The Sustainable Campus

The Newsletter of the Berea College Sustainability and Environmental Studies Program

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Berea Students Visit Solar Decathlon

By the SENS 345 Ecological Architecture Class

The Capitol Mall in Washington, DC was the setting for the second Solar Decathlon, a Department of Energy (DOE) sponsored event that celebrates the solar energy potential of residential construction. The Solar Decathlon featured 18 solar homes built by student teams from colleges and universities across the country, as well as Canadian and Spanish entries. The teams compete in a ten category contest that rates each entry on its architectural features and the ability to operate only on solar energy.

Colorado State University's 1st place BioS(h)IP.

SENS 345 Ecological Architecture students Elizabeth Nolan, Jessa Turner, and Micah Johnson took a road trip with instructor Jim Dontje to visit the Solar Decathlon. The following are short reviews of the three top finishers. To learn more about the Solar Decathlon, go to http://www.eere.energy.gov/solar_decathlon/ .

1st Place: Colorado State University's BioS(h)IP

Soy, corn, coconut, wheat, canola oil, flax, sugar, chocolate… sound like your latest grocery list? Think again. These are a few of the natural materials that make up "BioS(h)IP," the winning entry in this year's Solar Decathlon. The design was created by the University of Colorado (Denver and Boulder) and is the team's second victory in a row.

The team members paid very close attention to their material choices, developing their own when there wasn't something available to suit their needs. They wanted to use Structurally Insulated Panels (SIPs) because of the high insulative value. SIPs (also used in the construction of Berea's Ecovillage) are made of insulation sandwiched between rigid boards. However, the Colorado team was concerned about the materials used in most commercially available SIPs—Styrofoam and wood. They innovated by combining two commercially available products: Sonoboard, a lightweight but strong recycled cardboard, and Biobase 501, a soybean foam insulation, to form a new product, which they call BIO-SIPS.

The interior of the home is comfortable and visually stimulating. Bright colors were chosen for the low volatile organic compound (VOC) soy-based paint used in the common areas. The yellows and oranges make the home feel alive and welcoming. Bamboo flooring, a quickly renewable source, is attractive and durable. The kitchen, dining, and living areas are one open space. The bathroom, which

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Biofuel Co-Op Starts Its Engine

By Jessa Turner

On November 11, 2005 Jim Dontje and Jessa Turner hosted a Biofuel Co-op meeting for community and college members looking for alternatives to the use of fossil fuels. The 25 attendees ranged from Tech students working on a group project, professors, and environmentalists to local farmers, members of intentional communities, and factory workers. All were in various stages of working with biofuels from the curious to the converted to a few who were already making their own fuels.

Biofuel is any fuel that is derived from biomass — recently living organisms or their metabolic byproducts, such as manure from cows. Liquid biofuels include alcohols, vegetable oil, and biodiesel obtained from the processing of animal fats and vegetable oil. For more information, visit http://www.eere.energy.gov/afdc/altfuel/biodiesel.html

The meeting began with a quick survey of why folks are interested in using biofuels and followed with information on why and how biofuels are used worldwide. The meeting continued with a discussion of the various forms of biofuel (for example, ethanol, biodiesel, vegetable oil), types of vehicles well suited for running on biofuels and where to find them, and where and how to gather waste vegetable oil for processing into fuel.

One of the main reasons for gathering this group was to build a network of interested individuals who

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Join the SENS House

The SENS House is accepting applications for labor positions for summer 06 and for the 06-07 academic year. Both resident (students living in the SENS House at the Ecovillage) and non-resident positions are available.

The SENS House promotes sustainable living and works to engage all members of the College community in the creation of a sustainable campus. The SENS House also collaborates with groups outside the campus in developing a sustainable local and regional economy, while networking with student sustainability houses nationwide.

The SENS House is a unique and challenging labor program in which the students practice sustainable living while teaching others the skills and knowledge required for sustainability. The SENS House program maximizes experiential learning– learning by doing– and the especially rigorous learning that comes with having to teach someone else.

SENS Workers tending the Ecovillage Food Forest.

The seven SENS House Directors have led or supported projects including the Berea College Local Food Initiative, Ecovillage gardens and permaculture food forest, Ecological Machine waste treatment system, natural building projects such as the straw bale kiosk and the solar shed, editing *The Sustainable Campus*, and organizing an upcoming conference on sustainable campuses and communities in the post-oil era. The home base for the Directors is the SENS House, an ecologically-designed residence that showcases a set of appropriate technologies– low-tech and high-tech– that can contribute to a sustainable world. More important than the building itself, however, is the community that forms within and around it of talented and motivated students working toward developing a more sustainable community.

If you are interested in becoming part of this unique experiential learning and labor program or simply want more information, email SENS@berea.edu or call the SENS House at 985-3340.

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The Sustainable Campus Online

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Greening the Bluegrass: Green Building Workshop January 12, 2006 Woods-Penn Commons 2:00 PM

Richard Polk, Jr., AIA, LEED AP and the Kentucky Chapter of the U.S. Green Building Council will give a presentation and discussion on the current state of green building design and construction in Kentucky. Topics will include: what is green building, the USGBC and LEED (Leadership in Energy and Environmental Design); the benefits of green design; and green building projects in Kentucky. The presentation will be followed by questions from the audience.

Mr. Polk is a LEED Accredited Professional and principal in the firm of EOP Architects in Lexington, KY. He led the EOP team that designed Berea College's Lincoln Hall Renovation. In October, 2004 Lincoln Hall became the first building in Kentucky to achieve LEED certification.

For more information, please contact Randy Adams, Facilities Management Project Manager, at (859) 985-3856.

SENS Program Offers Compton Internships In Ecological Design

The SENS Program is again offering Compton Internships in Ecological Design for summer or other terms. Through these internships, students can gain hands-on experience in applying ecological design principles. Past interns have worked on renewable energy, ecological architecture, ecovillage development and construction, and educational garden design. The Compton Internships offer stipends for expenses. Contact James Dontje or Richard Olson for more information.

Watts Up at the SENS House?

By Richard Olson

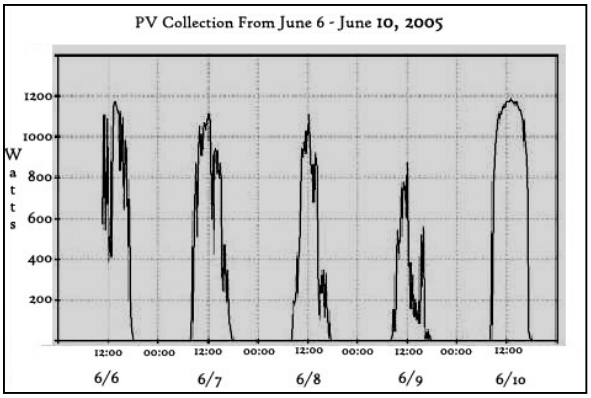
Since its installation in December 2003, a 1440-watt **photovoltaic (PV) panel** array has been converting sunlight into electricity for the Sustainability and Environmental Studies (SENS) House at Berea College's Ecovillage. During the past year (October 04 through September 05), the SENS House PV array produced 2067 kWh of electricity (one kilowatt hour equals 1000 watt-hours, enough electricity to run a 100-watt light bulb for 10 hours). Daily output ranged from zero on a cloudy winter day to a high of 12.2 kWh with an average for the year of 5.66 kWh per day.

The SENS House PV array is a pole-mounted system that tracks the sun throughout the day to increase the efficiency of the system. To date, the SENS House array is producing about 12% more electricity than would be expected for a fixed-position array of similar capacity. A tracking array was also chosen for educational purposes. Residents and visitors notice the change in the position of the array during the day, which leads to discussions of the sun's arc through the sky, seasonal differences in solar energy, and other information basic to solar design.

The SENS House has no batteries for storing electricity, but uses "net metering," so that on a sunny day the House exports electricity to the grid. During times when the residents' electricity use exceeds production, the House draws electricity from the grid.

SENS House electricity use averages 8.7 kWh per day. For comparison, the 18 original Ecovillage townhouse apartments use an average of 17.3 kWh per day (because the new Ecovillage apartments heat and cool with electric heat pumps, comparing their electricity use with the SENS House isn't appropriate). Even with this low-level of electricity use, the SENS House produces only 65% of its electricity.

The SENS House residents are currently conducting an energy audit to quantify exactly how their 8.7 kWh is used, and to identify opportunities for further reducing their use of electricity. Their goal is to live– on an annual basis– on their home-produced electricity. Their primary tool for their energy audit is the "Watts Up" Electricity Monitor. They plug the monitor into the wall, and any appliance into the monitor, and measure both the instantaneous use of power by the appliance (wattage) and the cumulative use of electricity (kWh). (If you are interested in borrowing a meter to audit your home or office, contact the SENS Program.)



Output (watts) of SENS House PV array for June 6-10, 2005.

The SENS House PV array and associated equipment in the House (for example, the inverter that converts the DC output of the panels to AC) cost approximately $11,000. At the residential utility rate of seven cents per kWh, one year's production by the array was worth $144, which presents a very lengthy payback period. Why then is this a good investment?

1. All of the electricity used at Berea College is produced by coal-burning power plants. The price of a kWh of electricity from Kentucky Utilities does not include the cost of mountains, forests, water supplies and communities destroyed through mountain top removal mining, the contribution to global warming of the carbon dioxide emissions, the pollution of streams and lakes with mercury released from burning coal, or the childhood asthma triggered by pollution from power plants. The true cost of electricity from coal-fired power plants is much greater than seven cents per kWh.

2. The 2067 kWh of electricity produced by the SENS House saved more than one ton of coal, and two tons of carbon dioxide emissions.

3. In the long term, a sustainable society will be a solar-based society. Oil, natural gas and coal are finite resources, and world oil and natural gas production is nearing its maximum or "peak" (see *The Sustainable Campus*, vol. 1, issue 2). In the near term, the decline of oil and gas production will drive up energy prices many times above their current levels, and contribute to a reduced reliability of the electric grid. During the August 2003 blackout that denied electricity to 57 million people in the northeastern United States and Canada, what would have been the value of a kWh of electricity from a secure solar source?

4. Homeland security is compromised by a centralized power system of large coal-fired or nuclear power plants that provide easy targets. A de-centralized power system of thousands of homes with solar panels on their roofs would be much less vulnerable.

If Berea is to become a sustainable campus, it must develop secure renewable power sources, and do so now while resources are still available to support the transition. The student Ten by Ten campaign's one kilowatt PV array to be constructed on the Alumni Building roof will nearly double the College's capacity. However, to put the task in perspective, during the past five years, the College's average annual use of electricity has exceeded 19 million kWh or more than 52000 kWh on an average day. To produce this amount daily would require roughly 9200 SENS House arrays as well as attention to the problem of storing and providing energy 24/7.

Even with an aggressive conservation program, economies of scale, improvements in solar technologies, use of biomass and other forms of solar energy, and collaboration with local and regional providers, Berea faces a daunting challenge. The experience gained by the students at the SENS House can help to meet this challenge.

Richard Olson is the Director of the Berea College Sustainability and Environmental Studies Program.

Solar Decathlon *(Cont. from Page 1)*

was planned by an interior design major, is simply stunning. Using a very small, square space, the student created what she called "a spa feel." The bathroom was also one of the few at the competition that replaced the standard flush toilet that so defines us as Americans with a more environmentally responsible composting toilet.

The BioS(h)IP, like the others in the Solar Decathlon is a net zero energy home intended to produce as much energy in a year as it uses. Photovoltaic panels with battery storage provide the electricity, while a solar water heating system provides the heat. The care the Colorado team put into it's use of natural materials, creating a versatile, livable design, and achieving energy efficiency is what tipped the judges' scales in a competition full of innovative designs.

2nd Place: Cornell University's House Surrounded by a Garden

Encompassed by a diverse vegetable garden, and beneath a roof of solar panels, Cornell University's home finished second in the Solar Decathlon. Like any other house in the Solar Decathlon, Cornell's house square footage is under 800 sq. ft. However, within this small frame is a technically luxurious home including trendy furniture, bamboo cabinets, and a spacious kitchen and bedroom. This house was also designed to expand, if necessary, by attaching additional modules. The entire solar collecting system, along with the heating, ventilation and air conditioning system, can be controlled automatically. Additionally, the 50-70 person student team experimented with silica gel as the main ingredient for energy recovery ventilation (ERV), which greatly reduces the energy losses in ventilation air.

Cornell University's 2nd place House Surrounded by a Garden

Some of the Solar Decathlon houses come with high price tags that reflect the expensive photovoltaic equipment and the requirement that the house be portable, as well as the research and development costs. The Cornell team has initiated an effort to commercialize their design, however, for a more modest $100K. The Decathlon is part of the team's strategy to familiarize the suburban population of America with renewable energy.

From the living room, the Cornell house opens through nine-foot high folding glass doors onto a surrounding yard packed with various vegetables such as beans, cabbage, and peppers, along with shapely miniature grass hills built to serve as seats. The plants tap into the grey water discharged from the sinks and showers.

3rd Place: Cal Poly's Passive Solar Strength

The third place finish of the California Polytechnic State University (Cal Poly) team is notable for the Berea community. The faculty leader of the Cal Poly team is Rob Pena who led the Draper renovation design and much of the design work for the Ecovillage.

The Cal-Poly team had three basic goals in mind when they designed their solar home: Simple, Functional, and Sustainable. Because the team had the farthest land distance to travel, they used those basics to create a "one truck solution" to minimize their transportation impact of almost 2,400 miles. While this "one truck solution" may have put even more of a size restraint on the 800 square foot competition maximum, the team was able to compensate for this with clever space use and an open, airy design.

The simple rectangular shape of the house is reminiscent of a traditional mobile home, but the similarities end there. An interesting mix of color and wood on the exterior give it a modern look and a portion of the PV system is cleverly disguised as a shade awning to keep out unwanted summer sun. Another expertly hidden feature is the water-filled Trombe wall, which helps to help regulate the indoor temperature and lessen the need for mechanical heating.

Inside, the house is light and uncluttered. Though the conditioned living space is around 500 square feet, it manages to have all the ingredients of a standard house: a kitchen with all the appliances, a dining area, room to relax, office space, a bedroom that can be separated from the living room, copious storage, and a bathroom with an all-in-one washer/dryer. The mechanical room resides on the other side of the bathroom wall and has ample access from an outside door. This room houses all the equipment for the solar arrays as well as storage for the solar heated water tank.

Though the rectangular shape of the exterior was boring, the interior was so well planned and comfortable that the exterior was forgotten once inside the home. Even under overcast skies, extra lighting seemed unnecessary and the thoughtful detail that went into every inch of space gave this house a very livable feel.

Jim Dontje is a faculty member in the SENS Program. Elizabeth, Jessa, and Micah are all SENS Independent Majors.

Biofuel *(Continued from Page 1)*

would be willing to contribute time, materials, skills, money, or other resources toward the creation of a co-op in which the people could help one another decrease their dependence on foreign oil and fossil fuels. For starters, one group of people who already own diesel vehicles are looking into buying 1000 gallons of biodiesel to share while others are interested in collecting and processing waste vegetable oil to use directly in their diesel vehicles or to make homemade biodiesel.

There is still work to be done in the planning and organization of a successful biofuel co-op, but the first steps have been made and now the task is to continue the momentum towards a more sustainable future. If you would like more information about the co-op or would like to be added to the co-op mailing list, please email jessa_turner@berea.edu.

The Green, Green Grass of Home?

By Phil Hawn

You've finished cutting the lawn and turn the mower off. Surveying your handy work you see beautiful green grass, neatly trimmed and ready for the neighbors to admire. You have watered, fertilized and killed the pesky insects, yet you feel that you have done your part to help the environment by reducing erosion and by adding beauty to the environment. Not quite.

Grass *is* an effective ground cover for controlling erosion. It grows quickly and has a uniform appearance that has come to symbolize the American home in the suburbs or the swank ivy-league college. What could possibly be wrong with grass? It is natural. What else is there to plant that would add lush, green beauty to your home or campus?

The problem lies in the fact that grass is a monoculture or the cultivation of a single species or like species of plants. In the case of a lawn it is not strictly speaking a monoculture as there are weeds and other varieties of grass present, but it cannot be considered diverse. Add to that the amount of water and chemicals required to keep it green and the amount of habitat destroyed to plant it and you may start to see a problem. Diversity is important when it comes to any environment and a lawn is no different.

Diversity or polyculture has many benefits, chief among them are: less susceptibility to disease, increased plant yields with fewer pesticides, and increased habitat for native animal species. Planning for a diverse vegetative cover insures that less maintenance, money and resources will need to be spent over the long term and likely will help cut down on the number of pesky insects. This is true in agriculture and landscaping. How you say? Well, there are not many places for birds and other insect eating animals to live in your yard but there is plenty of room for mosquitoes and ticks. Monoculture helps to throw out the balance of nature. Polyculture helps set it straight.

What can be planted in the place of grass? That is a good question and nature has provided the answer in the form of native plant species. All the plants that are removed to make room for the monoculture lawn are the ones that are best suited to the environment where you live. This often includes native grasses that are less green but have deep root structure. These plants are generally draught tolerant and do not require more nutrients than are already present in the soil, and what is more these plants are able to provide better storm water control than typical grasses. Best of all, planting native species will save time as they require less work to maintain after they are well established.

Eryngium yuccifolium Rattlesnake Master

So what about the Berea College campus? While some areas have been converted recently to native plantings, large areas of grass are being maintained for their aesthetic appearance and not for their usefulness. The result is that the facilities department or those with whom they contract spend lots of time and resources mowing and fertilizing grass that is only for show and is rarely used for recreation. Not only must they mow the grass, but because of all the deciduous trees on campus, the leaves must be removed or mulched in the fall to protect the grass. If, however, we had more areas of native understory plants there would be little need for the mowers to be out on the quad all the time and no need at all to remove leaves from the native plants in the fall. Furthermore, the campus would be much quieter with a reduced need for machinery throughout the growing season. As a result, air quality would improve, and the college would have more funds available to help the students it is here to serve.

So what can be done to improve plant diversity on campus? In the Ecovillage, seeds are being made available to that end. These seeds are in packets that provide enough to cover 120 square feet of ground with native perennial species of flowers and grasses. These plants include black-eyed susan, blue wild indigo, boltonia, butterfly milkweed, button blazing star, grey goldenrod, lanceleaf coreopsis, orange coneflower, pale purple coneflower, purple prairie clover, rattlesnake master, showy primrose, sky blue aster, smooth aster, smooth beardtongue and four native grasses: little bluestem, prairie dropseed, sideoats grama, and virginia wild rye. The hope in the eco-village is that instead of planting non-native showy flowers, the residents will choose to plant native species. This initiative will also help reduce the amount of grass that needs to be mowed and consequently the level of noise and air pollution will decline. An important side benefit is that these plants will attract birds and butterflies and increase the amount of habitat available for those animals.

Will any of this make a difference in the long-run? The short answer is yes. Any change that is made today is one step closer to a more sustainable campus tomorrow. It is important to note that Berea College is in a unique position to provide its own native plantings cultivated through its agricultural program at a major cost savings to the college. The continued climb in the price of fossil fuels may force more colleges to make the choice to reduce the amount of high cost grassed areas and return those same areas to their native beauty. Berea College can make an effort toward that goal, and with the involvement of students, staff and faculty, the college can become a model of native plant beauty and diversity.

Phil is a non-residential SENS House Director and resident of the Berea College Ecovillage.

Recycling: We Treat it Like Garbage

By Richard Olson

In 2004, Berea College sent 515 tons of municipal waste to the landfill. At the same time, the College's recycling program diverted 127 tons of materials from the landfill, transforming waste into a useful resource. This means that the College recycled 20% of its garbage.

However, the recycling rate for the United States is 28%, and Berea's Campus Environmental Policy Committee has recommended a recycling goal for Berea of 50%. Is 50% a reasonable goal? Does Berea's garbage even contain 50% recyclable materials?

Each year the SENS 100 classes conduct their always popular "garbage labs" in which the students collect a representative sample of garbage bags from classroom and office buildings as well as outdoor trash containers on campus. Donning plastic gloves, they sort the garbage into recyclable and non-recyclable categories and weigh them.

Category	Percent of total (by weight)
Recyclable	
Beverage containers	18%
Paper	10%
Cardboard and paperboard	4%
Compostable materials	31%
Total recyclable	**63%**
Non-recyclable	37%

Results of SENS 100 garbage sort, November 2005

When we consider that 20% of the College's garbage is already diverted to recycling, 63% recyclables in the remaining 80% of the garbage indicates that roughly 70% of the entire garbage stream is recyclable or compostable. The spring 05 SENS 100 class found that 74% of their garbage sample was composed of recyclable or compostable materials. Ashland University (OH) did a waste audit of 48 bags of trash and found that 70% was recyclable.

So, to reach the 50% goal we don't have to be perfectly efficient in sorting out the recyclables. We will however need to institute separation and composting of food wastes as part of the campus-wide recycling system because of the large proportion (by weight) that food comprises of our garbage. The Ecovillage recycling program already institutes weekly collection and composting of food wastes from the apartments and the use of this compost as fertilizer for the Ecovillage gardens.

If recycling 50% of College garbage still seems like an impossible goal, consider the SENS House, which during the 04-05 academic year recycled or composted 80% of its garbage. Even this, however, is just an interim achievement. Ultimately, a sustainable society, like an ecosystem, will have zero waste. This will require a radical change in how and what our economy produces. For more information on a zero waste economy, see http://www.grrn.org/zerowaste/index.html.

For information on Berea College's recycling program, and steps you can take to increase our recycling efficiency, contact Kevin Long, head of the recycling program (Kevin_Long@berea.edu) or Michael Hilterbrand, assistant to the Berea College Sustainability Coordinator (Michael_Hilterbrand@berea.edu).

Berea Students Study Water Quality in Local Reservoirs

By Paul Smithson

Berea residents have received several letters from Berea Utilities with a bold-faced header informing them that their water has "levels of disinfection by-products above drinking water standards." These by-products result when chlorine— added to the water as a disinfectant— reacts with dissolved organic matter in the water to form compounds such as trihalomethanes. Berea Utilities is instituting alternative processes to reduce the levels of disinfectant by-products to below the standards, but is still interested in learning more about the source of dissolved organic matter in their reservoirs.

During the past two summers, environmental chemist and Chemistry/SENS faculty member Paul Smithson has led student research teams to study that question. Smithson's students have extensively sampled the water in Berea's water supply reservoirs. They measured nutrient levels, algae growth, and the amount of trihalomethanes produced in the samples. After two years of study, we still do not know for sure, but evidence points to excessive summer algae growth as the source of the organic matter that forms the unwanted by-products.

If these results are confirmed by additional studies, it will give the utility managers another angle from which to fight the problem. If the managers can reduce the summer algae blooms they may be able to further reduce any unwanted by-products in their final product, which is safe and clean water. Meanwhile, Berea chemistry students are honing their skills by applying their classroom knowledge to a real-world problem – an excellent example of service-learning.

Paul Smithson is a faculty member who divides his time between the Chemistry Department and the SENS Program.

Berea chemistry students Sarah Kim, Laxman Gurung and Kofi Diggs take water samples from Berea'a Owsley Fork reservoir in June 2005.