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Contents

ACKNOWLEDGMENTS

ABOUT CAMPUS ECOLOGY

Since its inception in 1989, NWF's Campus Ecology program has earned respect as a national leader in the campus sustainability and climate solutions movement. Originally named Cool-It!, the program has long recognized the opportunities for higher education to lead society to a clean, just and prosperous energy future. Over nearly two decades, the program's tools, training and expertise have evolved to serve students, faculty and staff in a wide range of capacities. Its publications, workshops, fellowship programs, web-based resources and talented staff have empowered students and inspired environmental stewardship on hundreds of campuses nationwide. Equally important, its personal assistance with energy efficiency and conservation projects has led to significant financial savings. Working partnerships with the Energy Action Coalition's Campus Climate Challenge (climatechallenge.org), Clean Air-Cool Planet (www.cleanair-coolplanet.org), AASHE (Association for the Advancement of Sustainability in Higher Education - www.aashe.org), APPA (Leadership in Educational Facilities - www.appa.org), SCUP (Society for College and University Planning - www.scup.org) and other organizations give Campus Ecology a strong national voice. In 2007, Campus Ecology launched a new initiative to recognize and cultivate Campus Climate Champions—schools that demonstrate significant emissions reductions and engage their peer institutions, communities and elected officials in tackling global warming.

SPONSORS

The Energy Action Coalition
P St NW, Suite
Washington DC
http://www.energyaction.net

Gaylord Nelson Institute for Environmental Studies
University of Wisconsin-Madison
N. Park St.
Madison, WI
http://www.ies.

If you have questions please call us at (703) 438-6000 or email campus@nwf.org
And be sure to keep up with the latest at www.CampusEcology.org

In 2005, the National Wildlife Federation established global warming as one of three chief concerns for the organization, recognizing that it could not successfully protect wildlife without also working to stabilize the climate. While the impacts of global warming are an overarching threat to wildlife and ecosystems, their reach also will touch every facet of society—human health, agriculture, national security and the economy. Turning the tide on global warming may be the most far-reaching challenge of our time, but it also is an extraordinary opportunity to create more efficient, resilient and sustainable colleges and universities—and to inspire students to make a commitment to climate action in their lives and careers.

NWF's Campus Ecology program has focused its attention on global warming solutions and is committed to providing resources to assist postsecondary institutions make the transition to a low-carbon, clean energy future. ConGreea

2 What Climate Science Tells Us

Scientists overwhelmingly agree that global warming and rising levels of CO_2 and other greenhouse gases in the atmosphere are the result of human activity and far exceed natural variations. At no time over the past 650,000 years have CO_2 concentrations in the atmosphere been as high as they are today (see graph). The 2007 report of the Intergovernmental Panel on Climate Change (IPCC) confirms and strengthens earlier conclusions about our changing climate. Measurable signals of change are multiplying and include:

- Rising sea levels and global temperatures
- Extreme weather events
- Vanishing polar ice
- Shifts in wildlife migration patterns

Local impacts. Closer to home, there will be climate change consequences for colleges and their surrounding communities—many of which are unpredictable. Weather extremes and natural disasters can be an immediate and costly concern, as coastal schools like and in New Orleans know all too well. Mosquito-borne viruses and other diseases are expected to spread more readily in areas with milder winters. Warmer temperatures also will lead to increased energy and water demand—and higher utility bills. The Union of Concerned Scientists' map of the North Central states[2] shows how local conditions could change dramatically by the end of this century.

So far, the consequences of global warming have been relatively modest—and many could be reversible if the climate stabilizes. But if global average temperatures increase just a few degrees more, scientists predict the planet will reach a series of "tipping points" where nature may not be able to easily rebound.[3]

Emissions of CO_2 and other greenhouse gas pollutants are steadily rising worldwide. The solutions "wedges" strategy developed by Pacala and Socolow[4] (see diagram) offers a multidimensional approach to bring that upward trajectory under control, though it will take a long-term global effort. The graph shows a simplified view of how it could happen. If each action is large enough, the desired reductions can be reached.

Choosing the path. The National Wildlife Federation urges significant emissions reductions (80% below 2005 levels by 2050) across all sectors of society ove

Minimizing the consequences of climate change will call for the best and brightest ideas over the next century and

Colleges and universities have considerable influence over ideas, too. Starting in the 1 70s, environmental activism on campuses helped steer the national conversation toward issues like clean air and water. It took a long time for schools to turn the spotlight on themselves, but now there are hundreds of schools integrating sustainability principles into their master plans, operations, courses and research. And recently, widespread concern over global warming and climate change has been a galvanizing force.

This shift to greater awareness and action was documented in NWF's 2001 national survey of colleges and universities. In the study, nearly 00 presidents, academic deans and chiefs of administration responded to a comprehensiv [illegible]

[redacted] gas emissions

[redacted] regarded as collections of energy-consuming [redacted] centers to energy-intensive 24-hour-a-day [redacted] ngs was constructed in times of cheap energy, [redacted] g, ventilation or lighting.

[redacted] ngs in the U.S. are currently maintained at [redacted] f $5 million per campus per year. But there are [redacted] osts and comply with government regulations, most [redacted] rporate efficient, money-saving heating and cooling [redacted] d water-conserving lighting and plumbing.

[redacted] d (eadership in Energy and Environmental Design) [redacted] accelerated the trend toward efficiency. Often these [redacted] become campus showcases as well as learning opportunities. [redacted] s Center at [13] (Ohio) is a prominent example. [redacted] neutral design integrates both building and landscape into a [redacted], and it serves as a real-time educational laboratory. But it is still [redacted] Indeed the majority of the other buildings at Oberlin and [redacted] energy-demanding structures.

[redacted] ngs is by far the [redacted] print" of most [redacted] n for

Campus emissions totals are a function of size and activities. Research universities tend to be energy intensive with laboratory buildings consuming the most. At the [16], for example, 26 research/laboratory buildings (out of a campus total of around 300 buildings) account for 60% of electricity use. Colleges with primarily a teaching focus have much smaller carbon footprints.

When facilities are individually metered, energy use among building types can be compared. The 2006 emissions inventory at [17] (Calif.) revealed wide differences in energy intensity between residence halls and non-residence buildings (see tables), with Pendleton Pool using 200 times more electricity per square foot than the Clark residence halls. When looking to decide where to focus energy conservation measures, comparing kilowatt hours per square foot points to the greatest potential savings.

Energy Consumption at Pomona College: Where would you invest funds to cut energy use and emissions?

Energy Intensity: TOP 10 RESIDENCE HALLS

Residence Hall Bldgs.	Total sq ft	kwh used 2005-2006	kwh/sq ft
Mudd-Blaisdell	,	,	
Oldenborg Center	,	,	
Lyon Court Dormitory	,	,	
Wig Hall	,	,	
Norton Hall	,	,	
Walker Hall	,	,	
Smiley Hall	,	,	
Harwood Court	,	,	
Lawry Court Towers	,	,	
Clark I, III, V	,	,	

Energy Intensity: TOP 10 NON-RESIDENCE BUILDINGS/FACILITIES

Non-Residence Hall Bldgs.	Total sq ft	kwh used 2005-2006	kwh/sq ft
Pendleton Pool		,	
Haldeman Pool	,	,	
Richard C. Seaver Biology Bldg.	,	, ,	
Pauley Tennis Complex	,	,	
Hahn Building	,	, ,	
Seaver Building	,	, ,	
Frary Dining Hall	,	,	
IT (Multi-Use) Building	,	,	
Frank Dining Hall	,	,	
Replica House		,	

SOURCE: *A First Step Toward a Climate Neutral Pomona College: Greenhouse Gas Emissions Inventory and Recommendations for Mitigating Emissions, 2007*

3. Opportunities for the future: Taking the long view

In the National Wildlife Federation's view, global warming is a solvable problem. And while it encourages all sectors of society to do their share, NWF looks to higher education to be an example for others.

"Since 1997, we've saved about $36.6 million dollars in energy. We prefer a portfolio approach in renewable generation and energy conservation, but we emphasize energy conservation because it has a much better economic payback. Also it has more potential to reduce greenhouse gas emissions."

—Jim Dewey, 2007, Former Associate Director of Facilities, University of Califorla[PfcZWcYEg–,UpbEWE–fGYwESWTZE–n,,MbN]-t,WTXaYEVE–VfWk

Addressing climate change will be a decades-long proposition. But there are three important opportunities inherent in that extended time horizon. First, investments in efficiency and a clean energy future will yield good returns, and savings will compound over the years. Second, decoupling fossil fuels from the campus energy system will lead to greater stability of price and supply—and offer a hedge against an uncertain regulatory future. Third, the prospects for new careers and a more relevant college education for students will only get better.

Those opportunities are covered briefly here. ater sections of the report provide: 1) the steps needed to initiate a climate campaign, 2) examples of cost-effective strategies to reduce emissions, and 3) financing options.

Returns on investment

Simply put, energy-conservation and other sustainability initiatives cut costs and emissions. By generating savings year after year, the returns can add up to impressive amounts. In ten years, savings from energy efficiency projects at the [18] have totaled over $36 millio

Ensuring long-term control over both energy price and supply, the [25] has plans to take its nine campuses "off the grid" by installing 1 megawatt of solar electric capacity at each location. It will be the first community college district in the nation to generate all of its own electricity.

Diversified energy systems that supply clean energy either on- or off-campus can help schools survive prolonged power outages, such as the blackout that hit the Northeast in August 2003 affecting eight states and 40 million people. Such systems also keep money in the community by investing in locally produced energy.

The future legal climate. Choosing efficiency, renewables and lower emissions is not only fiscally responsible, but also helps [illegible]

Educational, research and career opportunities

Climate change and sustainability are hot topics on campus and beyond. From guest lectures to new majors to large-scale research and teaching initiatives, they are attracting a growing clientele of students and teachers, and incre

Ne

Four steps are recommended to ensure success over the long term:

1. Establish an institutional commitment to reduce greenhouse gas emissions.
2. Build a climate action team.
3. Conduct a greenhouse gas inventory.
4. Develop and implement a climate action plan.

1. Establish an institutional commitment to reduce greenhouse gas emissions

A formal commitment is often the starting point for campuses to begin planning for climate action. This step can occur openly through public statements or policies set forth by top leadership, and may include specific reduction targets and timetables. Or it can happen more internally, through guidelines for energy conservation and other emissions-reducing activities undertaken by facilities and other staff. Once such a commitment is made, it becomes the guiding authority for action—with emissions reduction as the critical measure against which project ideas are evaluated.

Campus policies and goals for climate action. Making a high-level statement of support for sustainability and commitment to reduce campus emissions sends a clear signal to staff, students and faculty. And the greater the number of people involved in the policy decision, the more widely it will be accepted.

The Office of Sustainability at the **N** **H** [45], located prominently in central campus administration, outlines its strategy:

> "As a Climate Protection Campus, University of New Hampshire is committed to being a model sustainable community in the state and region. UNH is meeting this commitment through its University-wide Climate Education Initiative (CEI), the mission of which is to integrate the ethics, science, technology, and policies of greenhouse gas reductions into the University's identity and practices. To accomplish this mission, the CEI is actively engaging the University community in climate change education and emissions reduction efforts across campus and beyond."

At

Top leadership suppo

Committees, councils and task forces. While they go by many names, campus environmental committees share a common purpose to research, propose and implement projects that promote sustainability. For groups involved in climate action the focus is on reducing greenhouse gas emissions, with energy often at the center of the discussion.

See links[54] to these three campuses to learn about their members and tasks:

Sustainability/Climate staff. Unlike committees, having a campus office of sustainability or environmental stewardship calls for a financial investment for staffing and office expenses. But staff positions and resources are an investment that pays major dividends. Campus employees whose work focuses on sustainability can play a crucial role in influencing climate action and providing continuity over time. The box highlights three diverse examples.

Campus operations decision makers. Essentialci many campuses and continues to be improved. It is regarded as one of the eg

It shows the biggest sources of emissions—which are the biggest opportunities for reduction. If data are charted over several years, it also shows how emissions change over time due to new buildings, changes in fuel sources and other factors. The emissions breakdown of [60] (Calif.) (see chart) was created using data from the Clean Air-Cool Planet inventory tool. Of the total (17, 27 MTCDE), 88% of emissions derive from energy use in buildings. The inventory was conducted in 2007 as part of an environmental studies class called "Carbon neutrality at Pomona College."

The National Wildlife Federation's Campus Ecology program offers guidance on using inventories and creating climate plans as part of its "Campus Climate Champions" program.

4. Develop and implement a climate action plan

With emissions data in hand and committed staff, students and faculty on board, the next step is to explore a range of projects and funding options (see Sections 5 and 6) that will cut campus greenhouse gases. Ideas need to be vetted for both logistical and financial feasibility. While some campuses work on climate action "project to project" to reach their goals, a formal plan allows a more holistic analysis, showing how a set of projects will work together over time to cut emissions to the levels requreleteogf [illegible]

- NWF strongly recommends a minimum goal of 2% net reduction per year below a 2005 baseline (which translates to 30% by 2020 and 80% by 2050). This is the pace of reductions needed to stabilize atmospheric CO_2 at a safe level.
- Proposals should detail emissions reduction strategies, giving a full cost and lifecycle analysis for each project—including initial investment, payback, return on investment, net present value, emissions saved and cost (or savings) per MTCDE. Individual projects such as lowering thermostat settings, maintaining steam traps, running dorm energy competitions and installing solar panels can be analyzed and compared objectively. Some plans, such as [62], include indicators for risk and social benefits.
- Strategies should cover project priorities, timelines, working within the college or university structure, dealing with emissions "inflation" due to campus expansion and other factors.
- The planning document also should include existing conditions, personnel involved, financing strategies, policy implications, institutional barriers and benchmarks.

The following five action areas are great places to start.

PROVEN STRATEGIES TO SHRINK THE CAMPUS CARBON FOOTPRINT[63]

1. **Convert to zero-carbon or lower-carbon energy sources.**
2. **Update efficiency of HVAC (heating, ventilation, air conditioning).**
3. **Scale back heating, cooling and lighting demand.**
4. **Reduce plug loads.**
5. **Wise campus planning.**

These campus-tested methods can generate significant savings of both money and CO_2. With smart planning and budgeting, a coordinated package of actions can take a big bite out of greenhouse gas emissions and yield a good return on investment.
The [illegible]

PROVEN STRATEGIES TO SHRINK THE CAMPUS CARBON FOOTPRINT

1. Convert to carbon-neutral or lower-carbon energy sources (2% to 70% emissions savings)
On- or off-campus energy sources using fossil fuels are the primary contributors to campus emissions. ero-carbon and low-emissions options like wind, solar and geothermal can result in the greatest cuts in CO_2.

- Install onsite generation—central or distributed—from renewable or lower-carbon sources.
- Increase power plant efficiency (cogeneration and waste heat recovery).
- Switch to lower-carbon fuels like natural gas and biofuels.
- Purchase electricity from renewable sources.

2. Update efficiency of HVAC (heating, ventilation, air conditioning)
(2% to 30% savings)
Target the biggest users of energy first. aboratories, swimming pools, and older buildings are usually worst.
Replacing a large, obsolete ventilation fan can save as much as retrofitting dozens of light fixtures.
A building audit ial cTWgHRB p SW BRB cTWBRU q)RP BRB e S q)

Clim

A detailed study at created a plan for a single building (see box).

Climate action: Also an extraordinary educational opportunity

The entire process—choosing a climate goal, working with students, staff and faculty, inventorying, planning and carrying out projects—is a gold mine of possibilities for teaching and learning. [71] expresses that idea prominently in its 2007 plan:

> "Pursuing carbon neutrality will create many unique and dynamic educational opportunities for students and faculty at Middlebury. As a campus-wide endeavor, it will enhance education across the academic disciplines. By giving Middlebury students the opportunity to help design and implement carbon reduction projects, the College will connect the critical thinking intrinsic to the liberal arts curriculum with tangible solutions to climate change."

Indeed, Fer

IN THIS SECTION:

1. Energy efficiency
2. On-campus renewable energy
3. Fuel switching, cogeneration
4. Green buildings
5. Transportation
6. Behavior change and education
7. Purchasing renewable energy credits
8. Campus habitat

"Financial benefits from our energy conservation projects easily trump those of equally priced renewable energy projects – with payback times of only one to five years."

—Ryan Schauland, Energy and Sustainability Coordinator, University of California, Santa Barbara

Savings from EFFICIENCY

The U.S. Department of Energy (DOE) Rebuild America program estimates that colleges and universities spend over $6 billion each year on energy and that effective energy management could save 25% or more on every campus in energy costs.[72]

1. Energy efficiency

The project possibilities in this area are almost unlimited, as is the potential for savings. For most campuses this is the primary area for ongoing attention, there's always something that can be made more efficient—and as a result cut campus emissions. At every level, whether an entire campus or a single building, an energy-using appliance or fleet of vehicles, there are efficiency projects that can yield good returns on the investment of both capital and staff time. Most efforts focus on some aspect of buildings, with the greatest savings coming from better heating and cooling systems (HVAC), light fixtures and plug-in devices.

Whole-campus approach. Comprehensive efficiency initiatives across the whole campus have been launched by (see story in Top 5, Appendix A), and [73]. At Texas A M, their "Campus-wide Metering, Retrofits and Continuous Commissioning Program" cut energy consumption per square foot by 33% and has saved more than $50 million in electricity, chilled water and hot water costs since 1 6. In the period 1 8-2004, the [74] completed energy projects in 120 major campus buildings, including installation of energy-conserving lights, equipment and higher-efficiency motors, tune-ups of mechanical systems and direct-digital control points for automated systems. These projects reaped savings of $ .7 million annually and earned UM the 2004 EPA Energy Star Partner of the ear award.

"Our staff has been very committed to pushing forward with hundreds of energy conservation measures that not only make good business sense, but also strengthen our environmental stewardship commitment."

—Hank Baier, Associate Vice President for Facilities and Operations, Univ. of Michigan

Excerpts from a table in the N H [75] report, *Strategic Energy and Water Plan* (October 2006), illustrate the kinds of efficiency projects possible in a single year. These eight projects save UNC $365,000 annually, with simple paybacks ranging from immediate to eight years, with most from two to three years.

UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL 2005-06 ACCOMPLISHMENTS		
UNC: 2005-06 ACCOMPLISHMENTS	ANNUAL SAVINGS ACTUAL OR ANTICIPATED	PROJECT COST
Recommissioned three buildings	$155,871 (engineering estimate)	$390,620
Sealed ducts: McColl Hall	$6,500	$15,240
Lighting upgrades in 11 buildings	$52,515 (761,090 kWh)	$424,413
Boiler controls	$25,600 (24,060 therms)	$40,450
Energy efficient motors	$9,550 vendor est. (159,144 kWh)	$32,262
112 classroom lighting setbacks	$5,725 (95,414 kWh)	Staff time only
LED exit lights	$3,513 (32,149 kWh)	$7,875
Thermostat nighttime setbacks 17 buildings	$106,000	Staff time only

Creative new approaches to projects as well as old standbys offer plenty of choices to save energy and CO_2. Some are classic "low-hanging fruit" like thermostat setbacks and swapping out inefficient fans and lights. Others may cost more or have lower returns on investment, but most efficiency initiatives make money in the short or long run. Here's what some campuses are doing:

[76] (Mass.) looked at energy use in the ubiquitous campus vending machines. By installing "vending misers" on only 0 machines, electricity consumption was cut in half, saving an estimated $17,000 and 100 tons of CO_2 annually. The devices cost $165 each but save $1 0 a year in energy costs. Once converted, the vending machines turn themselves off when not in use while still keeping beverages cold.

[77] staff piloted a project to replace incandescent desk lamp bulbs with compact fluorescents. ointly funded by the Facilities Fee ($4,000), University Housing ($6,000), and Facilities Services ($5,500), the university bought over 2,500 CF bulbs. During the light bulb exchange in spring 2006, 1,760 bulbs were swapped and the old bulbs were recycled. Requiring only 25% of the electricity incandescent bulbs use, the CF s saved $4,1 0 and 60 tons of CO_2 in a single semester.

At [78] (Calif.), a 2007 study estimated that if all 800 school-owned computers were set up with E Save software by Energy Star (available for free on their website), energy savings could be over $53,000 a year. The software is easily installed and enables computers to power down when not in use. Campus greenhouse gas emissions would be reduced by 350 tons, the equivalent of taking 67 cars off the road. There are also an estimated 1,200 student-owned computers where even more savings are possible.

2. On-campus clean and renewable energy

The most promising path to a stable climate is through the wholesale adoption of clean and renewable energy sources—the sooner the better. The challenge is to supply useful forms of energy without the net release of greenhouse gases. Some advantages for doing so Once the is in pc the cli

eithe

Schools in all climate regions of the U.S.—from the wintry north to the sun-baked southwest—have the production numbers to prove the success of these alternative energy installations. While some—notably photovoltaics (PV)—are expensive to install, there may be utility or government subsidies available to offset part or all of the cost. And depending on location, some options are cheaper than their fossil fuel counterparts. The future of clean and renewable energy looks especially bright, with costs expected to drop and a broader range of options coming onto the market.

For an in-depth look at renewables on campus, see *The Business Case for Renewable Energy: A Guide for Colleges and Universities*,[81] (2006), publish

Geothermal

Only a few yards below t

groundwater through 30 wells. Tubes in the buildin with one capable of burning biomass has been approved. Around the country, switchgrass is being tested as a potential new farm crop for both biomass and cellulose ethanol production, with promising CO_2-reducing benefits.[111]

Biomass gasification

The [112] broke ground in uly 2007 for a biomass gasification facility that will begin operation in 2008. The reactor will convert corn stalks and other farm residual materials—around ,000 tons a year—into a syngas (synthetic gas) composed mostly of carbon monoxide and hydrogen. When burned, it produces clean energy to generate heat (as well as cooling in the future). It is expected to offset more than 80% of UM-M's heating and cooling needs, currently met by fossil fuels. The project cost is $8, 56,000 of which $1. million will come from DOE and USDA grants.

Biogas–from landfills and anaerobic digesters

When organic materials decompose in oxygen-poor environments, one of the byproducts is methane—the same substance (CH_4) as natural gas, a fossil fuel. In landfills, biological processes decompose garbage into huge quantities of methane, which is 21 times more potent than CO_2 as a greenhouse gas. When captured and burned, CH_4 converts back to CO_2 and water. Methane or biogas also can be made in special equipment called "digesters" which use plant materials, food or animal waste as feedstock. Campuses are beginning to experiment with both sources of fuel.nd

Fuel cells

Holding promise as a clean energy technology for the future, fuel cells on campuses today are mostly demonstration units to test different designs and efficiencies. These devices create electricity through an electrochemical process in which a fuel and oxidant (air) combine through a catalytic reaction. The fuel required is hydrogen which can be supplied as a pure gas or reformed from hydrocarbons like natural gas. If the source of fuel is carbon-neutral, then so is the energy made by a fuel cell.

In 2006, N V [115b] in Syracuse, N fired up a high-temperature, high-efficiency molten carbonate fuel cell on campus. For now it is fueled with natural gas which the unit reforms into hydrogen gas, but the college has plans to switch to biomass syngas made from willow, which will be high in hydrogen. The 250 kilowatt system is the size of a large trash dumpster and provides about 17% of campus electricity requirements. The New ork State Energy Research and Development Authority gave $1 million for the project and two other grants provided another $350,000 to offset the overall $2.5 million cost.

3. Fuel switching, cogeneration

For schools that generate their own heating and cooling in centralized plants, two alternative technologies can lead to significant cuts in CO_2 emissions. First, campuses can switch from high-carbon fuels like coal to lower-carbon fuels like oil or n

4. Green buildings

Building green is giving campuses the chance to “get it right this time.” Technology exists today to construct buildings that use half the energy—or less—of conventionally built structures. Building projects at campuses have demonstrated that green construction does not have to require more financial green (see Harvard example below). But regardless of upfront costs, green buildings are a cost-savings bargain over their lifetimes. And they have become prominent symbols of a school’s commitment to sustainability.

While new buildings can be designed with state of the art efficiency, adding square feet usually means an increase in net emissions. Unless a building is designed to produce all of its own energy (a feat achieved by Adam oseph ewis Center which is a net exporter of electricity) or another building is torn down, once online a new structure causes an upward tilt to the campus energy total. With that in mind, the existing stock of 240,000 college and university structures is where the greatest emissions savings await. Green renovations offer the chance to preserve a piece of history and also take a bite out of the energy bill.

Laboratories

[illegible] opened the doors of the Donald Bren School of Environmental Science and N [illegible]

Renovations

H [123] completed a green renovation of a historic building on campus in 2006, earning the coveted EED Platinum certification. Its 40,000 square foot Blackstone Office Renovation project included a ground-source cooling system, energy-efficient fixtures, an Energy Star reflective roof, and sophisticated ventilation controls. Energy use in summer is reduced 42% beyond code requirements. Construction and demolition waste was % recycled, cutting 15% off the overall project budget. Costs were $250 per square foot which is in line with non-go re S- q

5. Transportation

Cars, trucks and other vehicles add their share to campus greenhouse gas emissions—sometimes a sizable share. But schools have learned a number cost-effective ways to cut CO_2.[125]

- Reduce fleet size
- Switch to biodiesel and biofuels
- Use electric, hybrid or flex-fuel vehicles
- No-mow landscaping

- Carpooling and vanpooling
- More bike racks and safe bike routes
- Bus and public transit passes
- Preferred parking for multiple occupant vehicles

Campuses are great places to try out new transportation ideas:

Biodiesel[130]

Students at

Residence hall contests

In 2004, t

Cons

- Price can be higher than the cost of efficiency measures and there is no financial payback or return on investment.
- Concern over double-counting emissions reductions.
- Not all RECs represent new renewable energy being added to the grid, some represent GHG reductions that would have happened anyway and thus can't be counted. (The aim is to support increases in renewable energy capacity.)
- Decreased incentive to conserve energy or develop low-carbon generation capacity on campus.

(Best practices recommend that RECs only be counted against emissions from electricity use and not other emissions, such as fuels used in fleets, staff commuting or air travel. RECs should be an interim strategy while planning onsite installations and energy conservation measures. When emissions associated with electricity use are a large source of an organization's carbon footprint, the National Wildlife Federation suggests following the recommendation of the American Institute of Architects (AIA) and the Architecture 2030 Challenge[143] that no more than 20% of emissions reductions be purchased, rather than earned through efficiencies and onsite clean energy. In other cases, NWF recommends following the WRI-BCSD protocol[144] with regard to the use of RECs only for emissions associated with electricity use.)

An increasing number of colleges and universities have opted to strike a deal with their utility company, using green power to meet from a few percent to 100% of campus electrical needs. Here are a few examples.

The EPA has been encouraging adoption of green powRUPT~ q)S~ q) n iving forests, grasslands and unplowed agricultural lands act as a carbon “sinks” through photosynthesis. They tend to absorb more CO_2 than they give off, effectively storing carbon in wood and soils and sequestering it from the atmosphere. Actively growing trees are especially effective long-term repositories for carbon. By weight, trees are around 50% carbon[152] and can produce several tons of wood per acre per year.

Campuses

Arizona State University[158] landscapes for a desert climate

ASU established a policy of "using native species in campus landscaping." Across the campus, species have been planted that are drought tolerant and adapted to the harsh desert conditions, requiring minimal watering and fertilizers. A few years ago, one of the entrances to the university wa

This section is a brief introduction to funding alternatives. Several excellent higher education-specific resources can provide more details and a broader palette of options (see box). “And, of course, the best sources of expertise and inspiration and funding ideas are often the staff, students and faculty who have been the driving forces behind successful projects.

RECOMMENDED READING

Degrees that Matter: Climt

When seeking funds from external sources, colleges and univer

HOW-TO KIT NOW AVAILABLE

A new onlin [illegible]

These two examples show the range of possibilities:

[illegible][178] [illegible] performance campus design, operations, maintenance and occupant behavior projects. It supports projects in existing buildings with paybacks of less than five years. Projects can be bundled together so that short-payback projects can offset those with longer paybacks. Since its launch in 2002 with $3 million in campus money, the GC F has funded over 160 projects in areas such as lighting, HVAC, PVs, cogeneration, kitchen equipment, recycling and computer energy education. In 2006, after operating for three years, then-president awrence Summers shifted more money into the fund, increasing it to $12 million. The reason The loan fund had been getting twice the return on investment as the university's endowment, which hovers around 15%. As of March 2007, GC F projects were saving nearly $4 million per year with an average project ROI of 35%. Besides saving money, fund-supported initiatives have cut an estimated 27,400 metric tons of CO_2 from Harvard's total.

The Clean Energy Revolving Fund (CERF) at [17] (Minn.) was created in 2006 as a student initiative. Its initial fund totaled $27,000, of which $20,000 came from the Macalester College Student Government. According to the CERF website, "The mission of the fund is to encourage global sustainability on campus and in the community, by funding innovative projects that demonstrate environmental leadership and economic benefit." Proposals include money-saving projects dealing with fuel, electricity, water and building maintenance. It has two formulas for paying back project loans based on annual savings. A five-member board administers the fund which includes two students, an administrator, faculty member and an alumnus.

Other creative sources for funding

In addition to traditional sources like an institution's base budget or those described above, funding for climate action can originate from novel places. Besides creating new sources of revenue, they can attract media attention and win more supporters from the campus and community. Here are a few ideas:

Endowments

With the timeframe for mitigating global warming stretching ahead for decades, some new funding sources with a similar longevity will be needed. Endowments offer long-term stability as sources of revenue—as long as investment markets stay within normal ranges. And if operated as a revolving, self-expanding source of capital invested in high-yield projects on campus, an endowment could exceed market rates.

The Office of Sustainability at the **N H** [180] is the oldest endowed sustainability office in the nation. Beginning in 1 7, a generous gift of $11 million guarantees the presence of staff and a well-funded program in perpetuity. In summer 2007 the founding director, Tom elly, was elevated to the position of CSO—Chief Sustainability Officer—and his program is now administered through the Office of the Provost and Executive Vice President. UNH is one of the few campuses to date to have given sustainability such a high profile.

At [181] (Washington, D.C.), the Class of 2007 dedicated their class gift to their alma mater's green future. More than $38,000 was raised from seniors and parents to create the Campus Green Fund, an endowment that will be used primarily for energy conservation projects on campus. The fund will be administered by GWU Facilities Management.

"There has been a big trend toward endowments—because you give back more to the university this way and because … it will last the university forever."

—Katie Lux, Senior Gift Coordinator, George Washington University

Individual action: Personal CO_2 offsets

For years, campuses have been asking students and staff to turn off lights and take other personal actions. But in this approach, they pay cash to offset their campus greenhouse gas emissions.

The [182] recently launched a campaign for 1,000 faculty, staff and students to join the Wind Challenge 1000 and voluntarily pay a fee to purchase wind power to cover their personal campus energy footprint. Rates vary. A fulltime student living on campus pays $15.40 a semester, which offsets 5,118 kWh or ,484 pounds of CO_2. For students living off campus, it's $4.40. Full time faculty and staff pay $6.10. The offset covers only the on-campus footprint. Those living elsewhere are encouraged to pay for green energy through the local utility. [183] (Vermont) made a similar pitch in 2006. Their "Help Us ose a Few Pounds" program offered a chance for students in residence halls to cover their personal 3-ton CO_2 contribution for a year at college. Thirty-six students paid the $36 cost to pay for renewable energy credits (RECs) from Native Energy, a Vermont-based company selling green electricity made from farm manure digester methane or wind power.

Individual donations

SCHOOL	DESCRIPTION
Cornell University[184] (N.Y.)	Instead of a personal gift to her, a graduating senior asked her parents to give a gift to Cornell which became the $13,000 Krich Family Solar Fund. An alum and former trustee added to the idea by donating 90 solar PV panels. In 2006, these two gifts enabled installation of a 15 kW PV array on top of Day Hall.
Western Michigan University[185]	The chair and professor of the Manufacturing Engineering department, John Patten, self-funded the construction of a 2 kW wind turbine in 2007 at the College of Engineering and Applied Sciences. It stands 45 feet and cost $10,000. Patten says the turbine "generates clean, green energy, and that's what motivates me."
University of Tennessee[186]	Created in 2005, the Campus Environmental Stewardship Fund encourages and enables faculty, staff and other donors to help "Make Orange Green" by contributing to the fund at the Knoxville campus. fund at. The money will be used for green power, efficient lights, energy conservation and other projects. UT faculty and staff can

Partnerships with

BIG EMISSIONS REDUCTIONS AT FOUR INSTITUTIONS

INSTITUTION OR ORGANIZATION	ANNUAL EMISSIONS REDUCTION (tons)	PERCENT REDUCTION	YEARS TO ACHIEVE REDUCTION	ANNUAL SAVINGS (cost avoidance)	SIMPLE PAYBACK (years)
Pennsylvania State University	105,400	17.5%	6	~$8 million	5-10
Mt. Wachusett Community College (MA)	700	18%	1	$396,800	5
University of New Hampshire	58,000	67%	2	~$5 million	10-15
National Wildlife Federation Headquarters	705	70%	2-3	$90,000	16

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