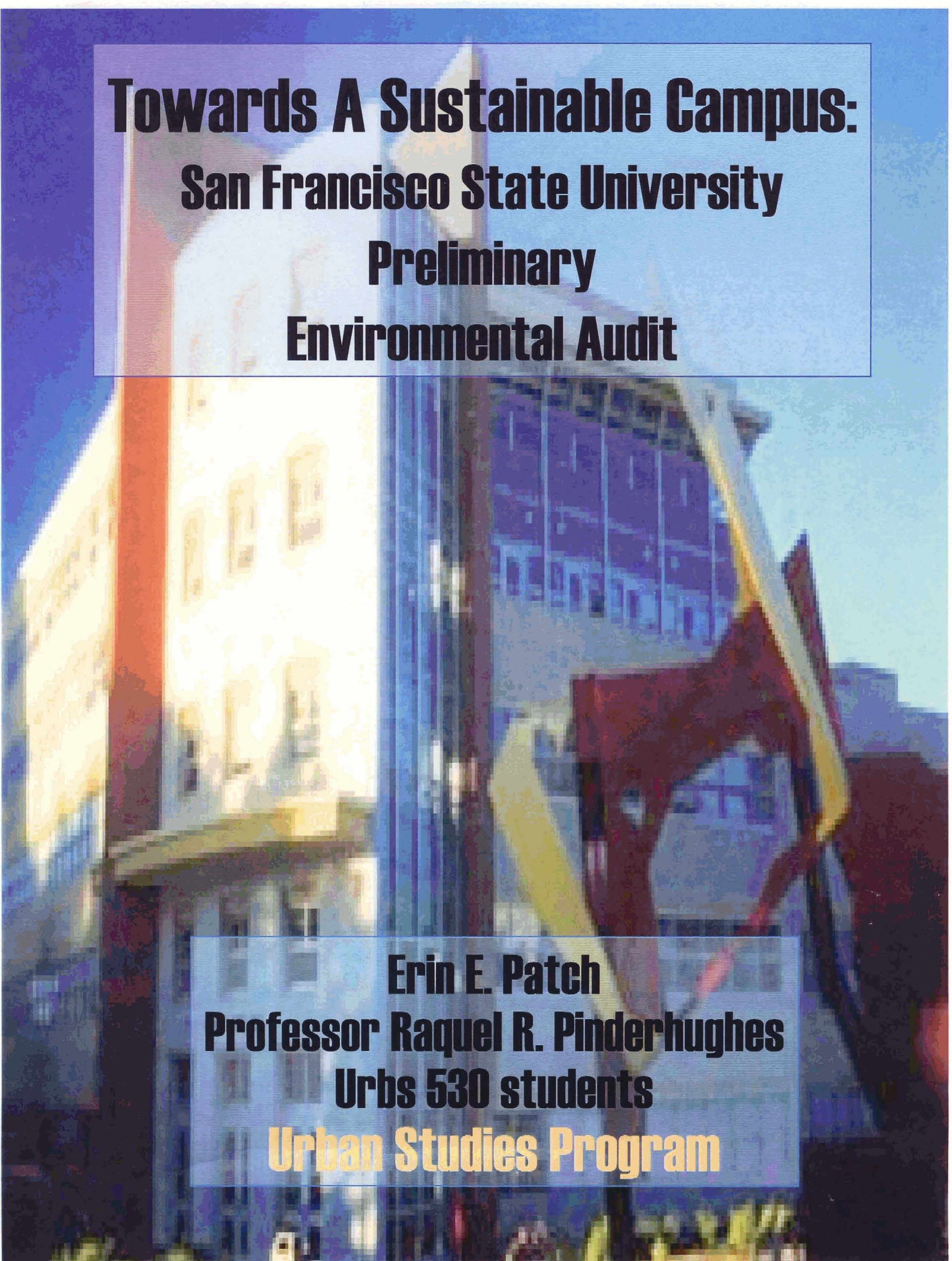
Towards A Sustainable Campus:

San Francisco State University

Preliminary

Environmental Audit



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Urbs 530 students
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Dedication

To those who struggle to make San Francisco State University a living model for a socially just, ecologically sustainable society.

Towards a Sustainable Campus:

San Francisco State University Preliminary Environmental Audit

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Erin E. Patch

Students enrolled in Professor Pinderhughes's 1998-1999 Urban Studies 530 course

Urban Studies Program

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Acknowledgments

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Executive Summary

At the time of this writing, San Francisco State University has implemented the following sustainable programs and programs:

The Recycling & Resource Center

The S.W.A.P. Shop

The In-vessel Compost Machine

The Green Waste Program

The Bike Barn

Low flow toilets, sinks, and showers in some buildings

Lighting retrofits and replacements in some buildings

But to move towards the goal of a sustainable campus the following actions are immediately required:

Reduce, Reuse, Recycle

Expand the capacity and successes of the Recycling and Resource Center

Support and expand all existing sustainable programs on campus

Involve students involved in an SFSU campus greening effort

Involve faculty and administration involved in an SFUS campus greening effort

Form a panel comprised of students and faculty to design and implement a plan for sustainable practices on campus with one-three- five and ten year goals

Gradually implement all of the amendments listed by category below:

Specific amendments:

<u>Paper</u>

Re-use paper whenever possible

Double-sided copies whenever viable

Substitute electronic documents for paper documents

Require paper recycling throughout the entire university system

Purchase recycled paper

Purchase standard size paper

Include a paper-recycling bin in every classroom

Include desk side recycling bins (for offices) from the Recycling & Resource center

Recycle all paper

Plastic

Educate students about problems associated with use and recycling of plastics

Reduce the use of plastics on the campus

Re-use plastic containers if they are used

Purchase less plastic (all departments and food services)

When using plastic, purchase only recyclable plastic

Require the purchase of glass containers for beverages

Give food discounts for the use of re-usable plastic or other containers

Install water-dispensing machines

Encourage campus community to bring/use their own plates, mugs and utensils

Water

Educate students, faculty and staff about using less water

Complete all retrofits, particularly toilets, sinks and showerheads

Re-use gray-water for campus irrigation

Implement a new drip irrigation system on athletic fields

Use alternatives to traditional grass

Water foliage only at night

Decrease water usage in particular departments and program

Food Service

Organize "health weeks" to feature and promote healthy food choices and educate the campus community about the importance of sustainable agricultural practices

Place flyers or table tents in the dining halls to explain the benefits of organically grown and local products

Implement an affordable, organic salad bar with locally purchased produce

Make connections with local organic farmers and farmers markets

Offer credit to students who volunteer to recycle food waste

Use the SFSU compost machine more efficiently

Employ a second compost machine

Separate all non-organic matter from food waste

Use less plastic utensils, plates, cups

Give food discounts to students, faculty and staff with re-usable utensils and dishes

Pressure food services to use organic and locally grown food

Pressure food services to buy food with less packaging

Landscaping

Replace gas operated mowers with less polluting mowers

Raise the blade on the mower,(grass requires less water and fertilizer and is more disease and pest resistant at two to three inches)

Adjust sprinkler heads in plant beds so that they spray only the plant beds

Use lower flows whenever possible

Replace traditional grass

Use natural non-toxic fertilizers

Use natural non-toxic pest control and eventually eliminate pesticide use and synthetic fertilizers entirely

Introduce predatory (beneficial) insects

Janitorial Products

Use biodegradable, non-toxic cleaner

Switch to citrus-based cleaning products whenever possible

Use natural enzyme-based drain clog products

Use non-petroleum chemical based soaps in bathrooms

Work with companies whose inventory includes non-toxic, environmentally friendly products

Pest Control

Buy non toxic pesticides

Use boric acid; (the least toxic way to kill ants and cockroaches)

Use diatomaceous earth and silica aerogel which lead to the dehydration and death of insects

Use citrus oil extracts, such as D-limonite and Linalool, to kill fleas

Use Soil Aid, Green Magic, And Lawn Restore to kill lawn pests.

Healthy plants and lawns are less susceptible to pests

Implement the highest standards of sanitation and daily cleaning of pest infested areas

Implement integrated pest management technology and contract only with IPM pest control companies

Lighting

Do not use lights when natural light is sufficient, particularly in classrooms and offices

Use solar power where possible

Use highly reflective, low glare paints for all interior walls

Use sensor lights

Retrofit old fixtures

Replace old fixtures

Implement sustainable lighting design elements in all new construction projects

<u>Transportation</u>

Education and orientation upon registering (show new students how to use public transportation)

Implement a designated carpool area

Reduce the amount of parking around campus

More bike racks on buses

Work with MUNI and BART to get student discounts

Encourage the use of the Bike barn

Fund an affordable Class Pass through student fees

Increase the number of bike racks on and around the SFSU campus

Work with SF Departments of Transportation to increase bike lanes in the city

Provide students with low cost helmets and bicycles

Provide incentives for faculty and staff to use bicycles to travel to work

<u>Sustainable building Practices</u>

Actively consider and implement sustainable building materials whenever possible

Substitute conventional materials with sustainable materials of equal value

Verify sustainable sources of materials

Deconstruct and recycle demolished buildings thoroughly

Conduct environmental assessments

Choose developers and architects with good environmental track records

Environmental education seminars for SFSU administrators

Include students in planning, design and research

Factor in hidden environmental costs of unsustainable building practices in design analyses

<u>Printmaking Department</u>

Use water based inks where possible

Recycle solvents

Investigate the use of less toxic solvents

Regulate the safe handling and disposal of toxic solvents

Properly mark containers holding solvents or other toxic substances

Photography Department

Replace the six-step chemical process with the three-step process

Switch to citris-based solvents whenever possible

Install a solvent station

Replace old developing machines

Re-use chemicals

Replace current chemical process with a digital process

Textile Department

Begin a textile study and research program about the use and advantages of natural dye

Replace chemical dyes with natural dyes

Start a textile garden and use plant based dyes

Include an awareness segment in the textile program

Chemistry Department

Implement micro-scale lab techniques

Blend conventional and micro-scale lab experiences

Introduction: Faculty Perspective

For the past five years, I have been actively engaged in teaching and research on urban sustainable development at San Francisco State University. Classroom discussions about critical problems facing cities reveal the deep concern that SFSU students have about the future of cities. The concept of sustainable development, that we should leave to the next generation a stock of quality of life assets no less than those we inherited, resonates deeply with most students. At its best, sustainable development seeks to respond to five broad requirements: (1) integration of conservation and development; (2) satisfaction of basic human needs; (3) achievement of equity and social justice; (4) provision of social self-determination and cultural diversity and (5) maintenance of ecological integrity. As students learn more about alternatives to destructive social and environmental trends associated with traditional patterns of urban development, they are provided with a sense of hope for their future.

In 1997, I designed an assignment in my *Alternative Urban Futures* course which would help students apply classroom discussions about concepts, methods and examples of sustainable development in cities to their own lives and shared community- the SFSU campus. The assignment required that students, working in teams of 2-5, select an area of the SFSU campus and learn about that sector's use of environmental resources. The students were required to: (1) document how environmental resources were being utilized and managed; (2) document campus contributions to pollution emissions and contamination; (3) document ways in which the campus was implementing environmentally sound practices and policies; (4) identify opportunities for reducing negative environmental impacts and contributing to environmental restoration and sustainability. Areas of analysis included: recycling efforts, water use, campus food service, landscaping, pest control, janitorial products, lighting and energy, transportation, building and design; and three specific departments--printmaking, photo lab and textile department.

The students were very enthusiastic about the project. Applying sustainable planning and design concepts and thinking about impacts on natural resources and pollution outputs, they searched like detectives to obtain information about SFSU campus practices, policies and planning. The final reports of the 1998 group provided us with a preliminary sense of campus decisions about utilizing, managing and sustaining natural resources. But there was still much more to learn. So, in 1999, I created a second assignment designed to fill in the gaps and help us learn more about environmental resource use, current practices and innovative ideas on the SFSU campus. I then worked, with Urban Studies student Erin Patch, to transform the student's work into a coherent final report.

This report, *Towards A Sustainable Campus: A Preliminary Environmental Audit of San Francisco State University*, is the result of this collective work. It is incomplete and preliminary but, it lays the foundation for the development of SFSU's sound management of environmental resources and innovative campus greening initiatives. It provides baseline information that can be used to inform sustainable design and planning practices and policies. It helps us understand what we are already doing to manage environmental resources sustainably and where there is need for improvement.

There are three immediate next steps. First, the President and San Francisco State University campus administrators must commit themselves to using environmental assets wisely and in a way that ensures that they will be available to the next generation. Second, the President must create a *Committee on SFSU Campus Sustainability* whose charge is to identify how to move forward on this commitment**.** This Committee should be composed of administrators, faculty, students and staff. Third, this Committee should be charged with two tasks. First, this Committee should work with administrators and managers to conduct a thorough environmental audit of the San Francisco State University campus. This task should not be stymied by lengthy discussions of financing and resources. The first step is to require all administrators to produce data on their resource use and current practices. The Committee on SFSU Campus Sustainability should be charged with oversight for this environmental audit. The Committee's second task should be to identify short and long-term goals and develop an implementation plan to achieve these goals. The new Environmental Studies Program at San Francisco State is the ideal partner in this process.

We hope this report inspires these next steps as well as the individuals who become involved in this effort on the San Francisco State University campus.

Raquel R. Pinderhughes

Professor, Urban Studies Program/Environmental Studies Program

San Francisco State University

April 1999

Student Perspective

Although San Francisco State University has participated in some sustainable practices for over twenty years, it has yet to dedicate itself to achieving a truly sustainable campus. The good news includes the progress of the Recycling and Resource Center, S.W.A.P. shop, bike barn and in-vessel-composting system: they reflect the real commitment that different students and faculty have had toward achieving a green campus. That some academic departments have begun to curtail wasteful habits and reduce the use and number of hazardous products further encourages campus environmentalists. However, the achievements of the few cannot overcome the enormity of institutional inertia; and many students interested in campus greening feel powerless to effect the necessary changes that will transform us into a "green university." While admirable, this individual and disorganized work on campus lacks the both consistency and breadth needed to meet the demands of a continually growing university.

San Francisco State University's progressive tradition means we have an obligation to the greater community: we ought to lead the curve on sustainable development processes and technologies. We students know that the return of a green campus warrants this investment of time. However, beyond environmental benefits lies our academic accomplishment and pride. We must not watch from the sidelines as other universities eclipse our progress and prestige in this arena. Brown University's highly successful integral green plan has made Brown famous with students and scholars interested in a health environment. And Brown, of course, is not the only university to exceed San Francisco State University's environmental commitment. Developing a comprehensive green plan will not only make us a model for other colleges, it will also increase our desirability to prospective students: a working green plan will attract students from across the country and around the world.

A successful green plan at San Francisco State University campus will require staff, faculty and student involvement: a panel of students and faculty is essential. We need this panel to regulate current campus practices because as this paper will show, some current programs are not working at full capacity. We will also need an integrated plan, properly executed, that features an aggressive education campaign. While students can do the legwork and supply many ideas, we cannot succeed without committed faculty, administrators and staff who will help create real change.

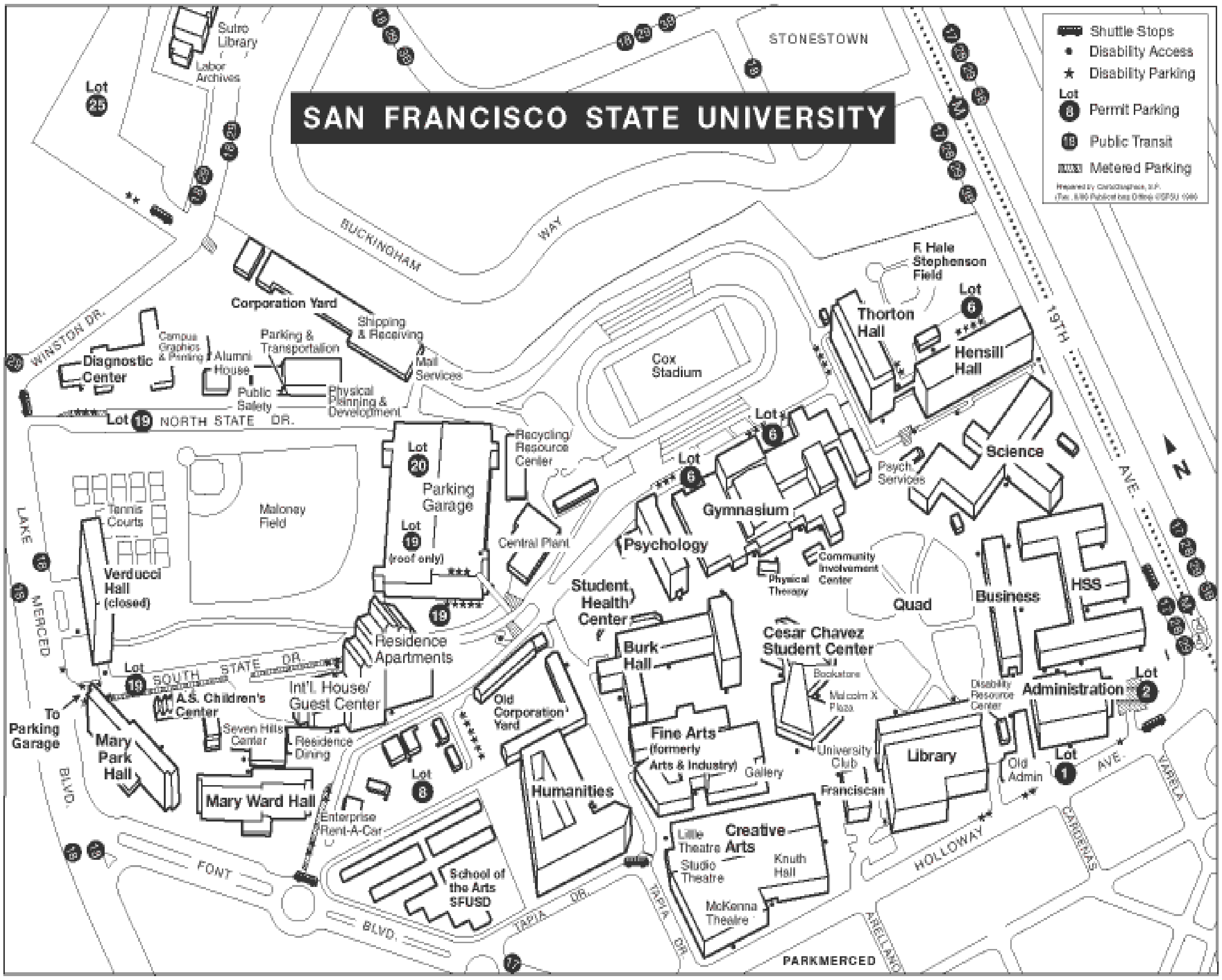
Representing a limitless horizon and renewed hope for human aspirations, the approaching new millenium presents an ideal time for San Francisco State University to implement real change. By example, we can encourage other institutions to reconsider their commitment to sustainable practices as well. As humankind contemplates its history and impact on the environment, we expect that people will be more ready than ever to forge this new relationship with the planet. We cannot afford to let this opportunity slip away.

Erin E. Patch
Urban Studies Program
San Francisco State University
April 1999

Disclaimer

The information and data contained in this report are based on face to face and phone interviews that students had with San Francisco State University administrators and staff. Most administrators and staff did not provide students with written documentation describing their department's resource use, practices and policies. Therefore, most of the numbers in this report are approximate, providing information that is designed to inform the next steps and processes that would lead to sustainable design, planning and policies at San Francisco State University.

Map of the SFSU Campus



Recycling and Resource Center

In the last two decades, campus recycling programs have progressed substantially. In 1982, only four universities, the University of Colorado at Boulder, Stanford University, the University of California at San Diego and Cornell University, had established recycling programs with funding for an office and a sense of institutional commitment. In California, most campus based recycling programs originated from a 1989 California law (AB939) that established state mandates for diversion of materials going to landfills. These mandates provided that 1989 waste levels be reduced 25% by 1995. Its larger goals are a 50% reduction, from 1989 levels, by year 2000.

The Recycling Resource Center was started at SFSU in 1987 by students and faculty in the Geography department. The Center provides students with a valuable hands-on employment opportunity to participate in improving and maintaining campus sustainability. In 1987, students began by collecting computer paper and aluminum. Initially, the student employees had 50 collection sites. Today, there are more than 1100 sites on campus and the students collect the following:

- **White paper and computer paper**
- **Mixed and colored paper**
- **Plastic PET #1 and #2**
- **Aluminum cans, tin and foil**
- **Glass bottles**
- **Toner cartridges**
- **Cardboard**
- **Metal**
- **Food waste**

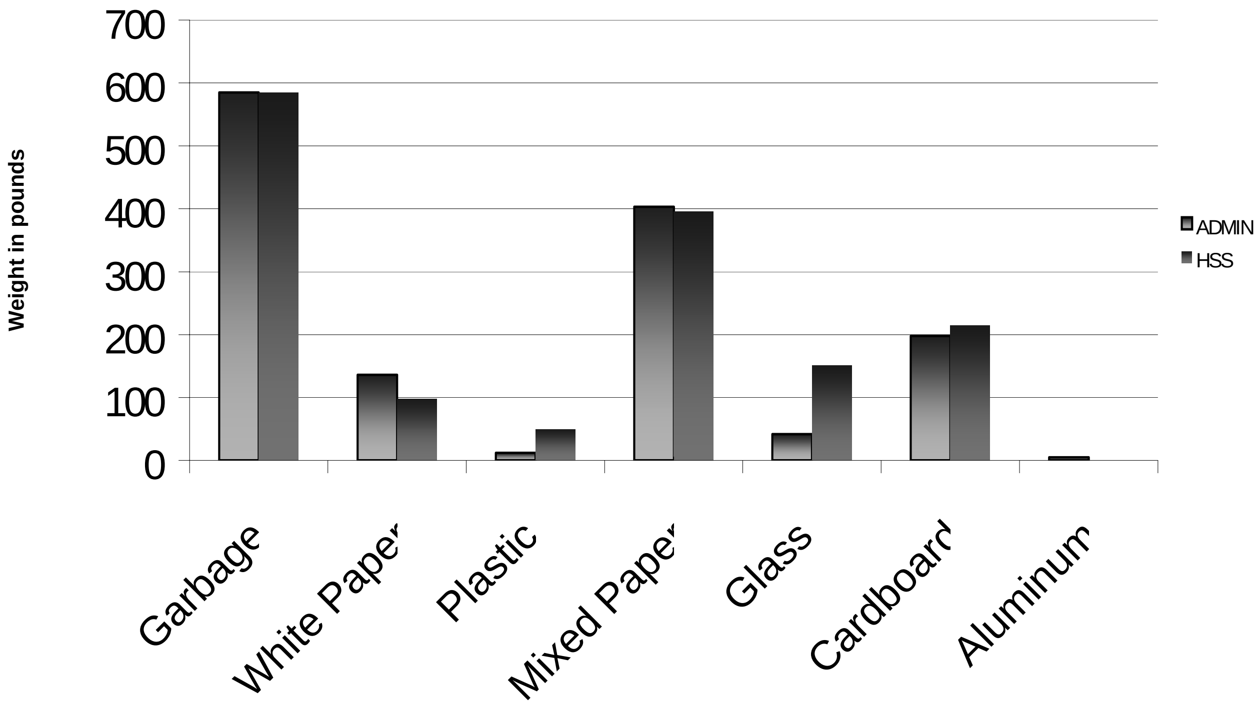
The Recycling Resource Center leases a tailgate-equipped Ford F-450 stake-bed truck to help collectors lift the 55 gallon “brutes” full of paper. The truck facilitates off-site collection and delivery of recyclable materials to local vendors. The Center also has one small electric truck and club car and a fork lift. The following vendors participate in the recycling program:

Company name	*Material*
All Star Inc.	***Paper***
Custom Alloy Scrap Sales Inc.	***Aluminum***
Western Strategic Materials Inc.	***Glass***
American Iron and Metal	***Metal***
Sunset Scavenger Co.	***Cardboard and Wood***
Total Office Management	***Toner Cartridges***
Haight Ashbury Neighborhood Council	***Plastics***

The Recycling Center's student outreach coordinators create literature on recycling, answer questions and interview new volunteer applicants. The Center's current educational and outreach programs include the "Environ-Mental-List, an annual publication of news and goals of the program. The Center also distributes *A Guide to Office Recycling* , to administrative personnel. The *Guide* demonstrates how to pre-sort recyclable materials; it also explains the importance of recycling in general and discusses the role of peer pressure in a successful recycling scenario.

The Center conducts an annual waste audit. According to the 1997-1998 audit, the Recycling Center diverted 648 tons of materials from landfills that year. In Fall 1998 students in the Geography department conducted the most recent waste audit. The waste audit was conducted in two one-week collection periods. The first collection was assessed from the Administration building. The second collection was assessed from the Humanities/Social Sciences building. The waste was bagged in gray bags and put into wheeled bins for the custodial staff. Separate blue bags were used for bathroom waste. Once the waste from each day was ready to be sorted, 3 large brutes weighing 13 pounds apiece and 4 smaller brutes (7 lbs.) were assembled in the sorting area. White paper, other mixed paper and garbage were placed in the large brutes; glass, aluminum, plastic and milk cartons were placed in the smaller brutes. Also sorted but not placed in brutes were cardboard, toner cartridges and various miscellaneous items. The brutes were then independently weighed and documented according to category. The garbage was then returned to the wheeled bin and the recyclable were put into their respective bins. The results form this two week audit were discouraging: a 1381 lbs. waste stream from the Administration building contained 796 lbs. (57.6%) of recyclable material. In the Humanities/Social Sciences building a 1508 waste stream contained 923 lbs (61.2%) of recyclable materials. This data clearly shows the need for significantly increased recycling on campus.

SFSU Waste Audit 1998
(This was done over a two week period)



	Garbage	White Paper	Plastic	Mixed Paper	Glass	Cardboard	Aluminum
ADMIN	585	136	12	403	42	198	5
HSS	585	98	50	396	151	215	0

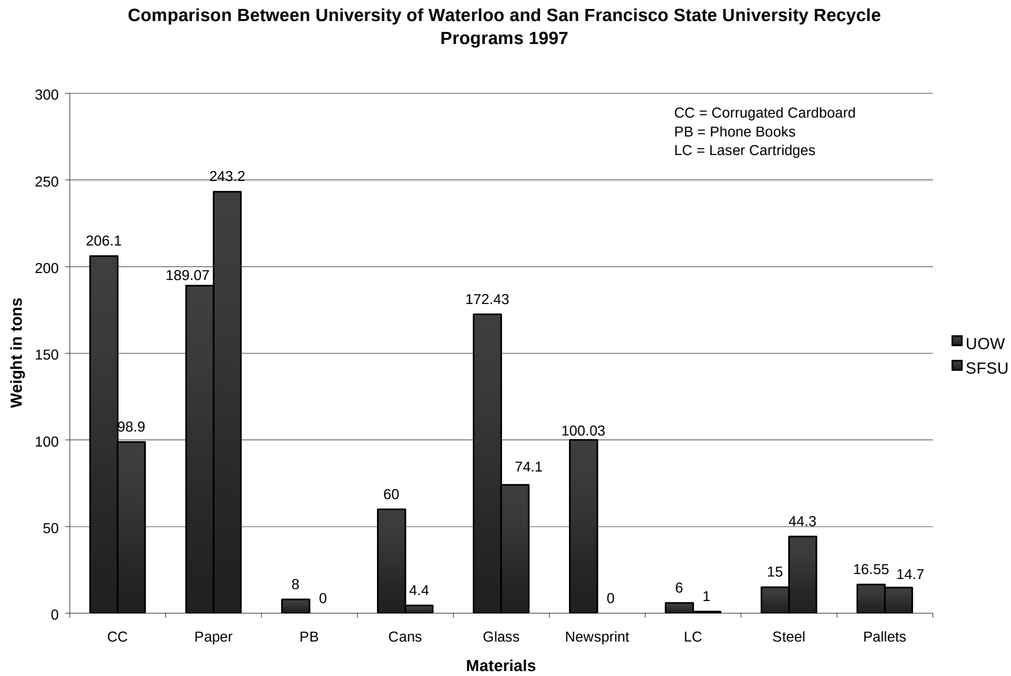
Materials

What other campuses are doing

University of Iowa at Waterloo

The University of Iowa at Waterloo composts food (vermicoposting) and has performed waste audits on their buildings. Between 1991 and 1997, they have recycled 5788.62 tons of material and recycled enough paper to spare more than 49,000 trees! Using work-study students has helped Waterloo minimize costs. Waterloo students take an intensive semester long course and volunteer four hours a week in the program; students must also complete a research paper that discusses recycling. Only then do students become eligible

to participate in the regular work-study program. One might think this level of preparation would not attract students but according to the coordinator, the program is so popular he had to institute a selection process. Two thousand additional labor hours come from community service work provided by university students convicted of first-time misdemeanors.



University of Colorado at Boulder

The University of Colorado at Boulder has diverted more than 40% of its waste. To fund its program the University got a $50,000 grant from Student Activity fees and a $500,000 loan to be repaid via disposal savings. To raise awareness among staff, the University translated brochures into the first languages of many of the custodial staff.

The Green Waste Program

A successful component of San Francisco State University's recycling program is its Green Waste Program. The Green Waste Program was implemented in November 1998 to dispose of organic debris in an ecologically friendly manner. Organic debris includes grass clippings, branches, foliage and miscellaneous items such as broken wooden furniture. When a debris box is full it is taken for composting to a Richmond, California facility. Occasionally, debris boxes are filled with dirt debris and used for special construction projects. The Green Waste Program has reduced the waste stream by 43 tons to date.

The S.W.A.P. Shop (Surplus With A Purpose)

Another succesful SFSU program is the SWAP Shop program was started by SFSU students in 1996. The two and a half year old student run shop has become a key resource for faculty and staff discarding unwanted campus furniture and office equipment. It also enables campus community members to obtain new (used) items for their offices. It is also a redistribution center for dozens of Northern California non-profits and public schools that receive the used school desks, chairs, computers and office supplies. Recent redistribution of 102 tons of filing cabinets, desks, chairs and computer equipment alleviated the need to dispose of these items in the garbage, resulting in savings estimated equal to $10,900. The shop received an award for *Best Reuse Program* from the California Reuse and Recovery Association.

Paper

San Francisco State University currently recycles all types of paper. The university has special bins designed for paper collection and recycling. The used paper collected from the bins goes to the Recycling & Resource Center. Currently, approximately 250 tons of paper are being diverted from the landfill and recycled. Unfortunately, we are not recycling enough SFSU paper. The Fall 1998 waste audit shows at least 33% of all paper used on SFSU campus is thrown in the regular garbage where it becomes soiled and unable to be recycled. While most departments are aware of the need to recycle paper, many departments and offices do not contribute to the paper recycling process.

San Francisco State University also needs to greatly expand its support of companies that sell recycled and recyclable paper goods. Although most departments use toner cartridges that can be sent back to the company for recycling (or to the Recycling & Resource center), the University at large does not currently buy recycled paper goods. Moreover, administration orders large amounts of non-standard size paper, much of which is rarely used. The University could avoid this waste by ordering standard size paper unless a use is specifically identified for non-standard size paper. Students and staff also continue to waste paper by producing single sided copies instead of double-sided copies.

The 600,000 to 700,000 sheets of paper per month, that Library Copy Services uses, goes primarily into course readers. Do-overs, which occur when the instructor does not approve a final copy, create unnecessary waste. So do multiple desk orders, copies of the reader the professor may order for a variety of reasons but frequently go unused. The library copy center also needs to encourage double-sided copying. In its defense, Rapid Copy does recycle all of its paper and trains its staff to minimize mistakes that lead to waste.

Although students and faculty collectively recycle paper, to significantly reduce the environmental impact of San Francisco State University's paper use we suggest the following methods:

- Re-use paper when possible
- Make double-sided copies when possible
- Double-sided copies when viable
- Substitute electronic documents for paper documents
- Purchase recycled paper with increasing percent of recycled content (post-consumer)
- Purchase standard size paper
- Include a paper-recycling bin in every classroom
- Transition to soy-based inks for copying and printing
- Request desk side recycling bins (for offices) from the Recycling & Resource center
- Recycle all paper
- More education about paper consumption and resource depletion
- Centralized use of phone books, minimize number ordered
- Order course readers after class size has been determined

Plastic

Every one on campus uses plastic. We buy food and beverages packaged in plastic, we eat with plastic utensils, and we use plastic bags to hold the goods we purchase from the bookstore, food services, etc. Where does all this plastic go? Some of it is recycled, but much of it goes to landfill where it does not biodegrade. Plastic use is at an all time high on the San Francisco State University campus (for more on plastic see Food Service section).

The Recycling & Resource Center currently recycles #1and #2 plastic food and beverage containers. The campus uses many different types of plastic several that are not currently recycled. Plastic containers that can be recycled are often thrown out with the regular garbage contributing to our current waste stream by 100s of pounds a year. Should San Francisco State University try to recycle more plastic, or should we try to reduce the use of plastic on campus? Recycling plastics is a controversial practice. It is unclear if the environmental toxins (like dioxin) that recycling plastic produces outweigh the landfill problem plastics create. According to a 1996 report produced by the city of *Berkeley Task Force*, while plastic packaging offers advantages such as flexibility and light-weight, it creates significant problems which outweigh its benefits. These include: consumption of fossil resources; pollution (including dioxin); high energy use in manufacturing; accumulation of wasted plastic in the environment and migration of polymers and additives into foods. Consequently, we conclude that the first priority is to reduce plastics at the source. As we move towards this goal, we need to do the following:

To reduce our plastic use we need to encourage food services to order and offer more glass bottled beverages; *to-go* containers should only be offered to people taking food off the premises. The price of *to-go* and other plastic containers should reflect the environmental cost of relying on such merchandise. Food services should also be encouraged to offer discounts to people who supply their own food and beverage containers. To aide in the effort of re-use, the campus should look into cold water vending machines; students could fill their containers (plastic or otherwise) thereby reducing the amount of plastic going to land fill.

It is important for us to begin to look at alternatives to using plastic reusable containers, water-dispensing machines and purchase price discount incentives are among the numerous ways our campus can begin to decrease our dependency on plastic. To reduce the environmental impact of San Francisco State University's plastic consumption we suggest the following:

- Move to graduate elimination of use of plastics on campus where feasible
- Educate campus community about problems associated with use and recycling of plastic
- Purchase less plastic in all departments and food services
- Utilize re-usable dishware
- Purchase only recyclable plastic
- Re-use plastic beverage containers
- Purchase glass containers for beverages
- Give food discounts for the use of re-usable plastic or other containers
- Install water-dispensing machines to minimize use of disposable water bottles

Water Use

Water use on campus can be separated into two categories: human consumption and plant irrigation. Human consumption consists of three sub-categories, (1) Laboratories, (2) Bathrooms, and (3) Auxiliary devices. Auxiliary devices are equipment not classified as part of the bathroom or laboratories. They consist of gym showers, wash racks, kitchen equipment, drinking fountains, cooling towers, the swimming pool, hose hips, washing machines, water cooled compressors, and ice machines. The buildings that use each of these three sub-categories simultaneously are the Academic buildings which consist of Arts and Industry, Burke Hall, Business Building, Creative Arts, Hensill Hall, Humanities, Psychology, HSS, Science Building, Thorton Hall and the Gym. Next there are the support buildings, this group consists of the new Administration building, the old Administration building, the Library, Student union, Franciscan, Health Center and other miscellaneous buildings. The dining centers include the Seven hills and the Child Care building. Lastly, the living quarters are broken up into two groups; Housing, which consists of residential apartments and the guest center, and Dorms; Mary Ward and Mary Park.

Human Use

First we will look at the water consumption in different buildings. According to a recent conservation study by the Engineering and Design Center, in all the Academic buildings, bathrooms use the most water. The bathrooms use approximately 81,133 gallons of water a day, compared to 20,813 gallons per day used by the laboratories in those buildings, and 22,032 gallons used by auxiliary devices. The building that uses the most water is the Humanities building, at a staggering rate of 22,810 gallons a day! The Humanities building is one of the largest on campus, thus houses the most bathrooms. Bathrooms are the prime contributor to water use on campus. The total amount of water used by the Academic buildings is 123,978 gallons per day.

In the support buildings, again, the bathrooms use the most water. On average, the total gallon per day use in support building bathrooms is 24,851. There are no laboratories in the support buildings. The Student Union uses the most water per day of the support buildings, close to 18,339 gallons, used for cooking and other food service. The total water usage of all support buildings in one day is 56,715.

In the dining center auxiliary devices use the most water, approximately 9,810 gallons. The total amount of water used in this area is approximately 10,624 gallons per day. The housing sub-section uses a total of 39,941 gallons per day. The residential apartments use the most water of this subsection at approximately 38,237 gallons a day; most of which is bathroom usage, 26,985 gallons. Of the two dorms Mary Park uses the most water, 17,704 gallons compared to Mary Ward with a consumption rate per day of 15,240 gallons. The discrepancy in usage is due to the number of people in each dorm. The total water usage per day in both of the dorms is approximately 32,944 gallons.

Annual usage for the Academic buildings is 26,917,393 gallons, the bathrooms alone use 16,514,913 gallons of the total amount. Annually the Gym uses the most water, 5,055,097 gallons, followed closely by the humanities building using 4,672,397 gallons. The support buildings use 15,336,762 gallons annually. In the support building category the Student Union uses the most water, roughly 5,083,215 gallons. The bathrooms in the support sector use 8,450,824 gallons per year. The housing sector uses 12,271,513 gallons of water per day, the residence apartments use 12,044,655 of that amount. Adding the totals from each category the amount of water used on campus per day (not including plant irrigation) is roughly 264,202 gallons.

Irrigation

The campus sits on roughly one hundred acres, on these acres 27 permanent buildings and 13 structures take up 3,300,000 square feet. Surrounding all of these structures you will find plant life of some kind. To talk about areas of irrigation it is simplest to use the building name that coincides with the area. Irrigation stations (the number of which depends on the size of the area) are controlled by irrigation clocks.

These clocks turn on watering stations within the area. Each station has various models of sprinklers installed. There are two main types of sprinklers used on campus: Rain Bird and Hunter.

The Student Union is the area that requires the most irrigation. It is split up into three different sections A, B, and C. The exact area of these sections is unclear. Section A uses 73,440 gallons per month, section B uses 51,059 gallons per month and section C uses 73,440 gallons per month, this is a total of 130,207 gallons per month. Cox Stadium has among the highest usage for campus irrigation, at 161,057 gallons per month. Total water consumption for all irrigation areas is 1,096,744 gallons per month. Summertime usage is higher at roughly 1,300,000 for all areas.

Soccer Field

The soccer field at San Francisco State University is not sustainable. The field is watered once a day and the soil used to support the field is basic dirt, which creates lots of drainage and wastes water. The soccer field uses gasoline powered mowers, which pollute and use one of the earth's finite natural resources. Several steps need to be taken to make the soccer field more efficient and sustainable.

One suggestion is a new drip system, which should be implemented to conserve water. In this system the water seeps through the grass and the soil and then into a layer of small-dispersed rock. The rocks allow contaminants to be diluted; the water then moves into a sponge which is located under the layer of rock. From this point it moves into a series of small pipelines where the water runs back into the main water pipeline and is recycled.

Soil amendments can include sand, peat moss and calcined clay. All of these materials give soil-added percolation, heightened moisture retention and increased pore space. Drain tiles can also be placed in a herringbone pattern, in the soil, and will remove water from the playing surface but hold it in the soil. When water is held in the soil watering does not have to take place every day. St. Augustine grass can be used on the soccer field. This grass grows outward instead of up and usually only has to be cut bi-monthly.

Water Reduction: Current Practices and Areas of Opportunity

According to the Engineering and Design Center, San Francisco State University uses approximately 83 million gallons of water a year, of which 79% is interior and 21% is irrigation. 47% of the interior water is used in campus bathrooms, which constitute the highest use of water. In an effort to reduce this consumption San Francisco State University has been installing water saving retrofits since the late 1980's. According to Sloan Royal the manufacturer of these devices toilets can save as much as 3.5 gallons per flush.

	Without Retrofits	With Retrofits
Toilets	7.0 gallons per flush	3.5 gallons per flush
Urinals	3.5 gallons per flush	1 gallon per flush
Showers	4.3 gallons per minute	2.4 gallons per minute
Sinks	3.0 gallons per minute	2 gallons per minute

An Engineering and Design Center study yielded these results:

	Toilets	Urinals	Sinks	Showers
Pre Retrofit Consumption	53.38	7.20	10.14	13.12
Current consumption	26.69	3.10	4.23	7.87
Savings (%)	50%	57%	58%	40%

Gray-water

In addition to implementing water saving devices another viable solution is re-using our gray water. Gray-water, unlike black water (sewage), is water from other sources like sinks, shower, and washing machines. Gray-water contains less nitrogen than black-water and can be used for irrigation purposes. To use gray-water effectively we would need to implement a gray-water collection system. This system would be located right on campus. This system would consist of a filter and a soil box to remove toxins, the water would then be dispersed for irrigation. To use campus water more efficiently we suggest the following amendments to our current water saving plan:

- α Educate students, faculty and staff (use less water)
- α Complete all retrofits (toilets, sinks and showerheads)
- α Re-use gray-water for campus irrigation
- α Implement a new drip irrigation system on all athletic fields
- α Use alternatives to traditional grass
- α Water foliage only at night

Campus Food Service

Our student research teams conducted a series of interviews with food service staff and management and found that the campus serves approximately 7,000-8,000 people daily. Food service staff and vendors do not record exact amounts of food sold. We did learn that 99% of food served is not organic – this means that almost all of the food served at SFSU is grown with synthetic chemical fertilizers and pesticides which have been found to harm human health. In addition, much unused food is thrown away. We also learned where the vendors order their food products, approximately how much waste they produce, and how food is packaged from suppliers as well as at the point of sale to students and how that packaging is disposed.

We divide the entire SFSU food service process into two segments, pre-consumer and post-consumer: in doing so we are able to identify where problems exist. In the pre-consumer segment, we recognize that food sources and packaging are key areas where San Francisco State University vendors can make considerable improvements. In the post-consumer segment our major focus is on the contribution to the waste stream—both from food waste and packaging waste. Although some positive actions have been taken on the San Francisco State University campus, very important elements of an effective sustainable food plan have been overlooked. By modifying each step of the process, San Francisco State University can have an environmentally sound food service plan. We feel that within ten years campus food services can be fully sustainable and environmentally sound.

We create a ten-year plan divided into three temporal segments: within 1 year, within 5 years, within 10 years. This puts a visionary proposal into realistic terms. We feel that with education and the full support of the administration, Campus Food Services at San Francisco State University can become a positive model for other campus food service programs.

Food Sources & Production

Buying locally grown foods rather than products that are shipped from hundreds or thousands of miles away results in less air pollution and fuel consumption due to transportation. It will also result in much higher quality food being served at San Francisco State. During our interviews with food vendors on campus, many of the managers stated that they ordered all of their food products locally. Unfortunately, this simply means that they are buying from local suppliers, almost all of whom purchase food from long distances. The residence dining halls, which are owned by an international corporation (Sodexo Marriott), purchase products from sources worldwide.

We believe that San Francisco State University food services have the immediate potential and responsibility to foster sustainable agricultural practices by purchasing locally, sustainably grown organic food products. We propose that, within a year student government and administrators on campus enforce a mandate that requires all food merchants to receive no less than 20% of their food products from local farmers, suppliers, and vendors who are growing food sustainably. In addition, all campus vendors must begin to integrate locally purchased, organic food into their menus. Within the first year, policy should require 10% of all food products on campus to be organically grown or produced. Within five years, we propose that 50% of all food products on campus be grown or supplied locally and organically. The ultimate long term goal will be to increase the requirements to 80 – 100% of food products to be locally and organically produced. Fortunately, Northern California is at the forefront of organic food production, there are many organic farmers right here in the Bay Area.

Local food wholesalers

Supplier	Address	Phone
Alma's Place	6154 Sawmill Rd., Paradise	(916) 872-9107
Antolini Farm	4575 Paul Sweet Rd., Santa Cruz	(831) 476-1648
Appleseed Ranch	1834 High School Rd., Sebastopol	(707) 823-4408
Associated Cooperatives	322 Harbour Way, Suite 12, Richmond	(510) 232-1111
B&B Organic Farm	P.O. Box 309, Leggett	(707) 984-8420
Cache Creek Organic Farm	P.O. Box 85, Rumsey	(916) 796-3521
Crystal Wave	P.O. Box 2298, Sebastopol	(707) 829-8336
Deer Gardens Foods	2230 Soquel Ave., Santa Cruz	(831) 462-6715
Falcon Trading Company	1055 17th Ave., Santa Cruz	(831) 462-1280
Farmvest, Inc.	P.O. Box 201, Clayton	(925) 672-8843
Fowler Brothers	P.O. Box 2324, San Raphael	(415) 459-3406
Giusto's Specialty Foods	241 East Harris Ave., SSF	(650) 873-6566
Greenleaf Produce	1980 Jerrold Ave., SF	(415) 647-2990
Gregory House Farms	P.O. Box 1615, Davis	(916) 753-3361
Grossi Farms	6652 Petaluma Hill Road, Santa Rosa	(707) 664-7723
H-S Farming Company	P.O. Box 724, Healdsburg	(707) 838-4570
Ini International	309 Sheffield Ave., Mill Valley	(415) 383-1869
Jacob's Farms	P.O. Box 508, Pescadero	(650) 879-0580
Knoll Organic Farms	P.O. Box 65-H, Brentwood	(925) 634-5959
Kona Kai Farms	1824 5th St., Berkeley	(510) 486-8334
Kozlowski Farms	5566 Gravenstein Hwy., Forestville	(707) 887-1587
Lundberg Family Farms	P.O. Box 369, Richvale	(916) 882-4551
Made in Nature	7 Mt. Lassen Dr., Ste. A120, San Raphael	(415) 296-7046
New Native/Greensward	1255 Hames Rd., Aptos	(408) 728-4136
Ocean Organic Produce Co.	P.O. Box 570, Moss Landing	(408) 722-1166
Organic Produce Co.	P.O. Box 14443, Santa Rosa	(707) 579-9297
Pacific Soybean and Grain	495 DeHaro St., SF	(415) 863-0867
Perlinger Natural Products	238 Petaluma Ave., Sebastopol	(707) 829-8363
Pleasant Grove Farms	P.O. Box 636, Pleasant Grove	(916) 655-3391
Pleasant Hill Produce Co.	2203 Morello Ave., Pleasant Hill	(415) 798-5275
Quong Hop & Co.	161 Beacon St., SSF	(650) 761-2022
S&S Produce Co.	P.O. Box 570, Moss Landing	(408) 761-0881
Santa Cruz Natural	P.O. Box 1510, Freedom	(408) 728-0515
Star Route Farms	Bolinas	(415) 868-1658
Star Valley Farm	2985 Mix Canyon Rd., Vacaville	(707) 448-5303
Swanton Berry Farms	5221 Coast Road, Santa Cruz	(831) 426-9614
Tassajara Bread Bakery	5700 3rd St., SF	(415) 822-5770
The Apple Farm Bates & Schmitt	18501 Greenwood Rd., Philo	(707) 895-2333
Tko Farms	101 E. Manor Drive, Mill Valley	(415) 389-0507
Valle Verde Farms	11397 Green Valley Rd., Sepastopol	(707) 823-0156
Van Dyke Ranch	7665 Crews Rd., Gilroy	(408) 842-5423
Veritable Vegetable, Inc.	1600 Tennessee St., SF	(415) 821-1450
Vitasoy, Inc.	99 Park Lane, Brisbane	(800) 848-2769
Webb's Organic Farm	5381 Old San Jose Rd., Soquel	(408) 475-1020
Western Skies Ranch	1156 West Ave., Santa Rosa	(707) 545-8079
Wholefood Express	3134 Jacobs Ave., Eureka	(707) 445-3185
Wild Rose Ranch	308-B Center St., Healdsburg	(707) 433-7869
Wildwood Natural Foods	135 Bolinas Rd., Fairfax	(415) 459-8636

What other campuses are doing

Hendrix College

Hendrix College in Conway, Arkansas conducted a comprehensive review of campus food resources in 1986, discovering that 95% of food served on campus came from out of state. As a result, the campus made significant changes in its food operations, resulting in a dramatic increase in the use of locally and organically produced food. Students and faculty report very high levels of satisfaction with the new program.

Middlebury College

Middlebury College in Middlebury, Vermont has also taken some positive steps towards a sustainable food service. Their dining services have increased vegetarian options and the total percentage of vegan entrees served at dinner and lunch is 32%. In addition, the College buys 75% of food through a local food service distributor that buys from local farms when in season.

Harvard University

Harvard University in Cambridge, Massachusetts serves an average of 15 meals a day. Despite intensive waste reduction efforts, the food service program was still generating a lot of waste. To reduce some of this waste, the campus expanded its recycling program and almost eliminated all plastic food containers, steel and aluminum cans and glass from the waste stream. The result was a savings of $79,000 each year. A second program was the use of a pulper machine which spins the waste 50% dry . Existing food grinders require large amounts of water. The resulting wastewater increases the biological oxygen demand at the local sewage facility, reducing the plant's efficiency. To lessen the environmental impact and save money on water, Harvard installed food pulpers in its kitchens.

We suggest the following:

- Require food service programs to purchase sustainably grown food from local producers
- Institute re-use packaging
- Increase vegetarian and organic food options
- Donate un-used food to non-profit emergency food programs
- Organize "health weeks" to feature and promote healthy food choices and educate the campus community about the importance of sustainable agricultural practices
- Place flyers or table tents in the dining halls to explain the benefits of organically grown and local products
- Offer an affordable, organic salad bar with locally purchased, seasonal produce
- Establish relationships with local farmers and farmers markets
- Offer credit to students who volunteer to recycle food waste.

Packaging & Plastics from Suppliers

According to student interviews, food merchants on campus are currently recycling cardboard, aluminum, and glass packaging from suppliers. However, there seems to be a problem with recycling plastics due to the wide variety of plastics that are used. There are between 500 and 1,000 different recyclable plastics; almost all of the packaging materials we are familiar with come from one of six groups. The problem with recycling this assortment is that the source material must be pure, if it is not recycling centers reject the material (including the Recycling & Resource Center). The result of not being able to recycle this material is more waste being diverted to landfill. In general, plastics are not environmentally friendly because the production of plastic relies on fossil fuels, which are detrimental to the Earth's ozone layer and the recycling of plastic emits toxic fumes, most importantly dioxin, which are extremely hazardous to human health and the environment. Our ultimate long-term goal is to prohibit the purchase of foods that are packaged in plastic. Until suppliers and buyers are aware of the problematic nature of plastic this may not be feasible. Our five-year goal is to minimize the amount of plastic we will accept from suppliers.

A policy that requires food merchants to order food that is packaged in one of the few types of plastics that are recyclable should be put in place. Food merchants will have to take some responsibility and voice their demands for environmentally friendly/recyclable packaging. If our campus begins to request less packaging from suppliers our demand is sure to be heard. Suppliers will eventually find that extra packaging is not necessary to sell their product, in fact less packaging means less production cost. It is true that we see these as only minor changes, yet we can not fully anticipate how food services will respond. The administration will have to influence the food services that will in turn influence the suppliers. Suppliers and other corporate entities must be made to recognize the needs of an environmentally responsible campus.

Packaging & Plastics within Food Service

This is an area where we can certainly make some immediate and effective changes. The majority of food and drink served on campus is served in some sort of disposable or recyclable medium, creating more waste than is necessary. Within the San Francisco State University student union food service area approximately 10,000 plastic forks, 7,500 paper plates and 2,000 *to–go* containers are used each day. There is no recycling process implemented for all of this waste. This requires immediate action.

We propose that in the short term, food merchants offer take-out containers only as an option if food is going to be taken off the premises. Dining services can in turn place an additional charge of $.05 - $.25 on take-out items to help incur the additional costs of dish washing. Also in the short term, the take-out containers must only be made of recyclable paper, aluminum or cardboard. In the last decade we have seen all the major fast food chains convert from plastic and styrofoam packaging to recyclable paper or cardboard making these alternatives widely available from manufacturers. Another immediate change that can be made is initiating a system where students are encouraged to bring their own coffee cups/beverage containers from home to be filled at cafes, soda fountains, etc. As an incentive, students could be offered a discount on their purchase when participating in such a program.

In the mid and long term, we can focus more on the smaller items being added to the waste stream such as straws, stirrers, and plastic utensils. Since there is such a perplexity surrounding the recycling of plastics, items that are not re-usable must be 100% recyclable. With the use of all recyclables, it will be important to be able to sift any recyclables from the food waste. Discount incentives should be offered to students faculty and staff who bring their own re-usable plates and utensils. Again discount incentives could be offered by food services for re-using cups (even if they are plastic or paper). We recommend the following:

- α Encourage students to bring their own plates, mugs and utensils
- α Take out containers of recyclable cardboard, paper and aluminum only
- α Implement dish-washing of food service utensils and plates
- α Offer discounts to students who use their own plates, mugs and utensils
- α Take all plastics out of the waste stream
- α Gradually reduce plastics

Food Waste

Students in the dorm throw away approximately 300 pounds of food per day that is an average of 8,400 pounds per month. . The buffet set up of the dorm food services may contribute to this waste. A buffet encourages a person to take more food than they need. To amend this problem we suggest a single plate limit. Dorm food services throw out approximately one hundred pounds of prepared food per week. The grand total of food waste per month is 12,400 pounds!

A simple and altruistic way of disposing of edible food (food which has not been taken from food services by a customer) is to begin a Community Food Recovery Program. Our interviews reveal that is much food waste in food services. We suspect that much edible food is thrown away each day. We propose that a program be implemented immediately which donates all extra, edible food to local, non-profit homeless shelters, soup kitchens and emergency food programs.

What other campuses are doing

Bowling Green State University

In the mid-1990s, Bowling Green State University implemented a take-out tray program in their student dorms. Each incoming resident was given a durable, fiberglass tray printed with the school logo to be used in lieu of disposable take-out trays. The disposable mediums were no longer made available. The result was a substantial saving in purchasing costs and much lighter waste stream.

The University of Wisconsin-Madison

The University of Wisconsin-Madison was one of the first campuses to implement a refillable mug program. The sales of the mugs were tracked and the program's success is reflected in the following figures:

Revenues		
Average sold Per year *	**Sales profit per mug**	**Annual revenue from mug sales**
9,000	**.95cents**	**$8,550**

*During the years of 1994-1997, with a purchase price of $2.00

Cost Savings			
Beverages purchased In refillable mugs	Cost of 1,000 foam hot cups	Cost of 1,000 paper cold cups	Annual cost savings
116,700*	$24	$45	$2,875**

***113,625 hot beverages (coffee, tea, hot chocolate), 3,075 cold beverages (soda, milk, juice)**

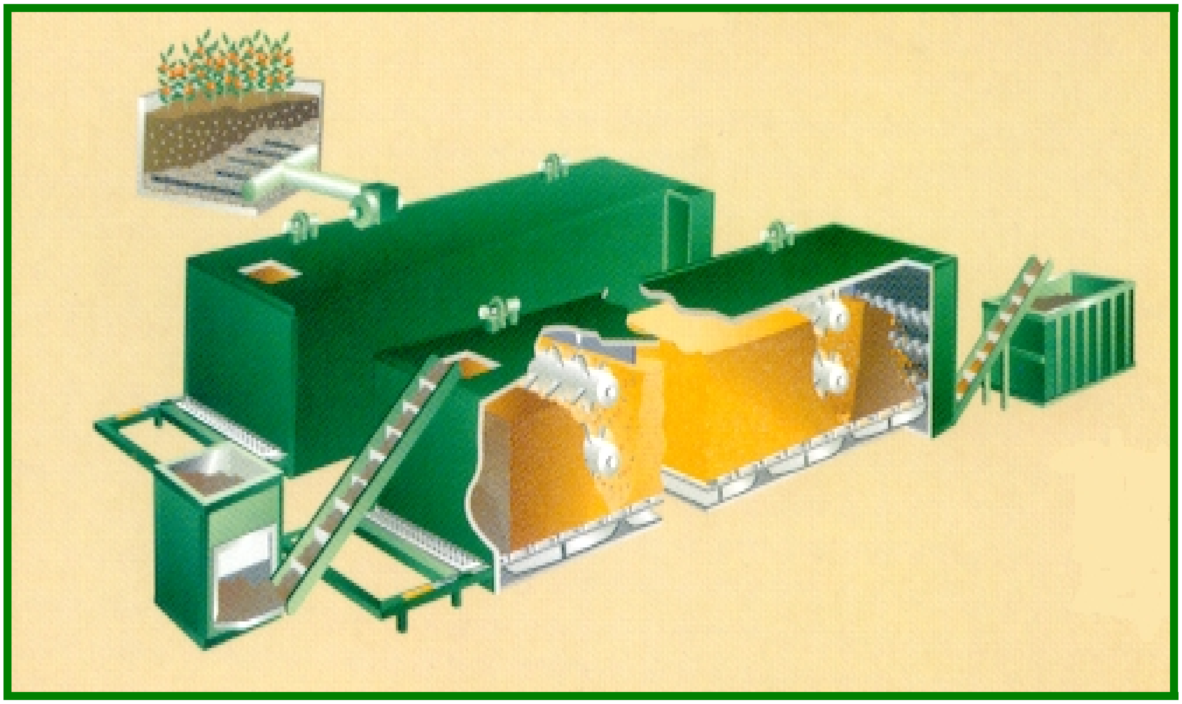
****Data for 1996-97 school year**

In-Vessel Composting

Composting is a form of recycling that can successfully divert food waste into valuable material that can contribute to soil when it is reused for gardening and agriculture. Currently, the San Francisco State University Recycling Center is operating an in-vessel-composting program, which handles most of the food waste from the residential dining facility. This exciting system processes approximately fifty tons of organic material per year. Unfortunately the compost that this In-Vessel system produces is not fully organic because we are not able to successfully remove small plastic (i.e. drinking straws and stirers) from the food waste that is being composted.

Although this is a model program for West Coast colleges and university campuses, we believe we can do more. After interviewing several members of the composting team, we discovered that the In-vessel composting system is not running at full capacity. It is only being used during daytime hours when students are on campus. While the current system diverts approximately 1,000 pounds of food per day, members of the team expressed the possibility of running the machine around the clock, allowing more waste to be diverted and more valuable compost to be produced. In the short run, we propose that the In-vessel be run 24 hours a day. Additional waste should be collected from the faculty dining hall and the remaining waste from the residence halls, this would bring the unit up to full capacity.

In-vessel Composting system at San Francisco State University



During the next five years, we would like to see an additional composting system implemented. All food waste should be used for composting. We suggest that the new composting system be located adjacent to the Recycling Center, on the opposite side of the building. A similar system can fit tightly into this space while allowing room for operation. Our plan allows for an ample design phase of two to three years with a building phase of equal length. The additional unit should be able to handle the waste from the remaining food services (in the Student Union) so we can reach our ultimate long term goal of 80 to 100% of food waste from all dining services on campus being composted in less than ten years.

Location of current and proposed composting systems

What other campuses are doing

Middlebury College

Middlebury College of Middlebury, Vermont is a fine example of food service management towards sustainability. The College composts 85% of its food waste using Passive Aerated Windrow technology and has developed a partnership with their regional waste management district to compost county wastes.

Dartmouth College

Dartmouth College also participates in a composting program, using kitchen trimmings and scraps from their dining halls. They have reported the following savings:

Cost Savings – Dartmouth College Composting Program				
Compost Produced	**Avoided purchase of fertilizer**	**Avoided landfill tipping fees**	**Program expenses**	**Project cost savings**
20,000 lb.	**$9,700***	**$1,700**	**$1,200**	**$10,000****

*Based on 1990 cost for a 50-pound bag of compost at $8.50.

**The project cost savings data cover only an 8-month period. A full year's savings would actually exceed this amount.

The University of Colorado

The University of Colorado found that an on-campus compost operation was not economically feasible for them, so they divert their food waste to an outside private composting facility 30 miles away in Golden, Colorado. This is an example of an excellent alternative when financial resources are limited.

Getting students involved

We recommend a Community Outreach program operated and staffed by students, who are paid with work study funds to collect and distribute the extra edible food to shelters in the community. As most students are aware of, and concerned about, the homeless problem in our city, it should be a program that yields high participation. Collection points can also be set up around campus for table scraps to be composted. Just like the existing aluminum, glass, and plastic collection points, well designed food waste bins could be designated for students to separate their excess food from meals. We recommend the following:

- Use the SFSU compost machine more efficiently
- Employ a second compost machine
- Separate all non-organic matter from food waste
- Compost 80%-100% of all food waste within five years
- Use fewer plastic utensils
- Give food discounts to students (faculty and staff) with re-usable utensils and dishes
- Require food services to purchase sustainably grown, organic produce
- Require food services to purchase food with less packaging and use less packaging

Campus Landscaping

The Grounds Department at SFSU is responsible for the upkeep of roughly thirty-five acres of landscaping on the main campus. The campus supports an estimated twelve acres of grass. Approximately two dozen native plants are grown on campus. The campus-landscaping department buys plants from commercial nurseries. The staff member interviewed in the landscaping department stated that the department uses as many perennials as possible. A perennial is a plant that lasts more than one season. At SFSU, perennials are replaced every two to three years because of the way staff gardeners perceive plants growing, maturing and presenting themselves overtime. The perception is that, at some point, these plants are no longer aesthetically pleasing. At SFSU, annuals are used for show and replaced at the end of their cycle. The landscaping department staff person was not sure how many plants were re-planted each year because the number is so high. The campus buys seed of grass and wildflower mixes, which are also replaced after a few years when the mix drifts and or are invaded by weeds. Before seeding fresh plants, the Grounds Department removes weeds carefully.

According to staff, toxic herbicides are used on “stubborn” weeds. The campus landscaping staff uses pinpoint spraying of toxins (fertilizer, and pesticides) rather than blanket spraying. Herbicides, pesticides and fertilizers are used on campus. With regard to water, sprinklers are used to water the grass. The lawn sprinklers are set to come on automatically at night and can be shut off when it rains. The department does attempt to use only as much water as the grass actually needs. Power mowers are used to cut the lawn, these mowers use a finite natural resource (gasoline) and are not sustainable.

Problems that exist with our current landscaping practices include: over-watering, the use of toxic chemicals to solve insect and weed problems, gasoline mowers and the reliance on artificial fertilizers. The fact that perennials are constantly replaced is also a problem. Herbicides are unnecessary as weeds can be pulled or dug up when necessary. Landscaping teams should look into the use of mutually beneficial plants as an aide to non-toxic fertilizer. Alternatives to power mowers should be looked into. Grass could eventually be replaced with soft low-lying ground cover that does not need to be cut. Edible landscape could be implemented in certain areas providing fresh organic food for the campus. To maintain diversity heirloom plants should be considered for campus use. The use of herb and plant gardens for certain departments could be implemented. To lessen the environmental impacts of our current landscaping process we suggest the following measures:

Simple steps to reduce landscaping fuel and resource use

- Replace gas operated mowers with less polluting mowers
- Raise the blade on the mower, grass requires less water and fertilizer and is more disease and pest resistant at two to three inches
- Adjust sprinkler heads in plant beds so that they spray only the plant beds. If there is still a large amount of runoff, use lower flows
- Replace traditional grass
- Use natural non-toxic fertilizers
- Use natural non-toxic pest control, eliminate pesticide use and synthetic fertilizers
- Introduce predatory (beneficial) insects/integrated pest management program

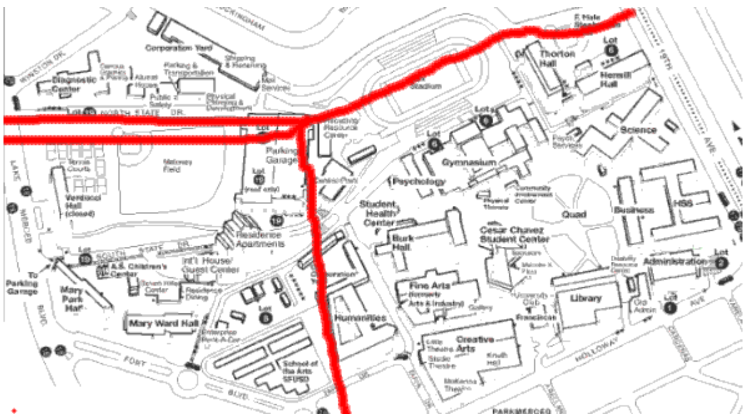
Landscape irrigation is achieved systematically through delivery systems which are specific to the needs of the campus terrain. Planters are serviced through a series of *Rain Bird* sprinklers and drip tubes. The drip tubes are set between 12 and 14 inches apart for maximum coverage without over watering. The tubes are expensive, but are also the most efficient. Sprinklers are set for 5 and 15 degree trajectories, the most efficient for planters. For large grass areas, the baseball field for example, the *Hunter* 1-25 and 1-40 series sprinklers are employed, which deliver water with a greater range. In the case of all sprinklers and drip tubes, the run time is set so that the precipitation rate is equal to the evaporation time. The Grounds Department states that it employs every conventional water conservation measure in the school's irrigation program, some of which are:

Conventional water conservation methods employed at San Francisco State University

- Water pressure is adjusted to reduce fogging
- Sprinklers are set to low angles to avoid wind interference
- Low head check valves are installed to insure equal pressure to all sprinklers
- Watering takes place at night and during times of low wind
- Mulch is used to prevent over evaporation
- Campus is not watered during periods of rain

Storm sewer irrigation

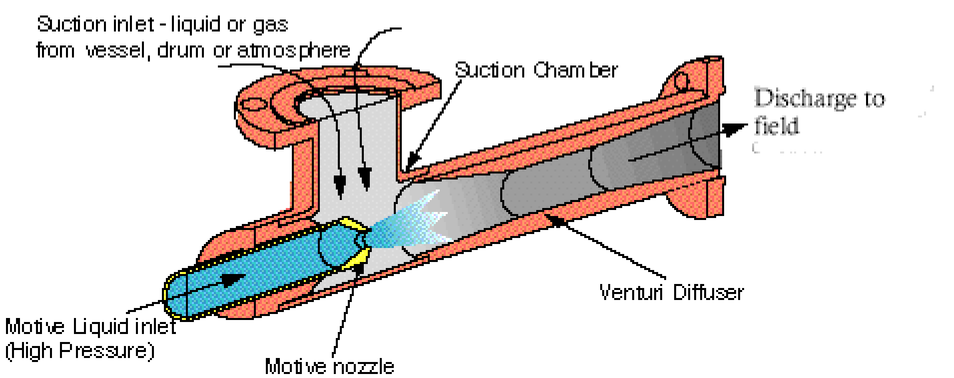
Currently lying beneath campus, the storm sewer, or drainage system, effectively pull vast amounts of rainwater from collection areas and is gravity fed into the city's main sewer line that runs across campus. The area, in which the university is located, received 47.22 inches of rain between July of 1997 and June of 1998. (Null) There are nearly 300 storm drains branching out over the campus. We believe that rainwater could be successfully diverted from the sewage lines to on campus irrigation.



Main sewer line

In the past few decades, somewhere in the height of the California drought, a small project was undertaken to see if ground water could be used to irrigate the field areas on campus. A well was drilled near Hensill Hall that yielded 25 gallons per minute. Two 20,000-gallon tanks were placed on F. Hale Stephenson Field to support the effort. The plan however was later abandoned.

A rain water collection project could work well on campus. The campus is well sloped in many areas. Collection tanks would be placed underground. Receiving areas could be equipped with an eductor system. An eductor uses the flow of one fluid, in this case an existing water line, to move another fluid, the rainwater from the tank.



The only major roadblock to a project of this type is that the campus sanitary sewer directly ties into the storm sewer, therefore rendering the water black. The best chance for this project would be in the next few decades when the existing sewers will need to be overhauled. At that time, a secondary system could be placed for rainwater collection.

Composting

The Grounds Department makes use of compost derived from the In-vessel composting machine. The eight-stage composting device, located between Cox Stadium and the parking garage, produces a steady supply of compost from the food waste supplied by the various campus food services. Unfortunately this compost is not organic because of the plastic straws and utensils that are not removed from the food waste. Although the compost from this machine is not used everywhere, because of it's questionable appearance and it's questionable composition, it is used throughout the campus. Non-organic compost is also used on campus, limited mostly to grassy areas where yellowing has occurred.

Landscaping; predatory insects

The grounds department is currently adopting integrated pest management (IPM). Groundskeepers are very pleased with the methods that are used in maintaining the landscaping for San Francisco State. "Chemicals that are used are no stronger than household products", according to one of the members of the department. Unfortunately, this is a problematic reference since many household chemicals and over the counter pesticides are harmful to human health, other species, and the environment. Round up, for example, is used on the SFSU campus to deter "unwelcome" weeds.

Fortunately, staff is considering the use of predatory insects. Predatory insects eat insects that feed on foliage and create a nuisance on the grounds. For example, Decollate Snails feed on common brown snail and sail's eggs. They also eat slugs as well. They provide non-toxic control when released into the environment. The snails have a life expectancy of up to two years and can lay up to 2000 eggs. Another insect used in pest control is the Green Lacewings. These tiny insects are such ferocious predators that are sometimes referred to as lions. Green Lacewing larvae will dine on garden or greenhouse mites, white flies, small worms, insect eggs, and other soft bodied insects for up to three weeks. Thereafter, they metamorphosize into the adult lacewing, which will lay up to 1,000 eggs, enough to cover a 5,000 square foot garden. Ladybugs feed on aphids in their "ladybeetle" stage then aphids, rootworms, weevils, Colorado potato beetles, and other insects in their less-well known larval stage.

One of the most effective organic pest control insects is the Praying Mantis. In late spring, after hatching, these insects feed on aphids until full grown. At that time they select larger pray such as caterpillars and beetles. The use of predatory insects is inexpensive, non-toxic and a reasonable alternative to chemicals harmful to human health and the environment.

Campus Pest Control

Pesticides are toxic to human beings and the pesticides we use on campus as part of campus pest control programs are no exception. Unfortunately our student research teams had little success getting information about the kind of pesticides used in the SFSU campus. We have not been able to obtain information concerning names or amounts of any specific products used on the SFSU campus, so we cannot speak directly to that issue. We were told that pest control products used on campus include "traditional" forms of pesticides. This refers to toxic chemicals used to kill or deter pests. It is important to make the distinction that on campus we use pesticide not pest control. We do not currently have a pest control staff at San Francisco State University, the campus contracts out with private firms. Because we were unable to get information on pesticide use on campus, we did research on least toxic pest management practices generally. Below, our recommendations for the SFSU campus based on this research.

Least Toxic Pest Management

- Use boric acid to get rid of ants and cockroaches
- Use diatomaceous earth and silica aerogel to dehydrate and get rid of insects
- Use citrus oil extracts such as D-limonite and Linalool to get rid of fleas
- Use Soil Aid, Green Magic, And Lawn Restore to get rid of lawn pests
- Healthy plants and lawns are less susceptible to pests
- Require complete sanitation and daily cleaning of pest infested areas

What other campuses are doing

Ottawa School district in Michigan

Ottawa School district in Michigan uses alternatives to traditional pesticides. They work with a company called Get Set Inc that was founded by a former pesticide sprayer. Get Set Inc. uses pesticide alternatives such as baking soda, vinegar and molasses. This is a cost effective alternative, The Ottawa School district spends approximately 12,000 dollars a year for pest control at 10 schools.

Janitorial Products

San Francisco State University uses 20,000 to 30,000 dollars worth of cleaning products per year. Currently all of these products are chemical based, industrial cleaners. Chemical cleaners harm the environment and have a negative impact on human health. Instead of continuing to use non-biodegradable, toxic industrial cleansers we should consider using citrus based solvents. Citrus solvents can be used to clean floors, walls and toilets as well as glass and other surfaces. Citrus-based cleaners should replace toxic industrial cleaners.

We can replace the hydrochloric acid based drain clog remover that we currently use at San Francisco State University with a natural enzyme based product that is non toxic and non corrosive helping lengthen the life span of the schools plumbing system. A sustainable solution to the petroleum chemical based soaps used to wash hands in the restroom would be a natural based soap that can kill bacteria such as a tea tree oil soap. Yearly purchases of cleansers and drain clog remover are made in the summer, which provide administrators with time to research alternative companies and implement a new purchasing plan by next year.

Janitorial Products

- Use bio-degradable, non-toxic cleaner
- Switch to citrus-based cleaning products whenever possible.
- Use natural enzyme-based drain clog products
- Use non-petroleum chemical based soaps in bathrooms
- Work with companies whose inventory includes non-toxic, environmentally friendly products.

Lighting and Energy

San Francisco University, a university that consists of 27,446 students and 3,086 staff and faculty in Fall 1998, used roughly 2.5 million kilowatthours (kWh) in 1998. According to Kevin Gonzalves-Lew, Systems Administrator and Senior Electrical Engineer at SFSU, 40% of this consumption, that is, about one million kilowatt hours was consumed for supplying heat and ventilation; another 40% were consumed for lighting. The university campus also consumed over 1.6 million therms of gas for heating. The company that supplies electricity to the university campus is a Houston-based company called ENRON. This company provides electricity to the campus through a thermal station, in which natural gas is burned to generate energy for power production. In 1998, about 1.2 million dollars were paid for lighting. Since lighting accounts for 40% of the university'' energy consumption, we estimated the university spent about three million dollars on electricity in 1998.

Heating for the campus is generated in a central heating system. Two 24 MMBtu/hr boilers in the central plant consume gas (therms) to heat the building loop (hot water distribution system). Then, the central plant pumps the hot water throughout the campus. At the buildings, fans and pumps are responsible for moving the hot water to heating coils. Air is pushed through these coils to heat the building spaces.

The SFSU campus is continuously installing energy saving implements to increase consumption efficiency and reduce energy usage. Each building on campus has a management system that controls all pumps, fans and valves, dampers and heat exchangers in the buildings. The system uses set programs that include specified on/off times and heating control sequences. As far as new construction and all new projects, such as the corporation yard and childcare center are concerned, they must meet energy efficiency guidelines as mandated by the California Energy Commission.

Lighting on campus includes lighting for classrooms, laboratories, bathrooms, offices, public facilities such as the library, student union, gym, theaters, etc. Lighting is also needed outdoors, especially at nighttime, for many tasks such as security while getting about on foot (walkways, crosswalks, and in parking lots), security at entrances, storage areas, for driving and on bikes (roads, parking lots, driveways). For security purposes, lights are on at night when very few people or none are using the space, for example, in the Administration building. Two thirds of spaces on campus have some type of motion control sensors or timers that automatically turn off lights, the other one third do not. These spaces rely on manual systems for controlling light. The university is gradually changing to energy efficient lighting, lighting controls and exit signs.

A noteworthy project that is currently underway is the TOU (time of use) electrical metering project. Soon, all buildings on campus will be monitored using a computerized electrical meter that will record energy information such as kilowatt (kW) demand and kWh consumption. Using this information can help the administration better understand how and when the university uses energy so as to better manage its electrical load. For example, once the administration knows how the university uses energy they will be in a better position to study how they can save additional money by applying energy management techniques such as load shedding. Load shedding includes turning off electrical loads during peak hours to avoid paying electrical demand charges and minimizing energy usage during peak hours of the day.

Sustainable Energy Alternatives

Solar Energy

Solar energy sustains life on earth for all plants, animals and people. The earth receives radiant energy from the sun in the form of electromagnetic waves, which the sun continuously emits into space. The earth is essentially a huge solar energy collector. This energy takes on various forms, from direct sunlight used through photosynthesis by plants to grow, to heated air that causes wind, to evaporation of the oceans that falls back as rain and become rivers. This energy can be tapped indirectly…and directly as *solar energy* (thermal and photovoltaic). Unlike fossil fuels such as coal, oil and natural gas, solar energy is a renewable resource that is inexhaustible and readily available. It is a clean energy source that is pollution free and allows for local energy independence. The amount of power from the sun that reaches the earth at noon on a clear day is about 1,000 Watts per square meter. This is equivalent to a 100 Watt light bulb completely focused on a surface the size of a large notebook. Capturing solar energy often requires purchasing expensive equipment. Yet because renewable energy resources are free, the cost to use them is significantly lower than other energy sources, such as fossil fuels when you consider the hidden environmental costs of extraction, transporation and global impact of their use. In this case, the environmental costs of renewable energy sources are much lower than conventional energy sources.

Although, the best alternative lighting comes from the oldest light source in the solar system: the sun, on this campus the implementation of solar energy in existing buildings is unlikely. That leaves us to consider the use of direct or redirected natural lighting. The three different ways to do this is with skylights, sola- tubing, and Prisms. These lighting features in conjunction with smart building design can reduce the use of conventional energy use.

Passive solar systems rules of thumb:

- The building should be elongated on an east-west axis.
- The building's south face should receive sunlight between the hours of 9:00P.M. and 3:00 P.M. (sun time) during the heating season.
- Interior spaces requiring the most light and heating and cooling should be along the south face of the building. Less used spaces should be located on the north.
- An open floor plan optimizes passive system operation.
- Use shading to prevent summer sun entering the interior.

Light shelves are the key to solar energy. Light shelves are reflective horizontal surfaces that extend from the exterior into the interior of a building. They can extend the useful range of perimeter daylighting on a building's south side to about 25 feet on sunny days. Light shelves can prevent unwanted direct sunlight, which is a source of glare, from entering a space. The shelves reflect sunlight onto the ceiling, minimizing glare and boosting light levels in the space. Lightshelves work well at high solar angles, but at lower angles the shelves need to extend deeper into the room to catch the sunlight. Light shelves can also reduce the amount of heat that enters a space.

Prismatic glazing

Refraction is the principle behind prismatic glazing, a material with ridges on one side that bend light to specified angles. Prismatic glazing can be used

to exclude sunlight from a space or redirect it, usually to the ceiling. Prismatic glazing works effectively only at certain solar angles. As the sun moves beyond the critical angles, sunlight passes through the glazing and can cause glare. Prismatic glazing obscures the view out, so it is usually placed at the top of a window.

Holographic films

Holographic films are created using laser light, which records a three-dimensional pattern of lines on photographic emulsions. The lines create a diffraction pattern through which light exits at certain angles. The film, which is attached to a window, appears clear except at the diffraction angle. Thus, in theory the film will direct sunlight onto the ceiling to be reflected further into the room while preserving the view out of the window. However, the diffraction separates the sunlight's spectrum and creates colored patterns on the ceiling. Because the film is attached to a window, it can't track the sun and has a limited time of exposure. It is not effective at manipulating diffuse daylight, and it reduces the total transmittance through the window. Richard Mistrick, a professor at Penn State University reported problems in the film's manufacture-- the material shrinks as it is cured, making it difficult to maintain the proper number of holographic lines per inch.

Passive skylights

The common skylight, or roof window, provides a simple way of bringing daylight to the upper floor of a deep building. An example of a passive daylighting system is the common skylight which contains no moving parts and is fixed at an optimal position. Manufacturers have been working to develop systems that minimize thermal and glare problems and increase the light levels brought into a space.

In 1993, Andersen Corp. installed nine prototype skylights in a Wal-Mart store in Lawrence, Kansas. The interiors of the convex windows are covered with a prismatic film to help enlarge the apparent area of the window. According to Patty Perez, Green Coordinator at the Lawrence store, shoppers respond positively to the skylights. "I've had customers come up to me and mention how much they prefer to shop in the areas with skylights, says Perez. Wal-Mart has since opened two more stores that use skylights extensively

The SunPipe Company produces the SunPipe, an aluminum pipe that is lined with silver to reduce reflection losses. A clear acrylic dome on the top and a translucent dome on the bottom diffuse light through a space. SunPipe developer Greg Miller claims that a SunPipe mounted 16 feet above the door can deliver 20 to 40 foot-candles onto the floor directly underneath. Elbows give the installer flexibility in placing the SunPipe; installation typically takes only three hours in a residential building. "The installer doesn't need to make significant structural modifications to the building because of the size of the pipe," says Miller. The SunPipe Company markets the SunPipe primarily to residential customers, although the company is looking at promoting it for use in warehouses and small offices.

Active skylights

Active daylighting systems contain moving parts that track the sun. The tracking mechanism is most effective when the sun is out; they cannot redirect significant amounts of diffuse light from cloudy skies. The Natural Light Co. manufactures both passive and active skylight systems. Their basic passive system uses a 4-foot by 4-foot light well with sides made of foil-lined insulation board that has a reflectivity of 85 to 90%. The top is a prismatic lens that helps to redirect low-angle sunlight into the shaft. The bottom of the shaft can be one of three types of diffusers, two of which hang below the ceiling. “In an industrial space requiring 35 foot-candles and a mounting height of 20 feet, each unit can cover 800 square feet," says Eric Lancing, business manager of Natural Light Co.

What other campuses are doing

Brevard Community College

Brevard Community College has replaced all fluorescent light fixtures on its four campuses with energy efficient T-8 fixtures. Annual savings of the project are estimated at around $300,000 in three years. The College also achieved significant savings by installing computer-controlled energy management systems, retrofitting parking lot lights and hooking up motion sensors to classroom lighting.

Sustainable Energy Alternatives that can be implemented at SFSU

Given available technology and financial resources, sustainable lighting changes at San Francisco State campus are entirely possible. The catch, as with most re-engineering projects, is the costs associated with state-of-the-art innovations. Sheer size alone affords SFSU almost unlimited opportunities for improvement—both in terms of efficiency and economy. Two areas to focus on are: (1) new building design, (2) retrofitting and upgrading existing buildings.

As with any other industry, progress and the idea of new development is preferable to having to make do. For this reason most of the energy efficient designs will need to be incorporated into new buildings. The simplest of these designs is well lighting. The idea is to design a building in the shape of a doughnut or a “**U**.” In either case the structure allows for light to penetrate more interior square footage. The new Humanities Building is an excellent example of architectural design towards sustainability. According to Jordan Lerner, a Principal Engineer with the firm Abacus Engineered Systems, “the best way to design a building, is to design it as if it were your own home. Meaning, most people prefer to have as much natural light coming in as possible, and to have the space as efficient and comfortable as possible.” Mr. Lerner seems to advocate going against the grain of traditional educational institution design. In the past school buildings were built simply to meet requirements, not to be anything more.

Looking around the San Francisco State University campus today there are many dramatic differences between old and new—different shapes, colors, and materials. New technologies in materials such as glass coatings, make glass panes more energy efficient, allowing for the use of more glass resulting in brighter interiors. Many times upgrades to older buildings are limited to more efficient light bulbs as opposed to replacing the entire fixture. Ninety percent of the estimated 4.8 million commercial buildings in the United

States are over 10 years old yet, most energy efficient lighting products have been developed within the last 10 years (EPA 1997). At SFSU, about 80 percent of the main campus buildings are more than 10 years old. These buildings require the most consideration. These buildings range from small utility sheds to the biggest building on campus—J. Paul Leonard Library. In the utility sheds, lighting options are the most diverse even allowing for some degree of experimentation. Dependent upon the size and nature of the facility sustainable lighting alternatives could be as simple as opaque roofs, i.e. the landscaping tool sheds and possibly even the tractor and heavy equipment garages. At minimum, standard T-8 fluorescent fixtures could replace any and all incandescent lights.

For the larger buildings a more systematic approach is recommended. It is not unusual, especially in buildings which are more than 10 years old, to find that the current lighting system is wearing out and costing a lot more than it should in energy costs and maintenance. Convention is that changing the current system to new and more efficient technologies would not only improve the quality of illumination but also reduce energy costs and maintenance costs. A new system is likely the right choice.

Typically, when the time comes to install a lighting system, first cost becomes a prime concern and may be used as a deterrent to a more efficient but more costly system. In reality, the less costly system may be actually more expensive to own and operate, making the decision to use the less expensive system the wrong decision. It is important to consider the cost of maintaining old fixtures. They not only use more energy but are costly to repair. Again, it is critical to consider the hidden environmental costs of particular developments.

Life cycle costing looks at the cost of a system over its entire life including first costs, period costs, and associated costs. These costs can be easily compared and put into perspective. According to EPA Green Lights, first cost constitutes about 8-9% of the cost of owning a lighting system over its life, maintenance 1 - 2% and energy consumption the remaining 90%. First costs include the money associated with fixtures, lamps, ballasts, rewiring, installation and any other costs associated with the initial purchase and installation of the equipment. When looking at upgrading or replacing a current lighting system several things must be considered.

Which type of system(s) is needed to meet current and future needs? Fluorescent lighting is generally used for offices, classrooms, and areas where there is a relatively low ceiling height. High Intensity Discharge (HID) lighting systems include metal halide, high pressure sodium and low pressure sodium lighting. Metal halide developments are now allowing certain systems to achieve efficiencies similar to high pressure sodium lighting. The advantage of metal halide is improved color rendering. Both of these systems are available in hi-bay and lo-bay light distributions and are predominantly used in large spaces such as gymnasiums and the outdoors. Low pressure sodium lighting is mostly used for outdoor, parking lot, and roadway lighting. Retrofit or replace fixtures? Retrofitting can be accomplished in a number of ways and of course with a wide variation of costs.

The simplest and least costly is a ballast and lamp change. This is most common with fluorescent systems. The standard 2x4 fixture would be a straight 4 lamp replacement which runs the risk of over-lighting a space when using full light output systems. A second alternative is to remove the ballasts, lamps and socket bars in a fixture and replace them with a retrofit kit which contains the ballast and a new socket bar attached to a reflector. These fixtures are available with either specular or white painted reflectors and in 2, 3, or 4 lamp configurations. This method eliminates the need for cleaning the inside of the fixture and offers a highly reflective interior surface which in some cases may increase the performance of the fixture.

Fixture replacement is also an accepted and in many cases a desirable alternative. Replacing fixtures assures that the distribution of the light is not compromised and all materials are new. It also gives the installer the opportunity to inspect the condition of the current wiring system and locate potential problems.

The alternative, which usually has the greatest first cost, is a complete lighting redesign. This scenario usually begins by bringing in a lighting designer who will evaluate the space and tasks performed and suggest optimum alternatives which take fixture location and quality of illumination into consideration. Starting with the freedom to completely redesign a system opens the door to considering all of the new technologies available to provide the most energy efficient solutions and customize an area[1]s lighting for its particular purpose and assures not only the quantity but the quality of the lighting.

The most important and influential period cost is the cost of power to operate the system. This of course goes on year after year and is controlled by the utility. Fixture cleaning and lamp replacement can be done in two ways: the spot or group method. Group relamping and maintenance has been proven to be the most cost effective from both an economic and performance standpoint especially where aesthetics are important and where there are high mounting heights. The following chart compares the two methods. Disposal costs should also be considered with either relamping method, since mercury is considered a hazardous waste.

In many cases, buildings, which are ripe for energy upgrades, were not designed with modern tasks in mind. In the case of offices, and classrooms, tasks have evolved from reading from paper on a horizontal surface to the use of computers, whiteboards, and multimedia presentations. This has changed not only the light level requirements but also the need for glare control to reduce eye strain. Another problem associated with the use of computers with older lighting systems is eye fatigue which may be caused by the constant flickering of the computer screen in unison with the fluorescent lighting. Utilizing high frequency electronic ballasts in these situations with deep cell parabolic louvered fixtures can significantly reduce these problems and in turn increase productivity by creating a more comfortable work environment.

The most obvious example and biggest single concern is the J. Paul Leonard Library; six stories of library resources, administrative offices, and lounge/study areas—all of which suffer from inefficient lighting. The majority of the library is fortunate that it was purpose-built, mean that for the most part, lighting was designed around the book stacks; this will facilitate any future upgrade.

Ways that San Francisco State University can move towards sustainability in lighting include the following.

1) Do not use lights when natural light is sufficient (classrooms and offices!)
2) Use solar power where possible
3) Use highly reflective, low glare paints for all interior walls
4) Use sensor lights
5) Retrofit old fixtures
6) Replace old fixtures

Green Power: biomass

At present, no renewable sources of energy are used at San Francisco State University except for a meager portion of renewables utilized in the power mix at PG&E, our campus primary power provider. Additionally, San Francisco State University utilizes two Cogeneration systems on campus that provide supplemental electrical and heating capacity. Cogeneration provides two types of energy from one source. A gas-fired turbine provides electrical power while a waste heat thermal jacket wrapped around the turbine utilizes exhaust heat to boil water for heating systems. This system is efficient but since the turbine uses a fossil fuel, this is not a green power source.

What Green Power options do we have? Solar and photovotaic are great sources of renewable power that harness the sun's energy, but since our campus is shrouded in fog for much of the year, these options are impractical since back-up systems (PG&E) would have to be used most of the time. Geothermal, hydraulic and wind power are out of the question due to location and space limitations. We are left with biomass as an alternative.

Biomass is essentially stored solar energy in plant form. Included are wood, wood wastes, agricultural crops and their waste byproducts, municipal solid wastes, waste from food processing, and aquatic plants and algae. Fossil fuels are formed from biomass, but since it has taken millions of years for the biomass to fossil fuels metamorphosis to take place fossil fuels are not considered renewable resources. Biomass is converted into energy by direct combustion or gasifying biomass then burning it, the latter process is much more efficient. The main byproducts of burning biomass are water and carbon dioxide. Plants can then recapture the carbon dioxide and water, created from the burning of biomass. These plants can be grown for biomass energy, thus completing a renewable cycle. Although we strongly believe biomass generation should be looked into as a long-term option, it is not realistic that campus could support one anytime soon. In the mean time, to reach our current goal of sustainability we will turn our focus to green power providers.

Green Power providers are energy providers who offer alternatives to traditional finite energy sources. Due to the recent deregulation of the California energy market, we can choose where our power comes from. We now have several providers to choose from who offer alternative power sources. Cleen 'n Green, Edison, Enron, Green Mountain, and the Sacramento Municipal Utility District all offer green power options to institutions and or residential consumers. The first step in greening San Francisco State University is to green our energy source, this means contracting with one of the above providers to purchase a renewable resource energy package.

Innovative Research at San Francisco State

In Spring 1999, the U.S. Department of Energy honored SFSU's Industrial Assessment Center in the School of Engineering. They praised the Center for its work in providing energy conservation, waste minimization and productivity assistance to small manufacturers in California. The Center has completed nearly 200 energy audits of small manufacturers since it began operation in 1992.

Transportation

Why Reduce Automobile use at San Francisco State?

- **Air pollution and global warming, as a result of transportation costs total as much as $50 billion to $230 billion annually**
- **Motor vehicles are the largest source of air pollution**
- **In the United States motor vehicles produce at least 50% of the air pollution**
- **Exposure to air pollutants can cause or contribute to lung cancer, asthma, chronic bronchitis and emphysema**
- **In the United States estimated deaths from outdoor air pollution range from 65,000 to 200,000**

Students and faculty come to SFSU using various modes of transport. San Francisco State University is readily accessible by public transportation from all parts of the Bay Area. Six San Francisco Municipal Railway buses and light rail lines referred to most people as *Muni* serve the campus at ten to fifteen minute intervals. Commuters from the East Bay have a choice of BART (Bay Area Rapid Transit) and connecting to a bus service, or BART and connecting to a light rail from downtown San Francisco. Two San MateoTransit bus lines link the peninsula and the San Francisco Airport with the campus. Free shuttle service is offered to students at SFSU that runs from the Golden Gate and

Bay Bridges and the Daly City BART. On the average 600 to 700 people access these shuttles daily.

Our campus is located in an urban residential community and parking on surrounding streets is very limited. Most streets surrounding the campus either require residential permits that can only be obtained by renting or owning a home in that community or the parking is metered. The meters vary from one to four hour maximum time limits. The general sentiment on campus is that there is not enough public parking. Many students pay more in parking tickets as they do for their books each semester.

Approximately 2,500 spaces are available on a first-come basis for a $ 2.00 daily fee in the general parking garage, located on the east side of Lake Merced Blvd. between Font and Winston Drive. There is a satellite parking lot, Lot 25, which is on Winston Drive between Lake Merced and Buckingham way. Fees for the parking lot can only be paid in quarters and the lot assignment of your permit is strictly enforced. The 2,500 spaces for students are divided into four lots. These lots are 2,4,20, and 25. The campus transportation department estimates that between 4,500 and 6,500 parking permits are sold per semester and daily approximately 1,000 to 1,500 permits are sold.

Students that live in San Francisco can access public transportation by paying $35.00 for a “fast pass” that is good for the month or paying $1.00 each way (this permits a two-hour time travel before another fare must be paid). The “fast pass” enables a commuter to access the bus, light rail lines and BART (within the city). Fast passes are available at the student union information booth on a cash only basis. There is no discount for students.

Students that come from outside of the city by way of public transportation may travel up to three hours each way and pay up to $15.00 round trip to get to campus. From either the North Bay and East Bay the commute is costly and time consuming often discouraging students (who have a choice of transportation) to take public transportation.

In 1997,Marie-Lorraine Mallare conducted a student survey. Her main focus was looking at how students get to school. The primary goal of this project was to promote student ridership on public transit through the use of an alternative fare instrument option, developed by a joint two-year pilot transit project involving both SFSU and *Muni* .The project hoped to alleviate problems by having the University encourage students to use public transportation by subsidizing their public transportation costs with public grants or standard administrative fee. In return students would receive unlimited access to local bus and train services through use of their student ID card. The underlying theory is that if students have their public transportation fees paid for in advance through the administrative fee or public grants, then ridership to and from the university campus will increase, and traffic congestion will subside.

In this survey 444 students were given a detailed survey about their ridership trends and preferences. Of the students surveyed 71.62% were from San Francisco. For 75% of the students surveyed their primary mode of transportation was public. For 21.4% of students surveyed their car was their primary mode of transportation with only 1.4% carpooling. Other modes included walking with 4.1% students accessing this mode and 2.3% of students riding their bike. The remaining students rode a motorcycle with .7% using that mode and .2% used a wheelchair as their mode of transportation. The survey also showed that 85.8% of students rode the *Muni* and 30% rode BART to campus. Fourteen percent of students rode the SFSU shuttle and 7.0% accessed SamTrans to SFSU. Other agencies that were used were Golden Gate Transit which 1.1% students said they used and 4.1% of students used AC Transit. The remainder of students surveyed used either the Ferries or Caltrain. When asked why they took *Muni* 50% of students answered "no car", 30.4% stated that parking was too difficult, 18% found *Muni* to be more convenient, 18.7% liked the low cost of *Muni*, 12.2% stated they rode *Muni for* environmental reasons, and 7.4% just didn't like to drive. This survey was conducted two years ago and as admissions have increased we can estimate that these percentages are higher.

What other colleges are doing

Bastyr University, Washington: Alternative Transportation Awareness Project

During Earth week in Spring 1998, students at Bastyr University, Washington held a series of contests. During the week students filled out a ballot with the types of transportation that they would use that week and received different point values for different types of transportation. Higher points were given to the most sustainable mode of transportation. Prizes were given and the main project goal of increasing awareness was obtained. Corporate funding and donations were provided by Odwalla and Office Depot.

University of Colorado at Boulder: Student Bus pass, Eco pass Programs

The student bus pass is provided to students through an administrative fee of $10.00 paid at the beginning of the semester. This fee allows the student to ride the local and regional transit system and shuttles to campus. Since the implementation of this program ridership of the regional transit district has more than tripled. Through this program this university has decreased car dependency, and saved precious finite natural resources. In addition, it reduced demand for parking by 1000 spaces! The *Student Bus Pass Program* was awarded the EPA's *Way To Go! Award* because of its success in encouraging alternative transportation.

The University also adopted a program from the city called the Eco pass. This program is aimed at businesses and institutions throughout Boulder. The Eco pass provides unlimited bus and light rail service for its employees and is issued at no charge. The University of Boulder adopted this program in 1998. Within a next couple of years the University would like to adopt this program for their students as well. The Eco pass also provides a free ride home in case of emergency with one stop along the way to people who use any alternative form of transportation that day such as a walking, bicycling and roller blades.

One of the unique features at Boulder is a Committee on Alternative Transportation. This Committee hosts an alternative transportation fair at the beginning of each school year. This is a large event and includes bicycle and roller blade sales and information about alternatives to gas powered vehicles. The committee has installed over fifteen bus information displays that include a description of the student bus pass program and bicycle/pedestrian maps.

University of Washington: U-Pass

The U-Pass is a comprehensive program consisting of nine different features:

- Increased transit service
- Shuttle service
- Carpools
- Vanpools
- Ride-match
- Bicycles
- Reimbursed Ride Home
- Commuter Tickets
- Merchant Discounts

On The Washington University campus seventy-five percent of the students and faculty access this program. That is approximately 40,000 students. This program costs $17.4 million dollars to function. Fees paid by students and faculty fund Forty percent of the program. Students pay $6.67 a month and Faculty pays $9.00 a month for their U-Pass. Parking system revenues supports 30% of the cost. The remaining 30% comes from various university funding sources. Vehicle trips to campus are down 16% there by decreasing parking lot use from ninety-one to seventy-eight percent. Transit ridership is up 35% and carpools have increased 21% and the number of Vanpools has increased from eight to twenty. The nine options of alternative transportation are the best part of the U-pass.

University of South Florida

University of South Florida has a fleet of electric vehicles are recharged with solar energy using a PV array.

San Francisco State University: suggestions for future transportation programs

Our first, and least drastic proposal, is a designated carpool area. The area would have sign up sheets that would specify departure and arrival times from specific cities. People with cars could be given incentives to participate, these could include food discounts or bookstore discounts. For students (and faculty) coming over the bridge toll free incentives may be enough. Carpooling should be encouraged upon registration and in classes.

In our research we have sifted through many case studies and these were a few prime examples of what universities need to have in order to provide sustainable alternatives. We have found funding and grants to be an integral part of making a plan or project happen. Incorporating students and faculty together in programs provides solidarity enabling both groups to work together to improve the conditions of the environment and their school. The Bus Pass programs of the above universities substantially increase the flexibility of campus commuters. In our research we have found flexibility plays a key role in achieving sustainability. These programs and projects succeeded increasing awareness of the problems and solutions of transportation to and from campus. We feel we can learn from and use some of these ideas where possible.

Looking at our current practices we have determined several areas within the transportation system at San Francisco State that require a "sustainable overhaul." We believe that our recommendations and or alternatives to the current system are both feasible and employable. With the help of grants, support from administration and campus dedication, a new alternative transportation plan could change the way we view and use transportation.

The alternatives outlined below provide a systematic plan to relieve congestion created by traffic, parking problems, one-car commuters, excessive driving habits, and wise use of grant money. Most importantly, these alternatives create a living laboratory where we are able to provide proof, by example, that sustainability is possible and preferable. We can show that getting out of your car and taking the bus to school can not only be reliable but more time efficient when the hassles of parking, tickets, traffic, tolls are removed. The use of alternatives, coupled with heavy marketing and awareness strategies, could make the alternatives preferable to the student body. Before long, these proposed policy changes in the transportation system at SFSU won't seem so drastic or cumbersome. Eventually the new program would be as integrated as (or more hopefully) recycling, and people would think you were not "forward thinking" if you did not participate. New transportation guidelines would benefit students, staff, residents, and the ecosystem as a whole.

We also suggest a dialogue with the city regarding residential parking restrictions. We feel that if less parking was available on the city streets surrounding campus more students would be inclined to take public transportation. If students were not interested in taking public transportation from their homes, they would have to park long distances away and use the shuttle system or the bus. Local residents should be encouraged to pressure the city into issuing resident only parking permits. This would not only reduce automobile use, but it would unclog residential areas. The next step is to work with MUNI to increase ridership and efficiency.

The addition of an east/west and a north/south line of MUNI streetcars would allow easier access and quicker service. The N Judah and L Taraval have ten blocks between each other and adding a line on Pacific Ave. would break-up that distance making it only 5 blocks as opposed to 10 to get to another train. Another useful new line would be along Sunset Ave (30^{th} Ave). Sunset Ave is not usually congested and makes the availability of a Limited Train service attractive. Another line could be extended to Pacifica or to a central location that Pacifica residents can ride share from or directly jump on the train.   Along with the additional MUNI lines, which generate funds that will pay for construction costs, we hope that MUNI will provide several other transportation alternatives.

Currently, MUNI is very strict about taking bicycles on board because of the large number of people that ride the trains daily, there just isn't any room in the cars. There are a few buses that are equipped with a bike rack on the fronts of the bus. A problem with this is that since there are only a few with this capability if your bike breaks down or you're late and the bus would be faster, there is no guarantee that you encounter a bus with a rack. We believe more students would ride bicycles if their ride could be shortened or supplemented by the availability of bike racks on bus lines that service San Francisco State University. This would ensure availability and the option to shorten your ride at each stop along these lines service routes. This alternative would make riding bicycles at night more attractive and more practical. It would also compliment the new Bike Barn that is currently available for supervised bike storage while on the San Francisco State University campus.

Another MUNI related alternative, that has been an ongoing project in San Francisco for the last 3 years, is the Class Pass. The last proposal submitted to MUNI from former students Marie Mallare and Tony DeVito called the "Development of A Student Public Transportation Fare Instrument at San Francisco State University" was turned down by student vote. The plan called for unlimited rides on the MUNI by showing a valid student I.D. hence the name Class Pass. To fund this action grants would be sought out for the first year but thereafter; the funds would come from in increase in student fees. This particular plan was voted down by students because of the false figure of increase given to students. The students should have been voting on a $23.00 increase, they were told the increase would be $70. Mallere, who now works at MUNI as the Public Information Officer, confirmed the discrepancy but was unable to explain why it happened. She remains committed to the implementation of this program and is currently seeking ways in which she can lobby for it successfully. The Class Pass is a great trend among universities and a very important transportation alternative. The veto of this plan was stemmed from a lack of knowledge and information, which illustrates the need for awareness among student, faculty, staff, and the local homeowners Association.

The key to succeeding with transportation alternatives is information and education. Future plans must be communicated in such a way that students get excited about being a part of a conscious environmental movement that benefits everyone. Simply posting fliers or handouts will not be enough exposure for 28,000 students (although this does not hurt). We feel that upon registration students should be informed about green transportation along with other relevant green programs on campus. A summary of our suggestions and goals are as follows:

- Education and orientation upon registering (show new students how to use public transportation)
- A designated carpool area
- Reduce the amount of parking around campus

- More bike racks on buses
- Working with MUNI and BART to get student discounts
- Encouraging the use of the Bike barn
- Fund a Class Pass through student fees

The Bike Barn

In Fall 1998 SFSU opened their newly renovated bike locker called the *Bike Barn*. This facility not only holds bikes at no cost to students, it also offers a repair shop. The old *Bike Barn* was only able to hold 125 bicycles. Most students who biked to campus didn't even use this opportunity to store their bikes because of the way the bikes were kept, stacked on top of each other. The new *Bike Barn* holds 350 bikes and is open from Monday through Thursday 7:30 am to 10pm and on Fridays from 7:30 to 5pm. The *Bike Barn* has a computerized security system and is located underneath the gymnasium next to Lot 6. Many bikers access this resource but the capacity is never entirely full. The Transportation coordinator for SFSU, Patricia Tolar told us that on the average 75-100 bikers access the facility and on a good day the *Barn* has had 300 bikes locked up for students. According to campus police students are not allowed to lock their bike on anything else but a bike rack or at the *Bike Barn* or the result will be a citation that includes a fine. We suggest the following recommendations to increase bicycle use on campus:

- Increase the number of bike racks on and around the SFSU campus.
- Work with the SF Department of Transportation to increase bike lanes in the city.
- Provide students with low cost helmets and bicycles.
- Provide incentives for faculty and staff to use bicycles to travel to work.

Building and Campus Design

Green building reduces the environmental impact of toxic materials and aides in the reduction of precious finite natural resources. Proper design can eliminate the need for costly lighting and heating systems. Green building starts in the design phase and continues until the last brick is laid. San Francisco State University is constantly growing. We are engaged in several different renovating processes at this very moment. The Ceaser Chavez Student Center is currently adding another floor and the square footage will be increased by 25% to 30% by the time all is said and done. Unfortunately, it may be too late to influence this project.

From what we could tell, SFSU administrators have not made any commitments to sustainability in the execution of campus construction projects. According to one person in the Capital Planning department, there was a push to incorporate greener construction methods and design a couple of years ago, but it was not developed. While they have installed things such as motion sensors for lights and bathroom fixtures, these are more to save money on utilities than a concern for resource use efficiency in and of itself. It appears that the primary reason sustainable materials are not being used is a concern for expense and a lack of leadership which encourages designers and administrators to implement sustainable design and construction elements.

Until recently, the funds for most University building projects has always been acquired from the state legislature, which is raised by bonds. The exceptions have been the Student Union, the residence halls, and the new Centennial Village that is scheduled to be completed in August 2000. These funds have come from Associated Students, a residential fund, the SFSU Foundation Inc and the Federal Emergency Management Agency (FEMA), respectively. In terms of state funded projects, Capital Planning determines the needs of the campus, giving priority to certain types of construction, like life safety systems and infrastructure. New classrooms and dorm construction are relatively low on the list. They then develop the Five-Year Capital Improvement Program, which shows the annual funds needed per project, and the stage of development that money is going towards. (See Appendix F. Capital Planning: “Previous Five-Year Capital Improvement Program 1994/1995 Through 1998/1999”, and maps, plans and pictures) According to this plan they apply to the Chancellor's office for funds every spring for the receipt of the following year's funds. That is, they apply in the spring of 1999 for the 2000 funds. The Chancellor tells the state legislature, whom then allocates the money. The actual costs are then refined during construction. This was described as a very controlled process, one that does not allow for much deviation from tried and true design. The actual construction costs must be within the budget by ten percent. The focus of the Capital Planning department has been to get the most for the littlest amount of money.

There are fundamental problems to this system that Capital Planning is trying to address with a new approach being taken with the Centennial Village. First, the limited amount of funding available for construction projects restricts what can be done in a project and when it can be done. The present thinking at Capital Planning appears to be that while the economy is currently strong and a lot of buildings are being raised, state money for campus construction remains inaccessible because it is going towards things like prisons and infrastructure. Further, that if there is the money to build, the legislature won’t allocate the money to maintain them so that sometimes it is easier to just renovate or rebuild. Furthermore, the time lapse in getting projects approved is prolonged. For instance, the problem encountered with Hensill Hall’s seismic retrofitting and renovation (e.g., upgrading lab spaces and improving the building’s handicapped accessibility) was that it took four years for the architects and planners at the Chancellor’s office to review the estimates. The traditional method of fund procurement is very slow with a huge number of bureaucratic steps and guidelines along the way. Lack of funding is one of the main reasons given for why SFSU construction does not typically deviate from standard practice. As a Capital Planning person related it, there is a “resistance to trying” different materials because the cost of greener/recycled materials is higher than that of materials currently in wide use, they look for systems that are compatible with the existing systems for ease in maintenance, and it is felt that not enough is known about their durability. He said that as the market makes these products more of a standard, as has been happening on the residential market, these products will become cheaper and more easily obtained—a “natural substitution based on the economy.”

In contrast to traditional fund procurement is a method new at SFSU that is being tried with the Village. Capital Planning heads has touted Hensill Hall as the last to be funded the old way. While not without its own difficulties, the Village has been called by Capital Planning vice president Bob Quinn “a breakthrough project, a model of thinking differently.” The largest construction project SFSU has ever done, the Capital Planning web page describes the process as being:

“The University will lease the land to the SFSU Foundation, Inc. in return for which the SFSU Foundation will construct and own the Village at Centennial Square. At the end of the ground lease, the property will revert to the State of California. Financing for the project will be provided by the University’s Foundation which will issue no-risk construction bonds, as well as by the proceeds from the settlement with FEMA.”[60]

The facility will consist of 190 units of two and three bedroom student apartments providing 760 beds (matching Verducci’s capacity), approximately 160 units of parking, approximately 12,000 square feet of commercial space, and a 50,000 square foot student affairs complex to house the University’s many student support programs and provide ‘one stop shopping’ for student services.

The $9 million acquired from FEMA was the result of “nine years of often difficult negotiations with both state and federal agencies.” When Verducci Hall, a dorm building, was damaged in the 1989 Loma Prieta earthquake, the building’s closure resulted in a loss of 750 beds and over $50 million in revenue over time.[61] It was discovered that half of the building was built on unstable bay mud and the building did not address the soil conditions structurally. However, FEMA would only provide funds to repair the earthquake damage which would not make the building safe. The cost of retrofitting Verducci Hall was prohibitive for SFSU. The initial negotiations with FEMA were to not only implement the necessary repairs but to bring the building up to current building code standards. When FEMA agreed, SFSU began trying to convince them to raise the amount so that SFSU could construct a new building entirely. The argument was that Verducci was a 30-year-old building, that hazardous materials are present within it, and that it does not fit the campuses present needs. At first they said no, but they finally relented. This $9 million is going toward the $48 million total cost estimate of construction.

The developer of the Village is Catellus Residential Group, and the architects are from Sasaki and Associates. It was not clear to us through our interviews with Capital Planning what the exact relationship between Catellus and SFSU Foundation is and who carries the most profit incentive. That is, in what ways does Catellus benefit, and whose decision has the most weight in the utilization of sustainable materials. Student researchers were told that the developer gets the right to rent out space and receive the profits—the developer being Catellus, with the lease to the SFSU Foundation. We were not sure how the dynamics of this functions. In response to a concern over the extent of private control of a major University facility, we were assured that there are "quality guidelines" for the buildings' operation; i.e., choices in staff, maintenance, and rental rates. These were established in the request for qualifications, early in the process.

The project is being fast-tracked. The request for qualifications went out last fall, received 50 responses and the developer was selected in January. The preliminary sketches of their intentions are now being converted into construction documents. Site work began on April 1, soon after the implosion of Verducci on March 29, and is scheduled to be finished at the end of June 1999. They are going by a "design-build" process, where basically they are designing as they go along. Thus, there is a lot more latitude in designing the Village than has been previously and, student teams were told that the developer has been encouraged to be as innovative as possible.

Based on the above situation, the potential for the use of sustainable building materials is great. The design and construction of the Centennial Village is a crucial opportunity in that the SFSU administration is feeling positive and expansive towards the project overall. We are not sure what Catellus and Sasaki's intentions are in terms of sustainability, but because the process is happening quickly, the ensuring of sustainability is required to likewise be met with speed and effectiveness.

Sustainable Building Materials

Considerations in choosing materials

What are the criteria that make one material more favorable over another? Environmental Building News (EBN), a periodical that often has detailed product reviews, discusses the examination of a building material's sustainability, the life cycle analysis or life cycle assessment (LCA). [9] (See Appendix B, EBN: "Materials Selection: Tools, Resources, and Techniques for Choosing Green.") "The LCA process is based on a lifecycle inventory, in which a researcher identifies and quantifies all of the raw materials and energy consumed in the production, use, and disposal of the product, as well as pollutants and by-products generated." These are aimed at understanding the entire environmental impact that a material has, from its cradle to its grave. (See also Appendix C, Van der Ryn and Cowan: Questions Adapted from AIA "Making a Difference: An Introduction to the Environmental Resource Guide".) They break down their own "Simplified Method" into four different points of examination, which they call the "hierarchy of life-cycle stages": construction and use, manufacturing, raw material acquisition and preparation, and disposal and reuse. Beneath them fall more specific criteria, such as energy use, occupant health or hazardous by-products, wastes and durability, that are particular to each process. EBN's diagram of the process is essentially a flow chart. EBN makes general suggestions in the case that a particular product doesn't hold up well to one of the criteria. The consideration of building materials in terms of LCA provides a holistic perspective; there are many factors in choosing materials, and some benefits may override others. It also takes into account the toxicity of the production processes. These processes always take place in someone's backyard, and thereby affect the residents of the area's standards of living.

The energy aspect of this discussion is generally broken down further to look at the varying ways energy is spent throughout construction. According to David Lloyd Jones's book Architecture and the Environment, the first type, embodied energy, is the amount of energy used in the production of the material.[10] The closer a material is to its raw state, the less embodied energy it has. A material also has a lower embodied energy if it includes recycled elements in it, such as fly ash as a concrete additive, or ground concrete as an aggregate. The second, or gray energy, is the energy used to transport materials from where it was extracted and manufactured to the construction site. The more localized the source of the material, the less energy is expended. (See Appendix D: EBN: "On Using Local Materials".) The third is induced energy, or that which is used in the actual construction. While not as great as the amount of energy spent in the embodied or gray energy, it remains something to pay attention to.

Sim Van der Ryn and Stuart Cowan in Ecological Design deal with a material's total energy on only one level; they mention embodied energy in the context of the term encompassing extraction, processing, manufacture, and transportation.[11] With this definition in mind, they cite a study that attempted to quantify the embodied energy for different types of materials. Wood came to 639 kilowatt-hours per ton, brick was four times the embodied energy of wood, then came concrete at five times that of wood, plastic (6x), glass (14x), steel (24x), and aluminum (126x). The Greening of the White House section on building materials (which can be found on the Center for Renewable Energy and Sustainable Technology, or CREST, website called Solstice:www.crest.org or solstice.crest.org) agrees that aluminum does have a high embodied energy, but cautions against reading a lot into comparisons by weight, as aluminum is relatively light.[12] The energy spent will, of course, vary between specific products.

Concrete- fly ash as an additive

Fly ash is a waste product of coal burning, found particularly at utilities plants. The American Coal Ash Association (ACAA) states that industrial facilities produce almost 50 million tons of fly ash a year. Thirty-five million tons go to the landfill with the remaining 13 million tons (22%) used elsewhere.[13] They also say that what is restricting a wider use is a poor ash quality that has too much unburned carbon. But, there are still several applications for fly ash, including use as an aggregate, but the best known is its use as a pozzolan. The Means Illustrated Construction Dictionary defines a pozzolan as "a siliceous, or siliceous and aluminous, material which, in itself, possesses little or no cementitious value but will, in finely divided form and in the presence of moisture, chemically react with calcium hydroxide at ordinary temperatures to form compounds possessing cementitious properties."[14] Typically, fly ash substitutes 15-35 percent of portland cement in most structural applications of concrete, but only 15 percent is allowed by code because it is said to lessen the initial strength gain.[15] However, a professor emeritus of civil engineering at UC Berkeley, P. Kumar Mehta, believes that this proportion can go up to 60 percent, together with a superplasticizer, and the concrete will maintain a good strength and durability. Also, after 28 days the bond is greater than normal concrete according to the senior principal process scientist at Construction Technologies Laboratory, Inc. The Northern California Architectural Resource Guide, published by Architects/Designers/Planners for Social Responsibility, describes concrete-fly ash mixtures as "smoother, denser, more workable and less permeable" than conventional concrete mixures.[16] Caution must be taken, though, because some concrete companies have contracted to use the fly ash of burnt toxic waste from nuclear and chemical companies so the source must be checked, inspected and identified.

Fiber Reinforced

Fibers in concrete essentially have the same effect as reinforcing steel bars in concrete, in that they slow the crack growth that concrete gets when its load capacities are reached, except that the fibers are evenly distributed through the concrete. [17] While there are several types of fibers can be added, the sustainable options include recycled high-density polyethylene (HDPE) and glass. While polypropylene has long been used as a fiber, the HOK Architects (Hellmuth, Obata and Kassabaum) Database for Healthy and Sustainable Building Materials cites a study that "found substantial performance benefits and cost savings" in using recycled HDPE over "virgin" polypropylene for secondary reinforcement; the recycled HDPE was from milk jugs.[18] The SFSU Capital Planning website says that during the retrofitting of the Administration building they used Glass Fiber Reinforced Concrete panels (GFRC), which are used in the interiors of buildings as cladding and lend support to the primary structure. While we are not sure if SFSU used them, there are GFRC's available that use recycled glass cullet or waste material from glass production.

Aggregates

Recycled concrete and glass can be used as an aggregate for concrete. The use of recycled concrete is an excellent way to address the enormous amounts of concrete that end up landfilled—over 67 percent of the weight and 53 percent of the volume of North American demolition debris.[19] The concrete can be crushed and mixed in "for performed materials such as pipe and slab, poured-in-place walls and floors, and clean fill for new construction."[20] Ground recycled glass is typically only used as a non-structural concrete aggregate as it will cause concrete to shrink more. Syndecrete, while very expensive at the time of EBN's 1992 product review, is an interesting and creative use of recycled aggregates.[21] It is a highly decorative finish material, architectural precast concrete that touches all the bases in its use of 20 percent fly ash, recycled polypropylene waste from a carpet plant for reinforcement, and recycled metal shavings and glass chunks. The metal and glass are mainly for their aesthetic value, but it looks great (for pictures, go to the Syndesis web page at syndesisinc.com). This example provides an idea of the range of uses for recycled materials.

The implosion of Verducci Hall, the dorms that were damaged in the 1989 Loma Prieta earthquake and since unoccupied, raised the question of what to do with the debris. The SFSU Capital Planning department says that was addressed in the decision to use the waste concrete as an aggregate for Verducci's replacement, the soon to be built Centennial Village. The reason given was the ease in transport and the cost effectiveness in using a readily available resource. The construction crew at the Verducci site ground the waste concrete there, and since the site of the new Centennial Village is very close by there was a minimal distance to haul the material.

Forms

Formwork constitutes "the total system of support for freshly placed concrete, including the mold or sheathing which contacts the concrete, as well as all supporting members, hardware, and bracing."[22] The HOK database says that plywood is the commonly used concrete formwork method, yet while these may be taken apart and reused, it is generally felt that this requires too much effort.[23] In 1991, plywood concrete forms were the third greatest use of plywood. To counter this waste, HOK suggests permanent formwork, reusable steel panel forms, or "planning flat surfaces in modules of standard plywood dimensions" if the use of plywood is necessary. Permanent formwork can have insulative benefits, and these come in two main types: rigid plastic foams and recycled wood fiber. The plastic foam type can be made entirely out of recycled expanded polystyrene.

Form release agents are of particular concern with regards to the toxicity of the agent used. Usually these are petroleum-based, such as plain oils, diesel, or used engine oil.[24] Not only do petroleum based agents have a high VOC content, but used oils can have heavy metals, or PCB's in the case of industrial waste oil. Healthy alternatives to petroleum-based agents are vegetable oils such as those derived from olive and rapeseeds (canola). According to EBN, rapeseed form release costs about double that of petroleum based ones. The cost, however, must be weighed against the polluting potential of the petroleum based, especially with foundation work, where they can easily leach toxins into the soil and groundwater.

<u>Metals</u>

Aluminum, steel and copper are the most widely used metals in construction from these, various alloys are made. The pollution associated with the extraction and manufacture of these metals is very great, leaving heavy metal sludges and waste waters. Even though supposedly much of the airborne pollutants can be diverted with methods like wet scrubbing or incineration, there is still a great deal that escapes. As mentioned previously, aluminum has a very high level of embodied energy, and should be used as little as possible. However, 80 percent of that energy can be cut out in the utilization of recycled aluminum as opposed to bauxite ore[25], so if it is necessary to use it, then make sure that it has a high recycled content. The HOK materials database says, "The U.S. steel industry has a strong economic incentive to recycle. The amount of recovered content used in steel is driven by supply at this time. For that reason, requirements for minimum recycled content of steel products have little or no value as a market incentive."[26] On the other hand, the Architectural Resource Guide says of the industry, "Many steel products, especially steel studs, advertise that they are 'recyclable.' Unfortunately, while there is some truth in this statement, the industry has not yet embraced the full potential for reusing resources. Steel studs for framing may or may not be made from recycled steel, but there remains an inherent difficulty in arranging to recycle these components when buildings are torn down. Structural steel members and reinforcing bars are easier to recycle and the market for this continues to grow."[27] In terms of Verducci Hall, only the larger pieces of steel and copper wire were saved. As a person from Capital Planning put it, "Some things that are not cost effective are simply thrown away," using the large number of usable, yet tossed out campus computers as an analogy. We question this logic and analogy since campus computers should be recycled.

Photovoltaic cladding

Photovoltaic cladding is another sustainable design element. Photovoltaic cells (PV) are varying types of thin silicon cells that produce electricity when exposed to light. PV cladding is beneficial not only as an energy generator but is also as protection against the elements. The systems are modular, and are easily installed, removed, and reused. However, they can be an expensive initial investment. [28]Advanced Buildings lists the benefits: “the cost of the PV generator is offset by the cost of normal construction material; requires no additional support structure, produces energy close to where it is used; produces electricity with little maintenance, no pollution and no depletion of resources; modular materials are easy to adapt to normal construction techniques.” They also mention that their life expectancy is over 30 years, and warranties presently cover only 20 years. One problem is that the less intense winter sun may cause lower energy production. But as cladding they can be used as sun shades, facades, or on roofs. Their use as sunshades permits ventilation and, like the name says, shades from the sun. Their placement at an angle gives them better exposure. The book *Concepts in Practice: Energy* describes the Northumberland Building, at the University of Northumbria in the United Kingdom, which at the time was the largest installment of PV in the country.[29] (See Appendix E, Peter Smith and Adrian Pitt: The Northumberland Building.). It was partly financed by the European Commission, and there was supposedly PV installation financing available in the U.S. from various domestic sources. PV systems can also be incorporated on the facades of buildings, which *Concepts in Practice* calls “a realistic option for retro-fitting to 1960’s and 1970’s office blocks.”[30] PV laminates can look like tinted glass. There are cells that are thin enough to permit light to go through it, which can be used on windows themselves. However, these are not capable of producing as much energy, but they are less expensive. PV systems, while a large initial investment, would be a good thing to implement on SFSU’s soon-to-be constructed and already existing buildings.

Insulation

Good insulation appropriate to the site climate is very important because it reduces the energy use that would go toward heating as well as the resource consumption and pollutants generated in the production of that energy. Because of Environmental Protection Agency (EPA) guidelines, that specify minimum amounts of recycled material to be used in projects receiving over 10,000 in federal funding, and similar state mandates, the insulation industry now incorporate recycled materials into design and construction. Insulation comes in the form of batts, loose fill, and rigid and spray foams.

Fiberglass batts are the most commonly used in the building industry, although they are also made as a loose fill. The fiberglass industry average of recycled content is 25 percent, which uses glass cullet.31 The replacement of every percent of sand for glass cullet, past 10 percent, will decrease the amount of energy consumed in fiberglass production by about one percent.32 Mike Rapp of Owens Corning, says that one of their plants overseas uses slightly over 90 percent. Supposedly, one of the main barriers to including higher amounts is the supply of clear glass cullet that is of good quality, although the equipment exists to use colored post-consumer glass. There are a couple of concerns with using fiberglass: the toxicity of the actual fibers and that of the chemicals used to bind them. The fibers of fibrous minerals, like asbestos, are connected to cancer;

the International Agency for Research on Cancer lists fiberglass as well as mineral wools as “possible carcinogens”.33 EBN says that this is not a risk if properly installed, and that some manufacturers have addressed the concern of flaking fibers by wrapping the batts in perforated polyethylene and making the fibers stronger. 34 With regard to the binders used to hold the fibers together, the majority use phenol formaldehydes, and both phenols and formaldehydes are carcinogenic. Recently, fiberglass insulation products have been developed that either use an alternative binder or no binder at all, so these are preferable to use and are good sustainable options.

The different types of loose fills are mineral wools, vermiculite, perlite, fiberglass, cotton, and cellulose. The main problem with loose fills are their tendency to settle over time, which lessens their insulative abilities. Mineral wool, which dominated the insulation industry until it was surpassed by fiberglass in the 1960’s and 70’s, consists of slag wool and rockwool.35 Slag wool constitutes about 80 percent of the mineral wool market, and it’s main component is the industrial waste iron ore blast furnace slag, which is the basis for the overall mineral wool 75 percent average coming from recycled material. Rock wool, on the other had, is made from minerals like basalt and diabase, which are melted and spun into fibers. As mentioned above, mineral wools are thought to be carcinogenic, although some people like it because its embodied energy is half that of fiberglass36.

Vermiculite is made of micaceous rock, and perlite of siliceous volcanic glass. While their only polluting factors seem to be only in their mining and they are both recyclable, their insulating abilities are less than other materials, requiring a higher volume of substance.37 They don’t rot, but they will retain moisture, which can reduce their insulative effect. Also, vermiculite is “typically found in close association with asbestos-containing minerals,” so it is possible that it might have asbestos in it.

During its development, cotton as an insulation material was promoted as an option to fiberglass.38 It soon began to include scraps from denim and T-shirt factories, and now it uses 95 percent post-industrial fiber. The downfall of cotton is its potential flammability, which purportedly has been addressed by a change in chemical fire retardant additives. Nonetheless, though it has passed federal tests, it still isn’t allowed by San Francisco code specifications.39 It typically costs around ten percent more than fiberglass batt.40 A January 1998 EBN article discussed shredded carpeting as potentially another textile originating loose-fill; at the time of writing it was undergoing testing.41 If it passed, it would put to use some of the annual four billion pounds that go to the landfills. There are questions raised regarding the toxicity of both cotton and conventional carpeting which need to addressed if they are considered in insulation.

Cellulose, derived from wood and wood-originated products, is one of the most favored sustainable options for insulation. The industry average for the inclusion of recycled fiber is 75 percent, according to the Cellulose Insulation Manufacturers Association, and most of it post-consumer newspaper (80 percent by weight)42. Furthermore, its embodied energy is eight percent of fiberglass’s. However, cellulose is 10-20 percent VOC emitting fire retardants, a trait some feel outweighs the benefits. If moisture is trapped, the cellulose can get moldy and the borates used as a fire retardant can leach out. Others argue that it is a matter of proper installation. Wet spray techniques, for example, use an acrylic binder to prevent both loose-fill settling and cellulose dust from being airborne. If this method is employed, it must be thoroughly dried before sealing it in.

Most foams are essentially plastics, made of petroleum derivatives, and their manufacturing process is highly polluting The majority also contain HCFC's (hydrocholorflourocarbons), which was a replacement for the now prohibited CFC's (chloroflourocarbons) as blowing agents. HCFC's are better than CFC's in terms of their effect on the ozone layer, but they still do damage, and alternatives to HCFC's are being sought. HCFC's will be prohibited in 2020. Some manufacturers are using carbon dioxide as a blowing agent instead. While petroleum-derived foams are very good as insulators, they are not very recommendable. In fact, they should be avoided. *The Architectural Resource Guide* ranks these insulators in terms of best qualities: expanded polystyrene, polyisocyanurate, polyurethane, polystyrene, and phenol.43 All of these emit VOC's. Expanded polystyrene doesn't use CFC's or HCFC's, instead, pentane is used to expand polystyrene beads.44 But, this makes it less effective thermally and also the pentane emissions augment smog levels. SuperGreen Polyurethane uses HFC's (hydroflourocarbons), which makes them more expensive. However, although these are not damaging to the ozone layer, HFC's are one of the main greenhouse gases that contributes to global warming. With regard to recycled elements, polystyrenes are recyclable, but polyisocyanurates and polyurethanes do not melt. The EPA guideline for polyisocyanurate rigid foam is nine percent, which the Polyisocyanurate Insulation Manufacturers Association says they satisfy.45 The industry purportedly has the largest demand for the mixed color recycled PET plastic. The EPA ranks extruded polystyrene as fifth chemical in terms of the hazardous waste produced as a result of its manufacture, and styrene is both a neurotoxin and suspected carcinogen. The now discontinued Amoco Chemical's Amofoam extruded polystyrene was 50 percent recycled content.46.

Overall, these petroleum-based foams should not be used. Some products tout themselves as being green, but there are obviously methods that are even greener. Icynene, carbon dioxide blown isocyanurate, was just recently introduced to the U.S. As more testing is done, it might be the best petroleum-based foam to if one is going to be used; its pollution during manufacture is said to be "negligible". However, it is still a petroleum-derived product, which is a finite resource whose extraction processes are very damaging to the environment.

Air Krete is a cementitious foam made of magnesium oxide, calcium, and silicate that is sprayed in. The magnesium oxide is obtained from sea water, and Air Krete is called the "least toxic insulating material on the market" by the Architectural Resource Guide.47 The downside is that it can be very expensive, 15 to 400 percent more than fiberglass batt. Nonetheless, they say, "The extra up front cost has a payback over time since its higher R-value [resistance to heat flow, the higher the better] and tight fitting draft prevention makes Air Krete a better insulating material, thus saving on heating and cooling costs, as well as health and safety costs." While it may be prohibitively expensive now considering the large size of typical university buildings, perhaps it can be used in smaller structures and as cost goes down.

<u>InteriorTrim and Finish</u>

The majority of particleboard is manufactured with urea formaldehyde as a binder, and according to EBN, it can offgas for five years or more.[48] If a product with formaldehyde must be used, phenol formaldehyde emits less VOC's than urea formaldehyde.[49] The Engineered Wood Association uses the APA trademark to designate products that use phenol formaldehyde. Although they can be very expensive, agricultural waste fiberboards made of various types of straws and soybean are a good alternatives to particleboard they are made of resources that are in more plentiful supply. These are made with mehtyldiisocyanate (MDI), which does not contain formaldehyde. However, "MDI is highly toxic before it cures, so its use increases the health risk to factory workers," if the right precautions are not in place. But, "once cured, it is very stable, without measurable offgassing from building products."[50] Some medium density fiberboard (MDF) also uses MDI. Cellulosic fiberboard is made from recycled newsprint and uses paraffin wax as a binder, and can be a good substitute for particleboard and MDF in certain applications.[51] In the use of lumbers, plywoods and other wood products, it is important to make sure that it comes from sources that are third-party certified, for example, organizations like SmartWood and Scientific Certification Systems (SCS). These groups investigate wood products and establish which ones come from properly managed forests and not places like clear-cut old growth forests, operations which have an significantly adverse environmental effect. For instance, plywood from the hardwood Luaun tree of the Phillipines has been a common material for doors but the tree is now endangered and it should not be used. An uninformed decision could contribute to the exacerbation of such problems.

The conventional wallboard is gypsum board, also called drywall and sheetrock. The EBN Product Catalog opinion is that, "Conventional drywall is quite environmentally friendly, as nearly all of it is made form 100% recycled paper backing, and natural gypsum, which is plentiful and low-impact to extract."[52] It also mentions that there is drywall available that uses synthetic gypsum, a made from post-industrial waste. The Architectural Resource Guide says that waste drywall is readily recyclable for new board.[53] However, cautions must be taken in storage, as it is "extremely absorbent," and will offgas the fumes of nearby toxins.

Floors

Vinyl flooring products are made of polyvinyl chloride (PVC), chemical plasticizers, limestone, and additives. Both sheet vinyl (30-50 percent PVC by weight) and vinyl composition tile (known as VCT, composed of 15% PVC)[54] contain "polyvinyl chloride and vinyl chloride monomer (carcinogens); formaldehyde (carcinogen); ethyl acetate (respiratory and skin irritant); toluene (targeted for elimination by the EPA); asbestos (in pre-1986 vinyl)," according to the HOK Database.[55] Also, the plasticizers can act as endocrine disrupters which mimic hormones and cause damage to reproductive functions and organs as well as embryonic development. VCT contains less plasticizer. Alternatives to PVC containing adhesives are tackless strips, velcro, and peel-and-stick systems (like that used on carpet tiles). While natural linoleum offgasses just as much or near the amount of VOC's as vinyl and has a more noticeable odor, its components are natural: linseed oil, pine rosin, sawdust, cork dust, limestone, and jute.[56] Linoleum was at one time the most widely used until the petrochemical industry became prominent. The use of these materials establishes a significantly less harmful production process than vinyl and it is also very durable. The only drawback to linoleum is its high cost. Nonetheless, we see this as being part of the fact that industries have so thoroughly embraced plastics that the production of older products became sidelined and thus more expensive even though plastics are not necessarily the better material.

Carpeting

In terms of carpeting, its chemical components and adhesives are very bad for human health. There are natural alternatives to synthetic carpeting, like wool and jute, among others. Carpeting also constitutes a huge problem for landfills: 3.5 to 4 billion pounds of carpet are thrown out annually.[57] Several companies have begun to address this. Milliken, Collins, and Aikman take carpet tiles and clean and retexture them. Interface will lease their carpeting, which creates a “closed-loop” relationship. Others are reclaiming carpet and recycling their components. SFSU should choose natural carpeting, or if not, carpeting that is either recycled or made of a high percentage of recycled components.

Paints

During the drying of paints, a volatile organic solvent carrier evaporates which causes VOC’s to be released into the air.[58] This has a negative affect on indoor air quality (referred to as IAQ), and the use of these paints contributes to the generation of environmental toxins in their production. Some of the chemical components of standard paints are carcinogenic or can cause other side effects, such as respiratory problems. According to Green Seal, an alternative paint manufacturer, paints should not be used that contain methylene chloride (carcinogen); 1,1,1-trichloroethane; benzene (carcinogen); toluene; ethyl benzene; vinyl chloride (carcinogen); napthalene; phthalates; isophorone; antimony; cadmium; chromium (carcinogen); lead (mot used since 1978); mercury (banned in 1991); formaldehyde (probable carcinogen); methyl ethyl ketone; methyl isobutyl ketone; acrolein; acrylonitrile (carcinogen).[59] The HOK Database describes natural, or alternative paints, as using plant resins, plant and ethereal oils, mineral fillers, and pigments. Some of the solvents are derived from citrus fruit peel , as in d-Limonene. However, EBN cautions that even some natural paints can emit high quantities of VOC’s. Also, they may have their own peculiarities in application, such as the need to apply more coats. Notwithstanding, a parallel in the benefits of using alternative paints can be drawn in the benefits of using linoleum, where the materials used are in and of themselves less toxic to use and more plentiful naturally than conventional ingredients.

We make the following recommendations. They are mainly focused on the Centennial Village but, they extend to other construction projects and SFSU as a whole.

- **Actively consider and implement sustainable design elements and building materials whenever possible**
- **Substitute conventional materials with sustainable materials of equal value**

- 🛠 **Verify sustainable sources of materials**
- 🛠 **Deconstruct and recycle demolished buildings thoroughly**
- 🛠 **Conduct environmental assessments**
- 🛠 **Choose developers and architects with good environmental track records**
- 🛠 **Environmental education seminars for SFSU administrators**
- 🛠 **Include students in planning, research and design decision-making**

The construction of the Centennial Village is San Francisco State University's immediate chance to demonstrate a commitment to sustainability. This commitment is not only to global environmental change, but to the health and livelihood of the SFSU campus community as well.

Specific Departments:

The Printmaking Department

The safe handling safe disposal and safe re-use of chemicals in the Printmaking department is extremely challenging. Many printmaking techniques and styles use chemicals that are extremely hazardous to people and to the environment. There are a number of problems with our current use of printmaking chemicals. Despite the inherent problems of working with toxic chemicals we have identified several ways in which the Printmaking department can become more responsible.

Solvents are primarily used to clean up oil based inks and paints; solvents pose a number of problems in printmaking facilities. Most solvents are Hydrocarbon mixtures that are petroleum based. The disposal of general shop solvents is a specific problem. In order to dispose of solvents properly they must be taken away by companies which are certified to handle them. In order to have companies pick up the solvents they have to be in safe storage containers.

We recommend a solvent station made up of a metal sink and hose that would enable students to reuse solvents. The station would make the need for safe storage containers obsolete. Solvent canisters are located under the solvent station, these canisters are easily removed sealed and taken away. Unfortunately the cost of having these canisters removed is extremely high and most public institutions are not willing to spend the money for this service. The result is that, currently, the printmaking department disposes of solvents on their own in very dangerous ways. An excellent alternative would be to transition to citris based solvents entirely.

Finally, water based inks are a good solution for the screen printing facility. Water based inks are priced the same as their more toxic counterpart and they do not require the use of solvents. There are now a number of water based inks on the market for textiles and paper based printing. However, screen-printing is just one of the processes that take place at the printmaking department. The other processes: monoprinting, lithography, and silk screening rely solely on oil based inks.

- ☠ Use water based inks where possible
- ☠ Install a solvent station
- ☠ Switch to citris-based solvents where possible
- ☠ Recycle solvents
- ☠ Investigate the use of less toxic solvents
- ☠ Regulate the safe handling and disposal of toxic solvents
- ☠ Properly mark containers holding solvents or other toxic substances

Photo Lab

The primary problems in the Photo Lab are chemical waste and wastewater. According to the Chemical Hazardous Waste Program the photo lab disposes of approximately 145 gallons of hazardous waste per month. Developing pictures is based on a chemical process. Water is also used to develop pictures, the problem is not only the amount of water, but what is in the water when it is finally dumped down the drain.

The lab has an old film developing machine, which develops both color slide and color negatives. The facility also has an area to manually develop black and white film and make prints. In all of these processes silver is removed from the film or paper; this silver eventually makes its way into the wastewater. The wastewater contains less than 5 parts of silver per billion, (any more would be illegal) but nonetheless the water is still contaminated and the silver accumulates in the wastewater stream. The lab actually has a silver reclamation machine that eliminates the by-product from the wastewater. But, to use the machine the lab must get certification from the state. This had not yet happened at the time this research was conducted so the photo lab still relied on campus contractors for silver reclamation.

Currently there are six separate chemical baths for slide film developing. Having six baths for slide film requires a large amount of water. In the black and white film developing area large amounts of rinse water are used. To reduce the amount of water and chemicals that are being used the photo lab is looking into getting a new three-step chemical process. Obviously moving from a six-step to a three-step process would reduce water and chemical use by roughly one half. The re-use of chemicals would also reduce the amount of hazardous waste that the lab produces. The other option is a film developing machine that they use at drug stores and 1 hour photo shops, these machines re-use chemicals until they are no longer viable.

Switching the entire process from chemical to digital would make the facility fully sustainable. Using a digital process does not entail the use of chemicals or water. However start up costs for digital photography are quite high. Ultimately switching to digital would be the most sustainable practice.

- Replace the six-step chemical process with the three-step process
- Replace old developing machines
- Re-use chemicals
- Replace current chemical process with a digital process

Textile Department

Students, who dye fabric and yarn for various projects use the textile lab. To dye the fabric a chemical dye powder dye is mixed with water and applied to the fabric directly or the fabric is submerged in a dye bath. These dyes contain carcinogens that are linked to bladder cancer in humans.

There is a large overhead fan for ventilation and sinks to rinse the excess dye from the fabric, then, the dye is simply washed down the drain. Students are shown safe ways to dye and are encouraged to wear gloves and a mask to reduce the risk of working with the dye.

Natural dyes were used to dye textiles until 1856 when a man named Sir Henry Perkins accidentally discovered mauve when trying to isolate quinine. Over 1,000 different sources were used to create natural dyes prior to 1856. The discovery of mauve marked the beginning of the artificial dye industry and a dependence on chemical dyes.

There are several simple steps we can take to make the dye lab more sustainable. First, change the practice of using only chemical dyes. To do this we can easily begin using natural vegetable based dye. The textile lab should be encouraged to grow its own plants, and make its own dyes, contributing to the students knowledge of dye and dye sources. More research should be done into the use of natural dyes. Textile classes should include a research and awareness segment. The main goal is to eventually replace the use of chemical dye with natural dye.

The following is a summary of our suggestions:

_ Begin a textile study and research program about the use and advantages of natural dye

_ Replace chemical dyes with natural dyes

_ Start a textile garden and use plants to dye fabrics

_ Include an awareness segment in the textile program

Chemistry Department

Although our SFSU Environmental Audit did not include an examination of the Chemistry Department, it is important to call attention to an innovative strategy for reducing the use of hazardous chemicals from chemistry labs. This strategy is the use of *microscale* lab techniques that use smaller quantities of chemicals as well as a commitment to use less harmful chemicals in lab experiments.

What other campuses are doing

University of Minnesota

Undergraduate chemistry labs at University of Minnesota serve about 7,600 students a year and have traditionally used large quantities of solvents and chemicals for experiments. Each year the labs were generating about 10,000 liters of solid and liquid waste. In 1993, the campus learned about *microscale* lab techniques and looked at options for using smaller quantities of chemicals as well as less harmful chemicals. Rather than transitioning completely to *microscale* lab techniques, the university blends conventional techniques with *microscale* lab techniques. One immediate change was that they got rid of a lot of heavy metals. In addition, they introduced a number of behavioral changes to cut chemicals in the labs. By providing smaller glassware and lowering spigots on the solvent dispensers so that large containers would no longer fit under them, they changed the pattern of students filling up large beakers with larger amounts of solvent than were needed. They also eliminated unnecessary repetitions of experiments.

Reduction of Hazardous Wastes Generated by the Chemistry Labs

Volume of waste before conversion	Volume of waste after conversion	Average Disposal cost	***Annual cost savings***
2,500 gallons	**23 gallons**	**$15 / gallon**	**$37,000***

***The total cost of the labor conversion was $30,000; thus the payback was less than one year.**

Conclusion

San Francisco State University has implemented the following sustainable programs and programs:

The Recycling & Resource center

The S.W.A.P. Shop

The In-vessel Compost Machine

The Green Waste Program

The Bike Barn

Low flow toilets sinks and showers (some)

Lighting retrofits and replacements

But to move towards the goal of a sustainable campus the following actions are immediately required:

Reduce, Reuse, Recycle

Expand the capacity and successes of the Recycling and Resource Center

Support and expand all existing sustainable programs on campus

Involve students involved in an SFSU campus greening effort

Involve faculty and administration involved in an SFUS campus greening effort

Form a panel comprised of students and faculty to design and implement a plan for sustainable practices on campus with one-three- five and ten year goals

Gradually implement all of the amendments listed by category below:

Specific amendments:

<u>Paper</u>

Re-use paper when possible

Educate students and staff about copier use

Double-sided copies when viable

Substitute electronic documents for paper documents

Purchase recycled paper

Purchase standard size paper

Include a paper-recycling bin in every classroom

Request desk side recycling bins (for offices) from the Recycling & Resource center

Recycle all paper

Plastic

Educate students about problems associated with use and recycling of plastic

Purchase less plastic (all departments and food services)

Purchase only recyclable plastic

Re-use plastic beverage containers

Purchase glass containers for beverages

Give food discounts for the use of re-usable plastic or other containers

Install water-dispensing machines

Water

Educate students, faculty and staff (use less water)

Complete all retrofits (toilets, sinks and showerheads)

Re-use gray-water for campus irrigation

Implement a new drip irrigation system on all athletic fields

Use alternatives to traditional grass

Water foliage only at night

Food Service

Organize "health weeks" to feature and promote healthy food choices and educate the campus community about the importance of sustainable agricultural practices

Place flyers or table tents in the dining halls to explain the benefits of organically grown and local products

Implement a student run all organic salad bar

Introduce student groups to local farmers and food production

Offer credit to students who volunteer to recycle food waste

Use the SFSU compost machine more efficiently

Employ a second compost machine

Separate all non-organic matter from food waste

Use less plastic utensils

Give food discounts to students (faculty and staff) with re-usable utensils and dishes

Give re-usable dishes and utensils to students upon registration

Pressure food services to use organic and locally grown food

Pressure food services to buy food with less packaging

Landscaping

Replace gas operated mowers with less polluting mowers

Raise the blade on the mower, grass requires less water and fertilizer and is more disease and pest resistant at two to three inches

Adjust sprinkler heads in plant beds so that they spray only the plant beds

use lower flows

Replace traditional grass

Use natural non-toxic fertilizers

Use natural non-toxic pest control, eliminate pesticide use and synthetic fertilizers

Introduce predatory (beneficial) insects

Janitorial Products

use biodegradable, non-toxic cleaner

Switch to citrus-based cleaning products whenever possible

Use natural enzyme-based drain clog products

Use non-petroleum chemical based soaps in bathrooms

Work with companies whose inventory includes non-toxic, environmentally friendly products

Pest Control

Buy non toxic pesticides

Boric acid is the least toxic way to kill ants and cockroaches

Diatomaceous earth and silica aerogel lead to the dehydration of insects, which results in death

To eliminate roaches non-toxic sticky traps work best

Citrus oil extracts such as D-limonite and Linalool kill fleas

Soil Aid, Green Magic, And Lawn Restore are all beneficial non-toxic products that will help kill lawn pests.

Healthy plants and lawns are less susceptible to pests

Sanitation: daily cleaning of infested areas

Lighting

Do not use lights when natural light is sufficient (classrooms and offices!)

Use solar power where possible

Use highly reflective, low glare paints for all interior walls

Use sensor lights

Retrofit old fixtures

Replace old fixtures

Transportation

Education and orientation upon registering (show new students how to use public transportation)

A designated carpool area

Reducing the amount of parking around Campus

More bike racks on buses

Working with MUNI and BART to get student discounts

Encouraging the use of the Bike barn

Fund a Class Pass through student fees

Increase the number of bike racks on and around the SFSU campus.

Work with the SF Department of Transportation to increase bike lanes in the city.

Provide students with low cost helmets and bicycles

Provide incentives for faculty and staff to use bicycles to travel to work

<u>Sustainable building practices</u>

Actively consider and implement sustainable building materials whenever possible

Substitute conventional materials with sustainable materials of equal value

Verify sustainable sources of materials

Deconstruct and recycle demolished buildings thoroughly

Conduct environmental assessments

Choose developers and architects with good environmental track records

Environmental education seminars for SFSU administrators

Include students in planning and research

<u>Printmaking Department</u>

Use water based inks where possible

Recycle solvents

Investigate the use of less toxic solvents

Regulate the safe handling and disposal of toxic solvents

Properly mark containers holding solvents or other toxic substances

<u>Photography Department</u>

Replace the six-step chemical process with the three-step process

Replace old developing machines

Re-use chemicals

Replace current chemical process with a digital process

<u>Textile Department</u>

Begin a textile study and research program about the use and advantages of natural dye

Replace chemical dyes with natural dyes

Start a textile garden

Include an awareness segment in the textile program

<u>Chemistry Department</u>

Implement micro-scale lab techniques

Blend conventional and micro-scale lab experiences

Relevant Internet Sights

Agriculture/Food:

- Food & Agriculture Organization of the United Nations (FAO)
  http://www.fao.org/
- Homestead.Org (Warning: There is some religious content to this site)
  http://www.homestead.org/

Building/Design-related:

- Arcosanti Foundation
  http://www.arcosanti.org/
- City of Austin Sustainable Development
  http://www.ci.austin.tx.us/greenbuilder/
- Crystal Waters Permaculture (Australia)
  http://www.gaia.org/crystalwaters/cw_toc.html#cw_toc
- Department of Energy (DOE) Sustainable Development
  http://www.sustainable.doe.gov/
- EcoHome Network
  http://ecohome.org/
- Office of Building Technology
  http://www.eren.doe.gov/buildings/
- Sustainable Architecture
  http://www.aloha.net/~laumana/elh.html

Business & Sustainability:

- Foundation for Business & Sustainable Development
  http://challenge.bi.no/

Sustainable Design:

- O2 Global Network
  http://www.hrc.wmin.ac.uk/o2/

- Sustainable Development on Campus
  http://iisd1.iisd.ca/educate/

Energy:

- Australian Sustainable Energy Sites
  http://www.fast.net.au/stephenp/alten-au.html
- Energy Efficiency and Renewable Energy Network (EREN)
  http://www.eren.doe.gov/
- SunLab (Solar Energy)
  http://www.eren.doe.gov/sunlab/

Education/Resources:

- Australian Ecologically Sustainable Development
  http://www.erin.gov.au/portfolio/esd/integ.html
- Center for a Sustainable Future
  http://csf.colorado.edu/
- The Earth Network for Sustainable Development (Costa Rica)
  http://www.ecouncil.ac.cr/
- Electronic Tools for Sustainability
  http://cpcug.org/user/dcf/
- Green Future Foundation
  http://ccn.cs.dal.ca/~ab006/gff/gff.html#file
- Green Plan Archives
  http://www.rri.org/otherdocs.html
- International Institute for Sustainable Development
  http://iisd1.iisd.ca/
- Latinsynergy (The Latin American Alliance) Sustainable Resources Links
  http://www.latinsynergy.org/organizationallinks.htm
- The Estonian Sustainable Development Network

http://www.agenda21.ee/

Local, State, National, International Case-study:

- City of Austin Sustainable Development
  http://www.ci.austin.tx.us/greenbuilder/
- Florida Internet Center for Understanding Sustainability (FICUS)
  http://www.ficus.usf.edu/
- Project of China's Agenda 21
  http://sedac.ciesin.org/china/policy/acca21/211-4.html
- Sustainable Calgary
  http://www.telusplanet.net/public/sustcalg/index.html

Pollution/Environmental Management:

- Environmental Defense Fund & Scorecard Polluter Index
  http://www.edf.org/ and http://www.scorecard.org/

Transportation:

- DOE Transportation Gateway
  http://www.ott.doe.gov/

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