built as designed and perform as expected.
- have lower operating costs and increased asset value
- are healthy and comfortable for their occupants
- reduce waste sent to landfills
- conserve energy and water
- reduce harmful greenhouse gas emissions
- qualify for tax rebates, zoning allowances, and other incentives in hundreds of cities
- demonstrate an owner's commitment to environmental stewardship and social responsibility.

**Common Misconception:** One of the main concerns for building and designing “green” is the cost. Often the idea is shunned because financiers do not like the idea of spending more money than is in their original budget plan. What most people do not know is that by building green and having a more sustainable, energy efficient building, the people funding the project will actually save money in the long run. The extra funds are also spent on important things such as the disposal of wastes from the building site to sounder and cleaner products used in the construction. Also, the building supplies often come from recycled materials which help to reduce waste and reuse resources previously disposed of. It is important to know that building green not only strengthens the environment, but it also saves money over time.



**Financial Benefits of Green Buildings  
Summary of Findings (per ft<sup>2</sup>)**

Category	20-year Net Present Value
Energy Savings	\$5.80
Emissions Savings	\$1.20
Water Savings	\$0.50
Operations and Maintenance Savings	\$8.50
Productivity and Health Value	\$36.90 to \$55.30
<b>Subtotal</b>	<b>\$52.90 to \$71.30</b>
Average Extra Cost of Building Green	(-\$3.00 to -\$5.00)
<b>Total 20-year Net Benefit</b>	<b>\$49.90 to \$66.30</b>

Source: Capital E Analysis  
www.cap-e.com

According to a cost/benefit report on the Capital E website, the approximate net benefit of a green building over twenty years is about \$71 per square foot. If we were to set this standard to the Curtis L. Ivey Science Center which is 33,000 square feet, Colby-Sawyer College would save more than two million dollars over the next twenty

years in energy savings alone. This is something for Colby-Sawyer seriously consider. Price is generally the issue that scares people away from building green but if you consider that it only costs about three dollars more per square foot and the net gain down the road is as substantial as it is, the initial cost of the project would be well worth it.

**Other Colleges Successes to Date:** There are many colleges and universities all over the United States who are participating in making their campuses more green by lowering their environmental footprint. This standard is also something that high school students are beginning to consider more when they apply to attend higher education institutions. A great example of successful green building is Middlebury College. In 1997, they began the construction of Bicentennial Hall, at the time the largest academic building in the country to use green certified wood. They are one of the leading higher education institutions in environmental policy in the country, constantly making improvements and finding new ways to become a greener campus. Right now they are working to become 100% carbon neutral, and would be the first to do so in our country.

**Survey:** Green ROUTES conducted a survey this spring in order to attain an idea of student, faculty and staff awareness of environmental issues on the Colby-Sawyer campus. One of the questions that was asked concerned the incorporation of green design into future construction and renovation projects on campus. The participants were asked that if the costs were neutral or would save money for the college over time, would they support green designs. All of the faculty agreed or strongly agree with this idea, as did the staff and the majority of students who participated in the survey. These results are important to consider because these are the people who live and work in the buildings on campus and will be the most effected by the outcome of the construction.

**Recommendation:** Green building design is a smart thing for Colby-Sawyer to consider and invest in because it would greatly decrease the college's environmental footprint while at the same time it would provide substantial long-term savings. Green building is an opportunity for Colby-Sawyer to use its resources efficiently while creating healthier buildings in which to live and work. Green ROUTES recommends that Colby-Sawyer incorporate green building designs into the college's policy regarding all future construction projects, whether it is building renovations or new building construction. Right now the college suffers major financial losses in part because of high energy loss and bad overall building efficiency. By building green, the college will save money and be able to use the extra funds and the college's environmentally friendly goals to encourage perspective students to attend the institution.

**Websites/Links:**

- US Green Building Council  
<http://www.usgbc.org/DisplayPage.aspx?CategoryID=19>

Green ROUTES Project Report



## **Green Fund**

Developing an environmental fund for greening initiatives

**Anna Clark**

### **Green ROUTES Recommendation Level : II**

**Introduction:** Green ROUTES' goal is to develop an Environmental Fund for Greening Initiatives to improve Colby-Sawyer College impact on the Environment and lessen its environmental footprint. A Green Fund is a support system that those who are involved or want to be can be a part of contributing to the better of Colby-Sawyer College campus. Green ROUTES would be more capable of achieving goals that it has set to improve the College's environmental awareness and actions toward greening initiatives. It allows for chances to publicize green initiatives and projects. It is time to become more aware and make change that is going to improve this campus. With a Green Fund capabilities range from implementing regulations for future buildings, safety regulations, adding policies, develop an enhanced recycling program and develop ways to decrease our own emissions. A Green Fund can have a positive impact of people's perspective on environmental perspective and impacts. This fund will allow Green ROUTES to develop a system that allows many opportunities for the future generations and the college.

**Objectives:** Some of the initiatives developed by Green ROUTES are to mitigate Colby-Sawyer College greenhouse gas emissions, develop a compost system, reduce energy usage, educate the community and students on green purchasing options, examine options for improved building renovations, have more recycling opportunities and increase use of alternative transportation. Make policies that will benefit this college's impact on the environment.

It is important to bring the reality of all environmental concerns and the impact the society has to this campus. By increasing Colby-Sawyer College's awareness and impact on the environment as well as those within this community we are educating and making efforts to create a difference for the future generations. This can be possible with a Green Fund.

Green ROUTES created a survey that was distributed to student's faculty and staff in the spring semester of 2007. This survey gives an understanding and perspective of where people are in terms of education of environmental impacts, and awareness of how to decrease the size of their environmental footprint and help locally and globally. By creating a Green Fund at Colby-Sawyer College it would be beneficial to the environment. The Green Fund would also contribute to benefits in the future of the college that have to do with its own impact on money spent and contribute to future savings on energy and money.

**Methods/Procedures:** Some ways in which students involved in Green ROUTES have learned more about Green Funds and initiatives is by traveling to other

institutions,(Middlebury and Proctor Academy), which have already started a successful Green program. This program has allowed for change of environmental impacts at these institutions. Colby-Sawyer College is capable of change, and implementing more environmental programs and projects with the development of a Green Fund.

**Findings:** Some of the ways that other schools, like Yale and Middlebury College have succeeded and continue to work hard to maintain a Green-Fund are through implementing non-formal sustainability education outreach in the college; Create a Leadership group for Energy and Environmental Design, a standard for Laboratory Renovations. Including standards set by the US Green Building Council, giving architects and builders a direction to measure the performance of their future projects.

To develop a Green Fund at Colby-Sawyer College would be beneficial to the college not only in savings of money but also in energy usage. Green ROUTES members and BUS 321 class in the fall of 2006 developed a Cost Benefit Analysis showing the details of water, paper, printer, light bulb and building savings that could happen in the near future if we have proper resources. The resources may include Green Fund, doing projects over time that would decrease this college's environmental impact.

**Survey Results:** Several colleges have established Green Funds. These are student, faculty and staff supported funds set up to promote environmentally friendly practices on and around campus. For example, Green Funds could be used to purchase more energy efficient light bulbs, finance the shift to 100% recycled paper, or purchase additional energy efficient replacement windows for residence halls, offices and classrooms. Over time the fund could be self sustaining or phased out based on savings gained. Below are the responses from the 248 students, 45 staff, and 97 staff that participated in Green Routes' Survey question of how willing would you be to pay an additional \$25 in tuition to establish a Green Fund at Colby-Sawyer.

**Students:** [195] Agree

**Faculty:** [31] Agree

**Staff:** [96] Agree

**NEWS:** Recent updates from other college campuses that have increased their student sustainability/Green Fund fees.

- *“81 percent of students at **James Madison University** voted in favor of a Green Fee of \$9 per semester to fund energy efficiency and conservation initiatives on campus, as well as the direct purchase of renewable energy. The funds would go into a Green Fund, which would be managed by a committee of students, faculty and administrators. The proposal now goes to the James Madison Board of Visitors for approval.”*

(Association for the Advancement of Sustainability in Higher Education)

## **Environmental Impact Statement for Developing a Green Fund at Colby-Sawyer College**

**Developing a Green- Fund @ Colby-Sawyer College:** Green ROUTES' goal is to develop an Environmental Fund for Greening Initiatives at Colby-Sawyer College. By having an Environmental Green Fund it allows for more opportunities for Colby-Sawyer College to lessen its environmental footprint. A Green Fund is a support system that those who are involved or want to be can be a part of contributing to the better of Colby-Sawyer College campus. Green ROUTES would be more capable of achieving goals which that it has set to improve Colby-Sawyer College's environmental awareness and actions toward greening initiatives, an example would be incorporating green initiatives within the dormitories. By developing a Green Fund it allows for change and can have a positive impact of people's perspective on environmental awareness and their environmental impacts as well as the college's reputation for the future.

**Objectives for developing a Green Fund @ Colby-Sawyer College:** Some of the initiatives developed by Green ROUTES are to mitigate Colby-Sawyer College greenhouse gas emissions, reduce energy usage, educate the community on green purchasing options, examine options for improved building renovations, have more recycling opportunities and increase use of alternative transportation. It is important to bring the reality of all environmental concerns and the impact the society has to this campus. By increasing Colby-Sawyer College's awareness and impact on the environment as well as those within this community we are educating and making efforts to create a difference and decrease our environmental impact. Green ROUTES has created a survey that was distributed to student's faculty and staff in the spring semester of 2007. This survey will give an understanding and perspective of where people are in terms of education of environmental impacts, and awareness of how to decrease the size of their environmental footprint and help locally and globally. By creating a Green Fund at Colby-Sawyer College it would be beneficial to the environment as well as this campus. The Green Fund would also contribute to benefits in the future of the college that have to do with its own impact on money spent.

**Benefits:** Benefits of creating a Green Fund at Colby-Sawyer College are that it not only there to raise money to help decrease our environmental impact, it also would help decrease the costs here at Colby-Sawyer College for energy use, electrical costs, and water usage. The benefits that could come from having this fund allow for changes to be made on this campus. With funds students, faculty, staff and whoever else is involved to make a change. Changes could range from adding a wind turbine on campus, developing a recycling center and program here or making possible changes within dormitories by adding recycling bins within the dorm rooms for students to have access to. Even with developing a recycling system raising the help to make these changes possible.

**Disadvantages:** There are very few disadvantages that would come from having a Green Fund at Colby-Sawyer College. It would be time consuming in the development of the Green Fund. As far as research from other institutions there has not been any specific identification of disadvantages of a Green Fund. The other downfall of such topics

involving the environment provokes the question of support. The fact of the matter is there is a lack of support that makes it more difficult to just develop such policies, like a Green Fund and programs at this institution. There are many opportunities that would come from a Green Fund. Through research conducted by Green ROUTES members and BUS 321 class in the Fall of 2006, each developed a Cost Benefit Analysis showing the details of water, paper, printer, light bulb and building savings that could happen in the near future if we have proper resources. The resources may include Green Fund, doing projects over time that would decrease this college's environmental impact.

**Alternatives:** An alternative idea would be an authorization from the President's office, supplying a grant for environmental sustainability programs, for a Green Fund. Supplying a price per year could be as minimal as \$5,000. By having a Green Fund, an example of where the money could be used would be installing motion sensor lights, conserving energy and saving money. There are many actions that could be taken with such a policy for a yearly contribution to a Colby-Sawyer College Green Fund.

**Websites/Links:**

- Yale Green Fund  
<http://www.yale.edu/recycling/greenfund.html>

## **Insulation**

Comparing the insulation quality of old and new buildings

**Chris McClellan**

### **Green ROUTES Recommendation Level : II**

**Overview:** Insulation is essential to efficiency in a building. Without insulation, buildings would lose heat very rapidly, and subsequently have drastically higher heating and cooling costs. Insulation efficiency and quality can be measured by comparing surface temperatures of opposing walls in the same room, as well as the inside and outside temperature of the exterior wall of the aforementioned room.

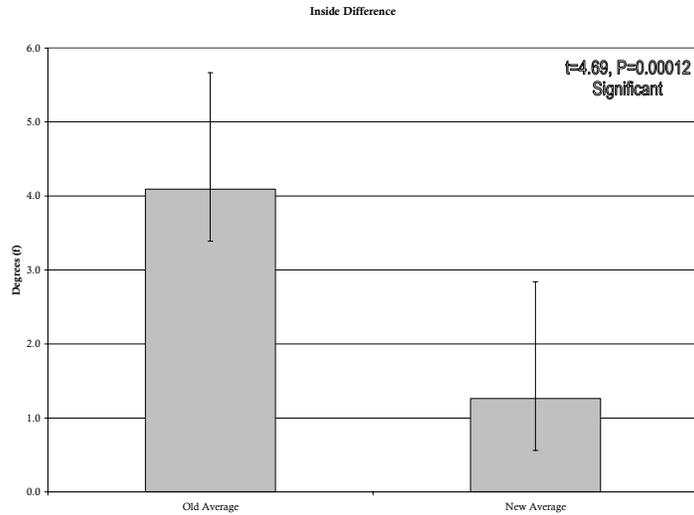
**Objectives:** To determine the effectiveness of the insulation in several new buildings on campus as compared to several old buildings on campus. This would indicate if the new buildings are more efficient in terms of insulation than the old buildings, as they should be. It could also pinpoint which buildings may need to have new insulation installed, so as to improve their energy efficiency; a step towards reaching campus sustainability.

**Data:** Surface temperatures were recorded with an infra-red temperature gun on three different walls in each representative room surveyed. The walls measured were the outside exterior wall, the inside exterior wall, and the interior (neutral) wall. Three measurements were taken for each wall and averaged out for the sake of accuracy. The numbers were then compared as follows: The temperature difference of the inside exterior wall to the outside exterior wall indicated the insulation quality of that one wall. The temperature difference of the inside exterior wall to the neutral wall indicated the overall insulation quality of the entire room, because the neutral wall represented the ambient temperature of the room, while the inside exterior wall indicated the effect on it from the temperature of the outside exterior wall. A greater difference between the inside exterior wall and outside exterior wall temperatures was ideal, representing minimal effect of low outside exterior wall temperatures on inside exterior wall temperatures, and thusly, more effective insulation. Conversely, a smaller difference between inside exterior wall and neutral wall temperatures was ideal because it indicated a very uniform ambient temperature, wall to wall, within the tested room, and thusly, more effective insulation.

**Findings/Graphs Continued:** Graph 1 compares the “inside difference” average of the old buildings versus the new buildings on campus. The inside difference is the measurement of the difference in temperature between the inside exterior wall and the neutral wall. As was mentioned before, this is an effective way of measuring the overall insulation quality of the room, and that a lower value is more desirable because it indicates higher effectiveness of insulation. As you can see, the new buildings average about 1.2 degrees difference from wall to wall, whereas the old buildings average about 4.1 degrees difference. This data, when coupled with a very

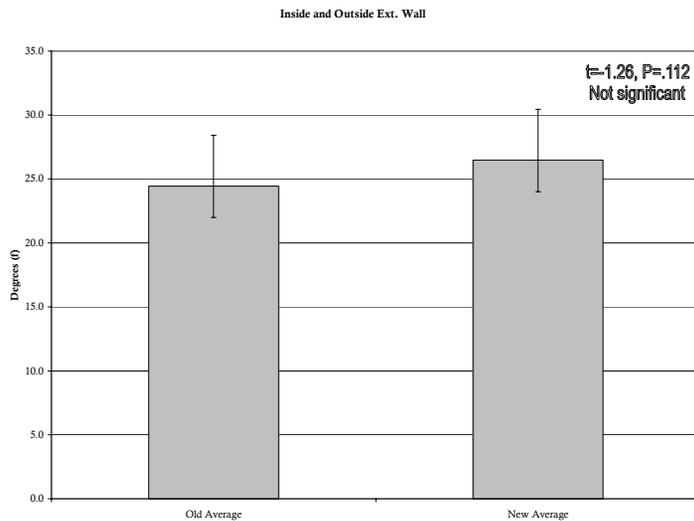
low p-value of 0.00012, indicates a consistently significant difference between the insulation quality of old buildings versus new buildings.

Graph 1:



Graph 2 shows the difference in old and new buildings between the inside exterior wall and outside exterior wall temperatures. As stated before, a large difference between these values would indicate effective insulation. As can be seen in graph 2, the new building average on the right side of the x-axis is more than 26 degrees, whereas the old building average on the left side of the x-axis is less than 25 degrees. This data would be conclusive, however, the p-value of 0.112 indicates minimal correlation in the data, which does not support a reliable conclusion.

Graph 2:



**Survey Results:** The survey taken in January yielded some interesting results which can be connected to new insulation installation.

Proper insulation is one key aspect of green building design; when asked if they were familiar with the term “green buildings” or “green design”:

- 66 percent of students answered “yes”
- 98 percent of faculty answered “yes”
- And 91 percent of staff answered “yes”

As a follow up question, students, faculty, and staff were asked how they feel about incorporating green design in future campus construction if there were neutral costs or money gains over time. The responses were distributed as follows:

- 77 percent of students agree or strongly agree, 23 percent reported no opinion
- 82 percent of faculty strongly agreed, and 18 percent agreed, which means that none of the faculty disagreed or had no opinion
- 99 percent of staff agree or strongly agree, only 1 percent reported no opinion on the matter

**Environmental Impact Statement:** The final aspect of insulation to assess is the environmental impact of installing new insulation in the buildings which showed the worst insulating properties. As with any major construction project, there would be a significant amount of trash or scrap material. Whatever old insulation needs to be removed before new insulation can be installed has to be factored in as waste. As part of the waste factor, disposal adds another dimension of environmental impact. However much old insulation must be removed from the walls before new insulation is put in, the same amount must be trucked away to a landfill or incinerator. This excessive trucking releases more greenhouse gas into the atmosphere than there would have been if the old insulation was left alone. It should be considered which option is more cost effective; extra trucking (and greenhouse gas emissions) plus disposal and new material fees factored with the cost savings of the new insulation, versus the waste disposal and new material savings of sticking with the old insulation and running less efficiently. Aside from the substantial waste factor associated with removing large amounts of old insulation, there is not a serious environmental impact involved with insulation replacement in the necessary buildings on campus. It should just be noted where the old insulation goes upon removal, so it is known how effectively and safely it is dealt with in terms of environmental health standards.

**Results/Conclusions:** Based on the conclusive data in graph 1, it is apparent that the new buildings on campus have significantly more effective insulation than the old buildings. The low p-value in graph 1 shows such a strong correlation between values that a conclusion may legitimately be drawn.

## **Motion Sensors**

Implementing motion sensors to reduce energy use

**Geoff Pushee, Sean Wheeler**

### **Green ROUTES Recommendation Level : II**

**Introduction:** Motion sensors are a good way to make sure that energy is being saved around campus. These sensors make sure that lights get turned off but yet come back on when needed. This ensures that lights are not left on and energy is not wasted. The implementation and buying of these products would ultimately save money over time with the amount of energy they would save and the decrease in the electricity bill. Motion sensors are an easy thing for Colby-Sawyer to implement in trying to make the school more green and environmentally friendly. By doing small things like this it will greatly help to assure that Colby-Sawyer lowers its overall impact on the environment.

**Objectives:** The main objective of this work plan is to switch over many of the light switches to motion sensors. Through doing this it will save the college money in energy costs and further reduce its impact on the environment. The main focus area is on classrooms throughout the entire campus where lights are frequently left on when they do not need to be. This would be the easiest place to incorporate these sensors and to ensure that lights are being turned off, thus creating lower energy bills and decreasing emissions.

#### **Methods/Procedures:**

- Lighting audit of various classrooms
- Determine how much per year it costs to light classrooms without motion sensors.
- Determine how much per year it costs to light classrooms with motion sensors.
- Look to see the best places to implement motion sensors

**Findings:** The analysis showed that Colby-Sawyer could significantly reduce the amount of energy it uses and save thousands of dollars through implementing motion sensors. An audit was conducted of the average time per week lights in classrooms were left on. It was found that many classes' lights are left on for ten hours a day which is fifty hours per work week. Then it was found that an average classroom was occupied 32.5 hours per week. If motion sensors were implemented this would mean that lights would be on 17.5 hours less per week than they would be without motion sensors or 910 hours less per year. It was then found using a classroom from the Curtis L. Ivey Science Center as an example that there are 36, 32 watt fluorescent tube light bulbs in that classroom. Using this and determining that one kilowatt hour is .12 cents this figures out that the college could save approximately \$110 per year, per classroom through implementing motion sensors.

**Benefits:**

- Motion sensors ensure that lights get turned off so that energy is not wasted.
- Motion sensors would also help to lower Colby-Sawyers overall Carbon footprint because of the energy saved from lights not being left on.
- Motion sensors help to save money spent on lighting because bulbs do not burn out as fast, because it ensures that they are turned off if nobody is in a room.
- Motion sensors are easy and affordable to be installed and they eventually will pay themselves off and save the college money, while also helping lower Colby-Sawyers impact on the environment.

**Disadvantages:**

- Motion sensors sometimes fail so you either have to have a back-up switch or else it could cause problems because people need light to do just about anything.
- If there is not a back up switch it could possibly lead to an increase in energy use because people do not always necessarily want lights on.

**Special Concerns:**

- Making sure that the motion sensors have back up switches.
- Making sure that people are educated and no not to use the back up switch unless it is completely necessary, but also making sure that they know there is a back up switch so that if they do not want the lights they can turn them off.
- Is it really necessary to put in motion sensors or can we really crack down as a campus and just turn out the lights when we do not need them?

**Recommendations:**

From the findings it would be a good idea for Colby-Sawyer to explore the possibility of installing motion sensors. As was shown from the finding they could save thousands of dollars per year in energy costs and reduce its impact on the environment. In our example we used the Curtis L. Ivey Science Center which has much lower wattage bulbs than older building so in these building they are spending even more money per year on lighting. These older building would be a good place to start in the implementing motion sensors. The initial charge of implementing motion sensors would be minimal to the amount of money that these sensors would save in the long run.

**Conclusion:**

It is important that motion sensors for lighting be looked into at Colby-Sawyer because it could be an easy way to lower the campuses overall carbon footprint and also save the college money in energy costs. These devices make sure that lights get turned off when people are not using them, and most have a back up switch or setting that you can use if you do not want the lights on. It would be important for people to understand that they should not use this switch to turn the lights on unless the motion sensor is failing, because then the same problem that the college faces now of having lights turned on would be back, and it would have been pointless for the implementation of these devices. These devices would save the college money and also help to further decrease its impact on the environment because of the reduce in energy use.



<http://www.espenenergy.co>

## **Paper: 100% Recycled**

Colby-Sawyer currently uses 100% non-recycled printing paper

**Geoff Pushee, Sean Wheeler**

### **Green ROUTES Recommendation Level : II**

**Introduction:** Everyday on the Colby-Sawyer campus the paper that runs through all of the copy machines and used in the printers is 100% non-recycled. It is possible for Colby-Sawyer to use 100% recycled paper and not cost the college that much more money. When looking at 100% recycled paper as compared to 100% non-recycled paper it is extremely difficult to tell the difference between the two. By using recycled paper the college could reduce the impact on the environment by reducing the number of trees that are cut down due to paper consumption.

**Objectives:** When looking into the topic of paper on the Colby-Sawyer campus it was determined that the impact that the school creates on the environment could be greatly reduced by simply switching the paper that the college uses to 100% recycled paper. Green ROUTES proposes that since the cost of this project would be approximately \$4 per student which is not a huge cost compared to the great benefit that the college would see environmentally.

**Findings/Graphs:** Five hundred sheets of paper equal one ream of paper, one ream of paper equals five pounds, CSC uses 12 tons of paper per year, and one ton of paper equals 24 trees. Colby-Sawyer uses 2,500,000 sheets of paper on average per year. Of these 2.5 million sheets 78% are used by faculty and 22% are used by students. The current amount of consumption on campus causes 288 trees to be cut down each year. If all of these sheets of paper were switched to 100% recycled paper the campus would not be responsible for any trees being cut down for paper consumption. Colby-Sawyer currently pays \$13,632 per year; by switching to 100% recycled paper it would cost approximately \$4 more per person.

**Survey Results:** Colby-Sawyer College should spend the extra money and make the shift to 100% recycled.

- 77.4% of students agree or strongly agree
- 91% of faculty agree or strongly agree
- 80% of staff agree or strongly agree

### **Related Items:**

- The use of double sided printers along with the switch to 100% recycled paper could greatly reduce our impact on the planet.
- Paper consumption could be greatly reduced by utilizing e-documents and double-sided printing.
- This initiative on campus could help to raise environmental awareness here on campus.

## **Pool Cover**

Saving energy with a heat-trapping thermal pool cover

**Chris McClellan**

### **Green ROUTES Recommendation Level: II**

**Overview:** The purchase and use of a thermal (insulating) pool cover for the swimming pool in the Dan and Kathleen Hogan Sports Center when it is not in use at nights and during periods of off-time could save money for the school. The Dan and Kathleen Hogan Sports Center pool is heated, and at night, a great amount of heat is lost off the surface of the water, resulting in more heating energy being needed to keep the pool's temperature stable. A thermal cover would minimize the heat loss during these times of no use, reducing heating costs. According to the U.S. Department of Energy, "The reason evaporation has such an impact on pool operating cost is that evaporating water requires tremendous amounts of energy. It only takes 1 BTU to raise a pound of water 1 degree, but each pound of 80° water that evaporates take a whopping 1048 BTU's of heat out of the pool! [With a thermal pool cover,] savings of 50 % - 70% are possible" (U.S. Department of Energy). Even if we get just 50% savings, that is already a huge gain.

**Data:** The pool in Dan and Kathleen Hogan Sports Center is 45 by 75 feet, which means a total of 3,375 square feet of water lays uncovered all night, every night when the pool is not even in use. According to the Recreonics website, a 10 x 10 outer layer density cover, which could equate to a 50% savings of heat loss, would cost \$1.29 per square foot, for a total of \$4,353.75. A 12 x 12 outer layer density cover, which could save up to 70% of heat loss, would cost \$1.55 per square foot, for a total of \$5,231.25. Total estimated heat savings per year: \$3000.

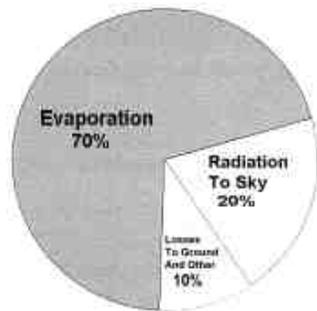
**Environmental Impact:** While there is no negative environmental impact associated with the purchase of a thermal pool cover, other than the obvious trucking impact of getting the cover here, it is important to assess the positive impact of such a purchase. The cover is expensive, undoubtedly, but what needs to be determined if this idea is to be taken seriously, is the costs currently paid to heat the pool. If these costs can be determined, it would be very simple to predict how much money can be saved, simply by applying the same 50% to 70% savings to the costs. Overall, a thermal pool cover would have positive environmental impact by reducing energy needs along with costs. Just how great this impact will be can be determined by establishing a system to monitor how much of the hot water heating costs go directly to the pool.



**Related items:**

- Electric heat pumps versus traditional heating systems' cost efficiency

Pool heat loss:



[http://www.flasolar.com/heat\\_loss.htm](http://www.flasolar.com/heat_loss.htm)

**Websites/Links:**

- Recreonics  
[http://www.recreonics.com/thermal\\_pool\\_covers.htm](http://www.recreonics.com/thermal_pool_covers.htm)
- SwimmingPool.COM  
[http://www.swimmingpool.com/articles/pentair\\_heaters.aspx](http://www.swimmingpool.com/articles/pentair_heaters.aspx)

## **Printers: Double Sided**

There are over three hundred printers on campus.  
Are all of them necessary, or could they be replaced by network printers?

**Sean Wheeler**

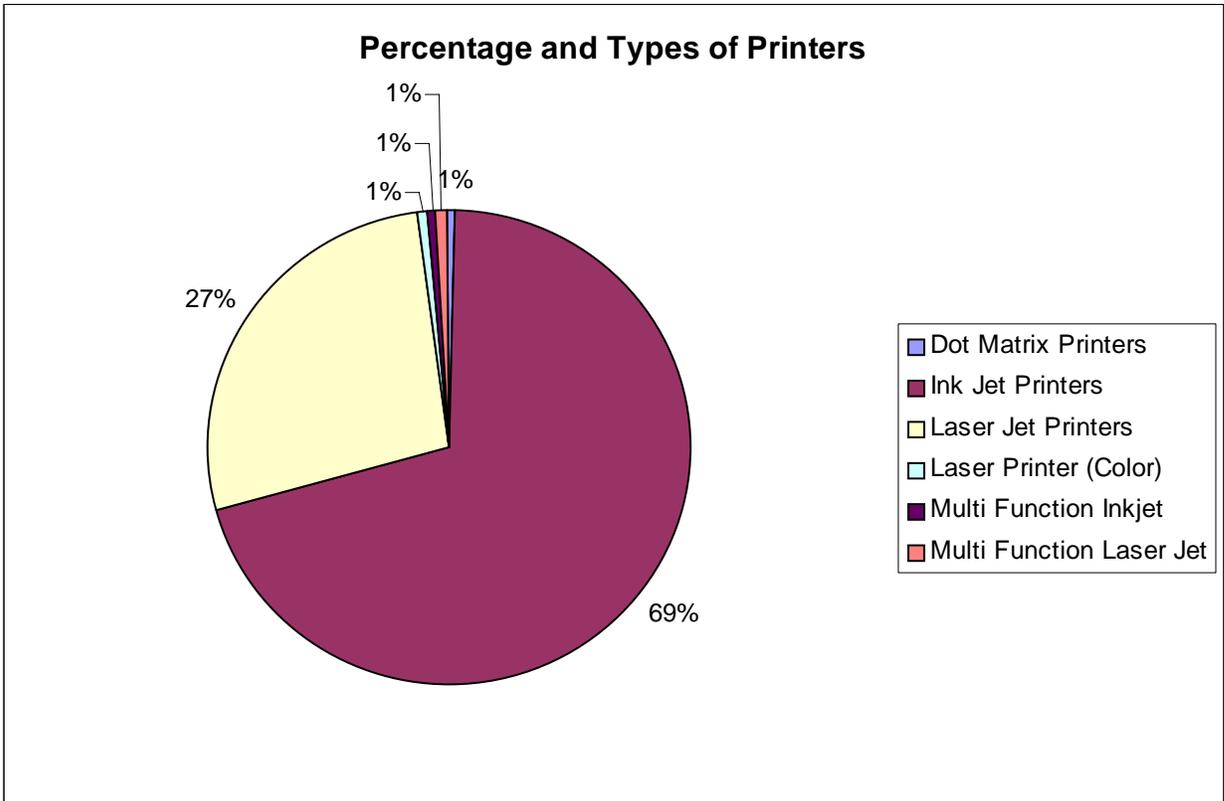
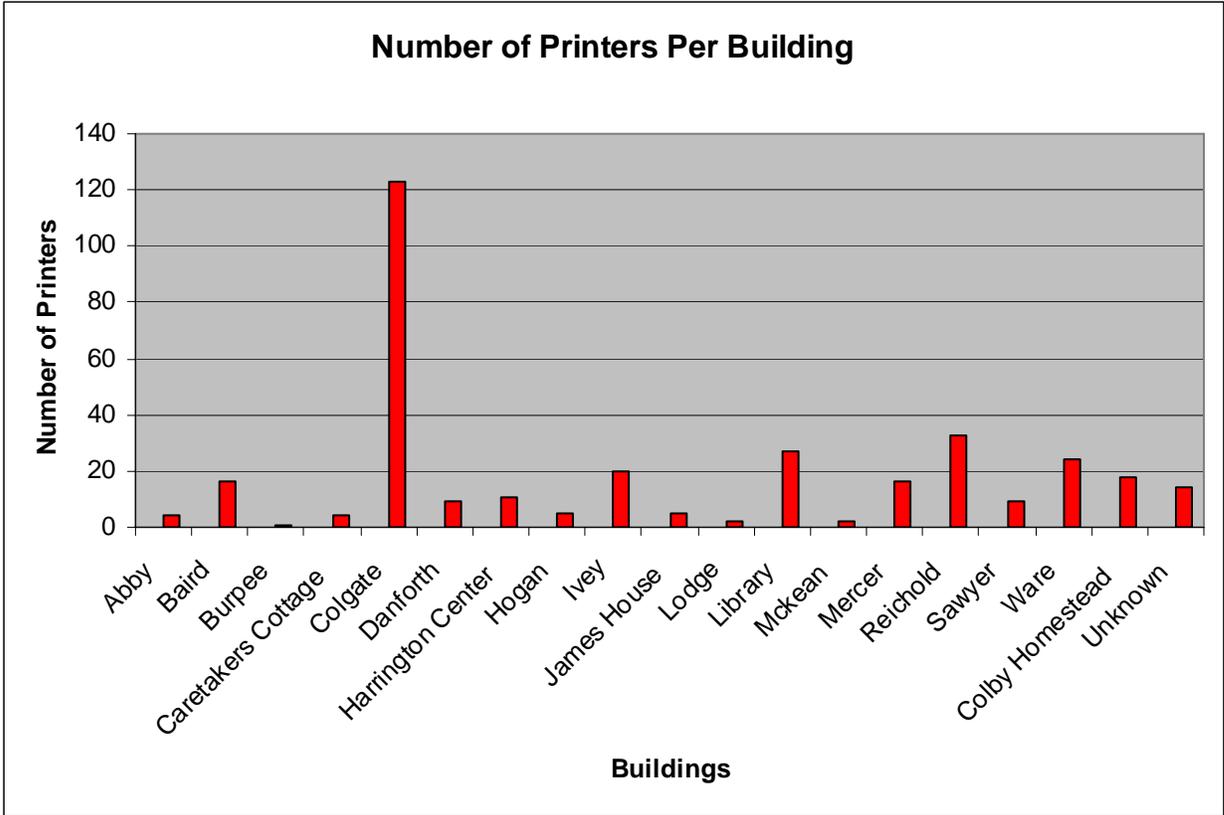
### **Green ROUTES Recommendation Level : II**

**Introduction:** Colby-Sawyer College currently has approximately 343 printers in use on campus. Most of the printers used by the college have only a capacity to be able to be hooked up to one computer at a time and are not Energy Star rated. If the college were to use fewer printers which had the capacity to print double sided, it could not only reduce its energy costs, but it could reduce the amount of paper we use. When looking at the data it is easy to see that the majority of printers on campus are located in Colgate (123). Colgate has 100 rooms, if 23 printers were taken out of the building there would be one printer for every room. This includes the classrooms which do not even have printers. If we were to switch to network printers we would need only one or two printers per floor compared to 123.

**Objectives:** This analysis looked into double sided printers and focused on Colgate as an area where a big difference could be realized in the number of printers in use, the paper usage, and energy use. The first thing was to try and reduce the number of printers in Colgate with an ultimate goal of turning it into a double sided network printing environment.

**Methods/Procedures:** The project was started with a list of all of the printers that are located on campus with a focus on Colgate. This allowed Green ROUTES to see what could realistically be done in Colgate in terms of switching printers, taking printers out, and possibly even getting a network environment started there.

**Findings/Graphs:** It was determined that a high volume double sided black and white printers cost approximately \$2,400, which sounds like a lot, but if only three or four were needed in one building, it would be comparable price wise, to having a printer in each room. In terms of energy and paper efficiency, the printers would begin to pay for themselves much quicker than a desk jet could. The pie graph below indicates which type of printer is most predominating on campus, which is the HP ink jet printer. The bar graph shows the dispersion of printers of campus and shows clearly that most of the printers on campus are located in Colgate. These graphs can help with putting this plan into action and slowly changing things in Colgate and on campus.



**Results/Conclusions:** This is an area with great possibilities where energy and paper could be saved. Colgate hall is also a high traffic area where people would see what is being done; this could raise more interest for other projects.



## **Printers: Energy Star**

Saving energy by using Energy Star printers

**Geoff Pushee**

### **Green ROUTES Recommendation Level : II**

**Introduction:** The goal of this project is to reduce and replace many of the personal non-energy star printers with Energy Star printers. Throughout the campus there are 343 printers most of which are not Energy Star. Energy Star printers save approximately thirty dollars per year in energy savings as compared to non Energy Star. These printers are a little more expensive but with the savings in energy cost the school would break even in a very short amount of time. With the implementation of Energy Star printers Colby-Sawyer could significantly reduce their ecological footprint and save thousands of dollars in energy costs.

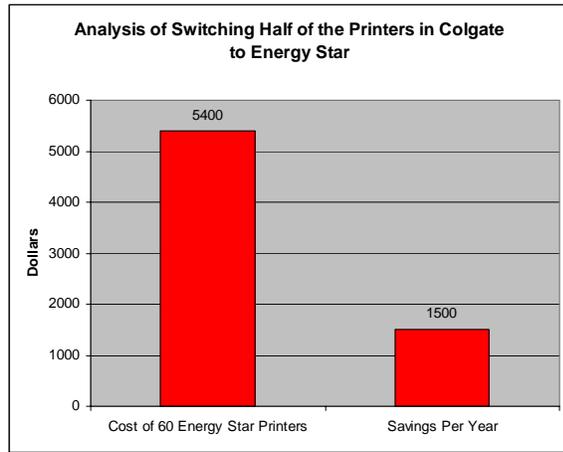
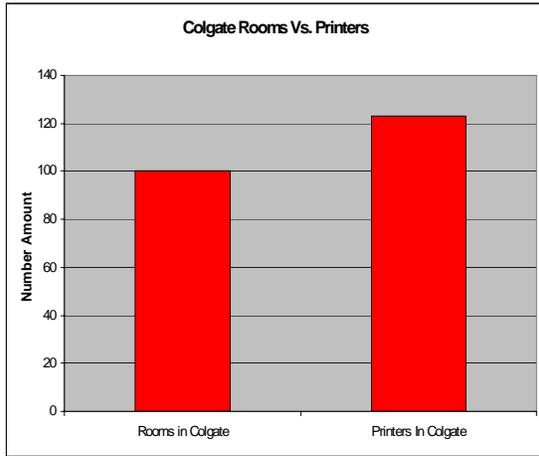
**Objectives:** The main objective with this project is to switch over from using non Energy Star printers to Energy Star printers. Through this the college money in the long run and reduce its impact on the environment. Right now the main focus is on Colgate where there are more printers than rooms. This building is the biggest area of concern in this subject and is a good place that can be focused on and a huge difference can be made.

#### **Methods/Procedures:**

- Printer audit of the whole campus.
- An individual audit of Colgate.
- Determine the number of rooms vs. number of printers in Colgate.
- Determine where printers can be gotten rid of and where they can be replaced by energy star printers.
- Calculate how long it will take Colby-Sawyer to break even in the implementation of Energy Star printers.

**Findings/Graphs:** The findings show that there are 123 printers in Colgate and there are only 100 rooms. Personal use Energy Star printers are around eighty dollars a piece. It was determined by Green ROUTES survey that most professors like to have a personal printer in their office. It was found that if 60 of the non Energy Star printers were replaced, with a savings of thirty dollars per printer a year, the original cost of the sixty printers would break even in approximately three and a half years. This would be win-win because it would allow for Colby-Sawyer to reduce its carbon footprint, and also keep professors happy.

Green ROUTES Project Report



**Benefits:**

- Energy Star printers save \$30 a year in energy costs per printer when compared to ordinary printers.
- Energy Star Printers use a significantly less amount of energy producing less carbon emissions and decreasing the college's carbon footprint greatly.
- CSC can reduce its carbon footprint because of the reduction in energy that would result from the energy star printers.
- Double sided printers would significantly decrease the amount of paper used by the college which would in turn reduce the college's ecological footprint because they would not be using as many trees to support their paper needs.

**Disadvantages:**

- Creates waste

**Special Concerns:**

- Disposal of old printers
- Do double sided printers use less energy?

**Conclusion:**

Energy star and double sided printers could possibly be a huge area that Colby-Sawyer College could look into in the future in significantly reducing their impact on the environment and also saving themselves money. An energy star printer saves approximately thirty dollars per year in energy savings as compared to non-energy star printers. Because they use less energy by working off of a lower power settings the school would not produce as much carbon emissions which would significantly reduce their carbon footprint. With the introduction of double sided printers Colby-Sawyer would use less paper, further decreasing their environmental impact by using fewer trees and eventually the printers would be paid off by the money saved in the amount of paper consumed.

One problem with switching over to new printers is that it creates waste. There are a lot of printers on this campus and if most or even some of them were to be replaced they would have to go somewhere and these old printers could have a significant impact on the environment if not disposed of properly. This is a special concern that needs to be thought about when looking into this project. Another special concern is do double sided printers actually save money with the decrease in paper that they use, because they might actually use more energy. So even though you might be gaining in one aspect environmentally with using less trees, does the increase in carbon emissions that may come from these printers out weigh the benefit of using less tree's?

**Recommendations:** From the findings it is very clear that Colby-Sawyer should put effort forth into converting their printers over to Energy Star printers. Switching over does not only help to reduce our carbon footprint but will also save the college thousands of dollars in the years to come. The college also can look into simply just getting rid of many printers, especially in Colgate where there are more printers than rooms. Switching to Energy Star printers and reducing the overall amount of printers on campus are two simple ways that Colby-Sawyer can save money and be more green. It should be a

priority for the college to implement these printers and ideas within the next one to three years.

**Websites/Links:**

- Energy Star  
[www.energystar.gov](http://www.energystar.gov)
- Hewlett-Packard  
<http://www.hp.com>

## **Recycling**

Reduce, Reuse, RECYCLE

**Stephanie Goggin**

### **Green ROUTES Recommendation Level : II**

**Recycling Objectives:** Expanding the current recycling program at Colby-Sawyer College is an important part of greening our campus. Janet St. Laurent started a small scale program five years ago, and now it is time to expand it.

**Current Initiatives:** Currently on Colby-Sawyer Campus it is possible to recycle paper, bottles, and cans. The bins for recycling these materials are located on the first floor of each dorm, and at least one station in each non-residential building. Recent initiatives have been put in place to recycle old cell phones and batteries. Bins for these recycling initiatives can be found in the purchasing office, the Susan Colgate Cleveland Library Learning Center, the Curtis L. Ivey Science Center Science Center, James House and the Campus Activities Office in Ware Campus center.

**Recommendations:** Expand the recycling program currently on campus to include:

- Small recycling bins in each dorm room and office group
- Recycling Centers on more floors of dorms and administrative buildings

### **Survey Results:**

- **60%** of students would welcome recycling bins in their dorm room and would be more likely to recycle with these bins.
- **76%** of students, **86%** of faculty and **87%** of staff currently make efforts to recycle cans, bottles and paper used on campus.

“I would very much like to see an increase in the number of recycling areas in dorms. I know many people who would be much more likely to use the recycling centers if they were more readily accessible, or if they were promoted more; some people just aren't aware of them!” *student comment on survey*



Institute for Community and Environment

Colby-Sawyer College

**Curtis L. Ivey Science Center Recycling Station:**



**Recycling Center:**





## **Water**

High vs. Low Flow Toilets / Urinal Audit

**Kris Ramsay**

### **Green ROUTES Recommendation Level : II**

**Changing Colby-Sawyer's Culture:** Green ROUTES's goal is to make Colby- Sawyer more environmentally friendly and to lessen the schools ecological footprint. One area we of potential improvement is water conservation. This can be done by focusing on the replacement of toilets and urinals.

**Leadership in Environmental Water Sustainability Objectives:** To determine how many low flow (1.6 Gallons per Flush) and high flow (3.5-6 Gallons per Flush) toilets Colby Sawyer has. To conclude the amount of money and water Colby- Sawyer would save if all high flow toilets were converted to low flow, a complete dorm and academic buildings audit was conducted. Also to determine how many toilets could be replaced with urinals around campus in men's bathrooms.

**Methods/Procedures:** By physically walking in each dorm and academic building, reliable data was found on how many low flow and high flow toilets there are on campus. After doing this the data was compiled into Microsoft Excel to compare the amount of gallons used over a period of 32 weeks (student school year) between the two toilet types. Working hand and hand with the Business 321 class, calculations were made to determine that a gallon of water cost 17 cents. With this figure calculations were made to find the total cost of both high flow and low flow toilets to the school and then compared them in terms of money and gallons used.

**Results/Conclusions:** A study at Stanford University determined an average rate of 11 flushes per day for a typical college toilet.

(<http://daily.stanford.edu/article/1999/1/7/columnTheRoarOfUniversityToilets>)

For Colby- Sawyer College this rate was used over a 224 day academic year.

**Total High Flow:** 119

Gallons Used Per Year: 1,744,512

Cost Per Year: \$ 28,949.67

**Total Low Flow:** 131

Gallons Used Per Year: 520,396.8

Cost Per Year: \$ 8,635.83

**Recommendation:**

If all High Flow Toilets were replaced with Low Flow the initially cost would be \$35,400, but would save:

**Per Day: \$94.75**

**Per student year: \$21,224**

**Toilets would be paid off in: 373 Days**

**What if replace 26 toilets with no flow urinals...**

Cost of Urinal = \$400

Total Cost = \$10,400

Savings Per Year = \$5,616.58

**Replace 26 toilets with 1 gallon urinals...**

Cost of Urinal = \$300

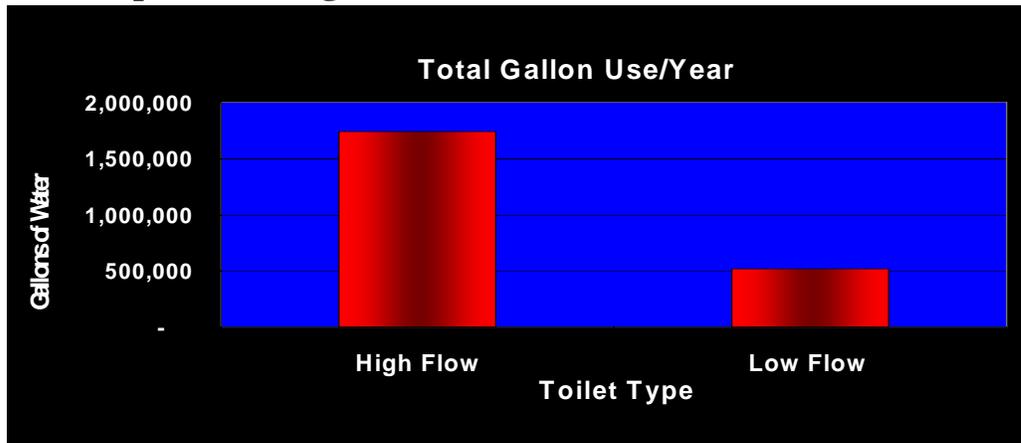
Total Cost = \$7,800

Savings Per Year = \$4,527.49

**Meaning:** Initially it may seem expensive to replace all high flow toilets with low flow toilets or urinals but in just over a year the school would be saving thousands of dollars.

**Findings/Graphs Continued:**

**Gallons per Year Right Now**

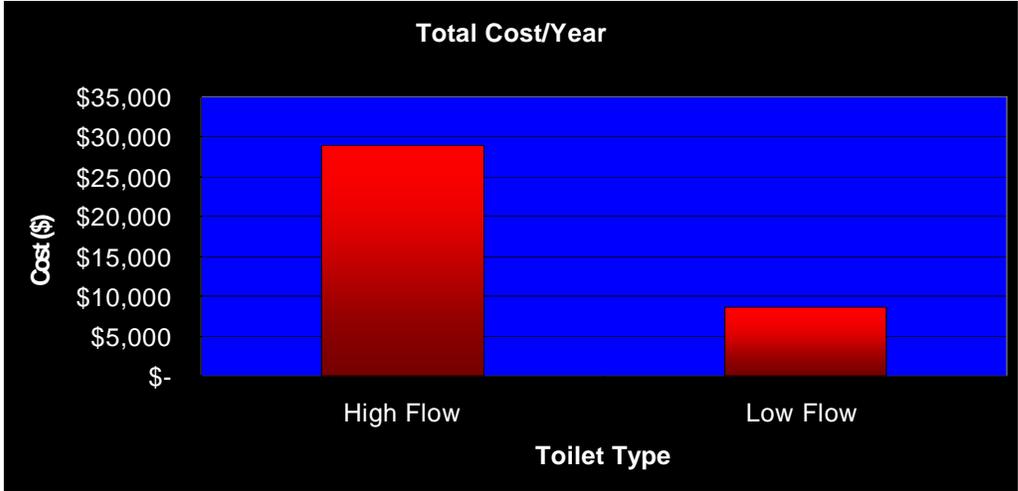


**Cost Per Year:**

Total Cost Per Gallon = **.17 cents**

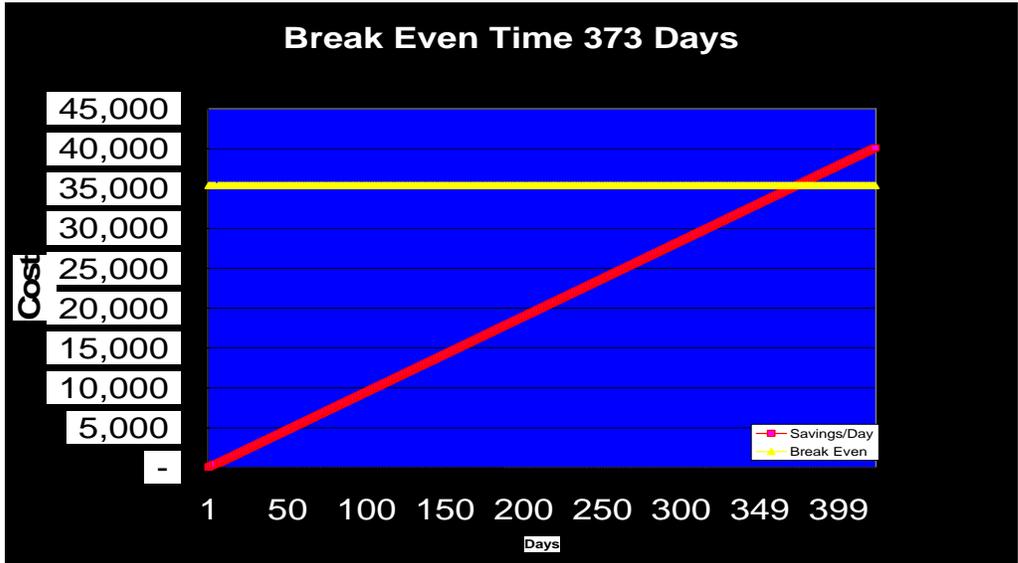
Total Cost Per Person = **\$34.74**

Total Gallon Use Per Person = **2,093.3**



Total Cost = \$37,585.50

If Replace all High Flow with Low Flow Toilets



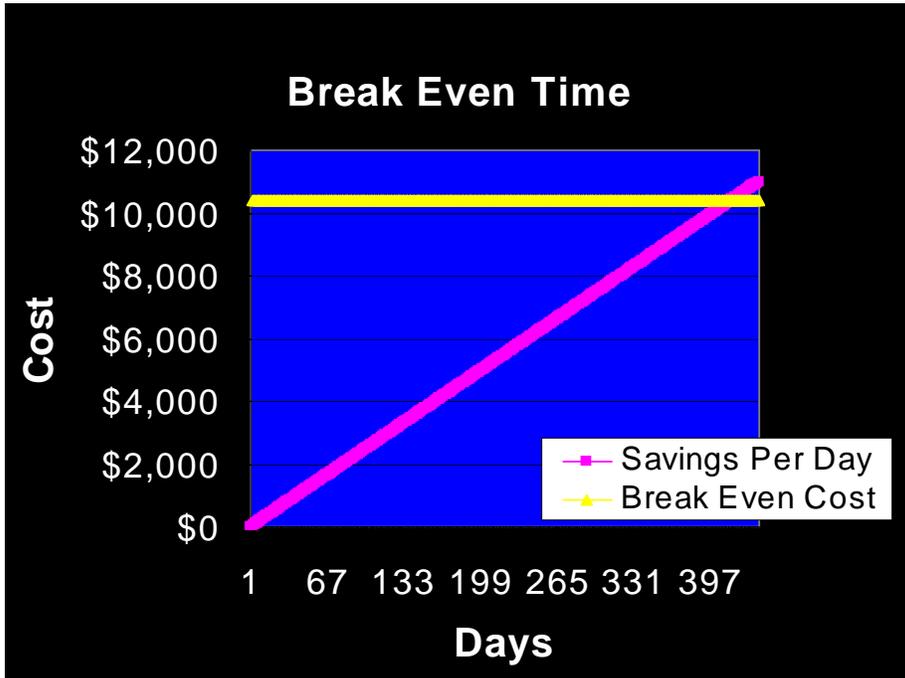
Saving/Year = \$21,230

Total Cost to Replace 119 toilets = \$35,400

Breakeven= 373 Days

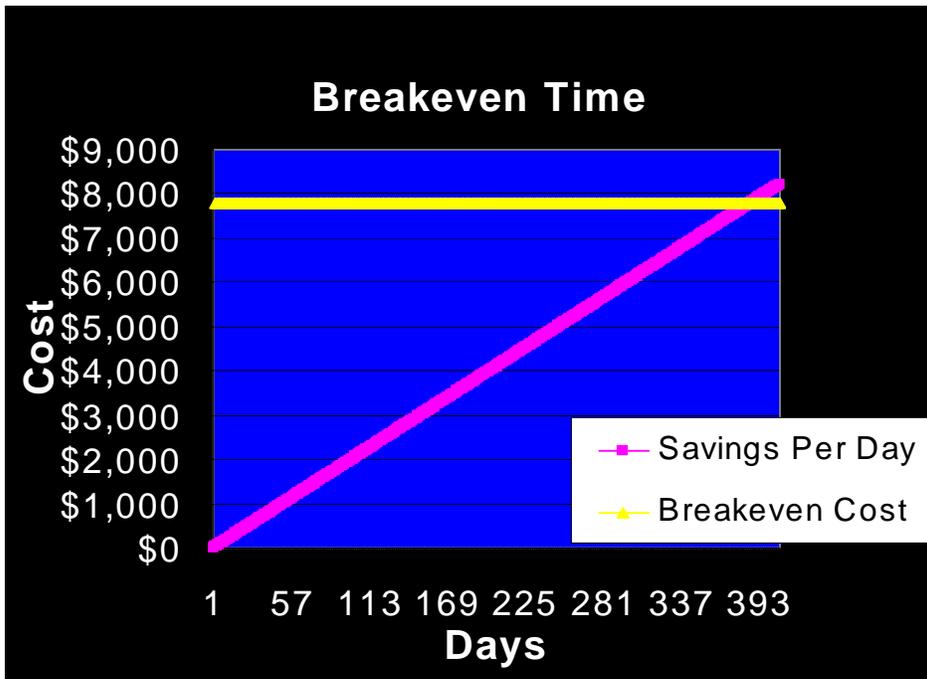
Findings and Graphs continued:

What if replace 26 toilets with no flow urinals...



Breakeven Point = 415 days!

Replace 26 toilets with 1 gallon urinals...



Breakeven Point = 386 days!

**Environmental Impact Statement:**

**Disadvantages/ Options to consider:** One other question the school would have to ask itself is what to do with all the porcelain toilets once they are taken out. It would be best if they could be recycled somehow. One option is to work with Richard Lee, Public Works Director in New London at 526-6337. Lee stated that, “The town of New London would be more than happy to help with the recycling of the old toilets if they are porcelain. We would take all the metal parts out of them and put them in with the glass we recycle. We have the glass ground up and use it in road rebuilding projects. New London has a collection site where they accept mixed glass (which includes porcelain toilets & sinks with the metal removed). This material is crushed by a commercial crusher and made into PGA (processed glass aggregate) which is reused for drainage, road base, etc. in the place of crushed gravel.” In doing this the school would know that all of the toilets are being recycled properly and being reused.

**Methods/ Procedures:** If Colby- Sawyer does not feel they have the money to replace the toilets all at once, they could make a plan to replace approx 38 high flow toilets with approx. 30 low flow and 8 urinals each year. This would still significantly reduce the amount of water coming in and out of the school, in turn drastically reducing the cost of water being used for toilets around campus. Once all 119 high flow toilets are replaced with the 93 low flow toilets and 26 urinals, the school could look at its water bills over the past 3-6 years and could determine exactly how much money and water has been saved.

**Conclusion:** By replacing all the high flow toilets with low flow toilets Colby-Sawyer would be taking a huge step forward in lessening its ecological footprint and becoming more environmentally friendly. Also, in less than approximately 2 years the school could pay off the replacement fees and actually be gaining money by using less water throughout the entire year. This could possibly gain the school positive attention, in turn bringing in more donations and a higher student enrollment.

**Websites/Links:**

- Advanced Buildings  
<http://www.advancedbuildings.org/>
- State of Michigan Water Efficiency Guidelines  
[http://www.michigan.gov/documents/CIS\\_EO\\_GLM\\_Water\\_conservation\\_156170\\_7.pdf](http://www.michigan.gov/documents/CIS_EO_GLM_Water_conservation_156170_7.pdf)
- City of Charlottesville, Virginia Toilet Rebate Program  
<http://www.charlottesville.org/Index.aspx?page=679>

***Level III Priorities***

**Carbon Footprint**

Going carbon neutral by purchasing carbon offsets

**Stephanie Seavy**

**Green ROUTES Recommendation Level: III**

**Introduction:** Carbon offsets are credits for emission reductions achieved by projects elsewhere, such as wind farms, solar installations, or energy efficiency projects. Purchasing carbon offsets will enable Colby-Sawyer College to reduce the CO<sub>2</sub> emissions it is responsible for offsetting, reducing or displacing the CO<sub>2</sub> in another place, typically where it is more economical to do so.

**Objectives:** To solve the problem of climate change, we all need to take account of our personal carbon emissions and make continued efforts to reduce them wherever possible. But it is impossible to reduce our carbon emissions to zero, no matter how hard we try. Going carbon neutral by purchasing carbon offsets is a practical and affordable way to do something about those remaining emissions.

**Methods/Procedures:** Colby-Sawyer College would have a lot of flexibility in choosing their carbon offset program. For example the College could chose to offset just the electrical energy used by the dorms or could go as far as offsetting the carbon emissions caused by student, staff and faculty commutes. Colby-Sawyer College could also create a program where students have the option to pay an additional amount of money each year (it is \$70 at University of Colorado) to offset their CO<sub>2</sub> while at school.

**Colby-Sawyer College's Carbon Footprint Calculation**

- Green ROUTES Project used Clean Air Cool Planet's carbon calculator to determine how much CO<sub>2</sub> Colby-Sawyer College emits each year.

The results of the carbon calculator are:

<u>Year</u>	<u>Net Emissions (Metric Tons CO<sub>2</sub>)</u>
2003:	5,142
2004:	5,713
2005:	6,671
2006:	6,887

The results show that Colby-Sawyer College's net CO<sub>2</sub> emissions have gone up every year. This is most likely due to new buildings.

*Colleges already purchasing carbon offsets:*

College of the Atlantic:

100% electrical

Linacre College, University

Middlebury College:

100% Snow Bowl ski area

University of Southern Maine

1.5 million kilowatt-hours to power two green buildings

University of Colorado

Students can choose to offset their CO<sub>2</sub> emissions while at school by paying an extra fee to live in the dorms.

**Modified Environmental Impact Statement for Purchasing CO<sub>2</sub> Offsets at Colby-Sawyer College:**

**Pros**

- **Help the USA transition to renewable energy:**
  - Purchasing carbon offsets from projects like wind farms help support the transition to a sustainable energy economy by providing additional revenue to renewable energy developers.
- **Being a leader in the academic field**
  - Colby-Sawyer College will become an example of how institutions of higher education can take progressive steps towards reaching environmental sustainability. Setting this example will encourage other academic institutions to progress towards sustainability.
- **Being an example for the students and community**
  - Purchasing carbon offsets will illustrate Colby-Sawyer College's institutional commitment of sustainability.
- **An immediate action Colby-Sawyer could take to help stop climate change**
  - Colby-Sawyer should consider contacting a company like Native Energy or Sterling Plant that sell carbon offsets and the chosen company would then calculate the College's emissions and inform the College how much it would cost to offset all or part of the emissions.

**Cons**

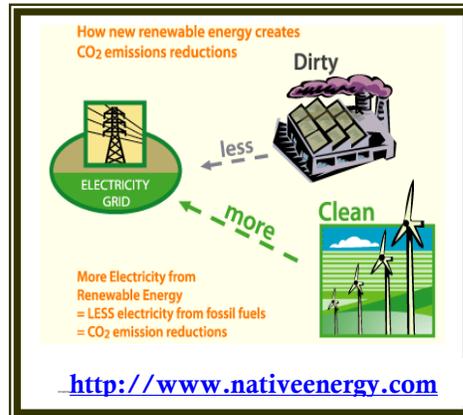
- It is important to remember that purchasing CO<sub>2</sub> offsets should be done in addition to also instituting a comprehensive energy conservation program at CSC.
- **Questions about the significance of CO<sub>2</sub> offset programs**
  - There is no industry standard for U.S.-based carbon offset organizations. As a result, these organizations vary greatly in how they calculate carbon emissions, how much they charge to offset one ton of CO<sub>2</sub> emissions (ranging from \$4 to \$12 a ton).
- **Questions about the accountability of CO<sub>2</sub> offset programs**
  - Organizations have many different methods for offsetting CO<sub>2</sub>. These methods range from planting trees, to building wind farms. There is debate around how much carbon these different methods actually offset. When choosing to offset carbon pollution, Colby-Sawyer College must research which type of carbon offsetting method is most effective and then research the numerous companies that sell carbon offsets to find a reputable and accountable organization.

**Related items:** It is important to remember that purchasing CO2 offsets should be done in addition to also instituting a comprehensive energy conservation program at CSC.

**Websites/Links:**  
[www.dauidsuzuki.org/.../carbon\\_neutral.asp](http://www.dauidsuzuki.org/.../carbon_neutral.asp)  
<http://www.nativeenergy.com/>  
<http://www.carbonfund.org/>  
[http://www.ecobusinesslinks.com/carbon\\_offset\\_wind\\_credits\\_carbon\\_reduction.htm](http://www.ecobusinesslinks.com/carbon_offset_wind_credits_carbon_reduction.htm)  
[http://www.usatoday.com/money/industries/energy/200703-02-offsets\\_N.htm](http://www.usatoday.com/money/industries/energy/200703-02-offsets_N.htm)

**CSC Staff member quote from Green ROUTES 2007 Survey:**

“I’d love to see CSC look into offsetting their energy use with green credits through an organization like nativeenergy.com.”



## **Composting**

Composting is an easy way to reduce the amount of solid waste, while creating a valuable resource

**Brian Valle**

### **Green ROUTES Recommendation Level: III**

**Introduction:** Composting, although messy, is a great way to cut down on the amount of solid waste and its disposal. There are many advantages to composting both post and pre-consumer waste, other than the reduction of sold waste and the low cost of the disposal. First, the return of our waste back to the land is both cost effective and natural. By producing compost, our facilities department will be able to mix the 100% organic material, with screened loam. This produces a more nutritious soil for the use in the landscape of the campus. Also, the opportunity for more student involvement and can give more understanding to the macrobiotic breakdown process that occurs within the compost. Moreover, the prospect for large scale composted creates more job openings in this field. For large scale composting to be possible it would need to be outsourced. This is due to the size of the necessary equipment and potential for unpleasant aroma.

**Objectives:** The scale of composting which the college would need to compost 100% of its food waste is unfortunately out of our reach. Currently the college works with local pig farmers along with a local student to compost some of the pre consumer food waste.

**Methods/Procedures:** The food waste challenge as a part of Sustainability Days is an awareness building activity. The intention of this activity was to show the campus how much food is wasted off of the average plate. Through the smart card system the class was able to obtain information about how many people entered the dining hall during the hours of the contest. For the sake of competition and fun the contest was men against women. The gender information was also available through the smart card system. The information was then used to proportionally judge the contest. (See Sustainability Day section of the report for results and analysis).

### **Findings:**

- **Small scale:** The Earth Tub, allows for composting of up to 200 pounds per day of organic mater.
- **Large scale:** The Containerized Composting System (CSS) allows for on sight composting with minimal smell. This system is capable of compositing between 1-100 tons of was per day.
- **Open compost:** An open compost area is low in cost; however there are many draw backs to this type of operation. There needs to be the right mixture of organic material to minimize the smell while maximizing the break down.

## Green ROUTES Project Report



### **Websites/Links**

- [Compost calculator](http://www.klickitatcounty.org/SolidWaste/fileshtml/organics/compostCalc.htm)

## Dining Services

Reducing our ecological footprint and saving money with Energy Star equipment

Kris Ramsay

### Green ROUTES Recommendation Level: III

**Objectives:** Food service equipment in the Ware Dining Hall uses a lot of energy and power to both cool and cook the food. Once the equipment needs to be replaced Green ROUTES is looking to convince Colby- Sawyer to only purchase Energy Star products so to save as much money as possible and lessen the schools ecological footprint on the environment. Over time it would be beneficial both environmentally and economically for Colby- sawyer to have all the equipment in the dining hall to be Energy Star. Energy Star equipment is in more than 50 categories. They use less energy, save money, and help protect the environment. It is a voluntary labeling program of the US Environmental Protection Agency (EPA) and the US Department of Energy that identifies energy efficient products. Qualified products exceed minimum federal standards for energy consumption by a certain amount, or where no federal standards exist, have certain energy saving features. Such products may display the Energy Star label.

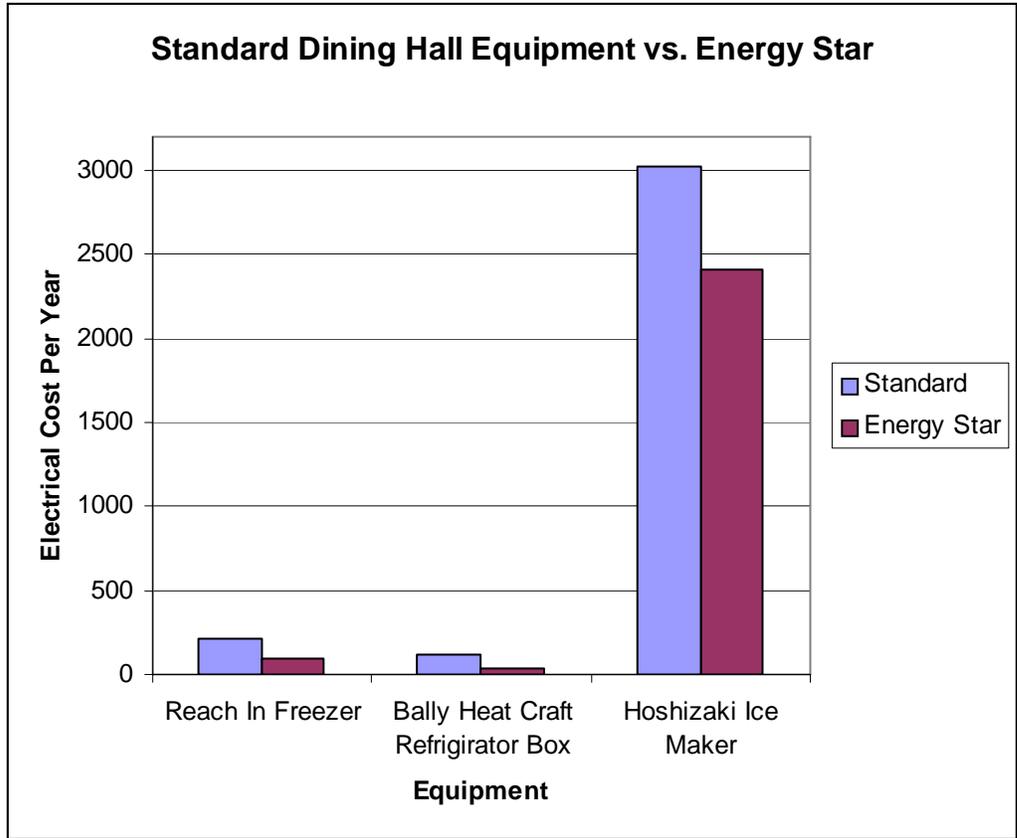
**Methods/Procedures:** A small audit was conducted on several major pieces of dining equipment including the gathering of the equipment model names and numbers. Once this is accomplished, the Energy Star website was utilized to determine how much money and energy Colby- Sawyer would save if a few pieces of equipment were switched from a standard efficiency machine to an Energy Star certified machine. This would be a long term plan in which as old machines needed to be replaced they are replaced with an Energy Star machine.

**Recommendations:** As the equipment wears out and needs to be replaced the school should make sure the products being bought are all Energy Star certified. Over time these products will save both money and energy. This is a long term plan (over the course of the machines life) that we recommend Colby- Sawyer follows.

Rates			
Gas	\$	1.00	\$/therm
Electric	\$	0.10	\$/kWh
Water	\$	2.00	\$/unit
Sewer	\$	3.00	\$/unit
Ventilation	\$	1.00	cfm/ft

Green ROUTES Project Report

Equipment	Standard Efficiency						
	Gas		Electric		Water		
	Therms	\$ Costs	kWh	\$ Costs	Units	\$ Costs	
Reach In Freezer			2102.40	\$ 210.24			
Bally Heat Craft Refrigerator:			1182.60	\$ 118.26			
Hoshizaki Ice Maker			30178.20	\$3,017.82	126.48	\$ 632.41	
<b>ENERGY STAR, High Efficiency, Best Practice or CEE Tier II</b>							
Equipment	Gas		Electric		Water		
	Therms	\$ Costs	kWh	\$ Costs	Units	\$ Costs	
Reach In Freezer			970.9	\$ 97.09			
Bally Heat Craft Refrigerator			386.9	\$ 38.69			
Hoshizaki Ice Maker			24133.8	\$2,413.38	105.40	\$ 527.01	
<b>Annual Single Unit Savings</b>							
Equipment	Gas	Electric	Energy	Water		Total	
	Therms	kWh	%	Units	Costs	Savings	\$ Costs
Reach In Freezer	-	-	53.8%	-	\$ -	\$ 159.14	
Bally Heat Craft Refrigerator	-	795.70	67.3%	21.08	\$105.40	\$ 709.84	
Hoshizaki Ice Maker	-	6,044.40	20.0%	20.46	\$102.47	\$ 230.23	
<b>Incremental</b>							
Equipment	Incremental	Total Incremental	Simple	Return on			
	Cost per Unit	Cost	Payback	Investment			
	\$/unit	\$	Years	\$			
Reach In Freezer	1149	1149	10.2	208.8			
Bally Heat Craft Refrigerator	220	440	2.8	1469.68			
Hoshizaki Ice Maker	492	491	0.7	8,027.09			



Over the course of a single year, Energy Star products are much cheaper and use less energy.

**Results/Conclusions:** After collecting data on 3 machines: A walk in freezer, an ice machine, and a reach in freezer it is easy to see the savings the school would make if just those three machines were Energy Star certified.

**Savings Per Year**

**Reach in Freezer:** \$159.14  
**Bally Heat Craft Refrigerator:** \$709.84  
**Hoshizaki Ice Maker:** \$230.23

**Payback Years**

**Reach in Freezer:** 10.2  
**Bally Heat Craft Refrigerator:** 2.8  
**Hoshizaki Ice Maker:** 0.7

**Return in Investment**

**Reach in Freezer:** \$208.8  
**Bally Heat Craft Refrigerator:** \$1469.68  
**Hoshizaki Ice Maker:** \$8,027.09

Colby-Sawyer would be saving both money and energy if the dining hall were to replace all old equipment with Energy Star certified equipment.

### **Energy Star Facts**

#### Freezers:

-ENERGY STAR qualified refrigerator models use at least 15% less energy than required by current federal standards and 40% less energy than the conventional models sold in 2001.

-Replacing all existing commercial solid door refrigerators and freezers in the US with ENERGY STAR labeled models would result in savings of almost \$250 million per year, or roughly 25% of the energy consumed by models currently on the market — the equivalent of eliminating the emissions from 475,000 cars.

#### **Websites/Links:**

- US Environmental Protection Agency Energy Star  
<http://www.energystar.gov>



[www.csuchico.edu/ba/barbecue%20photo.htm](http://www.csuchico.edu/ba/barbecue%20photo.htm)

## **Double Doors**

Looking at the doors on the Colby-Sawyer campus

**Sean Wheeler**

### **Green ROUTES Recommendation Level: III**

**Introduction to Subject:** Every building on the Colby-Sawyer campus has a door which covers and protects the opening of each building from the outside world. Without doors the elements of the outside world would be allowed to go back and forth through the buildings. In some places where doors cover high traffic building entrances doors have a double door air lock system. This helps during the winter and summer, when the heating or air conditioning are on to keep the heat and cold out, to help the building keep a constant temperature.

**Objectives of Work Plan:** An audit of the doors on campus was taken, which looked at all of the doors on campus which are outside doors. It found double-doors, single doors, and doors that were propped open. This audit was designed also to determine whether the doors were in high, medium, or low traffic areas, so that it could be determined how much the door is opened and closed, and how much this effects the inside of the building.

**Methods/Procedures:** The results of the door audit can be looked at and used to help the efficiency of the buildings on campus. With this it can be determined whether there are doors that do not have a double-door air lock system, but would be good candidates for this to happen. Areas that are good areas for this would be high traffic areas, like a main entrance, where the opening and closing of the door many times in one day would affect the temperature inside the building.

**Findings:** The audit found that there are twenty one high traffic doors on campus, and only nine of them are set up with a double door system. There are six medium traffic doors, and all six of them are set up with a double door system. Out of the five low traffic doors on campus three of them have a double door set up. The majority of doors to the outside of buildings are high traffic doors, and there are more medium and low traffic doors set up with double-doors, than there are high traffic doors. As well as looking at the actual doors themselves, the use of them was being looked at as well. Whether the doors were propped open or left to swing when we walked through completing the audit, out of all of the doors, six of the doors were propped open so they were not being used properly when we walked through.

**Results/Conclusions:** When double-doors are used properly they can help keep the buildings at a constant temperature, which would make for a savings in energy consumption, which would lead to a savings in cost as well.



## **Impervious Surfaces**

Managing the impervious surface throughout Colby-Sawyer College

**Brian Valle**

### **Green ROUTES Recommendation Level: III**

**Introduction:** Currently there is no long term management plan for Colby-Sawyer College which incorporates storm water management, replacement of current roads, and the creation of new roads. The current storm water management plan is very effective; however, there is room for improvement in the maintenance and cleaning of the system. The cleaning of the storm water management system allows for proper drainage of water from the impervious surface throughout the campus.

**Objectives:** The calculation of the impervious surface throughout Colby-Sawyer College is vital in the understanding of how our campus affects the surrounding habitat. Good environmental stewardship practices including the use of porous paving techniques and use of low impact materials such as gravel throughout campus in place impervious materials like asphalt, are environmentally friendly practices. A long term plan for the next ten years should be created for the college. This plan should recognize current pervious areas throughout campus. (see attached map) The plan should also incorporate the use of porous paving techniques. There are many benefits to the use of porous paving throughout campus. The benefits of porous paving include the ability to recharge the water table, while reducing runoff. Also, converting to porous pavement over the next ten years will visually show the college's dedication to environmental stewardship.

**Methods/Procedures:** The impervious surface throughout Colby-Sawyer College was calculated using GIS. This calculation incorporates buildings and roads together. The campus currently has about 24.5% impervious surface. Although this number is low, this amount of impervious surface has potential to effect the surrounding environment.

**Calculations:** Total amount of impervious surface throughout Colby-Sawyer College is about 24.5%.

#### **Related items:**

- Colby-Sawyer College Storm water Management Plan By: Stacey Philbrook 2005

#### **Environmental Impact Statement:**

An impervious surface is a surface through which water is unable to permeate, causing the water to flow in an alternate direction, usually the path of least resistance. This unnatural misdirection of water results in many ecological and environmental consequences, which can be referred to as nonpoint source pollution. Colby-Sawyer College is no exception. 24% our campus is made up of by impervious surface, which is necessary in the daily function of the college. Stormwater runoff can wash contaminants

off impervious surfaces into streams, rivers, and lakes. The management of the impervious surface and storm water runoff is important to the health of the surrounding ecosystem.

The importance of water permeating the earth's surface is two fold. First, the prevention of water permeation into the water table initiates many ecological disruptions, such as the depletion of underground aquifers. The water naturally enters the ground then filters down to the water table, where it eventually recharges an underground aquifer; however, when this process is prevented, the aquifers are not recharged and dry up. Underground aquifers are an important source of drinking water to many communities. When a water table is prevented from recharging, surrounding streams and lakes can also dry up. The recent perfection of the porous pavement process along with appropriate storm water management plans can drastically reduce the impact of existing impervious surface, ensuring the health of the surrounding ecosystems.

The issue of impervious surface is complex and difficult to address because there are many factors to take into consideration. Three major considerations are water speed, toxic materials in and on impervious surfaces, and where that contaminated water ends up. First, it is important to understand that harmful chemicals are collected as the water runs over impervious surfaces. These chemicals can come from a number of different places, such as particulate matter released into the air by vehicle exhaust. Along with the chemicals produced by automobiles, the impervious materials themselves may contain harmful chemicals which can be absorbed by the runoff and carried to other water bodies. "Asphalt is one concern, as it contains coal tar pitch, a recognized human carcinogen, as well as polycyclic aromatic hydrocarbons (PAHs) including benzo[*a*]pyrene, another carcinogen"(Frazer, 2005). The harmful chemicals within the asphalt, along with the contributions from the automobiles, and the speed which the water gains over pavement have the potential to cause irreversible ecological damage to the surrounding water bodies and wildlife. Alternative materials to impervious asphalt and concrete are currently being developed and used; however, their implementation is not as frequent as traditional techniques.

The creation of porous asphalt took place over thirty years ago, yet the process has just recently been perfected. The process is much like traditional paving techniques; however, the key to creating porosity is the use of a lower concentration of fine aggregate, and adding polymer fibers and liquid polymers to the asphalt mix. The combination of the polymer fiber and liquid to the asphalt prevents the binders from mixing with the aggregate. This type of layering system creates a filter which allows runoff to re-enter the water table. This new type of porous asphalt can tremendously impact the overall amount of impervious surface throughout the country.

Impervious surface currently covers 24.5 % of Colby-Sawyer College's campus which has the potential to impact the surrounding environment in a significant manner. Runoff makes its way down to the local watersheds, such as Susan Swamp, Pleasant Lake and the surrounding tributaries. As mentioned before, contaminants absorbed off the impervious surfaces can create many ecological and environmental problems. The current storm water management system is quite effective; however, there is room for improvement. (See Stacey Philbrooks' senior project, Colby-Sawyer College storm water Management Plan 2005.) Also noted, the current impervious surface and storm water

management plans for Colby-Sawyer College are effective; however, it will be imperative to update them in the near future.

Although the college is not growing in size, the current roads and parking lots will need to be replaced or repaved over time. In the process of repairing and replacing these surfaces, necessary and proper storm water management techniques, which are compatible with the current system, are very important to the proper functioning overall. Moreover, it is important to keep areas of low imperviousness throughout campus such as “the pit” parking lot, the road to the tennis courts, and the road around Kelsey fields. These areas are not paved, allowing water to drain through them. Properly maintained areas like these throughout campus should not be confused with the unpermitted parking spaces in front of many of the residence halls. A preventative measure to these alternative unpermitted parking spaces is the implementation of curbing throughout the campus.

The current impervious surface and storm water management plan for Colby-Sawyer College needs to be revised and the creation of a ten year management and replacement plan carefully constructed. The management plan should recognize the low impervious areas around campus and maintain them as is. The management and replacement of the existing roads should take into consideration the shift to porous pavement. Over the next ten years curbing should be implanted in the necessary areas to prevent unwanted parking. Finally, the creation of new roads and parking lots over the next ten years should incorporate the use of porous paving techniques, and proper storm water management plans.

**Bibliography:**

Frazer Lance, (2005). Paving Paradise. *Journal of Environmental Health Perspectives*. 133, 456-462

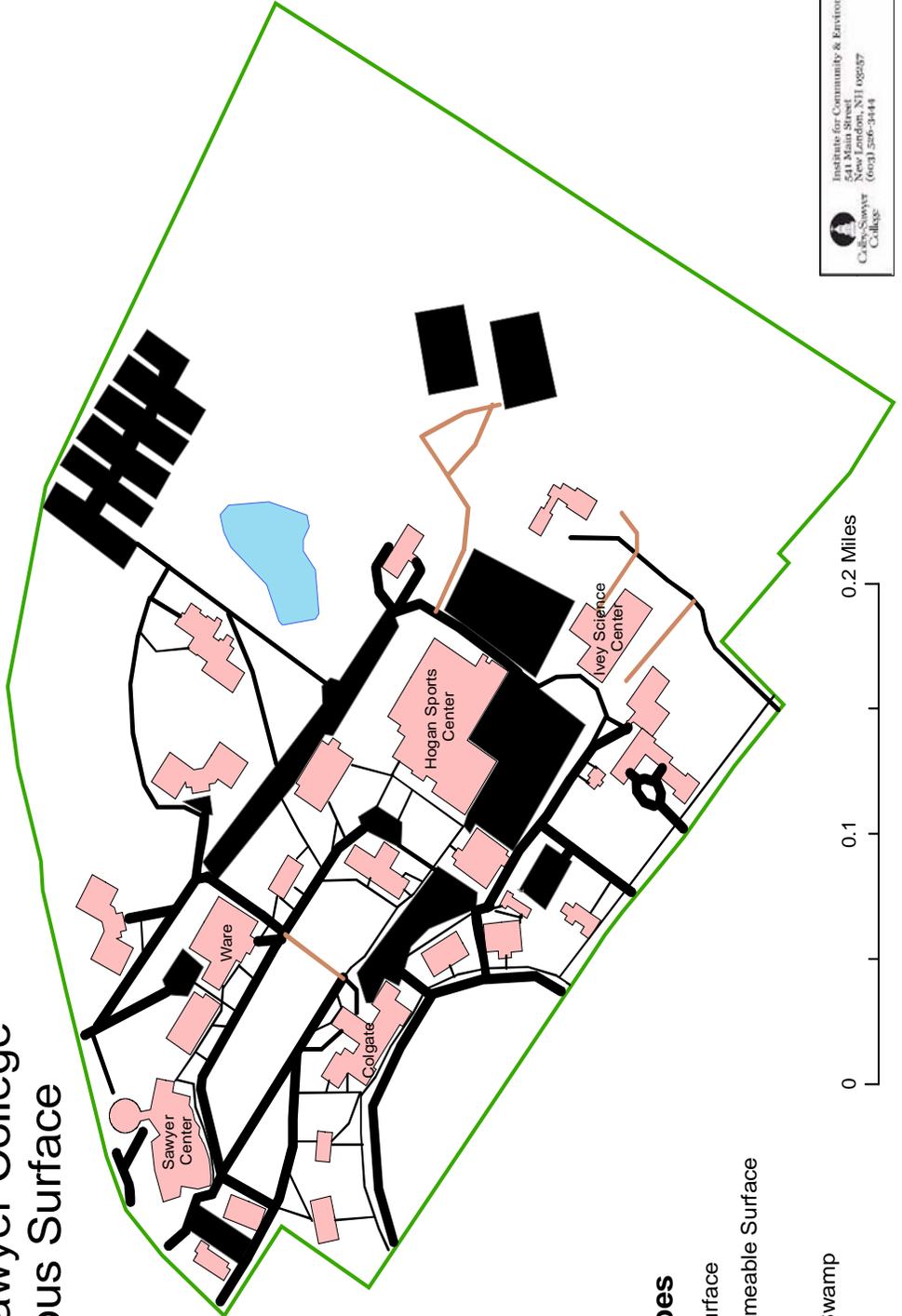
**Websites/Links:**

- Does your driveway matter  
<http://www.colby-sawyer.edu/assets/pdf/CES2006Poster4.pdf>
- UNH Stormwater Center  
<http://www.unh.edu/erg/cstev/>





# Colby-Sawyer College Impervious Surface



### Surface Types

- Paved Surface
- Semi-Permeable Surface
- Buildings
- Susans Swamp

Institute for Community & Environment  
Colby-Sawyer College  
New London, NH 03257  
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## **Solar Energy**

Clean renewable energy source

**Alexa FitzGerald**

### **Green ROUTES Recommendation Level: III**



**About Solar Energy:** Solar energy is a safe, renewable energy source. Because solar power gets its energy from the sun, and does not burn off any kind of waste, it is clean, emitting no toxins into the atmosphere. Renewable energy is a vital resource for the world because our natural resources, such as oil and coal, which we so heavily depend on, are being depleted quickly because of high demand as a result of population increase. Solar power is one of the cheapest, hassle and pollution free energy sources available. It is a reliable source because the sun shines almost everyday and when it does not, the electricity created by the sun can be stored and used later.

**Methods/Procedures:** There are two ways that the sun gives off energy: heat and light. Heat energy can be trapped by thermal collectors that are assembled on roofs or walls. The heat is trapped in the collector and the heat collecting pump runs through a tank of water, raising the temperature. This tank is then used as the hot water source for the building. Light energy is the best way to trap solar energy in order to transform it into electricity using photovoltaic cells, and what is most often meant when people talk about “solar energy”. The photovoltaic panels convert light energy directly into an electric current that can either be used right away or stored in a battery bank to use later. One worry of solar energy is the fear of what happens when the sun goes down, but if the electricity can be stored in a battery bank, it can last for the hours of the day that lack sun light. Of course this also means that places with more sunlight and longer daylight hours will be able to use solar power more effectively. Solar panels are made up by Solar cells that are made of semiconductor materials, such as silicon. The panels operate by collecting photons and releasing electrons, which allows the flow of electricity.

#### **Advantages:**

- Solar energy is free (after the panels are bought and installed) and does not pollute or produce waste after it has been used.

- It can benefit people who live in remote places where electricity is hard to come by.
- It is a renewable energy source: the sun will not be going out any time soon.
- It can reduce electricity bill.

**Disadvantages:**

- The panels do not operate at night because the sun is not shining.
- The initial cost of solar panel installation can be expensive; these costs can however be offset by very low running/operating expenses and also reduced by government subsidies that a solar energy user may be eligible for.
- Solar power can be unreliable if you are not in a sunny climate.

**Health and Energy:** According to Christine Ervin of the Department of Energy, power plants are one of the leading causes of greenhouse gas emissions in the United States, one third of which is particulate matter. This is a serious health issue because doctors contribute 50,000 American deaths a year to particulate matter. Solar energy does not give off any waste so it is safe and healthy energy alternative to power plants that currently supply America's electricity.

**Federal Solar Tax Incentives:** In December of 2006, Congress passed a bill that extended the 30% solar energy investment tax credit for homeowners and businesses for one additional year, through the end of 2008. There are also tax incentives given at the state level. The Public Service of New Hampshire (PSNH), for instance, offers incentives to customers who achieve "measurable" (359 kw or more) energy savings by installing energy efficiency items. If Colby-Sawyer invested in this renewable energy source, it could potentially receive financial aid in the process.

**Survey:** In a survey that Green ROUTES conducted this spring, students, faculty and staff were asked if Colby-Sawyer College should set a goal of utilizing alternative energy sources such as wind, solar or biofuels to meet at least 25% of campus energy needs over the next 10 years if costs are neutral or will save money over time. Most everyone who responded to the survey agreed with the idea. Having the support of the college community is very important and their thoughts should be taken into serious consideration.

**Recommendation:** Green ROUTES recommends that Colby-Sawyer College consider setting up some solar panels on campus, perhaps on the roof of the Dan and Kathleen Hogan Sports Center and on the south-facing side of any other roof. Colby-Sawyer College would benefit from investing in this clean energy source because whether a solar power setup is small or is on a massive scale, it is possible to reap the benefits of solar energy and solar power. If the college chooses to invest in solar panels on a small scale to begin with, it can still save money by using the solar energy and not generated electricity. Not only will the college likely save money with this investment, but the initial costs can be supported by government funding. It is a good, safe and clean alternative.

**Quick Facts:**

- A business can save 40 - 80% on electric or fuel bills by replacing its conventional water heater with a solar water heating system.
- Utilizing only 1% of the earth's deserts to produce clean solar electric energy would provide more electricity than is currently being produced on the entire planet by fossil fuels.
- Over 60% of U.S. solar technology sales are exports.

**Websites/Links:**

- American Solar Energy Society  
<http://www.ases.org/climatechange/toc.htm>
- Public Service of New Hampshire  
<http://www.psnh.com/Business/Efficiency/Rewards.asp>
- Solar Energy  
[www.solarenergy.com](http://www.solarenergy.com)
- National Aeronautics Space Administration (NASA)  
<http://science.nasa.gov/headlines/y2002/solarcells.htm>



## **Wind Energy**

Renewable energy through the power of wind

**Stephanie Seavy**

### **Green ROUTES Recommendation Level: III**

**Introduction:** A wind turbine creates wind power by transforming the kinetic energy of the wind into mechanical or electrical energy that can be used for human energy needs. Wind power is a renewable and environmentally sustainable source of energy. It has been estimated that wind power could supply 20% of the United States energy needs if properly developed. Currently, the U.S. produces approximately 10,000 megawatts of electricity which is enough to power 2.5 million homes each year, according to the National Renewable Energy Laboratory.

**Objective:** In order to solve the problem of global climate change, we must begin to adopt and utilize forms of renewable energy that are available. Unlike the burning of fossil fuels, wind energy has no greenhouse gas emissions. Colby-Sawyer College could help fight climate change and make a commitment to using renewable energy sources by constructing a wind turbine the campus that fed into the College's power grid.

### **How much energy can a wind turbine make?**

The amount of energy produced by a wind tower depends on the turbines size and the speed of wind passing through the rotor. Wind towers vary greatly in size, from 50 meters to 135 meters in height. "A 10-kW wind turbine can generate about 10,000 kWh annually at a site with wind speeds averaging 12 miles per hour, or about enough to power a typical household. A 5-MW turbine can produce more than 15 million kWh in a year--enough to power more than 1, 400 households" (awea.org). Wind power can not be the only form of power that a college or university can rely on because the wind does not blow all the time.

### **Benefits:**

- Cost-effective, sustainable way to reduce annual electricity costs
- Will reduce Colby-Sawyer's carbon emissions that pollute the air, thereby helping to fight global warming
- A symbol of Colby-Sawyer's commitment to environmental sustainability
- A valuable learning tool that can be integrated into curriculum



[http://apps.carleton.edu/reason\\_package/reason\\_4.0/www/images/60759\\_tn.jpg?cb=1155925043](http://apps.carleton.edu/reason_package/reason_4.0/www/images/60759_tn.jpg?cb=1155925043)

**Examples of schools that currently generate some power with a wind turbine:**

**University of Minnesota**

5.6 million kilowatt hours of power each year (1/2 of the schools annual electricity bill)

**Carleton College**

1.65 million kilowatt hours a year (30% of the college's annual electrical consumption)

**St. Olaf**

6 million kilowatt-hours of energy annually (one-third of the college's electricity)

**Energy Pay-back:** The energy pay-back time is a term used to describe how long a wind turbine must operate before it makes up the amount of electricity used to manufacture and construct the tower. The American Wind Energy Association notes that wind towers have one of the lowest energy pay-back times (ranging from 3-8 months).

**What Colby-Sawyer College students, staff and faculty said in the 2007 Green ROUTES survey:**

One of the survey questions asked participants if they thought that Colby-Sawyer College should, "set a goal of utilizing alternative energy sources such as wind, solar or bio fuels to meet at least 25% of campus energy needs over the next 10 years if costs are neutral or will save money over time." 79% of students, 96% of staff and 64% of faculty that answered the survey agreed or strongly agreed with the idea that Colby-Sawyer College should commit to 25% renewable energy use within ten years. The results from this survey question indicate that the majority of the campus community would like Colby-Sawyer College to begin using more renewable energy.

Some campus community members even think that Colby-Sawyer College should use more than 25% renewable energy in 10 years. One student expressed this idea when they wrote, "*alternative energy sources for the campus should be implemented quickly instead of over a 10 year period. Also, we should aim our sights higher and try for 50%-75% of our energy needs to be met by alternative sources, not just 25%. There are so many*

*resources that could help us achieve these goals quickly and at low cost. Changes need to be made now for the protection of our global environment.”*

The survey also produced many additional comments that encouraged the idea of wind power. For example, a staff member wrote, *“wind power should be looked into more closely considering the elevation and winds on the hill. We should take advantage of this opportunity. A tower could be placed in the area of the Susan Colgate Cleveland Library Learning Center, the Curtis L. Ivey Science Center, Colby Farm or the tennis courts which would be out of the neighbors view.”* In addition, a faculty member even suggested, that Colby-Sawyer College *“investigate grants for wind power.”*

**Costs to Colby-Sawyer and possibility of grant funding:** The initial cost of constructing a wind tower can be considered high. If Colby-Sawyer College chooses to build a wind tower the school should investigate the possibility of finding a grant for the project. In May of 2005 Middlebury College in Middlebury, VT received a grant of \$22,500 from the United States Department of Energy to construct a wind turbine on their campus. Middlebury College provided matching funds to complete the wind turbine project. The wind turbine is connected to the Middlebury College grid and off-sets the college’s use of electric power from Central Vermont Public Service.

St. Olaf College in Northfield, Minnesota is another school that received a grant to construct a wind turbine. In 2004 St. Olaf received \$1.5 million of funding for a \$1.9 million project from the Xcel Energy's Renewable Development Fund. The wind turbine is considerably larger than the one built at Middlebury (which explains the why the price was much higher). The turbine now generates 6 million kilowatt-hours of energy annually, replacing about one-third of the college's electricity purchases.

**Zoning Regulations in New London, NH:**

In order to find specific zoning regulations pertaining to the construction of a wind tower, contact: Peter Stanley, Zoning Administrator: (603)526-4821 ext.16, [\\_zoning@nl-nh.com](mailto:_zoning@nl-nh.com)  
New London Zoning Ordances:

<http://www.newlondonnh.govoffice2.com/vertical/Sites/{26F9F697-D5BE-4423-95D7-E1EECBB7F549}/uploads/{165158B3-68FE-42B1-8961-C61D4B620124}.PDF>

**Websites/Links:**

- American Wind Energy Association  
<http://www.awea.org/>
- National Renewable Energy Laboratory  
<http://www.nrel.gov/wind/>
- College News – Middlebury Wind Turbine  
<http://www.collegenews.org/x4419.xml>
- St. Olaf  
<http://www.stolaf.edu/green/turbine/>
- University of Minnesota – Morris  
<http://www.mrs.umn.edu/greencampus/WindsOfChange.pdf>