Higher Education in a Warming World

The Business Case for Climate Leadership on Campus

By David J. Eagan, Julian Keniry and Justin Schott
With Praween Dayananda, Kristy M. Jones and Lisa Madry

NATIONAL WILDLIFE FEDERATION®

Highlighting the business, educational and moral arguments for reducing greenhouse gas emissions on campus, with best practices from U.S. colleges and universities.

The Campus Ecology program of the National Wildlife Federation promotes climate leadership and sustainability among colleges and universities by providing resources and technical support, creating networking opportunities and organizing educational events.

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Design and production by Linda Rapp

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ACKNOWLEDGMENTS

We would like to express our appreciation to the following people for their input and support in developing this document.

The National Wildlife Federation thanks the Kendeda Fund of the Tides Foundation for support of this and other Campus Ecology projects, along with the Educational Foundation of America, Nathan Cummings Foundation and the Town Creek Foundation.

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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

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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

Overview

If any sector of society has the potential to model the transition to a low-carbon future, it is higher education. With their depth of expertise, innovative research and societal influence, colleges and universities have been at the forefront in addressing global warming. As living laboratories, campuses have developed and implemented cutting-edge energy conservation practices and clean power technologies. Of even greater importance, they are educating future generations of engineers, architects, scientists, business leaders, teachers, government officials and citizens to create effective solutions to global warming.

"No institutions in modern society are better equipped to catalyze the necessary transition to a sustainable world than colleges and universities. They have access to the leaders of tomorrow and the leaders of today. What they do matters to the wider public."

—David W. Orr, professor and author, Oberlin College, from *The Last Refuge*

As a founding organization of the climate action movement, NWF's Campus Ecology has helped hundreds of colleges and universities cut greenhouse gas emissions, save millions on energy costs and embed environmental values in campus operations and curriculum. Campus Ecology has worked closely with all types of schools: public and private, large and small, community and technical colleges. As a result, it has a breadth of experience, ideas and resources to offer any college or university. The mission of Campus Ecology is to foster climate leadership on campuses nationwide and to protect wildlife and our children's future against the growing threat of global climate change. This report is a guide for administrators, staff, faculty and students exploring the implications of climate change and seeking cost-effective solutions. It presents a scientific overview of global warming and a review of the business, educational and moral arguments for confronting this problem. Case studies from a diverse group of leading campuses illustrate energy-conserving and emissions-saving projects, effective financing strategies and creative ways to involve the campus community. A section on the planning process and implementation steps is included to help campuses get a jump on cutting costs and reducing their carbon footprint.

David J. Eagan

NWF's goal for society—and for higher education—is to reduce carbon emissions by 2% per year, leading to an 80% cut by 2050. Achieving 2% or greater reductions each year can start with simple actions like lowering the thermostat or installing occupancy sensors. But this call for action on campus goes beyond asking for small steps. Heeding the world's top scientists who warn that global warming will trigger a potential cascade of negative consequences, Campus Ecology urges bold action and critical leadership today and throughout the next decades, when our actions will determine the fate of the climate for generations to come.

"Students on today's campuses are helping to lead the way now, and will soon be the leaders in business and government who will be called on to address this ongoing worldwide threat."

—Al Gore, former Vice President,
in April 2007 Broadcast of NWF Chill Out: Campus Solutions to Global Warming

1 The National Wildlife Federation and Global Warming

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.

Great-horned owls and other native wildlife seek refuge in campus natural areas.

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. Contrary to conventional opinion, the path to climate sustainability not only is technologically possible but it can save substantial amounts of money. This report offers a roadmap for how colleges and universities can make it happen.

> *"That's one of the things that's quite powerful about the basics of sustainability – discovering that it's less expensive to operate sustainably."*
>
> —Charlie Lord, Director of the Urban Ecology Institute, Boston College

Climate Action Opportunities
FOR HIGHER EDUCATION

By taking strategic, climate-positive action, campuses can dramatically cut CO_2 emissions by at least 2% per year, 30% by 2020 and 80% by mid-century—the targets advocated by the majority of scientists. By achieving these benchmarks, campuses will also:

- Reduce operating costs and generate favorable returns on clean energy investments.
- Buffer against uncertain future energy supplies, rising costs and mandated emissions limits.
- Identify exciting new research and service-learning opportunities.
- Encourage interdisciplinary collaboration among faculty.
- Prepare students for sustainability and climate leadership in all careers and professions.
- Appeal to current and prospective students, parents and donors.
- Foster a campus-wide ethic of environmental stewardship.

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:

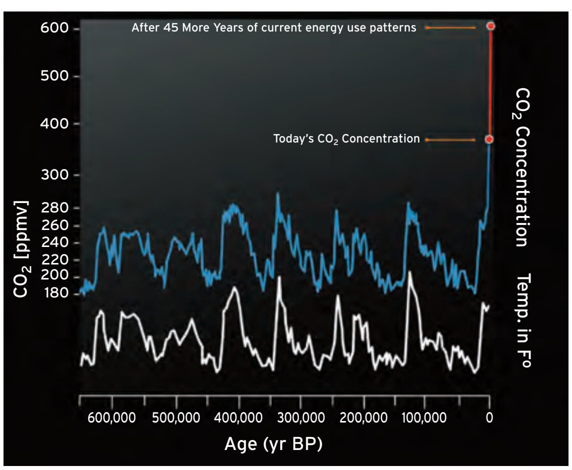
- Rising sea levels and global temperatures
- Extreme weather events
- Vanishing polar ice
- Shifts in wildlife migration patterns

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 Tulane and Loyola Universities 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.

Cause and effect

The IPCC[1] concluded, based on exhaustive research by over 2,500 climate scientists, that there is greater than 90% certainty that global warming in recent decades is due to human-caused emissions, primarily from the burning of fossil fuels. The panel's findings suggest a troubling forecast for the future—if we don't take action soon:

- **Major changes in ecosystem structure and functions, with mostly negative consequences on wildlife and supplies of food and water.**
- **Extinction of up to one third of all species of animals and plants with only a 2-3 degree F rise in global temperatures. Higher extinction rates as warming increases.**
- **Spread of pests, infectious diseases and their vectors.**
- **Increased deaths, disease and injury due to heat waves, floods, storms, fires and droughts.**

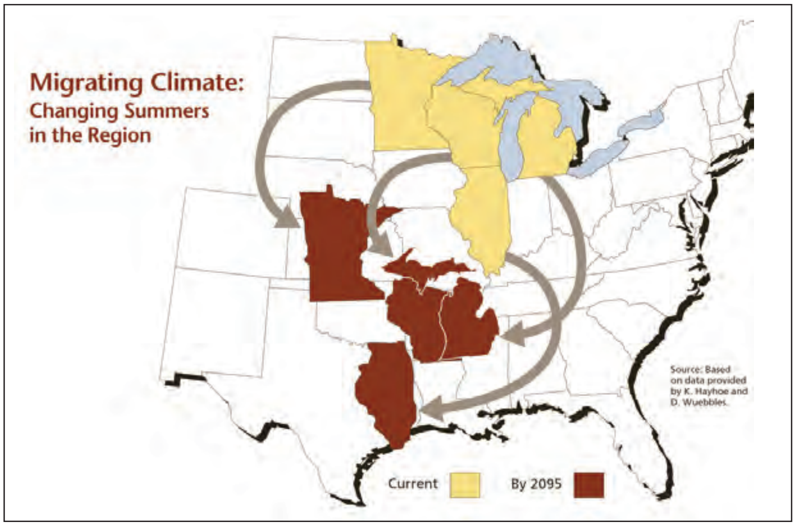


Temperatures and global atmospheric CO_2 concentrations have kept pace with each other for hundreds of thousands of years, as revealed through Antarctic ice cores. But CO_2 has reached new heights and is headed into uncharted territory. Can temperatures be far behind?

SOURCE: The Climate Project

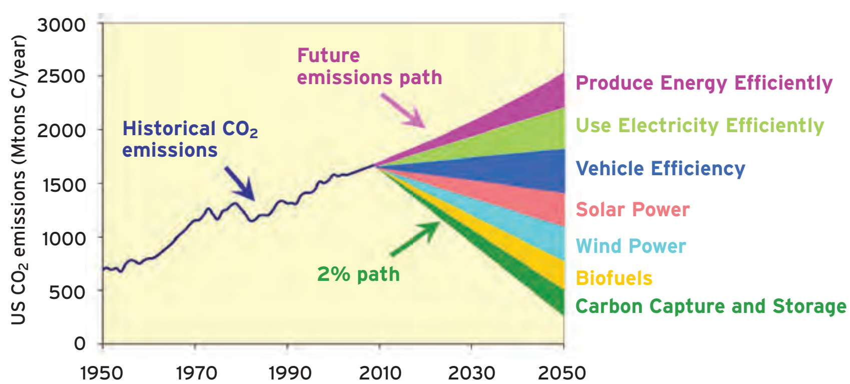
So far, the consequences of global warming have been relatively modest—and many could be reversible if the climate stabilizes. But if global average temperatures increase just a few degrees more, scientists predict the planet will reach a series of "tipping points" where nature may not be able to easily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



Union of Concerned Scientists/Ecological Society of America, 2003

Choosing the path. The National Wildlife Federation urges significant emissions reductions (80% below 2005 levels by 2050) across all sectors of society over the next few decades. This recommendation is aligned with a growing scientific consensus on the strategies required to reverse global warming. Using existing technology and resources, this goal is achievable and can be reached with a stepwise approach that averages 2% reduction per year below a 2005 baseline level. To demonstrate its own commitment as the nation's largest conservation organization, NWF has pledged to achieve these emissions-reduction objectives and is developing a multi-tiered initiative to reach them. (See story, Appendix A)



Predictions are not destiny if people choose the right path. Projected increases in CO_2 can be reversed by collective effort—the "wedges" of emission-reducing action.

SOURCE: NWF 2% factsheet, 2007

NWF greenhouse gas pollution REDUCTION GOALS

The 2% per year path

30% by 2020, **80%** by 2050

These goals are consistent with what science tells us is needed to stabilize global CO_2 levels at around 450 parts per million (ppm). At colleges and universities, reductions are calculated from an institution-wide emissions inventory.

Minimizing the consequences of climate change will call for the best and brightest ideas over the next century and an unprecedented commitment to act. One thing seems clear: Continuing on the same path will seriously strain the fabric of both the environment and society. The window of opportunity is likely to be less than 50 years—based on current scientific data—but much can be achieved in that time.

What will we decide... AND WHEN?

… the future, particularly in the longer term, remains largely in our hands—the magnitude of the expected change depends on what humans choose to do about greenhouse gas emissions.

—William Collins, and others. *Scientific American* (2007)[5]

3 Higher Education and the Case for Climate Action

Colleges and universities are like towns or small cities in their size, environmental impact and financial influence. Roughly 1,000 schools have enrollments of 5,000 or more[6] and some, including faculty and staff, have weekday populations over 60,000. Given their research focus, educational mission and intellectual leadership in society, there may be no better setting to model sustainability and implement global warming solutions.

"You can align profitability and social responsibility, and there is no reason we can't integrate concerns about long-term sustainability into every business decision that we make."

—Deborah Merrill-Sands, Dean, Simmons College School of Management

1. U.S. higher education: Size, economics and values

The nation's two-year and four-year colleges and universities have a measurable impact on the U.S. economy and its greenhouse gas emissions. Collectively, they spend over $360 billion annually and hold roughly the same amount in endowment investments. The higher education sector represents about 3% of U.S. GDP and 2% of the workforce.[7]

Nine of every 100 Americans aged 18-64 currently attends a college or university and 28% of the population eventually will earn a bachelor's degree.[9] Between 1995 and 2005, enrollment increased by 23%, and from 2005 and 2015 is expected to climb at a slower rate (14%) to 19.9 million students. Including staff and administrators, the total population today on U.S. college and university campuses is around 20 million individuals.[10] Add the hundreds of thousands of business suppliers, property owners, publishing and travel companies and employees of countless other commercial and nonprofit entities—and the overall economic clout of American higher education both at home and abroad is sizeable.

Higher education BY THE NUMBERS[8]

In 2005/06:

- 4,100 colleges and universities
- 17.5 million students
- 2.7 million faculty and staff
- $364 billion in annual expenditures
- $28 billion added to endowments

Colleges and universities have considerable influence over ideas, too. Starting in the 1970s, 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.

"You have 4,000 universities in the country spending $190 billion on goods and services (in 2001) annually. That's greater than the GDP of all but 20 nations. If schools were practicing renewable energy and buying environmentally sound products, it would have a huge impact."

—Anthony Cortese, President, Second Nature

This shift to greater awareness and action was documented in NWF's 2001 national survey* of colleges and universities. In the study, nearly 900 presidents, academic deans and chiefs of administration responded to a comprehensive list of questions related to their environmental actions and curricula. The result was a groundbreaking report: *State of the Campus Environment: A National Report Card on Environmental Performance and Sustainability in Higher Education*. Here are some of its findings:

NWF

Students from Manhattanville College helping with stream restoration.

With increasing frequency, terms like "environmental stewardship" and "sustainability" are appearing in college mission statements, master plans and press releases, with global warming often noted as the basis for action. Practical climate-related actions are underway on campuses ranging from small private schools like **Green Mountain College** (Vermont) to large public institutions like the **University of Florida**, both of which have adopted comprehensive, institution-wide emissions reduction campaigns. The states of **New Jersey** and **California** have set energy conservation expectations for all public institutions, motivated by economics as well as climate protection. And savings are no longer figured only in terms of dollars and kilowatt-hours (kWh), but also in tons of avoided greenhouse gases, reflecting the growing value placed on mitigating global warming.

What campus leaders told NWF about ENVIRONMENTAL STEWARDSHIP AND SUSTAINABILITY IN 2001[11]

- Fits with culture and values of campus (64%)
- Good for public relations (47%)
- Environmental improvements are cost effective (41%)
- Helps with student recruitment (17%)

*(*A second national NWF survey is underway, with results to be released in 2008.)*

"Sustainability is now recognized as one of UNH's core identities and strengths with faculty, staff and students from many disciplines working together in new and innovative ways to advance a common goal."

—Mark Huddleston, President, University of New Hampshire, 2007

2. Campus climate footprint: Built space and greenhouse gas emissions

From a climate standpoint, colleges and universities can be regarded as collections of energy-consuming buildings, ranging from weekday-only classroom and office centers to energy-intensive 24-hour-a-day research laboratories. Most of the existing stock of buildings was constructed in times of cheap energy, when little thought was given to efficient heating, cooling, ventilation or lighting.

Higher education's BUILT ENVIRONMENT[12]

- 240,000 buildings
- 5 billion square feet of floor space
- $15-18 billion in new construction and renovation each year
- $20 billion annually and rising for facilities maintenance, operations and utilities

The quarter-million campus buildings in the U.S. are currently maintained at considerable expense: an average of $5 million per campus per year. But there are promising trends. Both to save costs and comply with government regulations, most new buildings and retrofits incorporate efficient, money-saving heating and cooling systems along with energy- and water-conserving lighting and plumbing.

"Green" and LEED-certified (Leadership in Energy and Environmental Design) buildings on campus have accelerated the trend toward efficiency. Often these state-of-the-art structures become campus showcases as well as learning opportunities. The Adam Joseph Lewis Center at Oberlin College[13] (Ohio) is a prominent example. Its zero-waste, energy-neutral design integrates both building and landscape into a super-efficient whole, and it serves as a real-time educational laboratory. But it is still the exception in campus architecture. Indeed the majority of the other buildings at Oberlin and elsewhere—for now—are traditional energy-demanding structures.

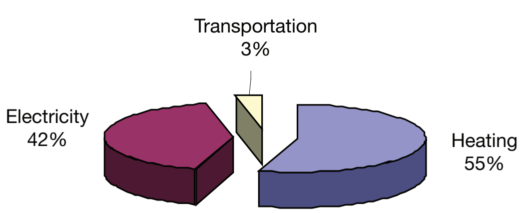
The energy requirement of buildings is by far the largest factor in the carbon "footprint" of most schools. In the simplified diagram for Tufts University (Mass.),[14] all but a small fraction of direct emissions are due to buildings. Whether generated onsite by a coal- or gas-fired power plant or purchased from a local utility, the energy used by buildings typically pours 70-90% of a school's CO_2 and other greenhouse gases into the air. Other emissions result directly from campus fleet vehicles, refrigerants and fertilizers and indirectly from commuter travel and the energy used to manufacture and transport goods.

Oberlin College News Service

Adam Joseph Lewis Center for Environmental Studies, Oberlin College.

Collectively, the nation's schools of higher education account for:[15]

- Tens of millions of metric tons of direct CO_2-equivalent emissions
- An estimated 5% of U.S. commercial building sector emissions.



Primary emissions sources - Tufts University, 2005

Campus GREENHOUSE GAS EMISSIONS

- On a typical campus, 70-90% of direct greenhouse gas emissions are due to buildings.
- 620,000 metric tons a year total from 21 campuses of the **Pennsylvania State University** system.
- 320,000 metric tons a year from **Harvard University.**
- 3,890 metric tons a year from **Mt. Wachusett Community College** (Mass.).

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 University of Wisconsin-Madison, for example, 26 research/laboratory buildings (out of a campus total of around 300 buildings) account for 60% of electricity use.[16] 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 Pomona College (Calif.)[17] 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	65,496	888,951	14
Oldenborg Center	71,000	918,937	13
Lyon Court Dormitory	24,238	181,398	7
Wig Hall	25,200	184,955	7
Norton Hall	9,000	63,174	7
Walker Hall	49,000	305,447	6
Smiley Hall	15,547	93,280	6
Harwood Court	63,100	339,434	5
Lawry Court Towers	18,200	71,883	4
Clark I, III, V	116,600	404,377	3

Energy Intensity: TOP 10 NON-RESIDENCE BUILDINGS/FACILITIES

Non-Residence Hall Bldgs.	Total sq ft	kwh used 2005-2006	kwh/sq ft
Pendleton Pool	500	301,867	604
Haldeman Pool	3,500	470,821	135
Richard C. Seaver Biology Bldg.	13,672	1,499,138	110
Pauley Tennis Complex	1,243	91,760	74
Hahn Building	27,000	1,286,274	48
Seaver Building	60,319	2,526,974	45
Frary Dining Hall	23,000	867,563	38
IT (Multi-Use) Building	12,000	418,778	35
Frank Dining Hall	19,637	646,190	33
Replica House	885	26,294	30

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 California, Santa Barbara

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. Later 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 **University of California, Santa Barbara** have totaled over $36 million.[18] On a much smaller scale, the **University of Alaska** in Anchorage spends $2,000 less a year by using "greasel" made from waste cafeteria cooking oil to run its recycling truck.[19] Case examples of savings from dozens of other campuses are featured later in this report, especially in the section titled Climate Action Solutions.

Hedging against uncertainty

Although a small (but vocal) minority dispute the data, most of the scientific community and much of the public are convinced that global warming is a reality. Much less clear, however, are its potential consequences. In the face of such uncertainty, measures that reduce fossil energy purchases or allow campuses to create their own energy will provide a hedge against future changes in price or supply. And voluntarily reducing emissions—by a minimum of 2% per year, ideally—will give schools a head start on compliance if tighter regulations on energy are imposed.

Unpredictable energy costs and supply. The era of cheap energy is over. Prices have zigzagged upwards in the past few decades, peaking in the months after Hurricane Katrina. Barring unforeseen interruptions in supply, prices are expected to keep rising, but less dramatically for the next two decades.[20] With much new construction underway on campus and higher costs for electricity, coal, fuel oil and natural gas, most institutions are looking for ways to cut energy demand—and CO_2 emissions.

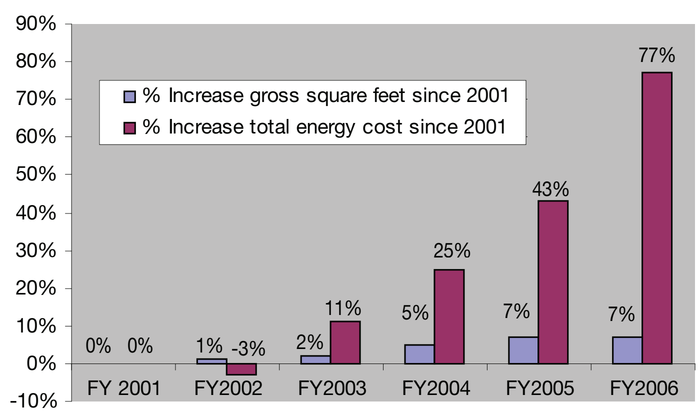
When new structures are built, campus energy consumption can spike upward, offsetting attempts elsewhere to conserve. Large research universities in particular, with their energy-intensive facilities, have seen costs soar. New construction at the **University of Wisconsin-Madison** from 2001 to 2006 led to an increase of campus square footage by only 7% while energy costs rose 77% over the same period.[22] In fiscal year 2006, utility expenses were a record $50.5 million (see graph).

An upward trend
IN UTILITY BILLS

- Natural gas prices doubled between 1996 and 2006.[21]
- 77% jump in energy costs from 2001-2006 at the **University of Wisconsin-Madison.**

The U.S. currently imports more than 50% of its oil and 17% of its natural gas—and both numbers are increasing.[23] Cutting both energy demand and dependence on fossil fuels in favor of clean sources of energy are ways to hedge against future volatility in costs and supply. This strategy worked for Concordia University in Austin, Texas (see box).

University of Wisconsin-Madison Energy Costs vs Building Space: Increases since FY 2001



Faramarz Vakili-Zadeh, UW-Madison

Ensuring long-term control over both energy price and supply, the **Los Angeles Community College District** 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.[25]

Fixed price for renewables pays off[24]

CONCORDIA UNIVERSITY (TEXAS)

buys 100% renewable electricity though its local utility. In 2001, the campus locked into a fixed price for its mix of wind, biogas, hydro and solar power. At first, Concordia paid a slightly higher price per kWh, but currently pays 0.78 cents less per kWh due to fuel cost increases for conventional electricity. These savings will likely continue through the remainder of the 10-year contract.

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 colleges and universities stay ahead of the regulatory curve. The state of **California**[26] led the way in August 2006 with a law requiring all public and private companies and agencies/institutions in the state to reduce global warming emissions to 1990 levels by 2020—or 25% from 2006 levels. A bill passed in summer 2007 in **North Carolina**[27] requires all new or renovated state-owned buildings—including higher education institutions—to be 20-30% more energy and water efficient than previous minimum standards. LED exit lights and low-flow bathroom fixtures are now required. Similarly, **Ohio**[28] public higher education institutions are required to reduce their energy intensity 20% below 2004 levels by 2014.

The state of **Massachusetts**[29] will formalize a greenhouse gas emissions policy in late 2007 requiring GHG inventories as part of the permitting process for many state-supported projects. The policy requires that projects needing review by the Massachusetts Environmental Policy Act Office quantify their anticipated GHG emissions and identify measures to avoid, minimize or mitigate them. Greenhouse gases will be regarded like other pollutants as having the potential to cause "damage to the environment." And **New Jersey**[30] passed a bill in July 2007 that applies to both the public and private sector institutions. They must reduce greenhouse gas emissions by 22% by 2020 and 80% by 2050 from a 2006 baseline.

As resources tighten and global warming intensifies, schools that have already taken emissions-reducing steps will be able to meet future local, state or federal regulations at a lower cost.

Climate change

AND THE CHANGING BUSINESS CLIMATE

With the latest **IPCC**[31] declaration that human-caused climate change is "unequivocal," many individuals and organizations believe that regulating carbon and other greenhouse gases is inevitable. Much less clear, however, are the details of when, how and by how much emissions will be regulated. A survey of business leaders and investors who attended the **Ceres**[32] 2007 annual conference showed that climate change is the top sustainability concern, with 92% listing reducing greenhouse gas emissions and improving energy efficiency as a major priority. Reducing risk was the most frequently cited reason for operating sustainably, with 64% of participants listing it among their top three motivations. Similarly, the **U.S. Climate Action Partnership** (USCAP)[33] was created by major businesses and environmental organizations to push a policy agenda at the federal level, based on a desire to establish regulatory certainty. Over thirty member corporations (such as Ford, BP, Duke Energy, Alcoa and Xerox) and nonprofits (including NWF) have stated in a recent report: "In our view, the climate challenge will create more economic opportunities than risks for the economy. The challenge is significant, but the U.S. can grow and prosper in a greenhouse gas constrained world." They are calling for mandatory carbon regulation to provide the certainty businesses need to forge ahead with clean energy development.

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 increasing investment in research and job training.

Curriculum offerings & research institutes. Colleges and universities nationwide are launching new or revamped academic programs in areas such as renewable energy, global warming science, environmental economics and sustainability. Global warming-related projects, courses, majors and minors, and certificate programs are some of the options available to students.

"I think young people are also critical for success in climate stabilization. … So it's really important to train and develop multigenerational leadership models that are sustainable. … You want the people who come right after your heroic victory to achieve their own. … Solving climate change is going to take one historic victory after another for the next hundred years."

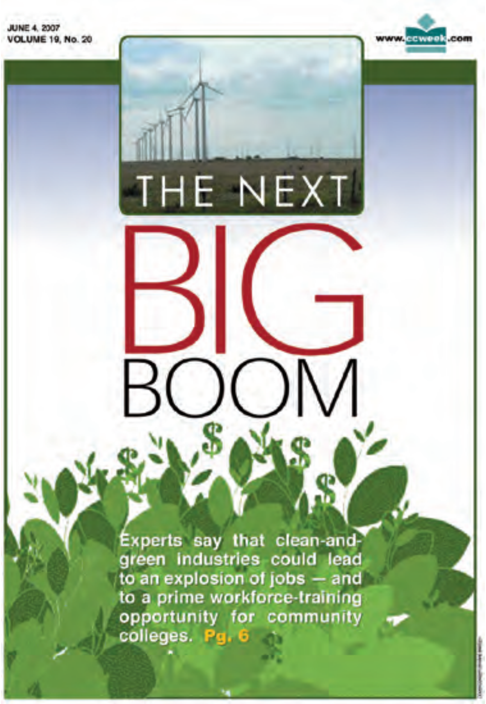
—Michel Gelobter, author, *Changing the Social Climate*, 2006

Institutions themselves benefit in a variety of ways. In the future, government agencies and private foundations are expected to invest heavily in basic science, new technology development, educational initiatives and health-related research—all prompted by predicted consequences from climate change. At the **University of Wisconsin-Madison**, for example, the Center for Sustainability and the Global Environment (SAGE) was established to examine the linkages between natural resources, human health and security, and changes in the global environment. It has attracted generous funding through government research grants, corporate gifts and private sources.

Schools that become leaders in climate awareness and action may also attract new gifts and donations from alumni and others who want to lend their support. A long commitment to environmental issues at **Arizona State University** helped attract a $15 million gift from an ASU Foundation board member. Her 2004 gift launched the Global Institute for Sustainability and was followed in 2007 by another $10 million to start ASU's new School of Sustainability.[39]

Innovative programs OF STUDY

- **Iowa Lakes Community College**[34] (Iowa) offers a two-year degree program in Wind Energy and Turbine Technology. Its 1.65 MW turbine, located a few blocks from campus, gives students hands-on training in this fast-growing field.
- **At Boston Architectural College**[35] (Mass.) students can earn a Sustainable Design Certificate that is endorsed by the US Green Building Council.
- **Illinois State University**[36] approved a new bachelor's degree in renewable energy in 2007, which will include a technical sequence and an economics and public policy sequence. The degree is a multidisciplinary undergraduate major.
- In 2003, **Aquinas College**[37] (Mich.) established a new sustainable business degree department and major. The Sustainable Business Program has 20 required courses within four areas of concentration—business, science, environmental studies and sustainable business.
- Since 1973, the **University of California, Berkeley**[38] has offered programs in Energy and Resources (ERG) for graduate students leading to M.A., M.S., and Ph.D. degrees, and also for an undergraduate minor.


JUNE 4, 2007
VOLUME 19, No. 20
www.ccweek.com
THE NEXT
BIG
BOOM
Experts say that clean-and-green industries could lead to an explosion of jobs — and to a prime workforce-training opportunity for community colleges. Pg. 6

Pam Barrett, Publisher

Community College Week newspaper (June 2007) predicts an explosion of jobs in renewable energy, and urges campuses to meet that demand.

New jobs and careers. Investing in climate- and environment-related education and involving students in campus sustainability projects and research will better prepare future workers for the anticipated wave of green careers.[40] According to a 2006 revision of a study by Daniel Kammen at the University of California, Berkeley, a national economy committed to meeting the 20% percent Renewable Portfolio Standard (RPS) could create 164,000 new jobs in the renewable energy industry by 2020—significantly more jobs than the fossil fuel sector is expected to generate.[41] Community and technical colleges in many states are stepping up to meet that workforce training opportunity with new programs in clean energy technology.[42]

A 2006 study by the Renewable Energy Policy Project analyzed the manufacturing implications of renewables. Especially in states that have seen an erosion of manufacturing jobs over the past few decades, an estimated 43,000 firms nationwide could create more than 850,000 new jobs if all components needed for the wind, solar, geothermal and biomass industries were manufactured in the U.S. This national development would represent nearly $160 billion of manufacturing investment to create 185,000 megawatts of renewable energy.[43]

Working toward A SUSTAINABLE FUTURE

For graduate students, it's getting ever easier to be green, thanks to an interdisciplinary newcomer called either sustainability science or sustainable development. Whichever label you use, the challenge of figuring out how to keep the world in balance "is a boom area," says Jeffrey Sachs, executive director of Columbia University's Earth Institute.[44]

4 Stepping Up: Strategies for Climate Action

David J. Eagan

Students, faculty and staff from Iowa colleges and universities met in Grinnell in 2007 to explore ideas for campus actions.

Reducing the campus carbon footprint begins with a clear roadmap. Setting a goal, creating a diverse climate action team, conducting a greenhouse gas inventory, developing and sticking to a plan, and evaluating progress regularly are all essential. Celebrating successes is a good idea, too.

While campuses have implemented energy-saving projects for at least three decades, long-term planning to reduce emissions is new territory for higher education. Campuses are just beginning to chart comprehensive paths to a low-carbon future. Among the challenges may be finding the resolve—and funding—to launch initiatives that can take years to show significant results. But the number of schools moving ahead with climate action plans suggests that the advantages and opportunities are beginning to outweigh the challenges. This is a learning process for everyone, and the more that schools share what they have learned, the greater the pool of cost-effective ideas to draw from.

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.

"As a Climate Protection Campus, the University of New Hampshire is committed to being a model … the key to implementation of sustainable practices is following a long-term program based on persistence, not insistence."

—Christopher Uhl, professor, Pennsylvania State University

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 **University of New Hampshire**, 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." [45]

At **Middlebury College** (Vermont), the first campus commitment in 2004 was approved by its board of trustees who set a goal to reduce climate-warming emissions to 8% below 1990 levels by 2012. In spring 2007, the trustees voted again, but this time for a stricter target—committing Middlebury to climate neutrality by 2016. In support of the new resolution, over 1,250 signed endorsements representing 70 different departments, teams, clubs, residences and individuals were submitted.[46]

In a less public way, emissions-reducing actions can occur through facilities policies and building improvements. Examples include energy conservation projects, constructing green buildings and buying renewable energy credits. Such actions require administrative approval, but may not be part of an overall campus climate plan. The **University of Michigan** has been implementing energy conservation measures since the 1970s, and over the years has saved over $78 million in energy costs. Plant Operations staff have installed efficient lighting, a cogeneration plant and improved fume hoods in labs. It tackles projects with short payback through its self-perpetuating Energy Conservation Measures (ECM) Fund, and its Steam Waste Attack Team (SWAT) alone has saved an estimated $6.5 million.[47]

Dial 1-800-CHAMPION
(Just kidding … but you can dial 703-438-6000)

Need ideas for institutional commitment policies that fit your school?

NWF's Campus Ecology staff can help get the process rolling. Our Campus Climate Champions program (see p. 49 below) provides resources and support for campus leaders to step up and make the 2% per year commitment—but they don't just go it alone. Climate Champion campuses become part of a local climate consortium with peer institutions, working collaboratively on solutions.

Top leadership support. A statement of support by a president or chancellor confers considerable weight and visibility to climate commitments. Such statements are not given lightly, and are usually made after careful consideration of their cost and policy implications. Two examples:

In 2006, Chancellor Robert Birgeneau of the **University of California, Berkeley**[48] implemented a campus climate protection plan recommended by the Campus Climate Protection Steering Committee. His support of the plan expanded existing actions toward a "greener Berkeley" and recognized the coalitions that had developed on campus around sustainability issues. In 2007, the chancellor committed the campus to reducing its greenhouse-gas emissions to 1990 levels by 2014.

Chancellors of four schools in the **University of Wisconsin** system—UW-Green Bay, UW-Oshkosh, UW-River Falls and UW-Stevens Point—all committed their campuses to become energy independent by 2012. Selected by Wisconsin Governor Jim Doyle, these institutions will avoid burning 260,000 tons of coal and reduce greenhouse gas emissions by 676,000 tons, as well as save taxpayer dollars. **UW-Green Bay** Chancellor Bruce Shepard spoke up in favor of the energy self-sufficiency initiative. "UW Green Bay has a long and proud history of commitment to environmental awareness and efficient use of energy," he said. "It's only appropriate that we help pave the way for a more sustainable future."[49]

Two large-scale initiatives are also underway that seek out campus leaders willing to dedicate their schools to climate action. The **American College and University Presidents Climate Commitment** (www.presidentsclimatecommitment.org), launched in early 2007, aims to sign up 1,000 campuses within two years.[50] It is a joint project of AASHE, Second Nature and Eco-America. As of December 2007, over 460 college and university presidents had signed the commitment which calls for developing and implementing a campus plan to achieve climate neutrality. In its first 10 months, 10% of all campuses representing around 20% of the student population had committed to a zero-emissions future.[51] A related initiative, **The Talloires Declaration**[52] – originally sponsored by Tufts University—has been signed by over 350 presidents and chancellors from 40 countries. Its 10-point action plan commits campus leaders to incorporate sustainability and environmental literacy in teaching, research, operations and outreach.

Practicing
WHAT WE PREACH.

At the National Wildlife Federation, president and CEO Larry Schweiger has committed the organization to a lower-carbon future. A plan is being developed to eliminate up to 80% of greenhouse gas emissions due to electricity use at the headquarters building.

2. Build a climate action team

Implementing effective climate solutions is a people-intensive process. In addition to top leaders, it requires coordinated effort and creative input from staff, faculty, students and other stakeholders. Not only does this encourage greater buy-in for proposed ideas, but it brings know-how and a range of valuable perspectives to the table.

Actors & Advocates
FROM *Degrees that Matter: Climate Change and the University*

In their 2007 book, Ann Rappaport and Sarah Hammond Creighton make an astute observation in recognizing people they call "climate actors and climate advocates" on campus. Climate actors are the decision makers in operations, academics and administration whose personal support and technical expertise are often essential to success. Climate advocates or champions—who may overlap with actors—are the influential opinion leaders who know how to get results in the social and bureaucratic network of a college or university.[53]

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 to these examples[54] to learn about their members and tasks:

Pomona College (CA)	President's Advisory Committee On Sustainability.
Case Western Reserve University (OH)	Energy Advisory Committee and Energy Conservation Committee
University of Florida	Sustainability Committee and three Task Forces: Energy & Climate Change, Zero Waste by 2015, and Education & Research

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.

California State University, Chico[55] has a Sustainability Coordinator who works with faculty, staff and students on campus-focused environmental issues, including a variety of renewable energy and efficiency measures.

At the **University of New Hampshire**, the Office of Sustainability is funded by a generous permanent endowment that covers the salaries of a half-dozen employees. Founded in 1997, many of its projects directly or indirectly address greenhouse gas emissions and climate issues. In 2007, as a sign of its growing influence on campus, the director of the office was given the new title of Chief Sustainability Officer.

Tufts University (Mass.) is a pioneer in campus sustainability with programs and presidential commitment dating back to 1989. Its current Tufts Climate Initiative (TCI) places the highest priority on CO_2 reductions. Its two staff members, along with faculty advisors and students, work on a wide range of emissions-reducing projects.

Campus operations decision makers. Essential members of the "climate team" include the administrative and operations professionals who run any college or university—and who also are committed to sustainability and cutting energy emissions and costs. They are typically found in business or facilities divisions and are the go-to people with questions about project feasibility and cost effectiveness.

For example, at **Mt. Wachusett Community College**[56] (Mass.) Executive Vice President and CFO Ed Terceiro was the driving force behind securing the grants and managing all aspects of the campus biomass-burning cogeneration plant. At the **University of Iowa**[57], Associate Utilities Director Ferman Milster and his team of power plant technicians pioneered the use of waste oat hulls as a biomass additive to coal.

3. Conduct a greenhouse gas inventory

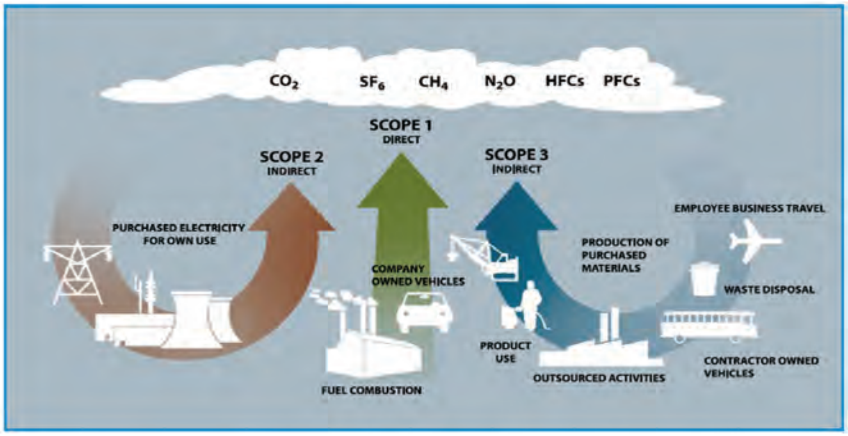
Once the commitment and personnel are in place, the next step is to calculate the baseline level of GHG emissions that will be used to measure progress toward the goal of 2% reduction per year. The GHG inventory takes a comprehensive snapshot of all emissions-producing activities in a given year, providing the background information needed for designing a climate action plan.

The emissions inventory process is straightforward, and a free online tool is available to guide campuses through the task. To aid comparability and consistency in reporting among schools, NWF recommends that colleges and universities use the emissions inventory protocol developed by Clean Air-Cool Planet (CA-CP) which includes its **Campus Carbon Calculator**.[58] This resource has been used successfully by many campuses and continues to be improved. It is regarded as one of the best and most user-friendly inventory tools and is consistent with key standards of the Greenhouse Gas Protocol (GHG Protocol) of the World Business Council for Sustainable Development (WBCSD) and the World Resources Institute (WRI). NWF has a partnership with Clean Air-Cool Planet and Campus Ecology staff have been trained to provide assistance.

What counts?

Gases. Campus-related sources of emissions include:

- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrous oxide (N_2O)
- Sulfur hexafluoride (SF_6)
- Refrigerants: hydrofluorocarbons (HFCs), perfluorocarbons (PFCs)



Emissions sources: Scopes 1, 2 and 3

SOURCE: New Zealand Business Council for Sustainable Development

Sources. Emissions sources fall into three categories with Scope 3 emissions the hardest to quantify.

SCOPE	EMISSIONS INCLUDED
Scope 1: Direct emissions	Heating & cooling College fleet
Scope 2: Imported emissions	Purchased electricity
Scope 3: Other indirect emissions	Staff and student commuting Waste emissions Outsourced travel Production & transport of goods and services

The CA-CP inventory defines emissions sources and their relative contributions. Natural gas, for example, produces about 50% less carbon dioxide than coal because of its lower carbon content. The Campus Carbon Calculator also provides guidance for tracking down the data. While some numbers will be easy, some sources are hard to quantify such as emissions from the manufacture and transport of goods (like food, paper and appliances). But the aim is to decide "what counts" for the inventory, calculate those emissions and use the total to determine reductions (or increases) from the baseline year.

CAMPUS INVENTORIES AVAILABLE ONLINE.[59]	
Evergreen State College (WA)	Baseline year 2007
Carleton College (MN)	Baseline year 2004-05
Univ. of California, Santa Barbara	Baseline year 2004
Oberlin College (OH)	Baseline year 2000
Harvard University (MA)	Baseline years 2003, 2005
University of New Hampshire	Baseline 1990

What's an MTCDE? (Metric Tons Carbon Dioxide Equivalent)

This is the unit of measure often used to report greenhouse gas amounts.

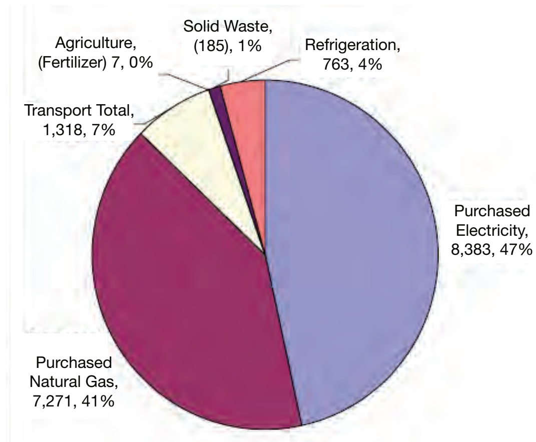
(Sometimes noted as e-CO_2 or CO_2e) It means:

MT = Metric Tons. Most of the world is on the metric system and its tons (often spelled tonnes) are 1,000 kilograms each or 2,205 U.S. pounds. (In measurement circles, our 2,000 pounds is called a "short" ton.)

CDE = Carbon Dioxide Equivalent. Some greenhouse gases have a more potent warming effect than carbon dioxide. The "warming potential" of methane (CH_4) is 21 times that of CO_2. Nitrous oxide (N_2O) is 310 times as potent. 100 pounds of methane, for example, has the warming effect of 2,100 pounds of CO_2. The CA-CP tool factors these differences into the emissions total.

What will an inventory reveal? 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 **Pomona College**[60] (Calif.) (see chart) was created using data from the Clean Air-Cool Planet inventory tool. Of the total (17,927 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" membership.



Pomona College Climate Footprint 2005-06

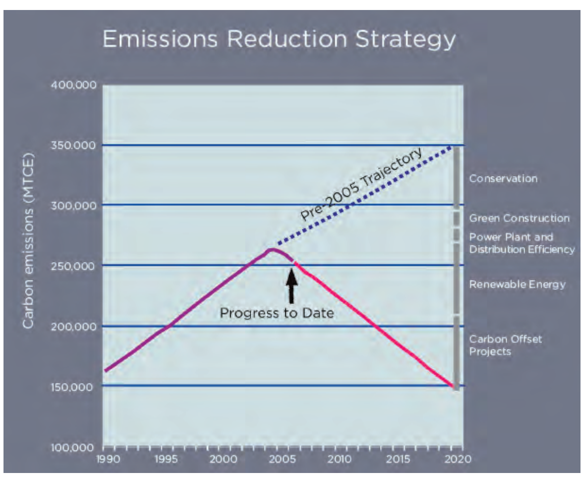
Greenhouse gas emissions by source, in MTCDE.

SOURCE: *A First Step Toward a Climate Neutral Pomona College, 2007*

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 required. It gives clear direction to the individuals charged with implementation.

A climate-oriented plan has an overarching goal: To cut greenhouse gas emissions over a specified timeframe. It may complement existing green campus or sustainability initiatives, but its focus and driving metric is always to reduce the tonnage of emissions calculated by the inventory. (See graph of Yale's strategy.[61])



Yale University Emissions Reduction Plan.

Their goal: To reduce CO_2 to 10% below 1990 levels by 2020. Main actions are on the right.

SOURCE: *Yale's Greenhouse Gas Reduction Strategy, 2007*

Key parts of a plan include:

- **Reduction goals.** 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.
- **Specific projects.** 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 **Middlebury College's**[62], include indicators for risk and social benefits.
- **Implementation strategy.** Strategies should cover project priorities, timelines, working within the college or university structure, dealing with emissions "inflation" due to campus expansion and other factors.
- **Background, financing and logistics.** The planning document also should include existing conditions, personnel involved, financing strategies, policy implications, institutional barriers and benchmarks.

Where to focus planning efforts? The following five action areas are great places to start.

Top 5 for a Fast 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 top five strategies are ranked in order of emission-savings potentials based on ranges of reductions experienced or planned by campuses and other types of institutions nationwide. Most focus on some aspect of buildings, which account for 70-90% of CO_2 according to most of the campus greenhouse gas emissions inventories conducted to date.

Many effective climate plans use a bundling or portfolio strategy in which a diverse group of emissions-reducing projects are undertaken as a whole. Portfolios include projects with both longer paybacks (such as solar electric arrays) and short paybacks (such as lighting retrofits) adding up to a favorable combined return on investment. Project start times will vary, but the aim is to move forward on many fronts. And making investments early on big projects with big CO_2 cuts can have financial advantages. They can act as a hedge against energy cost inflation, pay down deferred maintenance costs and free up money sooner for other investments—or simply help realize an earlier payback. See Appendix A for details about large emissions cuts at four institutions.

"We implemented $4.3 million of infrastructure improvements and it didn't cost Mt. Wachusett a nickel. That's the way to make it work, by compiling ECMs (energy conservation measures). You start to bundle big projects with smaller ones—and that makes the whole package more attractive."

—Ed Terceiro, Executive Vice President and CFO, Mt. Wachusett Community College

Top 5 for a Fast Start

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.
Zero-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. Laboratories, 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 will determine the proper size system for current needs.

- Replace inefficient fume hoods, steam traps, fans and motors.
- Install modern energy control systems.
- Upgrade efficiency of boilers and chillers.

Lydia Vendenbergh, PSU Physical Plant

Checking air flow in HVAC system. "Continuous commissioning" is one of Penn State's strategies to maximize building energy efficiency.

3. Scale back heating, cooling and lighting demand (2% to 20% savings)
Energy requirements for each building can be cut by reducing the need for heat, light and air conditioning. Some options, like changing thermostat settings, require no upfront capital.

- Implement thermostat setbacks (adjustments for day, night, weekends and holidays).
- Retrofit insulation, upgrade windows and weather seal building exteriors.
- Reduce occupancy demands (close unused space and buildings).
- Increase use of daylight and natural ventilation.

4. Reduce plug loads (2% to 20% savings)
Increasing numbers of machines and gadgets are putting a strain on campus electrical supply networks.
A combination of technological and behavioral changes can cut overall demand.

- Install power-down software on electronic equipment, occupancy sensors for lighting.
- Maximize appliance and machine efficiency by purchasing Energy Star-rated equipment.
- Encourage and reward energy-conserving behaviors.

5. Wise campus planning (Priceless)
Climate-based planning leads to greater levels of fiscal accountability, energy security and improved stewardship of resources. The commitment by campus planners to take action sooner rather than later will lead to smart decisions and significant long-term emissions reductions.

- Develop and implement a comprehensive campus plan, based on an emissions inventory.
- Conduct emissions life cycle analyses for all purchases and construction.
- Implement transportation demand management.
- Seek alternatives to growth.

Thinking big-picture

This table shows how four diverse institutions—including NWF itself—are planning or implementing major emissions reductions. Details for each are provided in Appendix A.

Note: These numbers pertain to the year when planned reductions were or will be achieved.

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 to 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

Climate Plans

Much can be learned from the campus climate plans available on the Internet. The emissions reduction plans in the following table come from four schools, each offering different perspectives on the process. All have ambitious agendas, and Middlebury College's plan contains a line that suggests why: "It's important to set the most ambitious goal possible to see the greatest possible result."

Planning for success

Middlebury College (VT)[64]	Goal approved in 2007 to reach carbon neutrality by 2016. Plan gives a "portfolio of strategies" with cost analyses of 20 emissions reduction ideas with internal rates of return, net present value and savings for each. The plan is both climate- and cost-neutral. A detailed study from 2003 ranks more than 50 projects by environmental and financial criteria.
Univ. of California, Santa Barbara[65]	Inventory and reduction plan with 26 project recommendations. Goal is climate neutrality by 2020. Provides extensive analysis of costs, benefits, institutional barriers, educational opportunities. Includes guide for involvement by student groups and lessons learned.
Oberlin College (OH)[66]	Inventory and plan by the Rocky Mountain Institute in 2002. Outlines four scenarios for action with the most aggressive plan leading to climate neutrality by 2020. Gives financing options, all of which have high internal rates of return averaging 15%.
Yale University (CT)[67]	A four-page summary of emissions reduction plans and progress. Goal is to reach 10% below 1990 levels by 2020—which is 43% below 2005 levels.

Not having a formal, whole-campus climate action plan does not mean a school is not "climate active." A great many schools are implementing projects on a case by case basis, and still are saving significant amounts of money and CO_2. For example, Tufts University does not have a published plan, but it nevertheless has an extensive history of past and ongoing projects (see Tufts CO_2 Reduction Projects website[68]) and continues to track progress through updates to its GHG inventory.

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

HOW MUCH CAN ONE BUILDING SAVE?

Thinking about climate action at the scale of a single building is not such a crazy idea. Many commuter and satellite campuses consist of only one or a few structures. The Mueller Lab building on the campus of **Penn State University** became the object of analysis for the biology department that wondered how many sustainability improvements could be made in their home building.

The result was **The Mueller Report**,[69] completed in 2001. In painstaking detail, it examined the footprints of almost everything: energy use, lights, computers, carpeting, cleaning chemicals, food and more. It researched project ideas that, if fully implemented, would reduce emissions by one third, cut 1.8 million kWh equivalents in energy consumption and save over $45,000 a year. The report team proposed a package deal for implementation, advocating the method of "implementing as many sustainable practices as possible … in the aggregate, [and] using the money saved from highly cost-effective improvements to finance the less cost-effective—but nonetheless environmentally desirable—improvements."[70] It is an excellent model for tackling emissions at a smaller scale and using a "bundled projects" approach.

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. Middlebury College 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."[71]

Indeed, a well-publicized campus climate initiative can be a learning opportunity for the entire campus and neighboring community—involving trades workers, alumni, suppliers of goods and services, local businesses and others. In time and with adequate support, a climate plan and its philosophy of climate protection will become part of an institution's values and culture. Regardless of changes in staff or leadership, or the pendulum swing of politics or the economy, a deep commitment to an energy-conserving, emissions-cutting approach to facilities operations will simply become "the way we do business" on campus—*every* campus.

The following section gives examples of best practices from schools across the U.S. It is followed by creative ways colleges and universities are financing them.

5 Implementing Climate Action Solutions

Does it cut it? Deciding what projects to undertake boils down to one recurring question: Does it cut emissions of CO_2? Other projects may be worthy, but without a stable climate that is healthy for people and wildlife, they might not make much of a difference.

Eight categories of solutions to global warming are reviewed below. They are listed more or less in order of their potential for both financial savings and emissions reductions. Campus examples are provided throughout to show the range of possibilities.

In this section:

"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 **Penn State University** (see story in Top 5, Appendix A), and **Texas A&M University**. 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 1996.[73] In the period 1998-2004, the **University of Michigan** 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 $9.7 million annually and earned UM the 2004 EPA Energy Star Partner of the Year award.[74]

"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 University of North Carolina at Chapel Hill 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.[75]

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

John Petersen

Students at Oberlin College track solar electricity production and use through an electronic display at the A.J. Lewis Center.

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:

Tufts University[76] (Mass.) looked at energy use in the ubiquitous campus vending machines. By installing "vending misers" on only 90 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 $190 a year in energy costs. Once converted, the vending machines turn themselves off when not in use while still keeping beverages cold.

University of Tennessee[77] staff piloted a project to replace incandescent desk lamp bulbs with compact fluorescents. Jointly funded by the Facilities Fee ($4,000), University Housing ($6,000), and Facilities Services ($5,500), the university bought over 2,500 CFL 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 CFLs saved $4,190 and 60 tons of CO_2 in a single semester.

At **Pomona College**[78] (Calif.), a 2007 study estimated that if all 800 school-owned computers were set up with EZ 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.

SUB-METERING:[79] 'YOU CAN'T MANAGE WHAT YOU DON'T MEASURE'

To accurately measure reductions in energy use and emissions, metering is required. Automated systems can be installed for submetering individual buildings (or parts of buildings) and keeping track of the data in one or more structures. The **University of Virginia** has more than 500 buildings with over 750 meters in place measuring flows of electricity, water, chilled water, and steam. Meter data shows efficiency gains and also reveals steam leaks and other energy-wasting problems. **Oberlin College** developed its own "Campus Resource Monitoring System" in 18 residence halls and 10 student houses which allows students to monitor real-time energy and water use, especially during inter-dorm competitions. Estimates suggest the system saves Oberlin $66,000 annually in electricity costs, has a financial payback of less than two years and saves over 100 pounds of CO_2 per resident per year.

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 infrastructure is in place, the fuel is either free or lower-cost than fossil alternatives. Price and supply are more stable, taking some of the guesswork out of the budget process. And there is less overall impact on, people, wildlife and the environment.

Colleges and universities have tailored a number of climate-friendly energy technologies to on-campus settings. Based on feasibility studies of the resource supply, physical location and lifecycle costs, dozens of projects have been initiated—often resulting in significant savings.

Technologies in this section include:

■ Solar: Electric and thermal ■ Wind ■ Geothermal ■ Biomass & Biogas ■ Fuel cells

CAMPUSES BUY GREEN ENERGY

In 2006, more than 200 U.S. colleges and universities were either purchasing renewable energy or producing renewable energy on-site for a portion of their energy needs.[80]

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), published by APPA, NACUBO and SCUP, and sponsored in part by NWF.

Solar energy

Harvesting heat and electricity from the sun is the oldest form of renewable energy used on campus—dating back to the 1960s and 1970s. For decades it was used for small projects or for demonstration purposes, but due to increasing climate awareness and changing economies of scale, the number and size of photovoltaic projects in particular have jumped in recent years. In addition to savings, solar projects have public relations value; they give greater visibility to a school's commitment to renewable energy.

Solar electric (PV). Campuses have installed small to large arrays of PV panels on buildings, over parking lots and on freestanding structures. And many projects are in the planning stages. It still is more expensive per kilowatt produced than other sources, but prices are gradually coming down. In California, for example, where 50 megawatts (MW) of solar was installed throughout the state in 2005, costs have been dropping 5% annually.[82]

"The solar project represents a major win for the college and our community. Solar saves money, improves the environment, and provides a wonderful opportunity to train students on environmental stewardship and alternative energy."

—Diana Van Der Ploeg, President, Butte College

Schools in California have been thinking big, installing many of the country's biggest arrays. **Butte Community College** (Calif.)[83] constructed a 1.06 MW system in August 2005, made up of 5,700 solar panels on a four-acre field. The PV system generates 1.6 million kWh and saves $300,000 annually, cutting utility bills by one third. It prevents emissions of over 1,200 tons of greenhouse gases. Under California law, the college received a $3.7 million rebate from Pacific Gas & Electric toward the total project cost of $7.4 million. At **California State University, Fresno**[84], one of the country's largest installations was begun in 2007. Photovoltaic panels cover 10 metal shelters shading 700 parking spaces, producing 1 MW and providing 20% of campus electricity base demand. And the **Los Angeles Community College District**[85] has major plans for the near future—to become energy independent and take its nine campuses off the grid. Initial plans call for each campus to install 1 MW of electricity—enough to power 1,000 homes—by 2008.

Washington University in St. Louis

Solar PV panels on the roof of Olin Library, Washington University in St. Louis, 2006.

On campuses elsewhere:

Monmouth University (N.J.)[86] switched on the largest solar array east of the Mississippi in summer 2006. The 454 kW PV system covers 33,000 square feet on the roofs of four campus buildings, and is made of a lightweight building-integrated PV roofing assembly installed over existing roof membranes. It produces 468,500 kWh—or 6% of the campus electricity needs—and saves $150,000 in costs annually. Total cost was approximately $2.8 million, of which the university received $1.7 million from the State of New Jersey Board of Public Utilities. The system should save $2.7 million in costs over the next 25 years and reduce CO_2 emissions by 5,000 tons. Monmouth was named 2006 New Jersey "Clean Energy School of the Year."

Georgetown University[87] (Washington, D.C.) has one of higher education's oldest systems, a 337 kW array installed in 1984 atop the seven-story Intercultural Center. When constructed, it cost $10 million (a demonstration project paid for by the EPA), showing how far costs have fallen since then. Its 10 panels covering 3,318 square meters still generate enough power to offset one third of the building's energy needs and save $45,000 a year in electricity costs.

Smaller PV installations cost comparatively less and are found on campuses throughout the country. At **SUNY Buffalo**[88] (New York) a 73.4 kilowatt system was recently installed on Norton Hall. This 6,300 square foot array produces 73,000 kWh a year, or 6% of Norton Hall's electrical needs. Its $560,000 cost was offset by a grant from the New York State Energy Research and Development Authority for $367,500. Remaining costs were paid by energy savings from other UB projects. Over its 30-year expected lifespan, the array will cut 1,000 tons of CO_2, equivalent to the carbon sequestered by 11 acres of trees. The **University of Michigan**[89] mounted a 30 kW system on the roof of the Dana Natural Resources building in 2005 that produces 44,800 kWh a year. The project educates the university community and public about solar energy on informative displays which show real-time data as well as past performance of the PV system. **Milwaukee Area Technical College, Mequon** (Wisc.)[90] installed two 1 kW panels to use in teaching at their Renewable Energy Technology Education Center. They plan to add a 17 kW rooftop array in 2008. And at **Cape Cod Community College**[91] (Mass.), the new Lorusso Applied Technology Center, a LEED Gold-certified building, has a 27 kW PV array which provides 15% of the building's electric power.

"The world, the community and our neighbors will benefit from this solar PV installation because we are not going to put 5,000 tons of carbon into the atmosphere. That's terrific. It's also great that our students realize this is going on. They'll leave this university as graduates and future leaders and they'll have an appreciation of both the technology and the kinds of solutions one can have to address global warming and other environmental issues."

—Paul Gaffney, President, Monmouth University

Solar hot water and passive solar. Employing much simpler technology, the sun's heat can also be captured actively or passively. As with solar electric, the amount of energy available depends on the time of year, time of day and current weather. Campuses using solar thermal collector systems include **Wright Community College** (Ill.)[92] which uses sunlight to heat water for its cafeteria and science labs. Installed in 2007, the system is mounted on a 10 by 25 foot awning. It produces up to 400 gallons of hot water a day and will cut six tons of carbon emissions each year. Wright uses the system, along with a 1.8 kW solar electric array, to demonstrate practical applications of renewable energy for its new Building Energy Technologies degree program.

The **University of Wisconsin-Green Bay**[93] was the first campus in the state to heat its indoor swimming pool with solar energy. On the roof, 3,880 square feet of solar collectors preheat water for the pool. In 2005, the system saved 6,540 therms of natural gas, which is equivalent to producing hot water for 20 residential households. A private company installed the system, and the university currently pays them the difference from previous amounts of energy consumption. Tapping into passive solar energy, **Oberlin College's**[94] Adam Joseph Lewis Center design features include eaves over the windows that block the summer sun while allowing it to enter during winter. During colder months, south-facing windows let in sunlight to warm the thermal mass in concrete floors and exposed interior masonry walls which retain and re-radiate heat, cutting overall heating needs.

WILDLIFE IMPACTS.

While wind energy comes with many advantages, one of its concerns is mortality to flying bats and birds caused by the spinning blades. For information on plans to coordinate research and identify solutions to prevent or minimize these threats to bats, visit the Bat and Wind Energy Cooperative website: **www.batcon.org/home/index.asp?idPage=55&idSubPage=26**

Wind energy

Campuses are beginning to harness the wind with both small-scale and large commercial-sized systems. A wind turbine on the campus skyline is a visible and dramatic statement about renewable energy. And as an energy source, it has the advantage of being capable of generating power 24 hours a day, all year long.

A range of possibilities

SCHOOL	TURBINE CAPACITY
St. Olaf College	1600 kilowatts (1.6 megawatts)
Massachusetts Maritime Academy	660 kilowatts
Lakeshore Technical College	65 kilowatts
Macalester College	10 kilowatts

St. Olaf College (Minn.)[95] erected a commercial-scale 1.6 MW wind turbine in 2006 on college farmlands adjacent to campus. It produces around 6 million kWh of electricity each year, replacing one third of the school's needs and saving $300,000 in utility costs. A grant paid for most of the $1.9 million project. Neighboring **Carleton College**[96] had previously built a large 1.65 MW wind turbine in 2004. Located 1.5 miles from the college, it was the first utility grade wind turbine in the country to be owned by a college.

"Traveling southwest on Main Street in Buzzards Bay, Massachusetts Maritime Academy's 660 kW, Vestas wind turbine is perfectly framed looming over Taylor's Point and the surrounding terrain. It is a magnet to school children, educators, journalists, municipal authorities, prospective cadets, alumni and tourists. Every visitor to campus asks about it."

—Allen Hansen, Vice President for Student Services Massachusetts Maritime Academy

The **Massachusetts Maritime Academy**[97] installed a 660 kW turbine in June 2006. It produces over 1 million kWh a year and saves $160,000 annually. In its first 15 months of operation, 690 tons of CO_2 were avoided. An online monitor shows daily, monthly and yearly totals of power produced (see www.maritime.edu/l2.cfm?page=160).

The 65 kW turbine at **Lakeshore Technical College** (Wisc.)[98] taps into the windy shoreline of Lake Michigan. Constructed in 2004, it yields 70,000 kWh per year and supplies around 3% of campus electrical energy needs. A grant from "Focus on Energy," a state energy assistance program, helped pay for the project. The turbine is used for technical training, workshops, seminars and courses on renewable energy systems at the college.


Mary Losure

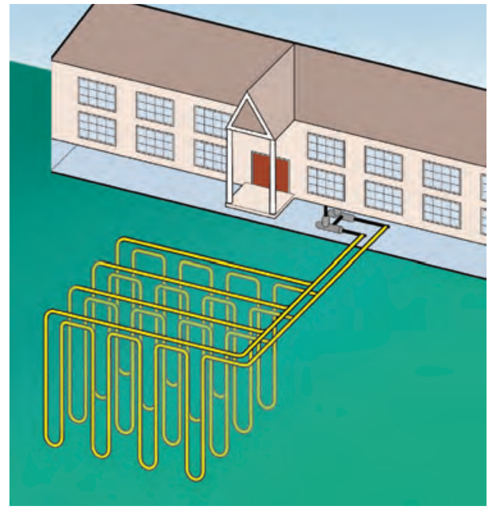
Wind turbine at Macalester College.

Macalester College (Minn.)[99], built its 90 foot "urban turbine" in 2003. The turbine and tower—worth $40,000—were donated by a local utility, and installation was paid for by the 2003 Class Gift. The 10 kW turbine generates a modest 12,000 kWh, saves $1,000 per year, and covers about one third of 1% of the college's annual electricity needs.

Like any complex project, installing wind power has many steps and costs. See the case study of **Carleton College's**[100] 1.65 MW wind turbine installation, which shows details like annual insurance and maintenance, landowner lease payments, utility contracts, permitting and costs for windless days.

Geothermal

Only a few yards below the surface the earth maintains a steady temperature—all year long. Special wells and systems of pipes can absorb that available heat in the winter or shed heat in summer using heat pump technology. Such systems can heat and cool single buildings—or an entire campus. The technology is gaining favor, especially for green buildings. Apart from the small amount of electricity needed to run the pump system, geothermal is emissions-free. The following examples show several approaches to using ground-heat systems.



Geothermal Heat Pump Consortium, Inc.

Closed-loop geothermal systems can be installed in most campus settings.

Multiple buildings

Richard Stockton College (New Jersey)[101] has one of the country's largest closed-loop geothermal HVAC systems, providing 1,740 tons of heating and cooling capacity. Installed in 1994, the system has 400 heat exchange wells and 64 miles of underground pipes. It reduced the school's electricity consumption by 25% and natural gas consumption by 70%, saving approximately $330,000 in energy costs per year. The geothermal system cost over $5 million to install, but most was covered by state grants and utility rebates. The project is the main contributor to a 13% overall reduction in the college's CO_2 emissions below 1990 levels. The college's latest project—a new student residence hall—will be heated and cooled with a geothermal system similar to the one that serves the main campus buildings.

Building renovations

During a whole-building renovation in 2007, **West Chester University** (Penn.)[102] added a geothermal HVAC system in the Swope Music Building, built in 1961. The geothermal system was buried under a lawn area next to the building. The system is expected to save around $32,000 a year in energy costs and prevent the release of 350 tons of CO_2. Cost of the system is covered by a $248,450 grant from the Pennsylvania Energy Harvest Grant Program.

"The new system saves a significant amount of money over its lifecycle in energy and maintenance costs. And because the grant covers the upfront costs … the University will realize all of those savings immediately."

—Tom Clark, Director of Facilities Planning, West Chester University

In upstate New York, **Hamilton College**[103] added a geothermal system to its historic Skenandoa House student residence hall during renovation. The result was to cut energy consumption by about 60%. per square foot. In the first year alone, the renewed facility paid off the difference between the costs for installing a geothermal system versus a traditional heating system.

New buildings

John Wood Community College (Ill.)[104] installed a geothermal heating and cooling system in its new Student Activity Center which opened in 2006. The system has 80 closed loops, each buried 200 feet in the ground near the building that provide the water source for the heat pump. The college saves around 540,000 kilowatt hours of energy annually, which translates to a cost savings of about $25,000 each year—equal to taking 138 cars off the road. A $50,000 grant from the Association of Electric Cooperatives "GeoAlliance" Program and the Illinois Clean Energy Community subsidized the project.

In Arizona at **Yavapai College**[105] Chino Valley campus, a new AgriBusiness and Science Center draws its heating and cooling from an aquifer 300 feet down. A closed loop water system taps the 68-degree groundwater through 30 wells. Tubes in the building's concrete flooring create radiant heating and cooling, depending on the season. The structure won an award from Southwest Contractor magazine as Best of 2004 Green Buildings Under $5 million, and is Silver LEED certified.

Biomass and Biogas

Biomass

The earliest campuses in this country used biomass energy: firewood. Today, concern over climate and uncertain fossil fuel supplies is leading to a resurgence of biomass as an energy source. Schools are developing ways to use plant-based fuels such as forest industry residues, agricultural and paper mill waste, and special crops grown as fuel. Besides being a renewable resource, biomass is carbon neutral (though fossil fuels used in production and transport diminish the advantage). When burned, biomass releases the same carbon that it took out of the air through photosynthesis. Biomass can be burned directly or mixed with coal. And new technologies for gasification of biomass[106]—which creates a less-polluting product similar to natural gas—are being developed.

100% biomass

At **Mt. Wachusett Community College** (Mass.), a biomass heating plant replaced electric heat in 2003. It uses woodchips for fuel and provides 85% of campus heating needs. See story in Top 5, Appendix A.

"Fuel payments to local companies stay in Idaho, benefiting the economy and tax base instead of going to west coast pipeline companies and Canadian gas suppliers. Since the university is tax supported, we, in effect, give the state and ourselves a rebate by buying fuel locally."

—Mike Lyngholm, Steam Plant Manager, University of Idaho

In the mid-1980s, the 12,000-student **University of Idaho**[107] converted from coal and natural gas to a wood-fired boiler for its central steam heating plant. It mainly burns cedar chips, a byproduct from local sawmills, and sometimes landscape debris and wood waste from the community which together offer a renewable, long-term supply. Providing more than 90% of campus heating needs at a quarter of the cost of natural gas, the system saves $2 million annually in fuel costs.

Biomass mixed with coal

The **University of Iowa**[108] began mixing oat hulls with coal in its campus heating plant in 2003 after experiments proved its heating and emissions values. The hulls come from a nearby Quaker Oats processing plant which delivered over 40,000 tons in 2006, replacing half the coal in one boiler (a circulating fluidized bed model) and saving $750,000 in fuel costs. In 2006, an estimated 20,000 tons of greenhouse gas emissions were avoided.

Utilities & Energy Management, University of Iowa

Oat hulls, which cost half as much as coal, cut CO_2 and other emissions at the University of Iowa.

The coal-fired heating plant at the **University of Wisconsin-Madison**[109] burns paper pellets made from paper mill waste, about 3% by weight of the total. In the future, the plant hopes also to burn the pelletized byproduct from a nearby corn-ethanol plant.

Six acres of switchgrass, a perennial prairie native, were recently harvested for a biomass test at **Purdue University** (Ind.)[110]. In winter 2008, researchers will burn the grass along with coal in the campus steam plant. The switchgrass is expected to provide 5-10% of the heat energy during the test. The experiment will help determine the best boiler design for adaptability to biomass fuels. Replacement of an aging boiler 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 **University of Minnesota-Morris**[112] broke ground in July 2007 for a biomass gasification facility that will begin operation in 2008. The reactor will convert corn stalks and other farm residual materials—around 9,000 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 $8,956,000 of which $1.9 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.

"In the wake of the blackout in August 2003 that crippled much of the Northeast and a heightened awareness of the potential for terrorist activities, it is important for the college to be a safe haven for the community in the event of another widespread blackout or disaster, natural or otherwise."

—Marco Silvestri, President, Hudson Valley Community College

Landfill methane is now the sole fuel used in the cogeneration facility at the **University of New Hampshire**[113] (see story in Top 5, Appendix A). The purified gas, after being cleaned and concentrated at the landfill, arrives through a 12-mile underground pipeline. The 2006 switch from natural gas to landfill methane cut 45% off UNH greenhouse gas emissions, and the cogeneration system provides over 80% of the electricity needed by the school.

Hudson Valley Community College (N.Y.)[114] began using landfill gas in 2004 to power one of its three cogeneration boilers. Together, the three boilers create enough electricity to take the 17-building campus off the grid. A 3,000-foot pipe delivers the gas which is expected to last until 2018. The 825 kW landfill gas generator provides 25% of the facility's power, but its fuel costs only around $20,000 a year versus $900,000 for natural gas for the other two generators. Greenhouse gas benefits of the cogeneration facility are equivalent to removing 36,000 cars from the road each year. The $8.4 million project, which saves $900,000 a year, was financed through a 15-year performance contract.

Making biogas from food waste is the goal of a project at the **University of California, Davis**.[115] This commercial scale system—an "anaerobic phased solids digester"—is a prototype of new technology developed by Ruihong Zhang, a UC Davis professor, that produces a mixture of hydrogen and methane gas. Operation began in October 2006 using tons of scraps collected from San Francisco area restaurants. The Biogas Energy Project system can handle eight tons of leftovers weekly, and later will be expanded to as many as eight tons daily. The system is expected to eventually produce enough fuel to power the equivalent of 10 average California homes per day.

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, **SUNY College of Environmental Science and Forestry** in Syracuse, NY 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 York 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 natural gas. Natural gas produces about 40% less CO_2 than coal. Second, equipment can be installed that generates both electricity and heat, called cogeneration or CHP (combined heat and power). And for greater savings, both methods can be implemented simultaneously. The cogeneration option has been favored by many campuses.

Bucknell University (Penn.)[116] converted from a conventional coal-fired heating plant to a cogeneration facility fueled by natural gas in 1998. By producing both heat and electricity, the overall efficiency of the plant increased to 75-80% and led to big reductions in greenhouse gases—about 44% below 1990 levels, based on a 2006 emissions inventory.

Judith Roberge, Smith College

At Smith College, a crane installs components of the new cogeneration system.

In 2003, the **University of Maryland**[117] converted from a steam-heat plant system to a CHP plant which can produce up to 90% of the university's electric demand in winter and about 50% in summer. Consisting of two gas-fired combustion turbines, one steam-driven electric turbine and two heat recovery steam generators, the system operates at efficiencies of about 70% and saves around 53,000 tons of CO_2 annually.

The **University of California, Irvine**[118] installed a CHP facility in 2007 with a 13.5 MW gas turbine generator and 5.6 MW steam turbine generator. The facility features a 4.5 million gallon thermal energy storage tank that can capture waste heat and store if for future uses.

Smith College (Mass.)[119] replaced its 60-year-old steam plant with a 3.5 MW single-boiler CHP system in summer 2007. The $11.5 million system will provide 70% of the campus's electrical needs, save an estimated $1.8 million a year in costs with a seven-year payback, and cut greenhouse gas emissions in half.

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.

"Our main problem is that we have buildings that are energy drains because they were built in the1950s when energy was cheap. (But) they are also historic landmarks, so you are under constraints when you try to retrofit them."

—David Baker, Vice President for External Affairs, Illinois Institute of Technology

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 Oberlin College's Adam Joseph Lewis 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.

Ball State University Photo Services

LEED-certified David Letterman Communication and Media Building at Ball State University (Ind.) opened in 2007.

Laboratories

In April 2002 the **University of California, Santa Barbara**[120] opened the doors of the Donald Bren School of Environmental Science and Management—the first laboratory to receive the LEED Platinum award for new construction. This green laboratory surpasses Title 24 (California's energy code) by more than 30%, saving the campus $50,000 and preventing 275 tons of CO_2 emissions per year. To provide some of its own energy, Bren Hall has a 42 kW photovoltaic array that provides 7-10% of the building's energy, cutting 20 tons of emissions a year.

Residence Halls

West Quad, the new 500-bed residence hall at the **University of South Carolina at Columbia**,[121] is larger than its traditionally built sister residence East Quad, but requires 45% less in energy costs. Opened in 2004, the building is Silver LEED certified and features the latest technology and environmental systems for conserving water and energy. It saves around $40,000 in electrical costs and the same amount in water. The building also serves an educational mission as the home of the Environmental Awareness Learning Community at USC.

At **Northland College** (Wisc.)[122], the McLean Environmental Living and Learning Center was one of the earliest green campus buildings, opening in 1998. This 38,000 square foot, 114-student residence was co-designed by students to be a teaching tool featuring energy-efficient construction, PV arrays, solar water preheating, a wind turbine, greenhouses and some composting toilets. It exceeds code requirements for efficiency by over 50%.

Renovations

Harvard University[123] completed a green renovation of a historic building on campus in 2006, earning the coveted LEED 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 99% recycled, cutting 15% off the overall project budget. Costs were $250 per square foot which is in line with non-green renovations, thus the project had no net "green premium."

High performance BUILDING STANDARDS

Guidelines and standards for green buildings can give direction to the design process as well as targets for efficiency and cost-savings. These are two of a number of programs that offer such guidance.

The **Leadership in Energy and Environmental Design (LEED)** Green Building Rating System is the nationally accepted benchmark for the design, construction and operation of high performance green buildings. LEED promotes a whole-building approach to sustainability by recognizing performance in five areas of human and environmental health: sustainable site development, water savings, energy efficiency, materials selection and indoor environmental quality. See http://www.usgbc.org/LEED

The **New Jersey Higher Education Partnership for Sustainability (NJHEPS)** developed a two-volume "High Performance Campus Design Handbook." **Volume 1** is an overview and rationale for green design, especially in the New Jersey higher education context. **Volume 2** is a technical guide for planners, designers and facilities personnel. Its guidelines have been adopted by many schools in New Jersey and around the U.S. See http://www.njheps.org/projects/greenbuildings.htm

Hundreds of campus buildings are certified or registered through LEED or have been designed according to their standards with the intention of applying for certification.

Here is a sample.

Commitment to high performance through LEED[124]

SCHOOL	ACCOMPLISHMENTS AND PLANS
University of Florida	Beginning in 2006, UF will require LEED Silver criteria for design and construction for all major new construction and renovation projects. To date the campus has two Gold Certified buildings, eight certified buildings, and several registered.
California State University, Chico	Two campus buildings are registered with LEED and the campus has made a commitment that all newly constructed buildings will meet LEED Silver requirements.
Southern Methodist University (TX)	The Embrey Building, which opened in September 2006, is pursuing LEED certification at the Gold level.
Cape Cod Community College (MA)	The Lyndon Lorusso Applied Technology Center received its LEED Gold certification in 2007.

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]

For direct emissions from fleet vehicles:

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

For faculty, staff and student commuters:

- Carpooling and vanpooling
- More bike racks and safe bike routes
- Flexible parking options
- Bus and public transit passes
- Preferred parking for multiple occupant vehicles
- Car-sharing programs

CAMPUS FLEET AND COMMUTER EMISSIONS

Campus-owned fleet vehicles along with commuter vehicles used by staff and students typically contribute 3-15% of total emissions. At **Pomona College**[126] (Calif.), 7% of campus emissions come from transportation sources (6%, commuting and college-related air travel; 1%, campus fleet), resulting in 1,320 metric tons of CO_2 a year. In contrast, commuter schools tend to have a higher share of emissions come from the commuters themselves. At smaller campuses in the **Penn State University**[127] system, student and staff vehicles can account for as much as 50% of total emissions.

Comprehensive transportation management programs have been implemented on a number of campuses, with one of their chief aims being to curtail the number of vehicles driving to and parking on campus.

The **University of Washington**[128] launched its U-Pass program to offer commuter alternatives to single-occupant vehicles. Public transit, carpools, vanpools, bicycling perks, emergency rides home, car-sharing and even discounts at local merchants for U-Pass holders are offered. Overall, these efforts cut the number of cars driving to campus by 10,000 vehicles per day—even while UW has been growing in size. At 19 pounds of CO_2 emitted for every gallon of gas that would have been burned by those vehicles, emissions were reduced an estimated 50 tons per day (based on a half gallon per vehicle per day). The campus also sponsors the Ride in the Rain Challenge every January, prompting 800 cyclists to commute by bike even during bad weather, saving a pound of CO_2 for each mile they pedal. UW's Motor Pool also joined in. It replaced older cars with hybrids and now owns 20 Toyota Prius hybrids. Efficient vehicles and biofuels are part of the university's Green Fleet Initiative, an effort to reduce pollution and waste in all Motor Pool vehicles.

> *"Travel patterns that students learn while in college are likely to influence their future travel choices."*
>
> —Will Toor, coauthor of *Transportation and Sustainable Campus Communities* (2004)

The **University of Michigan**[129] initiated several actions to cut CO_2:

- 470 vehicles (87% of the total fleet) are flex-fuel models that run on E85 (85% ethanol).
- Campus trucks and M-buses run on B20 biodiesel (20% biofuel).
- In 2005, the free campus M-bus served 5.2 million passenger trips and the M-Ride program (free rides on city buses) added another 1.6 million passenger trips.
- Vanpool ridership increased fivefold since 1999, serving more than 300 faculty and staff from 28 nearby communities and logging 5.7 million passenger miles in 2005 alone.

With most campus-owned vehicles using renewable blends of fuel by 2005, UM reduced fossil fuel consumption by 180,000 gallons and prevented 1,100 metric tons of greenhouse gas emissions in one year.

Justin Schott

Vegetable oil fueled bus promotes clean, renewable fuels.

Campuses are great places to try out new transportation ideas:

Biodiesel[130]
Students at **Appalachian State University** (N.C.) voted to pay $5 per semester to build a "closed-loop" processing system for biodiesel fuel in 2005. This included solar-thermal water heating and a PV system to supply all necessary electricity and hot water needs, as well as a greenhouse with aquatic habitats to treat wastewater. The 80-gallon processor converts waste vegetable oil to biodiesel and the finished product is blended with regular diesel (20% is biodiesel) and used in campus vehicles. The project won a $10,000 grant from the EPA for further development and education outreach. The **University of Illinois at Urbana-Champaign** also has a student-run biodiesel reactor that went into operation in 2007. Using waste cooking oil from campus cafeterias, the system is designed to produce 400 gallons a week. The biodiesel will replace some of the fuel used in campus trucks and will save an estimated $25,000 a year in fuel costs.

Bicycles[131]
At **St. Lawrence University** (N.Y.) the phrase "check out that bike" has a whole new meaning. The same ID that can check books out of the library now can check out a bicycle. The Green Bikes program started in 2005 with 10 bikes that can be checked out for two days at a time—along with a helmet and a lock. Student government funds paid for the equipment. Students at **Willamette University** (Oregon) created a bicycle repair co-op and rental program, both of which are available free to members of the Willamette community. The program aims to help ease the campus parking shortage. The program began in 2007 with seven bikes and if each is used to ride 1,000 miles a year, they will avoid an estimated 3.5 tons of CO_2 emissions.

David J. Eagan

Flyers posted at Grinnell College (Iowa) advertise two ways to borrow a campus bike.

Car sharing[132]
A new option for commuters is short-term rental cars available right on campus. By fall 2007, the Flexcar company had cars at 27 colleges and universities with the newest being **Arizona State University** and the **University of Wisconsin-Milwaukee**. Approved drivers—even undergraduates—pay a modest fee for these rent-by-the-hour cars which include gas, insurance, maintenance, parking and emergency service. Zipcar, another national car-sharing company, claims that each of its cars takes 20 private vehicles off the road. It offers hybrids and other efficient models at over 30 schools including **Boston College**, **Golden Gate University** and the **University of Chicago**. The car-sharing model can be local, too. Community Car based in Madison, Wisconsin has 14 cars and a pickup truck. Seven cars are parked on the **University of Wisconsin-Madison** campus and students with good driving records are eligible to join the citywide car-share pool.

6. Behavior Change and Education

"If we can just get people to turn off the lights . . ." As a strategy for climate action, behavior change holds considerable promise for emissions reduction—but it also is one of the most challenging to implement. Technical solutions can have predictable and measurable results, but the outcomes of changing people's behavior are much harder to determine. Creative ways to promote energy- and carbon-reducing behaviors have been tried on a number of campuses, offering insights on how to make these methods effective.

Residence hall contests

Inter-dorm competitions generally require combining both technology and behavior change. To be able to measure changes in energy consumption, residence halls need building-level meters (even better would be metering of individual floors). At **Washington College** (Maryland)[133], a three-week "George Goes Green" inter-dorm competition in 2006 inspired students to turn most of the lights off and avoid doing laundry. The winning hall was treated to a catered dinner with a live band. Even at this small school, savings amounted to 39,000 kWh and $3,700 in electricity, with over 26 metric tons of CO_2 avoided. Also see **Oberlin College's** story in the box on page 26. Oberlin's Campus Resource Monitoring System created sophisticated online displays (visit http://www.oberlin.edu/dormenergy) that constantly compare real-time energy use among 26 separate dormitories and houses.

David J. Eagan

Energy conservation reminders are posted on buildings at the University of Wisconsin-Madison. Visit www.conserve.wisc.edu/signs.htm to see all 16 messages.

Clever gimmicks and prizes help get students' attention. Borrowing the "Do It in the Dark" theme coined by Tufts University, both **MIT**[134] (Massachusetts Institute of Technology) and the **University of Connecticut**[135] held competitions in 2006-07. At MIT, the student Energy Club sponsored the two-month contest. The winning residence hall cut its average weekly consumption by 26 kilowatt-hours per student, earning a prize of energy-efficiency improvements worth $10,000, funded by MIT's Housing Office. Students avoided elevators, switched off lights and held a lights-out Ping Pong tournament using glow-in-the-dark paddles and balls. Overall, dorm electricity consumption decreased by 226,125 kWh, saving $13,290. At UConn, seven dorms competed for one month, with the top performer cutting its water and energy consumption by 6%.

In **Minnesota**, 14 private and public colleges and universities launched a month-long inter-school competition—in February, no less—called "Campus Energy Wars[136]." The idea started in 2006 on a couple of campuses and spread statewide in 2007. Students use the latest three years of energy-use data from their dormitories as the baseline to compare results. **Carleton College**[137] saved between 16% and 20% over both years. At the **University of Minnesota-Morris**[138], many participants—including the chancellor—signed a pledge to conserve energy. UM estimates that one third of the university's electricity usage is under discretionary control of the building occupants.

"The transition to a sustainable future will require the vast majority of people be persuaded to adopt different lifestyles. … Campaigns that rely solely on providing information often have little or no effect upon behavior."

—Doug McKenzie-Mohr and William Smith, *Fostering Sustainable Behavior: An Introduction to Community-based Social Marketing*

Social marketing

A new approach to marketing is being tried at many schools – resulting in more people changing their ways. The methods of "community-based social marketing" have proven that behavior change initiatives are especially effective when carried out at the community level and involving direct contact with the people targeted for change.[139] Tactics include using "prompts" (printed or verbal reminders of the desired behavior), fostering new community norms, providing incentives to change and framing messages more strategically.

At the **University of Southern Maine**[140] in 2006, students employed the tools of social marketing in a campaign to cut electricity use in a residence hall and a classroom building. They posted flyers and prompts in creative places, asked students and staff to sign a pledge to turn off their computers and gave public recognition to participants. The number of computers left on dropped over 90%. Overall, behavior changes occurred in 40-90% of areas targeted and an estimated 2,000 kWh was saved over three weeks.

In 2004, the **University of Iowa**[141] launched a campaign to save energy and cut hundreds of thousands of dollars from its utility budget. It put signs and prompts all over campus reminding people to turn off lights and equipment when not in use, including coffee makers, computer monitors and printers. A 26-member Energy Conservation Advisory Council composed of administrators, faculty, staff and students encourages conservation across campus and develops new initiatives. Campus-wide participation in conservation measures is a key part of the savings plan, which by 2007 had cut $5 million in energy costs.

Dave Jackson, University of Iowa Facilities Management

The slogan *"Not in use? Turn off the Juice!"* appears in unusual places at the University of Iowa.

7. Purchasing renewable energy credits

The above sections focus on actions that reduce greenhouse gas emissions directly—based on cutting campus energy consumption or generating clean energy right on campus. Purchasing renewable energy from offsite sources can be another approach to reducing emissions. The most common method is through Renewable Energy Certificates (RECs), also known as renewable energy credits, green tags and green credits. RECs are typically sold in megawatt-hours of clean electricity that are offered by a local utility, or by regional or national companies.

RECs derive from renewable energy that is produced by wind, solar, hydro, geothermal, biomass and landfill methane. Utilities and other industries produce carbon-neutral electricity from these sources and sell it to customers or REC brokers. Certification programs like *Green-e*[142] ensure that RECs aren't double counted and that the electricity comes from approved renewable sources. Colleges and universities support the green power industry by buying that power locally, when available, or from national REC markets, though it typically costs more than conventionally-generated power. As more capacity is installed, however, that cost differential is shrinking.

"This is a great step for us toward a sustainably-powered campus. We are happy to be supporting not just renewable energy but also the regional economy and the family farms that are so important to the Vermont way of life. It is a good fit with our mission, and departments across campus are supporting the project from their own budgets because they feel it's a priority."

—**Bill Throop, Provost, Green Mountain College (VT)**

Pros and Cons. There are upsides and downsides to RECs which each school has to weigh when considering buying renewables from the market.

Caitlin Littlefield

Middlebury College students promoting clean wind power.

Pros

- Inexpensive way to reduce campus emissions.
- Supports development of clean energy and the local economy (if production is local).
- Environmental benefits for water and air quality, human health, wildlife habitat.
- Good public relations value.
- Long-term, fixed-price contracts can be a price hedge, keeping utility bills consistent and possibly saving money in the long run*.

(*Austin Energy of Texas offers wind hedge deals that can start out cheaper than fossil power.)

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.

UNIVERSITY OF COLORADO[145]

10% of campus kWh

In 2000, students voted to raise semester fees $1 to buy wind power from a Colorado wind farm. In 2004, they voted to expand the purchase with even higher fees.

- Two million kWh purchased in 2000 on a four-year contract.
- Purchased 8.8 million kWh in 2004.
- Provides 100% electricity for three student-run buildings.
- Cuts campus emissions by roughly 5,400 metric tons CO_2
- Two new buildings offset with wind RECs, for another 2.5 million kWh.

UNIVERSITY OF TENNESSEE[147]

2.6% of campus kWh

Student fees in 2006 covered most of the cost of the green power purchase (mix of wind, solar and methane gas) from the Tennessee Valley Authority.

- First college in state to purchase renewable energy.
- Students purchased 3,000 blocks of green power (150 kWh each) and the campus bought 375 more for a total of 3,375.
- Equals 506,250 kWh per month.
- Offsets 4,560 tons of greenhouse gas emissions per year.
- Equivalent of removing 732 cars from the road.

BATES COLLEGE (Maine)[146]

96% of campus kWh

The college purchases 13.2 MWh a year on a five-year contract, which began in 2005.

- Maine-produced biomass and small hydro power.
- Provides 96% of campus electricity.
- Cost is 4% more ($76,000) than traditional electricity sources.
- Reduces emissions to near 1990 levels.
- Avoids 8,340 metric tons CO_2.

GREEN MOUNTAIN COLLEGE (Vermont)[148]

50% of campus kWh

Electricity produced on local farms from methane extracted from cow manure. Distributed by Central Vermont Public Service "Cow Power" program.

- Became nation's first cow-powered campus in 2006.
- Provides 50% of campus electricity.
- Costs 4 cents per kWh more than conventional power.
- Purchases 1.2 million kWh annually.
- Reduces emissions 3,500 metric tons per year.

The EPA has been encouraging adoption of green power in many ways. For sports fans, it hosts the College and University Green Power Challenge to compare purchases among schools in different athletic conferences. (The EPA also recognizes higher education's largest purchasers, see box.) For a list of participating schools and to see how your favorite conference is doing, visit http://www.epa.gov/grnpower/partners/hi_ed_challenge.htm

"Our commitment to green power is very much in line with our educational and environmental values. It's a significant honor to be named as one of the nation's top-ten institutions for renewable energy - I'm proud of the work that our students have done."

—Thomas L. "Les" Purce, **President**, Evergreen State College

EPA's Green Power Partnership:

TOP 10 COLLEGES AND UNIVERSITIES[149]

Since beginning the program in 2006, the top 10 higher education purchasers of renewable energy have tripled their use of renewables. By July 2007 they were buying enough electricity to power an estimated 60,000 average American homes for a year.

DATE	KILOWATT-HOURS (KWH) ANNUALLY
January 2006	216 million kWh
July 2006	370 million kWh
January 2007	634 million kWh
July 2007	650 million kWh

The future looks energized for RECs. Wind energy, for example, currently accounts for less than 1% of energy production in the U.S. But the wind industry has been growing at a rate of 22% a year for the past five years and the U.S. Department of Energy has announced a goal of obtaining 6% of U.S. electricity from wind by 2020.[150]

NON-REC CARBON OFFSETS

Another market exists for carbon "offsets" for air travel, conferences and other activities by individuals or organizations. For a helpful analysis and resources on the topic, see the 2006 report by Clean Air-Cool Planet: A Consumer's Guide to Retail Carbon Offset Providers. **http://www.cleanaircoolplanet.org/ConsumersGuidetoCarbonOffsets.pdf**

8. Campus habitat

Colleges and universities are usually more than a collection of buildings and roads. Many campuses have a tree-lined "quad" or other park-like areas; **Michigan State University** calls its campus a "5,000-acre arboretum." Wilder corners on campus protect wetlands, woods and other natural lands. These habitats offer havens for native birds, amphibians, mammals and insect life that may help them survive amidst changing climate conditions.

Natural and managed landscapes on campus enhance water and air quality, encourage groundwater recharge and beautify the institution. They help prevent soil erosion and filter nutrient runoff from lakes and streams. By planting native vegetation, schools can avoid resource-intensive species that require watering, fertilizers (which can release potent nitrogen-based greenhouse gases) and pesticides. And especially in urban areas, shade trees and green spaces can help buffer temperatures and mitigate the "heat island[151]" effect, keeping buildings cooler and requiring less energy in summer.

Living 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.

The University of Michigan's[153]

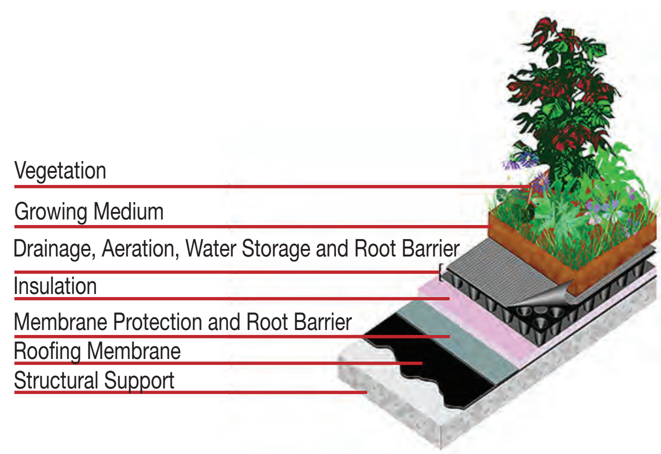
UNIVERSITY-WIDE CARBON SEQUESTRATION

According to UM statistics, healthy U.S. forests can sequester about 2.5 metric tons of CO_2 per hectare per year. The university owns over 5,800 hectares of forests and natural areas such as the Botanical Gardens & Nichols Arboretum in Ann Arbor, the Biological Station in Pellston, Osborn Preserves in the Upper Peninsula, and Camp Davis in Wyoming. This amount of land can sequester roughly 15,000 metric tons of CO_2 emissions each year.

Campuses can use their properties more effectively as carbon sinks by promoting tree planting and forest growth. Land grant universities and other schools own large tracts of land whose carbon-sequestering values can be used to offset some of their campus emissions. They can also choose to purchase wood products from sustainability managed forests certified by the Forest Stewardship Council (FSC).[154] And a new innovation in green construction—green roofs—have been installed on several campuses. Green roofs have insulating properties that can save energy by stabilizing temperatures within buildings. (See chart[155]).

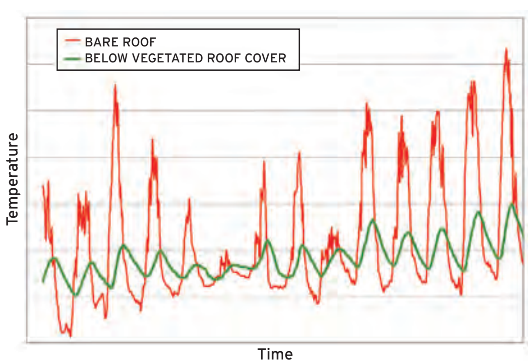
Here's what some campuses are doing:

Lawrence Technological University (Mich.)[156] sprouts a green roof on its new student services building.
The Alfred Taubman Student Services Center, which opened in 2006, is one of the first campuses in the country to install a green roof. It is constructed of insulation, a roof membrane, drainage fabric and a four-inch deep composition soil supporting nine species of sedum groundcover. At 9 inches thick, the roof insulates much better than traditional roofs. The 10,000 square foot living roof also controls and reduces rainwater runoff. In a typical year, about 60% of rainwater will be absorbed by the roof while the remainder drains into a 10,000-gallon cistern to be used as "gray" water for flushing toilets and irrigating campus landscaping.



The layers beneath the green: Components of a green roof.

University of Wisconsin-Milwaukee[157] restores campus woodlands
In 2006-07, the UWM student group "Ecotone" helped improve habitat in 11-acre Downer Woods on campus. Students surveyed the land for native species and cleared invasive species including buckthorn and garlic mustard. They identified over two dozen species of birds that nest on the property or use it as a migration stopover. The group also established a native prairie garden surrounding the Architecture and Urban Planning building.



Roofscapes, Inc.

On a green roof, soil and vegetation moderate the daily fluctuations in temperature, easing heating and cooling demands.

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 was restored to mesquite woodland and low-elevation riparian forest that historically dominated the area. Tree species include velvet mesquite, Fremont cottonwood and paloverde with native desert shrubs and cacti.

Tidewater Community College (Virginia)[159]

The college owns 69 acres of natural land near Chesapeake Bay. One segment includes an upland island separated from the main campus by a tidally influenced estuarine marsh. This environmental treasure has become an outdoor classroom used by faculty from many disciplines including English, science and history. At Tidewater, environmental education is integrated across the curriculum; faculty and administration believe that when students learn in outdoor settings it heightens their commitment to environmental stewardship. Well-studied coastal settings such as this can provide a benchmark for monitoring the effects of rising sea levels and other changes expected to result from global warming.

*"**Bowdoin College's**[160] mascot, the polar bear, is an iconic symbol of global warming. It stands resilient outside the student union, reminding passersby that steps taken at home have a much broader impact elsewhere. This message underlies everything that Bowdoin is doing to curb greenhouse gas emissions."*

—Katherine Creswell, student, Bowdoin College, Maine

Bowdoin College

6 Financing Climate Action

Individual projects as well as comprehensive climate plans need support to get them off the ground, although a few steps—like using maintenance staff to change thermostat temperature settings—have little or no startup costs. But regardless of size, these efforts are a good investment. Almost without exception, the clean energy and efficiency projects described in the previous sections led to net savings for the campuses. Whatever misconceptions there may be about cost barriers to launching expensive initiatives, the net-positive experiences of these schools and many others will prove them wrong. And more important than money—from a future climate perspective—is the contribution these efforts make in cutting greenhouse gas emissions and preparing students to be leaders in a clean energy economy.

Even for the simplest project, a thorough lifecycle cost analysis is recommended. This brings all the costs and funding streams—both obvious and obscure—to the table. It lays out the project timetable, debt service, expected savings, return on investment (ROI) and more. Calculating simple payback is a handy metric for comparison, but the ROI will be needed to argue for a project's fiscal viability. As mentioned earlier, when a number of projects are bundled and put forward together, those with the largest ROIs help balance the overall numbers and make the combined package more attractive.

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: Climate Change and the University, by Ann Rappaport and Sarah Hammond Creighton, 2007. MIT Press.

The Business Case for Renewable Energy: A Guide for Colleges and Universities, by Andrea Putman and Michael Philips, 2006. APPA, NACUBO & SCUP.

Transportation and Sustainable Campus Communities: Issues, Examples, Solutions, by Will Toor and Spenser Havlick, 2004. Island Press.

New Energy for Campuses: Energy-Saving Policies for Colleges and Universities, by Satya Rhodes-Conway, Brian Siu and Billy Parish, 2006. Apollo Alliance and Energy Action. Available online at http://www.energyaction.net/documents/new_energy.pdf

Green Investment, Green Return: How Practical Conservation Projects Save Millions on America's Campuses, by David Eagan and Julian Keniry, 1998. National Wildlife Federation. See http://www.nwf.org/campusEcology/resources/HTML/gigr.cfm

In this section:

- Performance contracts
- Utility & government incentives: Rebates, subsidies and grants
- Student self-assessed fees
- Revolving loan funds
- Other creative sources

Performance contracts

Energy projects are moneymakers, at least in the long run. This simple fact has led to a project-contracting innovation in which private companies bank on predictable energy cost savings to recoup their investment. Colleges and universities, often short on cash, find this an ideal option for advancing projects that otherwise would be out of reach.

Hiring an energy services company (ESCO) as a contractor to plan, finance, design and implement projects is an effective way to carry out large and expensive initiatives. These companies recover costs and make a profit based on project savings. They offer a "turnkey" deal, having the expertise for handling all aspects of a complex project and assuming all technical and financial risks. In the end, the school reaps continuing savings without having any negative numbers on its balance sheet.

"The performance contract has been very successful. We've been able to improve the campus without requiring any additional taxes from the citizens of Utah."

—Orfeo Kostrencich, Financial Analyst, University of Utah

Performance contracts tend to be short, but some last 7-10 years. This preference for a quick turnaround can be a deterrent to some renewable energy projects with longer paybacks. "But if several projects are bundled together, the combined ROI can bring the deal within range. And financing can be offset by grants and other incentives. Once a project is complete and the contracting company is paid for its services, the college or university continues to reap the savings. These examples show how:

Specific installations

At **Pierce College** (Calif.)[161]—one of nine campuses of the Los Angeles Community College District—a contractor undertook the installation of a 191 kW solar PV array (shading 80 stalls of the campus parking lot) and a 360 kW natural gas-fired microturbine cogeneration system. Combining the two projects increased the total project cost but reduced the overall payback time, enabling it to fit within the scope of a performance contract. Coming online in 2003, the two systems reduced campus electricity purchases by 30% and cut energy costs by $180,000 each year. Over their 30-year operating life, the systems are expected to prevent 13,000 tons of CO_2 emissions. The $4.1 million project cost was offset by over $2 million state and municipal rebates.

Campuswide

The **University of Utah**[162] used a performance contract to construct a new chilled water plant and to revamp dozens of inefficient older campus buildings. Among the improvements were 68,000 new light fixtures, 600 low-flow toilets and 400 fume hood upgrades. When completed, the $39 million, four-year initiative (from 2000 to 2004) saved $6.6 million in energy costs, $400,000 more than expected. The **Penn State University** system has a six-year, $60 million Guaranteed Energy Savings Program (GESP) initiative underway. This massive ESCO-run project is upgrading and recommissioning buildings across its campuses statewide and will lead to savings of around $8 million a year. In this case, the university needed to broker the low-interest loan for the project, but repayment is guaranteed by the contractor. For details, see Appendix A.

Utility & government incentives: Rebates, subsidies and grants

A wide variety of public and private sources for financial help on climate action projects are available, and thanks to the Internet they are getting easier to find—though some states and regions have more to offer than others. Monies may be open-ended, or specified toward feasibility studies, project planning, equipment or construction. A good place to start is the online **Database of State Incentives for Renewables and Efficiency** (**www.dsireusa.org**). DSIRE is a comprehensive source of information on state, local, utility and federal incentives that promote both renewable energy and energy efficiency. It also lists relevant state and federal rules, regulations and policies.

More than two-thirds of states currently have financial incentive programs. Among these are the Public Benefit Funds available in 15 states that come from surcharges on electricity sales and are used for energy efficiency project grants.[163] Many programs are utility- or state-specific (see box). Some state programs offer cost-sharing arrangements of 50% or more which can double the ROI for the campus portion of a project's cost. Programs at the federal level include the EPA's Supplemental Environmental Projects (SEPs) program to distribute settlement money from alleged pollution violators that is to be used for environmentally beneficial community projects such as renewable energy installations.[164] See the 2005 EPA *Toolkit for States: Using Supplemental Environmental Projects to Promote Energy Efficiency and Renewable Energy*.[165]

Large Onsite Renewables Initiative
OF MASSACHUSETTS[166]

The state's Renewable Energy Trust Fund sponsors the Large Onsite Renewables Initiative (LORI) which aims to expand the production and use of distributed renewable energy technologies in Massachusetts. Applicants must be customers of investor-owned utilities and selection is competitive. Three types of grants are available and eligible amounts are calculated through an incentive matrix.

1. **Feasibility Grants.** Capped at $40,000 with an applicant cost share of 15%.
2. **Photovoltaic Design & Construction Grants.** Capped at the lesser of $250,000 or 75% of actual costs.
3. **Non-Photovoltaic Design & Construction Grants.** Design is capped at the lesser of $100,000 or 75% of actual costs. Construction is capped at the lesser of $400,000 or 75% of costs.

When seeking funds from external sources, colleges and universities benefit from shopping around; there may be multiple sources of money available and targeted for different phases of a project. Here's how some schools funded their projects:

- Construction costs of the 1.6 MW wind turbine at **St. Olaf College**[167] (Minn.) were 75% offset by a grant from Xcel Energy's Renewable Development Fund, which paid $1.5 million of the $1.9 million project.
- A CHP facility at **Rowan University**[168] received a $1 million refund in 2006 from The New Jersey Clean Energy Program managed by South Jersey Gas and sponsored by the NJ Board of Public Utilities.
- The $5.7 million cost of a three turbine wind installation at the **University of Illinois at Urbana-Champaign**[169] will be offset by a $2 million grant from the Illinois Clean Energy Community Foundation and $300,000 allocation from the student clean energy fee program.

Student self-assessed fees

For decades, portions of student fees on many campuses have been earmarked for green activities such as recycling programs, Earth Day fairs and environmental organizations. But recently, a few enterprising students at the **University of Colorado** dreamed up the idea of trying to convince fellow students to tax themselves a little bit more to fund the costs of special climate action projects. Such initiatives usually involve proposing a project, promoting it with clever advertising campaigns and then putting the matter to a vote. It has proven not only to be a way to raise quick cash, but also an effective platform for students to "vote with their dollars" on important climate and stewardship issues.

The ballot in 2000 by students at the University of Colorado was the first to raise fees (by only $1 at the time) to pay for wind power. Here are several others.

SCHOOL (# STUDENTS)	FEE (TOTAL)	PURPOSE
Connecticut College[170] (1,900)	$25 / year ($47,500 / yr)	Renewable energy purchase: Wind power, provides 50% of campus electricity.
University of North Carolina at Chapel Hill[171] (26,800)	$4 / semester ($210,000 / yr)	On-campus solar hot water system; geothermal system for new building.
Western Washington University[172] (14,200)	$10 / quarter ($355,000 / yr)	Renewable energy purchase: Green power mix, provides 100% of campus electricity.
Northland College[173] (Wisc.) (700)	$20 / semester ($25,000 / yr)	On-campus Renewable Energy Fund, paid for solar panels, Prius hybrid for college.
University of California, Santa Barbara[174] (21,000)	$2.60 / quarter ($186,000 / yr)	Created Green Initiative Fund for green power, energy efficiency, waste reduction.
University of Illinois at Urbana-Champaign[175] (40,000)	$7 / semester ($560,000 / yr)	Clean Energy Technology Fee ($2) and Sustainability Fee ($5) for projects.

Revolving loan funds

Self-renewing loan funds to support sustainability projects are a relatively new idea for campuses, though one such initiative—the Energy Conservation Measures Fund at the **University of Michigan**[176]—dates back to 1988. The aim of these funds is to provide zero- or low-interest loans for campus projects that have short paybacks—and that otherwise would not be undertaken for want of financing. Savings that accrue pay off the loan, increase the principal and are then reinvested in new projects. Loan funds can be structured so that part or all of the savings return to the fund, growing its project leveraging power. Fund-supported initiatives reduce the environmental impact of the institution (and cut greenhouse gases), save money, and provide educational opportunities for the campus community.

HOW-TO KIT NOW AVAILABLE

A new online resource that explains the steps to establish and manage loan funds is available online: *Creating a Campus Sustainability Revolving Loan Fund: A Guide for Students*, 2007.[177] This guide was written by two students from **Macalester College** (Minn.) who established a loan fund on their own campus.

These two examples show the range of possibilities:

Harvard University's[178] Green Campus Loan Fund provides capital for high 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 GCLF 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 Lawrence 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, GCLF 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.

"A revolving fund capitalizes on the long-term profitability of sustainability projects by covering the initial costs while securing the return they produce for future initiatives."

—From *Creating a Campus Sustainability Revolving Loan Fund*

The Clean Energy Revolving Fund (CERF) at **Macalester College**[179] (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:

UB Green, SUNY-Buffalo

At SUNY-Buffalo, facilities staff are conducting a two-year cold-climate test of a hydrogen-fueled Prius hybrid car, funded by NYSERDA (New York State Energy Research and Development Authority).

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 **University of New Hampshire**[180] is the oldest endowed sustainability office in the nation. Beginning in 1997, 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 Kelly, 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 **George Washington University**[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

Sarah Surak

Banners promote the "Make Orange Green" campaign at the University of Tennessee-Knoxville (see http://environment.tennessee.edu)

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 **University of Colorado**[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 9,484 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. **Middlebury College**[183] (Vermont) made a similar pitch in 2006. Their "Help Us Lose 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. The money will be used for green power, efficient lights, energy conservation and other projects. UT faculty and staff can contribute directly from their paychecks.

Partnerships with local businesses
Teaming up with local business is an approach applicable to millions of students across the U.S. —and a positive step for town-gown relations.

In 2007, for the third year, the **University of New Hampshire's**[187] Office of Sustainability arranged a deal with Ace Hardware in Durham to offer discounts up to 50% on purchases of Energy Star-rated refrigerators, microwaves and other appliances, as well as compact fluorescent (CFL) light bulbs. The discount program extends to UNH and surrounding communities during student move-in in September, with pre-arrival orders available online. It is part of the overall UNH Climate Action Plan called "WildCAP."

"Electricity demand on campus has been growing rapidly, due in part to the increasing number of electronic devices we use. As students begin thinking about setting up their dorm rooms and apartments for the fall semester, it is more important than ever that they make energy efficient choices in lighting and appliances."

—Sara Cleaves, Associate Director, Univ. of New Hampshire Office of Sustainability

7 Support from NWF for Climate as Climate Champions

The Campus Ecology program of the National Wildlife Federation is a respected leader in promoting sustainability on college and university campuses nationwide. For nearly 20 years it has been working with students, faculty, administrators and facilities staff to improve environmental stewardship and wildlife habitat on campus—and also to influence higher education's thinking about its global responsibilities. Campus Ecology staff, fellowships, publications and resources have been instrumental in bringing about climate-positive change on hundreds of campuses. And its growing commitment to that purpose is reflected in NWF's new *Campus Climate Champion* program.

"Campus Ecology has proven to be a valuable resource. We constantly use [their] tools such as the online case studies and we frequently look to other universities through the Campus Ecology Yearbook for new ideas and practices."

—Duke University, North Carolina

Campus Climate Champions are a network of universities, colleges and community colleges that have committed to implementing climate solutions and providing leadership to peer institutions and surrounding communities. NWF Climate Champions make a formal pledge to reduce total greenhouse gas emissions 30% by 2020, averaging reductions of at least 2% per year (with 2005 as the baseline year). Participating schools document their emissions reductions regularly using greenhouse gas inventories, and share their strategies for success with other campuses.

In addition to working to meet emissions reduction targets, Campus Climate Champions also demonstrate leadership on climate change by taking other important steps such as:

- Convening leaders from other campuses to promote climate stewardship.
- Reaching out to decision-makers in the broader community and at state and federal levels to encourage policies that support climate action.

- Participating in national events on climate action such as Focus the Nation and NWF's national Chill-Out Competition: Campus Solutions to Global Warming.
- Influencing campus culture and curriculum to foster sustainable behavior and career choices.

NWF is committed to supporting this network of Climate Champion campuses and strengthening their ability to develop effective local solutions that will reduce their climate footprints. To assist these campuses, NWF will provide resources such as:

- Personal support from knowledgeable campus field staff.
- Priority consideration for Campus Ecology fellowships.
- Prominent recognition for successes and achievements on the NWF website and in other forums.
- Mini-grants to organize regional meetings and conferences.
- Full access to Campus Ecology resources and materials such as teleconferences, online courses, research tools, reports and more.

Schools can learn more about the Campus Climate Champion program at **www.campusecology.org** or by contacting Campus Ecology via email (**campus@nwf.org**) or phone (**703-438-6000**). Applications are accepted on an on-going basis.

A Call to Action

If committing to a comprehensive plan and an 80% emissions reduction by 2050 seems like a daunting goal, sticking to a strategy of 2% per year reduction will make the endpoint more reachable —and will ensure steady, gradual progress. There are big opportunities for energy conservation and other emissions-reducing actions in both the short and long term. At schools with ever-increasing utility bills, cutting even a modest 10% could save a lot of money and significantly reduce greenhouse gas emissions. Encouraged by early gains and with increasing buy-in from the campus and surrounding community, more and bolder initiatives could be attempted. Whatever the level of commitment, NWF urges campuses to begin *today*.

Justin Schott

Over 5,000 students rallied for a clean energy future at Power Shift 2007.

Tackling global warming by implementing energy and emissions-saving solutions is an act of moral courage—in addition to being one of fiscal prudence. The fruits of our labor will not be assured or even known until many years from now. But the goal of climate stability *is achievable*. Building consensus for climate action will, in part, spring from a desire for a sustainable planet for our families and communities. The National Wildlife Federation embraces this objective through its core mission: the protection of wildlife for our children's future. The connection between our actions and climate is clear—whether we are talking about the campus green or the rolling hills of the Green Mountains—the consequences of global warming are likely to affect us all. The question of *how much* rests in our hands.

"We have stumbled into a crisis that invites us to act. Global climate change comes as the greatest of teachers. … We can either have fossil fuels, or polar bears. We cannot have both."

—Guy Dauncey and Patrick Mazza, *Stormy Weather*, 2001

Top 5 for a Fast Start

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

1. Pennsylvania State University System—Net CO_2 reduction despite growth.[188]
(University Park, PA) Penn State is undertaking a university-wide, multi-campus retrofit of its buildings. A performance contract initiative called the Guaranteed Energy Savings Program (GESP) is on track to cut total emissions by 2% per year, or 12% by 2012. In GESP, contractors implement a wide variety of energy and utility savings projects including upgrades of steam traps, HVAC controls, light fixtures and thermostats. Payback on this $60 million, six-year investment initiative, including interest on the loan, is about 10 years. Further emissions cuts at PSU come from the purchase of renewable energy credits (10% of emissions), a variety of additional energy conservation measures (3%) such as converting all exit signs to LEDs, "continuous commissioning" of buildings (2%), installation of a combustion turbine with a heat-recovery steam generator (2%), and miscellaneous projects around campus including the use of biofuels and potentially a methane digester (0.5%). The total is a 29.5% emissions reduction by 2012. But based on expected growth of the campus over the period—and a matching rise in emissions —PSU expects a net emissions cut of about 17.5% below its benchmark level of 620,000 metric tons CO_2 equivalent from the 2005/06 fiscal year.

2. Mt. Wachusett Community College—From coal-based electricity to local, renewable biomass.[189]
(Gardner, MA) In 2002-2003, a coordinated set of energy-saving projects were implemented. The largest, a biomass heating plant using carbon-neutral woodchips for fuel, replaced electric heat on campus. The system reduced electrical consumption by 46% while covering 85% of campus heating needs. Other measures included retrofits of motors, fans and light fixtures. Combined, these projects cut CO_2 emissions by 18%, with the biomass plant contributing three-quarters of that reduction. These projects were bundled into a single performance contract. The college borrowed $1.87 million of the $4.3 million cost. Other funding came from the U.S. Department of Energy ($1 million) and Massachusetts Renewable Energy Trust Fund ($750,000) and utility rebates. Once installed, the combined projects started saving money right away. Annual cost savings of $396,800 have lightened the operating budget and provided a five year simple payback for the loan. In 2008, the college will install a 100 kW solar electric array plus a 900-1,500 kW wind turbine which will further offset utility costs and emissions.

3. University of New Hampshire—Shifting to cleaner sources for big savings.[190]
(Durham, NH) Two major steps combined to cut campus emissions 67% below their 2005 levels. First, UNH converted their campus power plant in 2006 to a cogeneration facility that burned lower-carbon natural gas, eliminating around 22% of emissions. The cogeneration plant cost $18 million but saves around $1 million per year through cost-avoidance. Scheduled to open in 2008, a 12-mile underground pipeline from a local landfill will provide captured methane and replace commercial natural gas as the primary fuel in the cogeneration plant. Because landfill gas is carbon-neutral*, it will drop emissions another 45%. Due to projected fuel cost savings, the $45 million project should be paid off in 10 years.

**As a source of fuel, landfill gas technically is carbon neutral but is controversial because of hazardous contaminants in the gas and the many issues surrounding landfilling as a method of waste disposal. The gas used by UNH, however, has contaminants removed before being piped to campus.*

CONTINUED NEXT PAGE

4. National Wildlife Federation—Aiming for a carbon-neutral national headquarters.[191]
(Reston, VA) NWF has developed a comprehensive plan to reduce the carbon emissions at its headquarters "campus" dramatically, and eventually reduce or offset 100% of these emissions. NWF currently purchases Green-e certified wind power for all of the electricity used at headquarters. However, the organization now plans to directly reduce the building's electricity demand by 70%. The centerpiece is a geothermal heat pump system (57% of emissions savings) to be installed underneath the parking lot. In all, 13 energy conservation measures are being considered at an estimated cost of $1.4 million. Some projects have short paybacks while others will take one or more decades, but the combined simple payback for the package is 16 years—or shorter if energy prices rise, as expected (for specific projects and calculations, see tables below).
A final step is also being considered: a second photovoltaic array that would bring the total direct reduction in HQ emissions to 80% (see table). The remaining headquarters emissions will be offset with the wind power purchase. This project is one piece of an overall effort to reduce NWF's carbon footprint by 2% per year.

National Wildlife Federation Headquarters Emission Reductions Opportunities

ACTION	RESULTING CO_2 REDUCTION (tons)	REMAINING CARBON FOOTPRINT IN TONS (from baseline of 1,000 tons)
13 energy conservation & renewable energy measures, including an energy awareness program. And possibly a second PV array. (70-80%)	700-800	200-300
Green power procurement (20-30%)	200-300	0

National Wildlife Federation Headquarters Building—Reston, VA
Combined Energy Conservation Measures (ECMs)

ECM	DESCRIPTION	ANNUAL ELECTRIC SAVINGS (kWh)	ANNUAL COST SAVINGS	SIMPLE PAYBACK (years)	CO_2 REDUCTION (tons)
ECM-1	Daylighting ballasts on perimeter fixtures	10,950	$821	6.6	6.4
ECM-2	Enhance EMS setpoints	102,800	$7,710	0.4	60.5
ECM-3	Disable VAV boxes	40,190	$3,015	Immediate	23.7
ECM-4	High efficiency domestic hot water	961	$72	5.9	0.5
ECM-5	Solar air preheating	36,948	$2,770	6.2	21.7
ECM-6	Geothermal heating system	978,403	$73,380	17.2	576.0
ECM-7	Solar PV power	12,350	$926	60.0	7.3
ECM-8	Green roof	4,500	$338	14.8	1.9
ECM-9	Solar parking lot fixtures	55,802	$4,185	11.4	31.2
ECM-10	Virtual servers	29,673	$2,225	10.0	17.3
ECM-11	EMS lighting control	37,040	$2,780	3.6	21.6
ECM-12	Solar scrim shading	2,400	$180	27.7	1.4
ECM-13	Energy awareness program	19,220	$1,440	–	10
		1,200,035	**$90,002**	**15.9**	**702.6**

Prepared by EMO Energy Solutions, LLC, Falls Church, VA - 2007 using installation cost estimates for each ECM.
(EMS = Environmental management system; VAV = Variable air volume ventilation system)

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ACKNOWLEDGMENTS

We would like to express our appreciation to the following people for their input and support in developing this document.

The National Wildlife Federation thanks the Kendeda Fund of the Tides Foundation for support of this and other Campus Ecology projects, along with the Educational Foundation of America, Nathan Cummings Foundation and the Town Creek Foundation.

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