Cool Campus!

A How-To Guide for College and University Climate Action Planning

BY WALTER SIMPSON, CEM, LEED AP

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AASHE is a professional, membership-based association of colleges and universities in the U.S. and Canada. Its mission is to promote sustainability in all sectors of higher education—from governance and operations to curriculum and outreach—through education, communication, research and professional development.

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TABLE OF CONTENTS

About Printing this Guide

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AUTHOR'S PREFACE

Almost every day there is another frightening news story about global warming and climate change. We now know that the process of atmospheric warming is well underway and even our most diligent efforts cannot stop it cold. Given the volume of greenhouse gas emissions to date, more atmospheric warming is in "the pipeline." The challenge we now face is to slow down the pace of further warming and hope to stop it before too much occurs and the worst consequences become unavoidable.

While the "eleventh hour" is a moving target, it does appear that we have waited that long to address what is surely the most serious environmental problem we – as a species – have ever faced. Even that characterization understates the problem because global warming is not just an environmental problem; it has many potentially catastrophic social, economic, and political dimensions.

Author Walter Simpson standing on the University at Buffalo's first PV array, financed by energy conservation measures through an energy performance contract (Photo credit: James Ulrich)

Nearly three years ago, echoing the beliefs of many leading climatologists, Jim Hansen issued his famous warning that "we have a very brief window of opportunity to deal with climate change ... no longer than a decade, at the most." Just *ten years* to reverse the trajectory of ever-increasing global greenhouse gas emissions or we risk reaching tipping points where warming occurs on an accelerated and potentially non-linear basis. While we can thank Hansen, who is director of NASA's Goddard Institute for Space Studies, for sounding the alarm, a meaningful response has not yet been forthcoming – at least not here in the nation most responsible for the problem.

Climate action leadership is urgently needed now. Fortunately, President Barack Obama and a large segment of the U.S. Congress appear to be ready to join the international community and begin tackling the climate change problem. It remains to be seen whether this effort will be too little too late but it is a refreshing and hopeful change.

As the federal government steps up, leadership on all levels of society is needed to push us forward to address climate change. Never before has the slogan "think globally, act locally' been more true. Cities and towns need to step up and encourage counties and states to do more. And states need to push the federal government to act faster and do more. This prodding need not be gentle and can get a boost from large and small socially responsible businesses that "get it." In fact, we all need to do more and encourage those around us to act. In this context, the critical role of colleges and universities should not be under-estimated.

Institutions of higher education can and should encourage climate action well beyond the boundaries of their campuses. College and university leadership can inspire action by others by making a commitment to significantly reduce campus greenhouse gas emissions. Schools can do even more by changing their curricula to ensure that graduates fully understand the nature of climate change and are prepared to combat it in their personal and professional lives.

The bad news is that we are in a big mess. The good news is that we know exactly what to do about it. Jim Hansen has argued for these three strategies for putting the brakes on climate change:

- Get the price signals right by putting a price on carbon
- Stop burning coal – the most carbon-intensive fossil fuel
- Make a more serious commitment to energy conservation and renewable energy as alternatives to fossil fuels

All three of these strategies can be implemented on campus as well as taught, studied, and researched at colleges and universities. The vehicle for doing this in a systematic way is the campus climate action plan. This guide is intended to help you create such a plan at your school.

Pricing Carbon. A campus climate action plan is premised on an understanding that releasing carbon into the atmosphere has a huge cost – to the planet, to future generations, and to the credibility and relevance of our educational institutions. Campus climate plans are motivated by a desire to internalize carbon costs by voluntarily investing resources to reduce these emissions. In order to get the price signals right, many schools will even establish a price for carbon and use that number when calculating the cost avoidance associated with greenhouse gas emissions reductions projects and efforts.

Kicking Coal. Unfortunately, many colleges and universities still burn coal directly. And almost all receive electric power from a regional grid that includes coal-fired electricity. A campus climate commitment is all about examining alternatives to coal. An effective campus climate plan will lay out strategies to reduce or eliminate direct or indirect coal-burning.

Conservation and Renewables. Campus energy conservation is old hat to many schools and new to others. Either way, it is the heart and soul of campus greenhouse gas emissions reduction. Hopefully your campus' climate commitment will prioritize and catalyze campus energy conservation efforts. To meaningfully reduce their carbon footprints, colleges and universities need to do more energy conservation than they have ever done before and even more than they ever envisioned doing. That applies even to those schools that are national leaders in energy conservation. There is no cleaner, cheaper, and more effective way to shrink carbon emissions than by conserving energy and using less fossil fuels in the first place. Campus renewable energy installations or green power purchases are critically important as well – and they will be most effective when implemented in the context of serious energy load reduction through energy conservation and efficiency improvement.

It is gratifying to see so many schools making commitments to be part of the climate solution and not just another part of the problem – and especially to see over 600 college and university presidents signing the American College & University Presidents' Climate Commitment (ACUPCC). However, simply making a climate commitment doesn't guarantee success or genuine leadership. What's important is what each school does with its climate commitment – how thoughtfully it is made, how far it goes, and how seriously it is kept.

Ironically and tragically, we have known about global warming and climate change for decades. Admittedly, the science was less certain in earlier years but nonetheless the message has taken far too long to sink in.

I "got it" when I became a parent in 1989. At that time, when my now 20 year old son Jay was just an infant, I wrote a booklet about global warming for use at the University at Buffalo entitled "Greenhouse Blues." At the time, I had to fight with a UB administrator to be able release it – though eventually I did, and in its modest way it alerted members of the campus community to this danger while providing one more reason why energy conservation on campus must be a priority.

"Greenhouse Blues," which I dedicated to my son and through him to all children, concluded with these words, "It is not too late. Catastrophe is not inevitable. Our actions today can make a difference. But it is the eleventh hour, time to cast aside comforting fantasies about the future and act decisively to keep a future worth living." Looking at this twenty years later I don't know whether to laugh or cry. We see two crucial decades lost and a continuing and lengthening "eleventh hour" – perhaps now approaching quarter to midnight – with the window Hansen described as closing quickly.

It has been an honor to work with Association for the Advancement of Sustainability in Higher Education and the American College & University Presidents' Climate Commitment and to collaborate with the peer-reviewers who helped me prepare this campus climate action planning guide. The final product is far from perfect but I hope nonetheless that it will help colleges and universities develop thoughtful, effective plans to reduce their climate impact and demonstrate real climate leadership.

Walter Simpson
World Environment Day
June 5, 2009

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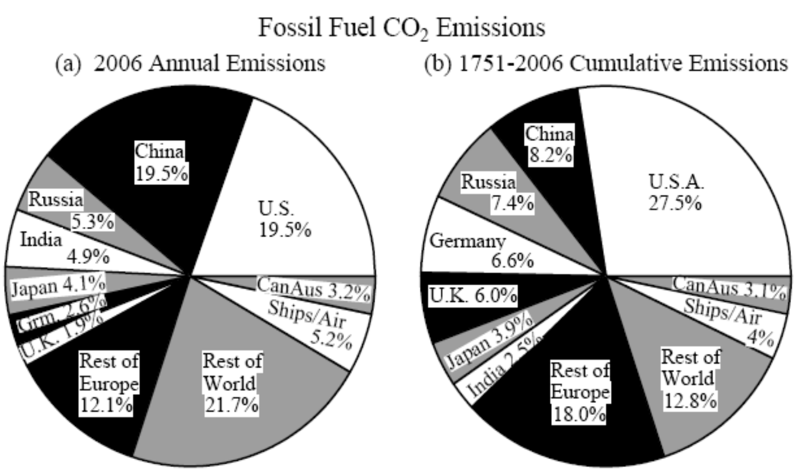
1. INTRODUCTION

1.1 The Movement for Campus Climate Action

Concern about global climate change has existed on college and university campuses for decades. However, it is only within the last few years that institutions of higher education have recognized this problem as *institutions* and done so *en masse.* Often the call for collective campus-wide action has come from students and faculty but occasionally it has emanated from facilities or other professional staff or from the highest levels of campus leadership. It is now commonplace for colleges and universities to make institutional commitments to address the warming of our planet as a result of excessive fossil fuel use and other human activity-induced causes. A movement by colleges and universities to demonstrate leadership on climate change has emerged just in time to catalyze broader societal action on this critical issue.

Initially, schools were largely on their own in efforts to address climate change. While some regional and national organizations like Clean Air-Cool Planet, the National Wildlife Federation's Campus Ecology program, Second Nature, and University Leaders for a Sustainable Future provided some support services to campuses that chose to address climate change academically and in campus operations, it was up to each campus to develop goals, program, process, and resources – and to proceed to implement curricular changes and operational greenhouse gas (GHG) emissions reductions on its own. This changed dramatically in the autumn of 2006 when the American College & University Presidents' Climate Commitment or ACUPCC was founded. Since then over 600 colleges and universities have signed the Commitment and thus have pledged to address climate change in their curriculum and research as well as to achieve climate neutrality at the earliest possible date.



While increasing levels of annual emissions from China and other rapidly industrializing countries are a concern and must be addressed, cumulative emissions over time is the relevant measure of responsibility for climate change since GHG emissions remain resident in the atmosphere and cause warming for many years. These charts show that while China has caught up to the United States in annual GHG emissions, the U.S. bears much more responsibility for global warming due to its cumulative emissions. (Greenhouse gas emissions pie charts provided courtesy of James Hansen)

Campus climate action serves many roles on and off campus – though perhaps its greatest significance is encouraging action off campus in the wider community.

Every advanced industrial nation except the United States has ratified the Kyoto Protocol, the only international agreement that sets binding greenhouse gas emissions targets. Moreover, as of early 2009 the United States had not adopted any meaningful national policies to address climate change despite its significant responsibility for causing global warming in the first place (see pie chart left). This climate protection "policy gap" has been filled to some extent by local, state, and regional climate action – including voluntary programs by colleges and universities. These actions have had the effect of incrementally moving the United States in the right direction despite paralysis on the national level. While it appears that meaningful action to address climate change by the federal government may be finally coming, the leadership role of colleges and universities in this area remains as important as ever. Much time has been lost and all concerned parties must do what they can to accelerate our collective response to this very serious global problem.

The American College & University Presidents' Climate Commitment represents one form of campus climate action. But it is not the only one. For a variety of reasons, some colleges and universities have developed their own campus climate action commitments with different goals and expectations. Despite the different definitions these programs have taken, all schools with climate action commitments have this in common: they recognize the over-riding problem of global climate change and have made an institutional commitment to exercise leadership by responding to it.

1.2 Types of Campus Climate Action Commitments

Campus climate commitments are typically multi-dimensional, addressing curriculum, research and operations. They can be as individual as individual colleges and universities themselves. Even those schools that have signed the ACUPCC have individualized commitments. While ACUPCC institutions may all agree that climate neutrality is their ultimate campus operations goal, climate neutrality dates and interim greenhouse gas emissions reduction goals will be different from ACUPCC school to school as will be their plans to incorporate climate change into curriculum, research, and public engagement.

The wide range of campus climate commitments can be seen by examining the commitments and plans in AASHE's Resource Center and in the ACUPCC Reporting System. As previously explained, an ACUPCC commitment (see section 1.3 of this guide for details on the ACUPCC) is not the only way to demonstrate serious concern about climate change. Any campus commitment to significantly incorporate climate change in the curriculum and reduce GHG emissions, if acted upon and actually accomplished, is important and may demonstrate leadership.

Schools may also choose different ways to define their carbon footprints. Typically Scope 1 and 2 emissions are included. Scope 1 refers to direct emissions, e.g. carbon dioxide released by burning fossil fuels on site, and Scope 2 refers to indirect GHG emissions associated with purchased electricity and other energy utilities.

ACUPCC institutions have agreed that Scope 1, 2 and some types of Scope 3 emissions are part of their carbon footprints and thus must be reduced as per their climate commitment. Scope 3 emissions are other indirect emissions. Of these, ACUPCC institutions agree to count and address emissions resulting from official business air travel and student, faculty and staff commuting. Non-ACUPCC schools may choose to include or omit these types of indirect emissions from their analyses and emissions reduction commitments. (For more discussion about types of emissions, see section 4.1 of this guide.)

1.3 The American College & University Presidents' Climate Commitment

The American College & University Presidents' Climate Commitment is a network of institutions led by a steering committee of college and university presidents and chancellors, and supported by three non-profit organizations:

- Association for the Advancement of Sustainability in Higher Education (AASHE)
  www.aashe.org
- Second Nature
  www.secondnature.org
- ecoAmerica
  www.ecoamerica.org

Participating schools have agreed to incorporate climate change and sustainability into the educational experience of all students and to achieve climate neutrality – a campus operations goal – at the earliest possible date.

For the purposes of the ACUPCC, climate neutrality is defined "as having no net greenhouse gas emissions, to be achieved by minimizing GHG emissions as much as possible, and using carbon offsets or other measures to mitigate the remaining emissions." Thus there is an emphasis on reducing emissions – primarily through campus energy conservation and switching to renewable energy sources – to the greatest possible extent and then or simultaneously addressing remaining GHG emissions with carbon offsets or some other mechanism.

Detailed information about the ACUPCC is available on the program's website, www.presidentsclimatecommitment.org. This site explains the nature of the commitment, lists college and university signatories and supporters, and contains a variety of resources that may be helpful to ACUPCC institutions as well as other schools which have made a commitment to address climate change. Reference to these resources and the ACUPCC will be made throughout this guide since it is intended to serve ACUPCC institutions as well as others.

The ACUPCC website discusses these reasons for signing this campus climate pledge:

- Higher Education must rise to the challenge
- Leadership by presidents and chancellors is critical
- Leadership by Higher Education will accelerate development of new technologies
- Collective action opens up new opportunities and helps to avoid "re-inventing the wheel"

- Standing on the sidelines poses a great risk to the reputation of Higher Education

While ACUPCC participants have agreed to develop plans for eventually achieving campus climate neutrality, it is admittedly a "stretch" goal that is intended to:

- Convey the magnitude of the societal challenge we face, i.e. the world's top scientists say that by 2050 we need to reduce GHG emissions by at least 80%
- Demonstrate leadership and inspire others to act in dramatic ways
- Encourage quick, significant greenhouse gas emissions reductions now
- Galvanize transformational changes on behalf of sustainability

ACUPCC institutions agree to undertake two or more tangible actions while starting their climate action plans. These plans are expected to be completed within two years of signing the ACUPCC.

1.4 What Is a Climate Action Plan and Why Develop One?

There are a variety of real-world reasons why campus leaders make commitments to academic and operational programs to address climate change. These include:

- Awareness of the problem of global climate change and a desire to contribute solutions
- A belief that in order to remain socially relevant a focus on climate change is necessary
- The perception that GHG emissions reductions will have substantial value with regard to reducing operating costs; attracting students, faculty, and funding; increasing productivity; and/or improving public relations
- Knowledge that other schools are doing it or are likely to do it ("so let's get on the bandwagon")
- The belief that implementing a climate commitment will not be that difficult given already existing environmental initiatives on campus
- Campus environmental advocates insisted that it is the right thing to do!

Of course, making a commitment and keeping it are two different things. On many campuses – especially those that have made genuinely challenging climate commitments – there are undoubtedly students, faculty and staff wondering, "Now that we've made a commitment, how do we get there from here?" That's where a campus climate action plan comes in.

While ad hoc actions can take you in the right direction, a plan can provide:

- A better understanding of the scope of the challenge
- An opportunity to define goals, strategies, and tactics
- A blueprint for action – defining the best way to proceed
- Milestones to measure progress
- A process which encourages collaboration and brings people together
- An institutional commitment and an effective response to climate change

A campus climate action plan can be a roadmap to get your school to the promised land of climate protection. Important components of a campus climate plan include:

- Your academic, research, and campus operations climate action goals
- Target dates for achieving goals including interim goals
- Strategies and actions to:
    - Make climate change a part of the curriculum and other educational experiences
    - Expand research on climate change and potential solutions
    - Reduce the institution's GHG emissions
- Mechanisms for tracking progress on goals and actions

In all likelihood your climate action plan (CAP) will contain more than these items since it is one thing to list planned actions and quite another to include all the details needed to facilitate actual implementation. Practical considerations such as funding and financing will have to be incorporated. The proper sequencing and combining of actions is important, not only so momentum is created but also so your plan can take advantage of synergies and allow early steps to set the stage for later ones. Since the success of your plan requires on-going effort by so many different individuals, offices, and constituencies on and off campus, you may find that the process used to develop the plan is as important as the final plan itself.

For sample campus climate plans, see: the "Climate" section of the AASHE Resource Center and the "Overview and Examples of Climate Action Plans" section of the ACUPCC website.

1.5 About this CAP Guide

While a number of excellent campus climate planning resources are available, this guide attempts to fill a gap by providing an abundance of "how-to" information. The goal of the guide is to assist climate action planning teams at schools that are well versed in campus climate issues and well along in the CAP process as well as those that are just beginning in this endeavor and may be wondering *where* to start and *what* to do. This guide deliberately errs on the side of providing a lot of detail to maximize its potential helpfulness. Apologies if there is too much detail!

Planning steps are presented in a logical sequence, but you may find that proceeding in a different order makes more sense for your school or that working on a number of these items simultaneously will be most effective. You can also use this guide as a reference book and just consult topics of interest.

All of the topics covered in this guide would make more sense if amply illustrated by real-life examples of campus projects and initiatives. However, to keep the guide's length manageable, campus examples are generally provided via reference to appropriate webpages on the AASHE and ACUPCC websites. In the event that campus examples for particular topics are not available on these sites (or if there are other websites with good campus examples), those other links are also provided.

Section 12 of this guide, "Campus Climate Action Planning Resources," lists and provides links for a number of other helpful CAP resources – organizations, publications, and web-based information.

Especially good resources in the campus climate action planning area are:

- National Wildlife Federation Campus Ecology publication, *Guide to Climate Action Planning: Pathways to a Low Carbon Campus*, which describes seven campus climate action plans
- APPA's *The Educational Facilities Professional's Practical Guide to Reducing the Campus Carbon Footprint*, a guide especially written for facilities managers.
- AASHE's Resource Center is the most complete and extensive green campus web resource of its kind. Note that some portions of this resource center have "members only" access so you may need to log in to use them. If your institution is not an AASHE member, information about joining AASHE is available on AASHE's membership pages.

2. CREATING AN INSTITUTIONAL STRUCTURE FOR YOUR CLIMATE ACTION PLAN

An important first climate action planning step is creating appropriate institutional structures for preparing and implementing your plan. Typically, this means identifying participants and establishing one or more committees or working groups – necessarily working with the full blessing, support, and involvement of top campus leadership. As you develop your CAP team, be sure to focus on existing institutional strengths and attempt to bring into the fold those who have already been working in this field, academically or operationally.

2.1 Your CAP Team and Leadership

If your school already has sustainability staff or an energy officer or manager, these are key players and should be involved in leadership roles. Your campus environmental task force or sustainability committee also should play a central role. This committee may not have all the right people, expertise, or organizational capacity to undertake full supervision of the development of your CAP but it should be substantially involved in the process. There is everything to gain by including already identified campus environmental leaders, advocates, and enthusiasts on your CAP team.

Who are the people, offices, and constituencies that should be included in some way? Here is one possible list:

- President's Office
- Board of trustees
- Vice presidents' offices including chief academic and business offices, VP for student affairs, VP for research, etc.
- Key operations offices including facilities management, purchasing, transportation, public relations, etc.
- Chief information officer (to address green computing)
- Energy officer or manager
- Sustainability director and staff
- Campus environmental/sustainability committee or task force
- Faculty and staff senates
- Faculty experts
- Student government officers
- Student environmental clubs
- Alumni
- Key community experts and representatives

Since our ultimate goal is to save the planet from the ravages of climate change, it is important to go beyond the confines of the ivory tower, get off campus, and include the wider community. Thus, your CAP team might include one or more liaisons with local government. Such an arrangement might inspire your county or local cities and towns to develop their own climate action plans. Similarly, if other schools in your area are committed to making significant reductions in GHG emissions, it could be mutually beneficial to include liaisons from each campus on CAP committees or organize a regional campus climate action consortium with many campuses participating. Quarterly meetings of the consortium would provide a great opportunity to share notes and resources, pick each others brains, and provide mutual support.

But who will lead the CAP effort? The leader or chair could be your sustainability director or energy officer, if he or she has enough experience and the right credentials, or a prestigious faculty member who is given release time to take on this project. It could be a special assistant to your school's president. Conceivably it could also be a very exceptional student who hopefully would be given substantial academic credit for taking this project on. An undertaking this large could have co-chairs. Whoever is selected to lead should be enthusiastically committed to climate action, have strong technical background in relevant areas, be engaging, fair, well-liked, and be able to motivate others and build a strong team.

The leader must be a collaborator at heart and encourage collaboration among all CAP team members and other members of the campus community. He or she must recognize key contributions while making all CAP team members feel as though the time spent on this project is time well spent – especially since many will be serving as "volunteers." The leader must be on good relations with your president, have a direct line to him or her, and be able to bridge the gap or perhaps "the great divide" that may exist between campus leadership and campus grassroots. In the end, this is a people process and personalities make a huge difference. The right or wrong person or persons leading the CAP process can make world of difference.

2.2 CAP Committee Structure

Developing a CAP is a complicated and multi-faceted undertaking. While it's a good idea to invite all interested and relevant parties to the table, they probably will not all fit around the same table! That means creating sub-committees or working groups. Here is a possible CAP organizational structure:

- CAP Steering Committee – Led by the CAP chair (or co-chairs), this committee reports to your campus president and chief academic and business officers and is responsible for overall CAP development, coordination, analysis, goal setting, and preparation along with supervision of the following sub-committees:
- CAP Sub-Committees
    - Curriculum and Research – responsible for developing those aspects of your CAP which will introduce climate change and sustainability into the curriculum, and enhance research to address climate change
    - Greenhouse Gas Inventory – responsible for creating, interpreting and periodically updating your campus GHG inventory
    - Energy – responsible for developing the energy conservation, on-site renewables, green power purchasing, new construction/green design, CFCs, and carbon offsets GHG emissions reduction strategies and projects

- Transportation – responsible for developing fleet vehicles, campus bussing, commuting and air travel components of your plan
- Solid Waste, Purchasing and Food – responsible for GHG mitigation areas not addressed by other sub-committees
- Communications – responsible for (a) keeping the campus community up-to-date on your school's climate action efforts and (b) developing and implementing plans to involve that community as much as possible in both the planning process and in actions that reduce GHG emissions

While all of the sub-committees have important assignments, the energy committee in particular has some heavy lifting to do. To accomplish its task, it might make sense for that sub-committee to create and manage individual working groups for each area – energy conservation, on-site renewables, green power purchasing, new construction/green design, CFCs, carbon offsets, etc. The energy sub-committee may be heavily comprised of facilities staff members who are responsible for campus energy systems and have expertise in the areas of concern.

Involving students in all committees and working groups is an effective way to maximize the CAP process' educational value.

Most campuses already have a proliferation of committees and meetings – so there is something to be said for economizing on the creation of new committees. Maybe existing committees can be assigned responsibility for some of the CAP tasks. Whatever structure you create, it should be a good fit to the way your school does business.

2.3 Transparency and Stakeholder Participation

Colleges and universities are intellectual communities whose members appreciate openness and enjoy vigorous public debate. Your CAP team should reinforce these desirable inclinations by maintaining a fully transparent process with lots of public or stakeholder participation and discussion. There are a variety of ways of doing this. Meetings of the steering committee and sub-committees can be advertised as "open meetings" so interested parties can sit in. Periodic reports and updates can be issued and publicized. Occasional presentations, workshops, and town meetings plus a regularly updated CAP website will keep the campus community informed and on-board.

Another way of encouraging participation and garnering support for the climate action planning process is to create a personal climate pledge for students, faculty, and staff. Those taking the pledge might commit themselves (and potentially their families as well) to achieving deep GHG emissions cuts or climate neutrality by a certain date. Through the pledge they might also commit to taking certain individual actions on campus that would help reduce greenhouse gas emissions and support the climate action planning process in a variety of ways. For example, a faculty member might make a personal promise to incorporate climate change and sustainability into his or her courses and curriculum planning. Of course, to make a personal climate commitment program work, helpful resource materials and training programs might be needed plus lots of outreach and encouragement.

2.4 Getting Started

As one of its first acts, the CAP Steering Committee – with full involvement from sub-committee members – could conduct a kick-off workshop, "charrette," or even a day-long retreat to:

- Review your campus climate action commitment or ACUPCC charge (if an ACUPCC signatory)
- Engage in a visioning exercise
- Conduct a SWOT analysis (see below)
- Ascertain CAP team members' interests, skills, and connections
- Assign sub-committee and individual responsibilities
- Identify near-term tasks

The vision exercise is a facilitated brainstorming session that asks CAP participants to imagine and create a vision of their institution as a genuine leader in addressing climate change, an institution that is:

- Teaching students to understand climate change and to help solve it after they graduate
- Doing critical research which contributes to climate change solutions
- Achieving deep cuts in GHG emissions
- Setting an example and inspiring the wider community to become part of the solution too

The results of this exercise can be captured in a vision statement. This exercise is essential because the CAP process requires departing from past practice and "business as usual" and thus imagining a different future.

A SWOT analysis identifies institutional Strengths, Weaknesses, Opportunities, and Threats that will help or hinder the CAP planning process and eventual achievement of CAP goals.

It's important that the CAP process be viewed as meaningful and effective public service as well as an enjoyable experience. The kick-off workshop should set the right tone. It's important that your school's president start it off with a brief statement and a hearty thanks to all participants.

2.5 Energizing the CAP Process

Here are some ways to energize your CAP team and its work:

1. Make sure you have an energized leader who is genuinely passionate about addressing the climate problem. This person needs to be inspiring and bring an abundance of positive energy, enthusiasm, and good personal relations to all aspects of your work.

2. Be inclusive and invite onto your CAP team those who care the most about climate change and who bring the most positive energy to the work. Behind this point is a simple truth: energized people energize others! So open the door and invite these spark plugs onto your team.

Cartoon courtesy of Tom Toles

3. Regularly remind your CAP team how important their work is by reviewing the critical nature and urgency of climate change while at the same time sharing positive developments. This is all about merging "gloom and doom" with hope! Both can motivate – though neither by itself is very effective. Guest speakers or faculty lectures on climate change can underline the importance of your work. Perhaps start each CAP meeting with a different committee member sharing two news stories, one about the latest scientific findings (generally bad news) and one about efforts underway to constructively address the climate problem (good news). To stay up-to-date with the latest news on climate change, consider signing up for the weekly newsfeed "Earth Equity News" from the Climate Crisis Coalition – founded by "climate crisis crusader" Ross Gelbspan among others.

4. Explore the emotional side of the climate change issue. While your CAP meetings may need to be business-like, it's important to find opportunities and venues where team members as well as others on campus can get in touch with their emotions about climate change. The reality is that most of us, even environmental activists, are in deep psychological denial about this threat. To some extent, denial or psychic numbing is a necessary coping mechanism. But denial is also a danger since it diminishes our perception of the problem and excuses a lack of effort or urgency in addressing it. Of course, helping people get in touch with their emotions is risky because it could be a painful experience and send them running for the hills! It's important to help people understand that they hurt when they contemplate the danger of climate change because they care so much about their families, future generations, human society, other species, and the future of life and the Earth itself. That understanding can help overcome paralysis and produce deep positive motivation to continue this important work.

5. Ask your president to regularly demonstrate interest and support. Regular visits by your campus president to see how your CAP work is progressing will do wonders to keep spirits and enthusiasm high. Providing the resources you need is also critical to CAP energy levels. It might make sense to schedule an informal get together with your president, say every six months, to share with him or her progress and problems-to-date and thus to invite his/her continued involvement, encouragement, and support. Keeping your president personally engaged will help your CAP team stay personally engaged.

6. Develop a strategy to regularly celebrate small victories (as well as occasional large ones). Achieving ambitious climate action goals will probably take many years. To keep your climate action program stoked up during this period, you want to celebrate many smaller victories and achievements along the way. These small victories and your celebrations of them are so important that it makes sense to be very conscious and deliberate in identifying them within your CAP and making plans ahead of time to announce and celebrate them. These celebrations are great occasions for bringing your entire extended CAP team together, inviting campus leadership to say a few words, and praising/rewarding those who did the most to make the accomplishment you are celebrating happen.

7. Have fun. Let's face it: so much of what we do on campus wears us down, especially when campus politics intervene. Contemplating the fate of the Earth is also a difficult assignment. So finding ways to have fun as you undertake campus climate action is very important.

2.6 CAP Communications

Reducing GHG emissions is a multi-faceted challenge. There are very strong awareness and behavioral change components. Thus, a communication strategy is key. That strategy should not only inform people about and invite them into the CAP process but it should encourage and facilitate their involvement as change agents, implementing carbon reductions and the CAP itself.

To be most effective, a communications strategy should tailor its message and media to different audiences on campus. Different strokes for different folks. At least these four steps are involved:

- Identify various campus constituencies
- Understand what gets their attention, motivates them, and how they can help
- Develop appropriate focused communication tools to reach them
- Provide incentives, rewards, and recognition where you can

Given the importance of communications to reducing carbon emissions on campus, it makes sense to involve faculty and professional staff experts in communications, public relations, art, design, and media.

There are better and worse ways of communicating with and motivating people. For some great ideas, see *Fostering Sustainable Behaviour: an Introduction to Community-based Social Marketing* (Doug McKenzie-Mohr and William Smith, 1999) and *The Low Carbon Diet: A 30 Day Program to*

Lose 5000 Pounds (David Gershon, 2006). The latter resource is often used in "global warming cafes" which use a highly effective methodology for motivating action on climate change.

2.7 Staffing and Resources Issues

But no matter how you look at it, addressing climate change in a serious way will increase workload. That's reality. It needs to be addressed irrespective of whether the work takes place in new or existing campus organizations. While smaller schools may find the additional workload of the CAP process more manageable than larger schools, developing a plan and especially implementing it will be more work even if you hire a consultant.

This raises closely related issues of staffing and funding. Effective campus climate action requires staffing, possibly new staff who will have the expertise and credentials to guide the planning process as well as provide the coordination and management to make sure the plan gets implemented. Implementing a CAP involves many tasks and getting those done will also impose other staffing needs to complete, and track needed projects and initiatives. Bolstering facilities staffing in the area of energy conservation is an obvious priority. If an existing staff member is assigned a major role in CAP planning or implementation, it may be necessary to "backfill" his or her position.

Adding staff and providing new resources during a time of economic stress is always difficult – though campus climate action advocates can argue that the climate program should be prioritized or at a minimum treated just like other campus programs that are adequately staffed and funded. In fact, on most campuses a great many programs are fully staffed that have far less significance – pedagogically and operationally – than campus efforts to responsibly address climate change. The extent to which your school provides the needed staffing and resources to develop and implement an aggressive and viable CAP is a true measure of top-level commitment. It will show in your final product and chances of success.

2.8 CAP Institutionalization

Success requires that climate action become an integral part of the way your college or university does business – day to day and over the long run. In other words, climate action needs to become institutionalized, part of "business as usual." The challenge here is making sure that successful institutionalization doesn't push climate action into the background. Your CAP and climate commitment need to be raised to a high profile and remain there.

Institutionalization of the climate initiative can be at least partially accomplished by incorporating the commitment into key documents that guide campus decision-making and planning, such as vision and mission statements, strategic and campus master plans, campus-wide policies, and annual "state of the institution" speeches by your president. But better than exploiting these modest opportunities is recognizing the unprecedented transformational potential of responding to climate change. For those colleges and universities that take this challenge seriously, addressing climate change can become a process for entirely rethinking our institutions of higher learning – thus increasing higher education's relevance and responsiveness to the larger problems we face as a planetary society.

While there are a great many factors critically important for successful institutionalization of your CAP, at the very top of the list is continuous support and encouragement by your president and top campus leadership. They need to follow the planning process carefully, support and empower those who are developing the plan, be realistic about what will be required, provide needed resources and staffing, set an example in their own behavior and the operation of their offices and units, and use the bully pulpit of their offices to educate and motivate the campus community to step up and be part of the campus climate solution. Yes, that's a tall order.

2.9 Some Guidelines for Hiring a CAP Consultant

Organizational capacity or expertise limitations may be overcome by selecting and hiring a consultant to assist campus participants develop a CAP. Even if your college or university is fully capable of developing a CAP on its own, it still may make sense to hire an expert consultant to increase the likelihood of developing the best possible plan in a timely fashion. Here are some possible criteria to use in selecting such a consultant to assist with the operations or GHG emissions reduction component of your CAP. While finding all of these attributes in one consultant might be difficult or impossible, ideally a consultant hired to complete or assist a climate action plan would:

- Demonstrate a strong corporate commitment to sustainability
- Have extensive experience in the primary greenhouse gas emissions mitigation areas, i.e. energy conservation & efficiency, power plant fuel conversion, renewable energy technology installation, green power purchasing, space planning and green building design, transportation planning, carbon offsets, etc.
- Be especially knowledgeable and have a proven track record in the area of energy conservation and efficiency, possibly having completed comprehensive energy master plans, large self-financing energy projects, or retrofit projects that have produced deep cuts in energy use in already energy efficient buildings, etc.
- Be able to demonstrate knowledge of the barriers large organizations like colleges and universities face that prevent them from adequately addressing energy and climate issues – as well as demonstrating knowledge about how to overcome these barriers
- Have experience working in a campus setting with diverse stakeholders that often have conflicting interests
- Demonstrated ability to conduct and interpret a GHG inventory
- Be able to use and provide helpful evaluative tools and measures to prioritize and sequence actions, projects, and measures
- Demonstrate the ability to identify creative financing strategies for large projects and successive projects over time
- Be skilled in developing educational and promotional resources for outreach purposes

- Have completed one or more successful campus climate action plans which you can review (though this is a new field and highly qualified firms might not be able to provide completed plans at this time)

In addition to the above, ACUPCC institutions should seek a consultant with thorough knowledge of the ACUPCC and who is able to explain the pros and cons of strategies which could lead to carbon neutrality.

3. PRIORITIZING EDUCATION, RESEARCH, AND PUBLIC ENGAGEMENT

3.1 Climate Change and Sustainability in the Curriculum

The world faces not only a climate change crisis but also threats to sustainability on all fronts. Thus, it is essential that colleges and universities formally acknowledge these transcendent problems and reorient academic programs to be relevant to the challenges all future graduates will face. Higher education has an obligation to lead in creating a healthy, just, and sustainable society.

It is essential that campus climate action plans address the curricular component of this challenge by making climate change and sustainability an important part of the curriculum and other educational experience *for all students*. Curriculum changes should involve all students given the critical nature of the climate and sustainability challenges we face and the urgent need for future professionals, leaders and citizens in all disciplines to be engaged and part of the solution to these problems.

To assist colleges and universities to do this, the ACUPCC has prepared *Education for Climate Neutrality and Sustainability: Academic Guidance for ACUPCC Institutions* (April 2009), a document which can be used effectively by all schools irrespective of their involvement with the ACUPCC. This chapter is draws heavily from the ACUPCC guide.

This guide recommends action and change in three areas:

- The Content of Learning – to reflect interdisciplinary systems thinking, dynamics, and analysis for all majors and disciplines with the same lateral rigor across the disciplines as there is vertical rigor within them
- The Context of Learning – to make human/environment interdependence, values, and ethics a seamless and central part of teaching all the disciplines, rather than isolated as a special course or module in programs for specialists
- The Process of Education – to emphasize active, experiential, inquiry-based learning and real-world problem solving on the campus and in the larger community

Content of Learning – What do we want students to learn?

An excellent set of content recommendations for sustainability education was contained in the *Essex Report*, a 1995 document presented to President Bill Clinton's Council on Sustainable Development. In that report, education leaders recommended teaching and learning experiences that enable students to understand:

- How the natural world works
- The interdependence of humans and the environment

- How to assess the effects on humans and on the biosphere of human population dynamics; energy extraction, production and use; and other human activities such as agriculture, manufacturing, transportation, building and recreation
- The relationship of population, consumption, culture, social equity and the environment
- How to apply principles of sustainable development in the context of their professional activities
- Technical, design, scientific and institutional strategies and techniques that foster sustainable development, promote energy and natural resource efficiency and conservation, prevent and control the generation of pollution and waste, remediate environmental problems, and preserve biological diversity
- Social, cultural, legal and governmental frameworks for guiding environmental management and sustainable development
- Strategies to motivate environmentally just and sustainable behavior by individuals and institutions.

To that list of educational outcomes can be added specific knowledge and understanding about global climate change:

- The causes and consequences of climate change
- Its severity and urgency
- The key role played by energy policy and practice
- Behavioral, technological, policy, and political solutions
- The role of institutions, businesses, governments, citizen and professional organizations, and individuals to address this problem
- Personal empowerment to become a change agent

The Context of Learning – What are the avenues available to academics for educating students about sustainability?

There are a variety of opportunities to introduce and address sustainability and climate change in the academic context. Some of these opportunities are course and program-specific while others infuse eco-literacy across the curriculum and in other student learning opportunities. These opportunities include:

- Including sustainability education in freshmen orientation
- Requiring students to take courses introducing these concepts
- Providing elective courses on these concepts to all students
- Integrating these concepts into existing courses
- Offering existing courses to more students
- Creating new multidisciplinary and interdisciplinary courses
- Creating new programs, institutes, and colleges
- Integrating sustainability across the curriculum

The Process of Education – What are the pedagogical methods for teaching systems thinking and the interdisciplinary concepts of climate change and sustainability?

Possible pedagogical methods include:

- Active, experiential, inquiry-based learning
- Student-based campus projects
- Outreach partnerships with local nonprofits and the community

A variety of strategies can be used to develop the capacity to launch and undertake these changes:

- Broad administration support for this intellectual direction (e.g. making it integral to mission, providing rewards/incentives for faculty, putting someone in charge of coordination)
- Broad involvement of faculty across the arts, sciences, humanities, social sciences, engineering and graduate professional schools
- Involvement of key staff members, e.g. facilities staff who can provide "campus as learning lab" experiences for students
- Faculty and staff development workshops
- Strong connection of formal education to practice of sustainability on the campus and with local and regional communities
- Strong student support and involvement and encouragement for student-based initiatives
- Ongoing attention, measurement of progress and re-adjustment

Here are some other specific ideas for greening academics:

- Establish a sustainability graduation requirement
- Include students and faculty on design committees for new buildings (or research projects intended to look at alternatives to new construction)
- Conduct your greenhouse gas inventory or campus environmental audit as a student or class project
- Develop student-faculty-facilities teams to research "deep efficiency" for existing buildings and renewable energy applications on campus
- Invite students and faculty to join and fully participate in campus sustainability committees as well as CAP committees and sub-committees.
- Participate in national climate change awareness raising and action initiatives like "Focus the Nation" and the "National Teach-In on Global Warming"
- Encourage and empower student environmental activism and clubs
- Organize an annual campus climate summit
- Invite nationally renowned expert speakers on climate change and sustainability to your campus
- Create Student Life residential environmental education initiatives such as "Eco-Reps," on-campus sustainable living opportunities, etc.

For campus examples and more discussion, see the "Academics" page of the "Solutions" section of the ACUPCC website and the Curriculum section of AASHE's Resource Center.

3.2 Climate Change and Sustainability Research

Another avenue for addressing climate change on campus is research. ACUPCC institutions agree to develop climate action plans that expand research and other activities that will address climate change. Of course, schools that have not signed the ACUPCC may want to expand research in this area as well.

Refocusing research on campus is a tall order since faculty research is driven not only by institutional priorities but also by the research interests of existing faculty (and they know their research interests and generally don't take kindly to others telling them what they should be interested in). The availability of research dollars is also a critically important factor. Fortunately, identifying new faculty with an interest in climate change-related research is probably going to get easier now that awareness of and concern about the climate change problem is becoming the norm in the U.S. Also, with the new Obama Administration it is clear that climate change is going to be dealt with seriously. Thus, even in the context of the current economic meltdown and unprecedented federal budget deficits, it is likely that much more money will be available for research in this critically important area.

Here are some possibilities for increasing on-campus research on climate change, drawn from a variety of sources including the ACUPCC Implementation Guide. This guide contains helpful information for ACUPCC and non-ACUPCC institutions alike:

- Identify climate change research as a major institutional priority
- Create new major research initiatives and academic centers in the area of climate change and sustainability
- Make a priority commitment to hire new faculty with expertise and interest in climate change and sustainability
- Establish fellowships or other financial support mechanisms for research related to climate change and sustainability
- Provide climate change and sustainability oriented research for students
- Connect research initiatives to the GHG emissions challenges your campus is facing including the development of renewable energy technologies and local sources of biofuels, carbon neutral engine technologies for autos and aircraft, hyper-efficient building systems to make zero emissions, net-energy producing buildings the norm rather than a rare exception, etc.
- Celebrate, reward, and publicize research on climate change and sustainability

For campus examples, see the Research section of AASHE's Resource Center.

3.3 Public Engagement on Climate Change

Here are some possibilities for increasing your school's public engagement on climate change taken from a variety sources including the ACUPCC Implementation Guide.

- Create a collaborative of local and regional colleges and universities working together to encourage, help and support each other achieve GHG emissions reduction goals
- Initiate service-learning and community service activities for students related to climate change and sustainability
- Encourage faculty to participate in public service activities that assist local governments, community organizations, businesses, and institutions to reduce GHG emissions and address climate change – and reward those activities when considering promotions or tenure
- Convene an annual regional climate change summit
- Develop town-gown community climate partnerships or initiatives to mobilize community leaders and use campus intellectual, financial and leadership resources to move the surrounding community to address greenhouse gas emissions and sustainability
- Engage in the public policy process to lobby for policies at all levels of government that will make it easier for campuses to achieve their climate goals since deep cuts in GHG emissions will not be possible on or off campus unless there are broader societal shifts
- Develop programs to assist students, faculty and staff to upgrade their own residences through improved energy efficiency and better utilization of solar energy to reduce greenhouse gas emissions
- Create a regional clean energy demonstration and resource center to inspire, educate, and assist members of the wider community to use conservation, efficiency, and clean, renewable energy to improve energy affordability and comfort while reducing greenhouse gas emissions
- While avoiding green-washing and exaggeration, widely publicize campus climate protection activities and success stories to motivate other community actors to get involved addressing climate change

And don't forget:

- Try to make all outreach events and activities climate neutral and as sustainable as possible, and publicize your efforts in this area to encourage others to organize green events and activities as well

Conferences and meetings can be carbon-free by locating them convenient to public transit, maximizing the use of teleconferencing, reducing on-site energy use and carbon emitting behavior, and then purchasing carbon offsets for remaining GHG emissions. See TerraPass' Event and Conference Carbon Footprint Calculator for an easy way to calculate these emissions.

Many sustainable event planning manuals are available on-line. For examples, see:

- Earthwatch Institute's Green Event Resources
- The National Recycling Coalition’s Green Meetings Policy
- Monash University's Sustainable Catering and Events Guide

There are many such manuals though the latter one from Monash University in Australia is somewhat unique in encouraging vegetarian food. See section 5.8.3 of this CAP guide regarding the significance of livestock production and diet in causing GHG emissions.

4. DETERMINING YOUR CARBON FOOTPRINT AND EMISSIONS TRAJECTORY

4.1 Conducting a Greenhouse Gas Emissions Inventory

While it is not necessary to conduct a campus GHG inventory to reduce GHG emissions, a GHG inventory is an essential step in assembling a CAP. ACUPCC participants agree to conduct a greenhouse gas (GHG) inventory within one year of signing and then to update that inventory at least every other year. This frequency for renewing a GHG inventory is appropriate for all campuses pursuing GHG reductions.

A GHG inventory will provide a general diagnosis and a measuring stick to determine success or failure in your efforts to reduce GHG emissions. The inventory does this by establishing and quantifying your campus' carbon footprint in terms of metric tons of carbon dioxide equivalent per year ($MTCO_2e$/yr). Metric units are used because of the international nature of GHG emissions accounting. GHG emissions are quantified in terms of "CO_2e" or carbon dioxide equivalent.

There are a number of greenhouse gases whose atmospheric concentrations are increasing as a result of human activity. These GHGs include carbon dioxide, methane, nitrous oxide, ozone, and chlorofluorocarbons. While all these GHGs are significant, carbon dioxide emissions from burning fossil fuels and destroying forests are having the greatest impact on climate. By international convention, emissions of all GHGs are generally given in terms of equivalent amounts of CO_2 or CO_2e. The CO_2 equivalence of non-CO_2 GHG emissions is calculated by multiplying the mass of the greenhouse gas in question by the associated Global Warming Potential (GWP) of that gas. GWP is a measure of the relative contribution to global warming produced by a given mass of greenhouse gas compared to the same mass of the reference gas, carbon dioxide. The GWP of a gas is determined based on a given time horizon. See the table on page 2 of the U.S. Inventory of Greenhouse Gas Emissions for GWPs of various greenhouse gases over a 100 year time horizon. Carbon dioxide, as the reference gas, is assigned a GWP of 1.0.

A campus GHG emissions inventory is also an awareness raising tool. It allows green campus advocates to equate energy-wasting activities to the problem of climate change by showing their consequences in terms of GHG emissions. This can be a big wake up call. Given increasing public awareness and concern about climate change, making this connection can motivate behavior change.

The first time you calculate your annual GHG emissions it makes sense to do so not only for the most recent year for which you have data but also for a number of preceding years in order to reveal your GHG emissions trajectory. By comparing inventories of successive years, you can see additional trends which will help your analysis.

These steps are involved in conducting a GHG inventory:

- Determine which categories of emissions you will be including. The possibilities include:
    - Scope 1 emissions – all direct emissions, i.e. from sources owned or controlled by your institution
    - Scope 2 emissions – indirect emissions from purchased electricity, steam, heating, and cooling
    - Scope 3 emissions – all other indirect emissions upstream and downstream
- Determine your time horizon, i.e. the years you plan to inventory
- Select your GHG inventory tool (see section 4.2 of this guide)
- Determine what input data you will need and gather that data
- Run the inventory spread sheet
- Analyze the results

GHG emissions scopes 1, 2, and 3 are defined by international protocols. Your campus climate commitment and CAP should specify which categories of GHG emissions you are committed to measuring and reducing and to what extent.

In making a commitment to climate neutrality, ACUPCC participants have agreed to eventually fully mitigate the following categories of GHG emissions and thus should include them in their GHG emissions inventories:

- Direct combustion of fossil fuels by equipment which is owned by and controlled by your school such as boilers, furnaces, fleet vehicles, etc. (Scope 1)
- So-called “fugitive emissions” from on-campus releases of CFCs and HCFCs and on-campus releases of methane from farm animals (if you have them) (Scope 1)
- Purchased electricity, steam, heating, and cooling (Scope 2)
- Commuting by students, faculty and staff to and from campus (Scope 3)
- Business air travel paid for by or through your school (Scope 3)

Non-ACUPCC signatories are not bound by this list, but may wish to draw similar boundaries for consistency. While accounting for commuting and air travel emissions is optional in most formal emissions reporting programs, it can be helpful in deciding how to allocate limited resources so as to maximize GHG reductions. It can also help ensure that institutions receive credit for taking actions that reduce such emissions but increase scope 1 and 2 emissions. For example, starting a new shuttle program will increase scope 1 emissions but will likely decrease commuting emissions even more. Likewise, building a new residence hall will likely increase the institution's scope 1 and 2 emissions but could potentially reduce emissions from commuting even further.

Many institutions also choose to include emissions from additional GHG sources in their inventories since counting and discussing them increases the likelihood that efforts will also be made to reduce them. These other sources of GHG emissions include waste disposal, embodied emissions in the products and services your college or university buys, outsourced activities, contractor owned vehicles, and even line losses associated with bringing electric power to your campus. Of the above, the most easy to calculate may be the GHG emissions associated with waste disposal since the Clean Air-Cool Planet "Campus Carbon Calculator" (see section 4.2 of this guide) is already set up to do this. The embodied energy in product purchasing is undoubtedly huge but can be quite difficult to calculate.

4.1.1. Greenhouse Gas Inventory Data Collection

The GHG inventory tool is essentially a spreadsheet which will calculate your school's carbon footprint once it has all required input data. The raw input data you will need generally falls into these categories:

- Fossil fuels burned on campus for heating, cooling, and electrical generation
- Purchased energy utilities – electricity, steam, and chilled water
- Transportation (commuting, air travel, and campus fleet)
- Agriculture (fertilizer use and animal waste)
- Solid waste (incinerated and landfilled)
- Refrigerants and other chemicals
- Offsets (Renewable energy credits purchased, composting, forest preservation, local offset projects such as paying for boiler conversion at a local K-12 school, etc.)

Obtaining this data can be like conducting a scavenger hunt. You will need to identify campus sources of data and then arrange for them to provide it to you. Helpful to both ACUPCC and non-ACUPCC institutions alike, the *ACUPCC Greenhouse Gas Inventory Brief* offers these excellent suggestions on gathering input data for your inventory:

- Keep a journal of the process and sources of data, including who you contacted, when you contacted them, their responses
- As you identify the correct data sources, record these in a legacy document to facilitate future inventory processes
- Give people deadlines for gathering information
- Where possible, create systems for future reporting, such as reporting forms to be collected by the climate action team annually
- Foster positive relationships along the way
- Where data is incomplete or unavailable, gather the information you can and note gaps to fill in later
- Encourage better record keeping in the future

For more information about conducting a GHG inventory, see the *ACUPCC Implementation Guide* and the Clean Air-Cool Planet's Campus Climate Action Toolkit.

4.1.2 Data Collection and Calculations for Commuting and Air Travel

More so than for most other categories of GHG emissions, those associated with commuting and air travel tend to be based on assumptions. To make these assumptions, some raw data is needed but it tends to be indirect in nature. For guidance on data collection and calculations for these two categories of emissions, see "Guidance on Scope 3 Emissions: Commuting" by Niles Barnes and "Guidance on Scope 3 Emissions: Air Travel" by Julian Dautremont-Smith.

For commuting, your goal is to estimate the number of gallons of gasoline that is consumed by this activity. To do that you will need to estimate total miles driven and make an assumption about average fuel economy. A fair number to use for the latter is the U.S. average fuel economy for all cars and light trucks, now estimated by the U.S. Environmental Protection Agency to be "an uninspiring 20.8 mpg." Coming up with total miles driven is a bit harder. Some schools have required that all students, faculty and staff requesting a parking permit fill out a questionnaire to provide this data, i.e. round trip commute mileage, number of trips per week, etc. Other schools have used existing parking hang tag databases which contain home or campus address information and extrapolated from that. Adjustment of hang tag data is needed because some people with parking passes occasionally carpool, bike, take public transit or walk. Depending on your methodology for calculating the carbon footprint of commuting, it may or may not capture the emissions reductions that occur as a result of transportation strategies you implement to reduce driving and fuel use.

For air travel, your data collection goal is total passenger air miles paid for by or through your institution. Getting to this number may be difficult, depending on how travel information is collected and archived by your school. In addition to carbon dioxide emissions associated with burning jet fuel, the climate impact of air travel is a function of upper atmosphere emissions of nitrogen oxides and other factors. The Clean Air-Cool Planet Campus Carbon Calculator incorporates a radiative forcing factor of 2.8 to account for this additional impact.

4.1.3 Addressing Potential Campus Forest Offsets

Please see "A Recommendation on How to Account for Carbon Sinks in Campus Forests or Lands" by Jenn Andrews and the "Campus Forest and Lands as Carbon Offsets?" section of this guide for a discussion of the tricky business of counting campus forest preservation as an offset to your campus carbon footprint.

4.2 Clean Air-Cool Planet Greenhouse Gas Inventory Tool

A number of GHG inventory tools are available. ACUPCC participants agree to use one compliant with the Greenhouse Gas Protocol – a standard procedure for analyzing GHG emissions created by the World Resources Institute and the World Business Council for Sustainable Development.

Clean Air-Cool Planet's "Campus Carbon Calculator" (available for free download) is compliant with this protocol and is the inventory tool most commonly used by campuses. Essentially, it is an elaborate Excel spreadsheet. You plug in the required data and it calculates total GHG emissions and the subsets of GHG emissions associated with various categories of input data.

The CA-CP Campus Carbon Calculator also makes analysis of your carbon footprint easy by providing a variety of ways of presenting, comparing, and trending the results. Each version of this excellent tool becomes more sophisticated and helpful. The Calculator will generate emissions trajectory graphs and allow you to normalize GHG emissions data in relation to various institutional statistics (see section 7.4.2 of this guide).

Version 6 of the Campus Carbon Calculator has a solutions module with a number of interesting features. It will allow users to analyze and compare specific projects once project data is entered – thus ranking carbon-reducing projects according to their relative cost-effectiveness (see section 6.3,"Carbon Reduction Efficacy," for $/MTCO$_2$e comparison of projects). This version can also calculate electricity line losses as well as production-related emissions for various grades of office paper. The latter may help you make the case for buying only 100% post-consumer content recycled paper. A future generation of the Calculator is expected to include a tool for calculating the carbon footprint and other environmental impacts associated with campus dining services.

For links to a number of completed campus GHG inventories, see the campus greenhouse gas inventories section of AASHE's resource center and the ACUPCC's online reporting system.

4.3 Your Carbon Footprint and Trajectory – What to Expect

While your GHG emissions inventory can quantify your carbon footprint and its major elements, it may not produce any real "Ah-hah's!" The major sources of your carbon footprint should already be obvious. Typically, they are:

- Electricity use (purchased or self-generated)
- On-site fossil fuel burning for space and water heating and cooling
- Commuting by students, faculty and staff (assuming you are including this indirect Scope 3 emissions source in your inventory)

Your own GHG emissions inventory will likely confirm this. Putting some numbers to it can help, though, especially for those who don't believe something is real unless it can be quantified.

When multiple years are analyzed, a GHG emissions inventory will show if emissions are holding steady, rising or declining over time. After some analysis, you might conclude that a trajectory of decreasing emissions over time can be explained by a successful energy conservation program or that an upward emissions trajectory can be explained by new construction, additional students, or more research activity. If you anticipate future campus growth, you could extrapolate from your recent trajectory and show that anticipated growth as an upward-pointing baseline from which you hope to deviate downward as a result of campus GHG emissions reduction efforts. Generally, your carbon footprint and trajectory will track energy use.

Your GHG emissions inventory may show you in graphic terms that your emissions are inching up each year for no apparent reason! This is often called "load creep." An unaccounted-for upward creep in energy use and GHG emissions might be due to increasing computerization of your campus or a great number of small unidentified developments that collectively add up to incrementally greater energy use and thus more GHG emissions.

Obviously, if your school's GHG emissions are on an upward trajectory for whatever reason, reaching aggressive campus climate goals is likely to be more difficult. As your CAP process identifies prospective strategies, measures, and projects that can produce annual GHG emissions reductions, subtracting those anticipated reductions from an upward trending line will yield less net reduction of GHG emissions than would occur if your trajectory were flat or already downward.

A GHG emissions inventory is helpful but it is not a silver bullet. It won't for example, tell you what emissions mitigation opportunities exist in various buildings. An energy analysis of those buildings is required for that.

4.4 Who Should Conduct Your Inventory?

If you haven't done a GHG inventory before, you might assume it is very complicated and that you need to hire a consultant to do it. But while it takes time, inventory tools like CA-CP's Campus Carbon Calculator make doing a GHG inventory relatively easy. You may find that the hardest part is just gathering the needed data from various campus offices and departments.

Thus, a GHG inventory can be done in-house. It could be assigned to an energy manager, facilities engineer, or a sustainability coordinator. Students and faculty could also be recruited to help conduct your GHG inventory. In that way the inventory becomes a broader learning experience. While conducting the inventory itself does not represent a full semester's work, an academic course could be created around the inventory by asking students to also unpack and study the "guts" of the inventory tool (examining its assumptions, learning how the spreadsheet works, etc.), develop campus GHG emissions mitigation strategies, create a simple CAP, and study the problem of climate change generally.

4.5 Rolling Out Your GHG Inventory

The completion of your GHG inventory presents an important opportunity to raise awareness about your school's impact on climate change and about the CAP process you have begun. For this reason, it makes sense to roll out your inventory with as much fanfare as possible. Your CAP team can brainstorm the most effective ways of doing this. It will help if the inventory is incorporated into a report about the need to reduce campus GHG emissions with examples of what your school is already doing and might do in the future.

Some outreach possibilities for releasing the inventory include:

- Call a press conference
- Write or arrange articles in campus and community publications
- Hold "town" meetings to discuss
- Give classroom talks
- Ask drama students to do street theatre about your newly quantified carbon footprint
- Ask art students to depict graphically
- Encourage the campus student environmental club to dramatize with giant black chalk footprints around campus
- Address prominently on your campus sustainability website and invite comments and dialogue

4.6 How Much GHG Number-Crunching Should You Do?

The increasing sophistication of GHG inventory tools comes at a price. After a point, more information and detail about your carbon footprint may not help you undertake the really important task of reducing those emissions. There are only so many hours in the day to do this important work, and energy and sustainability staff are already stretched thin and over-worked. Thus, it is critically important not to get sidetracked over-analyzing your carbon emissions and, as a result, not have enough staff time to implement mitigation measures and projects. For example, should you refine your GHG inventory to the point where you know the carbon footprint of each campus building? Probably not unless you are sure that having that information will actually help you modify building energy systems and human behavior in campus buildings to produce additional energy and GHG savings worth the time and cost involved in completing that level of analysis.

When it comes to number-crunching, you need to be selective. What types of analysis will really advance your program? Consider what can be done with a handheld calculator and some scribbles on the back of an envelope. Suppose your campus' carbon footprint was 100,000 $MTCO_2e$/yr and you have 20,000 students. Simple arithmetic tells you that on a per student basis your school's emissions are 5 tons of CO_2 per year. Suppose you wanted to depict that in terms of an amount of coal. Here how to calculate it.

By consulting a conversion table (see page 2 of U.S. Inventory of Greenhouse Gas Emissions), we learn that each metric ton of anthracite coal emits 2.122 $MTCO_2$ when burned. Now let's calculate how much anthracite coal would need to be burned to produce 5 $MTCO_2$.

$$5 \text{ MT CO}_2 \times \frac{1 \text{ MT coal}}{2.122 \text{ MT CO}_2} = 2.36 \text{ MT coal}$$

Thus, we now know that 2.36 metric tons of coal must be burned to release 5 $MTCO_2$. To convert that number to English units:

$$2.36\ \text{MT} \times \frac{1.1023\ \text{Short tons}}{1\ \text{MT}} \times \frac{2{,}000\ \text{lbs}}{1\ \text{Short ton}} = 5{,}185\ \text{lbs}$$

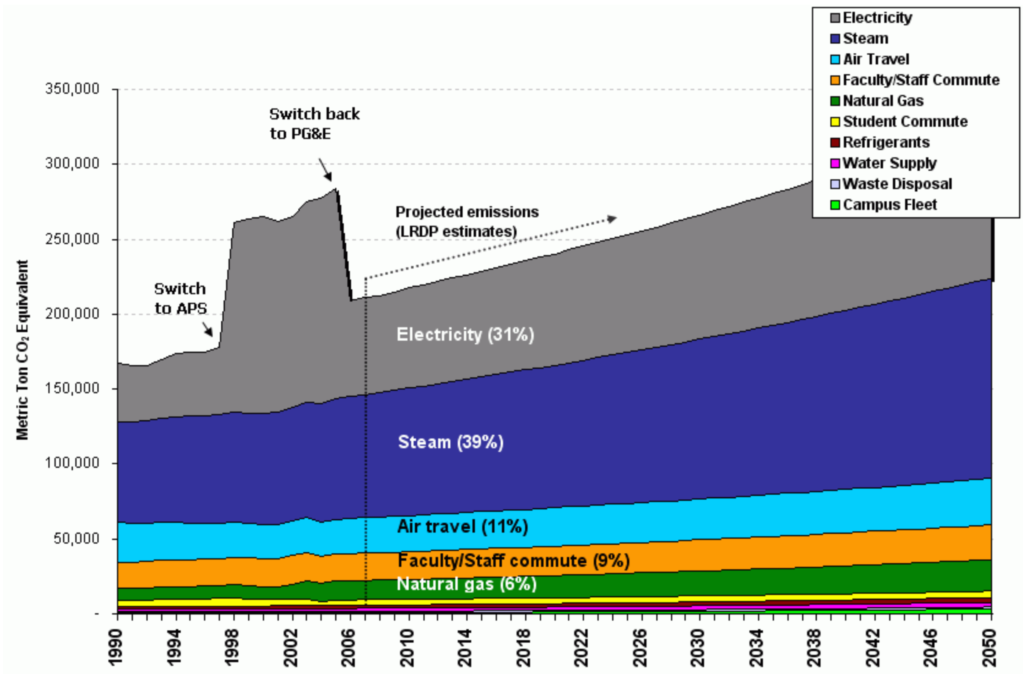
Thus, the average student's campus carbon footprint is equal to all the carbon in 5,185 pounds of coal. Your CAP team can now create a great motivational visual that dramatizes each student's contribution to carbon emissions and climate change by dumping 5,185 pounds of coal in front of the student union – with appropriate signage and apologies of course.

4.7 How Geography or Your Power Provider Can Affect Your Carbon Footprint

Campus GHG inventories reveal that the geographical location of your school can make a big difference. Consider a college or university in a region of the country where most of the electricity is generated by burning coal. Each kilowatt hour of purchased electricity from that coal-intensive electric grid "contains" or is responsible for a much greater release of carbon dioxide than a kilowatt hour purchased by a school that receives power from a grid dominated by "lower carbon" natural gas generation or "zero carbon" hydro-electric or nuclear power. These regional differences in GHG emissions-intensity are captured by GHG inventory tools like the CA-CP Campus Carbon Calculator because they use CO_2/kWh conversion factors based on the mix of electricity generation methods which exist in each region of the country.

It could be argued that colleges and universities in coal states like Ohio shouldn't be "penalized" and forced to deal with much larger carbon footprints simply because they are in a part of the country where electric power is mostly generated by coal. However, factoring in the actual carbon intensity of regional electric grids is reasonable and fair because there *are* real differences in the climate change impact of buying and consuming electricity in different parts of the country. Campuses in states with carbon intensive electricity generation will likely want to prioritize conserving grid-sourced electricity since each kilowatt hour they save will yield disproportionate carbon reductions.

A similar phenomenon can occur in electric markets where colleges and universities can buy power from private third party power producers (and use their local electric utility's distribution system to deliver the power). The graph immediately below from the UC Berkeley shows what happened when in 1998 the university began buying its electricity from Arizona Public Services (APS). That move caused the GHG emissions from UC Berkeley's purchased electricity to more than double because of APS' 38% reliance on coal.



Source: *UC Berkeley Climate Action Partnership: Feasibility Study 2006- 2007 Final Report*

In 2006 Berkeley's GHG emissions from purchased electricity dropped precipitously when the university resumed purchasing its electricity from Pacific Gas & Electric. In contrast to Arizona Public Services' heavy reliance on coal, PG&E reports a fuel mix of 2% coal, 47% natural gas, 20% nuclear, 16% large hydro, and 15% renewable.

5. GREENHOUSE GAS MITIGATION STRATEGIES

There are a great many ways to reduce GHG emissions on campus. This section of the CAP Guide presents basic GHG mitigation strategies and specific tactics/actions within these categories:

- Energy Conservation and Efficiency
- Heating and Power Plant Solutions
- Install Renewable Energy Technologies on Campus
- Buy Green Power
- Maximize Space Utilization to Avoid or Minimize New Construction
- Design and Construct Only the Most Energy Efficient Green New Buildings
- Sustainable Transportation Solutions
- Other GHG Mitigation Strategies (waste minimization, purchasing, food)
- Carbon Offsets

5.1 Energy Conservation and Efficiency

> "Nothing is cleaner than the BTU or kilowatt hour you don't need and don't consume.
> —Anonymous campus energy officer

Burning fossil fuels – and the subsequent release of carbon dioxide – is the primary cause of global warming and climate change. Burning fossil fuels, including burning them to generate purchased electricity, is also the primary source of GHG emissions at colleges and universities. It follows, then, that the first and foremost campus GHG emissions mitigation strategy is energy conservation and energy efficiency improvements to reduce the use of fossil fuels to a minimum.

5.1.1 The Power of End-Use Energy Conservation

Energy production and consumption have social and environmental impacts. Energy conservation avoids these impacts. Prevention is better than a cure.

End-use energy conservation has great power because units of energy saved at the point of use can save many times that amount of energy when the inefficiencies of energy production and distribution are taken into account. As the illustration below shows, turning off a pump that produces work equal to 9.5 units of energy saves 100 units of input energy (and embodied CO_2 emissions) at the power plant – and it saves even more energy (and CO_2 emissions) than that if we consider the energy it takes to produce and deliver fuel to that power plant.

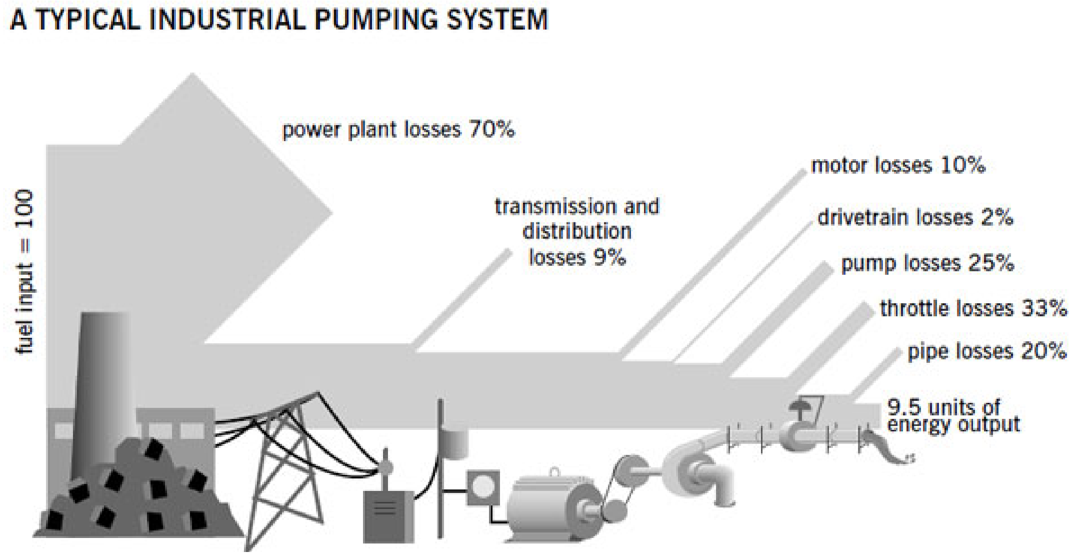


Illustration Copyright © E Source

Suppose we need that pump to run but not at full speed. That too can produce substantial energy savings at the power plant. The work done by a pump or fan is a function of the cube of its speed. Thus, slowing down this pump by only 20% reduces its end use energy requirements by nearly 50% and that would mean 50 units of fuel savings at the power plant.

Imagine the overall energy savings that could be achieved by turning off or turning down all the pumps, fans, lights, and other energy-using pieces of equipment on campus that don't need to be operating the way they are right now. Energy savings and GHG emissions reductions of this magnitude are exciting to contemplate!

5.1.2 Energy Conservation Program Elements

Here are key components of an effective campus energy conservation program that will reduce energy use and GHG emissions from campus operations:

- Strong Program Leadership
    - An energy officer to develop energy conservation measures and projects and catalyze the entire effort
    - Full support from facilities leadership, the chief business officer, and the president
- Enhanced Energy Awareness (see detail in section 5.1.3 of this guide)
- Aggressive Energy Conservation Policies which address:
    - Heating and cooling season temperature settings
    - Building HVAC and fan operating schedules
    - Computer operations and "green computing"
    - Ban on all incandescent bulbs and halogen torchiere lamps (the latter is also a safety issue)
    - Energy purchasing (including buying green power)

- Energy efficiency purchasing standards for various types of equipment – hopefully going beyond Energy Star compliance
    - Improved space utilization to avoid new construction or heating/cooling of underused space
    - Energy efficiency standards for new construction
    - Restrictions on the use of portable space heaters
    - Energy practices in on-campus residence halls and student apartments
    - Residential appliance policies (e.g. load limits per room, ban or restrict refrigerators, TVs, microwaves, etc.)
    - Campus curtailment or shutdown periods when campus use is minimal
- Engaged Facilities Operations
    - An active facilities energy conservation committee which meets regularly and is encouraged and empowered by facilities and campus leadership to push the envelope and aggressively pursue all conservation opportunities
    - Comprehensive implementation of no cost/low cost operational measures – e.g. temperature set-points, equipment run-times and building occupancy hours, etc. – that push the envelope, i.e. risk complaints
    - Adequate facilities staffing levels – especially HVAC controls technicians, heating and power plant operators, mechanics, and electricians so that the campus physical plant can be operated efficiently and energy conservation measures and projects can be implemented in-house
    - Periodic re-commissioning of all existing buildings to optimize energy efficiency
    - Facilities staff performance appraisals that evaluate staff on commitment to energy conservation
    - Rewarding of highly motivated staff who identify conservation opportunities and implement conservation measures
- Energy Smart Capital Improvement Program
    - Tough energy efficiency standards for all renovations and capital improvement projects
    - Prioritization of projects that conserve energy and improve efficiency
- Deliberate Targeting of Worst Offenders
    - Specific, aggressive, comprehensive targeting of the most energy intensive and energy wasteful buildings and energy systems, e.g.:
        - Electric heating
        - Large outside air ventilation systems (e.g. in lab buildings)
        - Fan systems which operate at full capacity when actual occupancy is usually a lot less
        - Super-cooling supply air in air handling units to 55 degrees and then reheating (during the cooling season)
        - Heating and power plants
        - Super-computers
- Energy Performance Contracting

    - Maximize the scope, effectiveness, and benefits of performance contracting, i.e. large comprehensive, self-financed projects involving energy service companies (ESCOs). (See detail in section 5.1.5 of this guide)
- Green Computing
    - Require that all computers on campus have their power management features engaged and be shut off when offices are closed
    - Match the number of operating computers to actual customer load in computer labs (e.g. most of the computers should be turned off during slow periods)
    - Full cooperation of campus IT departments in the design and operation of networked and campus-wide computer systems
    - Highest standards of efficient design for super-computers
- Incentives for Energy Conservation
    - Innovative strategies to assign energy costs to campus energy users or cost centers so that there are real dollar incentives for energy conservation for campus building occupants
    - Elimination of "split incentives" that discourage full cooperation with the energy conservation program
    - In multi-school college and university systems, a policy which allows all or part of the energy conservation dollar savings to remain with the school that achieved them
- Super Energy Efficient Planning and Green Design for New Construction
    - Schedule semesters when outdoor climate is least challenging and weather-related building energy loads are likely to be less
    - Reduce conditioned space and avoid new construction by consolidating operations and improving campus space utilization
    - When new construction is necessary, only build the most energy efficient buildings to reduce legacy energy costs and minimize the need for future energy conservation retrofitting
- Documentation of Savings
    - Keep a log to document conservation projects and savings
    - Publicize, publicize, publicize!

Campus energy conservation programs may find reinforcement through participation in LEED-EB (Leadership in Energy and Environmental Design for Existing Buildings: Operation and Maintenance). LEED-EB is a green building rating system that in its new version (V 3.0) emphasizes energy efficiency and renewable energy strategies by awarding up to 35 energy credit points out of 100 possible points for all green building strategies implemented in an existing building. Points are awarded by achieving various levels of performance. Depending on the number of points earned, a higher LEED-EB rating may be achieved – ranging from Certified (40 – 49 points), Silver (50 – 59 points), Gold (60 – 79 pts), and Platinum (80 points and above). Thus, if your school seeks LEED-EB certification for existing campus buildings, the rating system will focus attention on making those buildings more energy efficient. For a discussion of LEED in general and LEED-NC (new construction), see section 5.6.3 of this guide.

For campus energy conservation program examples, see the Energy section of AASHE's resource center This webpage includes links to numerous campus energy websites, energy plans, and energy policies.

5.1.3 Energy Awareness

It is essential that everyone on campus pitch in. This can be accomplished by an effective energy awareness program that encourages individual and group action. Here are some energy awareness program considerations and ideas:

Example of a building energy sign (University at Buffalo). Most UB buildings use a lot more energy than this! (Image courtesy of Walter Simpson)

- Strive for culture change – a real shift in the way members of the campus community think about energy and their role in and responsibility for saving energy on campus
- Be both creative and persistent in getting the message out because you are competing against a lot of other interests and activities on campus.
- Use environmental themes to motivate – especially climate change; explain that:
    - Climate change is real
    - Its happening right now and faster than we previously thought
    - The consequences will be dire if we do not act
    - Let's act now before it's too late!
- Take into account that not everyone on campus can do a lot to save energy – so target various constituencies with appropriate messages and aggressively target those who can do the most, namely:
    - Facilities management
    - Resident students
    - Building managers
    - Computer lab operators
    - Top leadership
- Develop a multi-faceted campaign using as many media as possible
    - Campus-wide actions and events
    - Newspaper articles and columns
    - Classroom presentations especially to large classes
    - A campus energy conservation program website
    - Campus energy dashboards, e.g. Arizona State University
    - Individual building energy use websites, e.g. Oberlin College

- E-mail blasts
- Creative signage, e.g., "For your health and to save energy, walk up 1 floor and walk down 2" in elevators
    - Building energy cost signs in building entrance vestibules
    - Contests and competitions
- Facebook groups, instant messaging
- Dorm or academic building energy competitions
- Mascots
- Crazy stunts

- Make sure your facilities department is not overheating or overcooling buildings or allowing outdoor light fixtures to burn during the day because no one will pay attention to your energy conservation appeals if they see visible instances of energy waste on campus and don't think facilities is doing its job
- Be sure that you have vigorous recycling and other environmental programs because green programs reinforce each other, and the campus community is much more likely to participate in energy conservation if they can also easily recycle, use 100% post consumer recycled paper, bicycle to campus, sit on pesticide free lawns, go for a hike in preserved green space, etc.
- Expand your awareness program through campus-wide sustainability coordinators or a building "conservation contacts network" with environmental liaisons in every office or department or an eco-reps program for residence halls and on-campus apartments
- Encourage conserving behavior at home as well as on campus since these behaviors will reinforce each other

How much energy saving can you produce through energy awareness raising? A great deal if it gets facilities staff and resident students to use the tools at their disposal to save energy. A great deal if you inspire your school's president to set an example and let others know he/she expects others to follow his/her lead.

But what about the general campus population? An effective energy awareness program might reduce energy consumption on campus by 5 to 10 % or more. A great student research project would be to take one or more buildings, launch an energy awareness campaign and measure energy use before and after, and determine from that experiment how to raise energy awareness with maximum success and how much energy saving is possible with various methods.

AASHE maintains an extensive list of campus energy websites. Also see the University at Buffalo's You Have the Power website.

5.1.4 Energy Conservation Measures

Standard techniques for conserving energy and improving energy efficiency in commercial or institutional buildings are well known to the vast majority of campus facilities managers. These strategies are discussed and explained in many places including in publications available through:

- ASHRAE
- Association of Energy Engineers
- APPA

And on websites such as these maintained by the U.S. Department of Energy:

- Building Technologies Program – Commercial Buildings website
- Energy Star's Building Upgrade Manual

Here is a list of some of some energy conservation measures that can be used in campus buildings:

- Building Envelope Improvement
    - Weather/infiltration sealing
    - Increased insulation
    - High performance window replacement
    - Low emissivity reflective window film (to reduce unwanted solar gain in the summer and increase the R-value of windows in the winter)
- Lighting
    - “Delamping,” i.e. permanently turning off/disconnecting unneeded light fixtures
    - “Relamping,” i.e. replacing inefficient light fixtures or lamps with high efficiency fixtures/lamps
        - Convert T-12 fixtures/lamps to T-8 or T-5
        - Relamp 32 watt T-8 lamps with 28 watt T-8
        - Eliminate incandescent bulbs
        - Convert all exit lighting to LEDs or photoluminescent signs that require no electricity
        - Beware of retrofitting with indirect lighting – while classy looking it may require more fixtures and more wattage to achieve comparable lighting levels
    - Increase reliance on task lighting in order to decrease general illumination without adversely affecting productivity
    - When converting to T-8 or T-5 lighting from T-12s, design for lower lighting levels (as measured in foot-candles) since the newer lamps produce higher quality lighting and appears brighter to the human eye than foot-candle measurements would suggest
    - Improve lighting controls
        - Occupancy sensors
        - Timers (stand alone or energy management system/EMS-interfaced)
        - Daylight harvesting sensors and controls including simple photocells
    - Convert outdoor lighting to high pressure sodium
    - Eliminate/reduce outdoor decorative lighting
    - Consider LEDs for general indoor and outdoor illumination (the technology is almost there)
    - Consider outdoor solar powered-LED light fixtures (this technology is also almost there)

    - Require white or off-white wall paints for maximum light reflectivity – so adequate lighting levels can be achieved with minimum lighting wattage
    - When renovating spaces, design new lighting to achieve a connected lighting load of less than 1.0 watts per square foot
- Boilers
    - Replace old boilers with new high efficiency boilers
    - Do not oversize replacement boilers
    - Retrofit boilers with variable flame burners
    - Consider multiple high efficiency modular boilers to improve efficiency by better matching hot water heating loads
    - Consider replacing boilers with cogeneration units (which produce both electricity and heat)
    - Control boiler output water temperature with outside air temp reset so boiler does not heat water hotter than necessary
    - Retrofit boilers with flue gas/stack heat recovery
- Chillers
    - Replace old chillers with new high efficiency chillers whose efficiency curve best matches your load profile
    - Do not over-size replacement chillers
    - Be aware that a lighting retrofit will reduce cooling load and therefore chiller capacity requirements
    - Operate at peak efficiency (by adjusting water flow, load, condenser/evaporator water temps, etc.)
    - Replace old cooling towers with new high efficiency towers
- Air Conditioning
    - Replace older AC equipment with maximum efficiency models
    - Discontinue use of inefficient window units
    - Reduce AC operating hours
    - In less humid climates, stop or significantly reduce super-cooling air (e.g. to 55 degrees) and then reheating in order to control humidity during the cooling season
    - Where dehumidification is required in buildings with variable air volume systems, try super-cooling the supply air to wring out moisture while reducing air volume to reduce reheat energy requirements
    - Clean cooling coils on a regular basis
    - Maximize use of "free cooling" with economizer cycle and enthalpy sensors
    - Use open windows and passive cooling when mechanical air conditioning is not needed
    - Close all windows when air conditioning is in operation
    - In dry climates consider evaporative cooling
    - In humid areas consider desiccant cooling
- Temperature Control
    - Reduce temperature settings in winter
    - Increase temperature settings in summer

  - Maximize night, weekend, and holiday temperature setbacks
  - Install tamper proof or remote thermostats
  - Control space temp remotely by EMS
  - If occupant controlled thermostats are required, then limit range of adjustment to ensure compliance with campus temperature policy
- Motors, Fans, and Pumps
  - Adjust operating schedule to minimize run hours (review and update periodically)
  - Replace old motors, pumps, and air handling units with high efficiency
  - Control motors serving fans and pumps with variable speed drives (VSDs)
  - Operate VSDs at maximum acceptable turn-down; vary by time of day and occupancy; also vary by season
  - Convert constant volume fan systems to variable air volume (VAV)
  - Completely close outside air dampers during morning warm-up cycle
  - Reduce outside air ventilation rates consistent with actual occupancy through the use of variable speed drives, modulated outside air damper settings, CO_2 sensors, and demand control ventilation
  - Reduce needless pumping by eliminating three-way by-pass valves
- Laboratory Ventilation and Fume Hoods
  - Switch to a "green chemistry" teaching program that doesn't require fume hoods or as much outside air ventilation
  - Turn off 100% outside air ventilating systems whenever possible, e.g. in teaching labs whenever classes are not in session; shut down or slow down related supply fans
  - Decommission/remove unneeded fume hoods and reduce fan system outside air volume
  - Eliminate unneeded fume hoods by using ventilated storage cabinets instead of fume hoods for chemical storage
  - Retrofit constant volume fume hood ventilation systems to variable air volume
  - Retrofit conventional fume hoods with low-flow hoods and reduce outside air volumes
  - Retrofit these systems with heat recovery

UB Cooke Hochstetter wet lab building with 200 fume hoods and 300,000 cfm of continuous outside air ventilation. Annual energy bill: $1,000,000+ (Photo credit: Walter Simpson)

- Heat Recovery
  - Run around loops
  - Heat wheels

    - Heat pipes
    - Desiccant wheels
    - Air-to-air heat exchangers
- Swimming Pools/Natatoriums
    - Install pool covers (these significantly reduce the evaporation of pool water – reducing pool heating and boiler loads as well as outside air ventilation and space heating requirements; pool covers save chemical water treatment too)
    - Use high efficiency boilers for pool water heating
    - Limit natatorium ventilation to that required to meet code
    - If code outside air ventilation requirements seem excessive in a particular application, consider applying for a code variance to reduce ventilation rates consistent with energy efficiency, safety, and proper humidity control
    - Install heat recovery
- Energy Management Systems (EMS)
    - Switch to direct digital control (DDC) systems
    - Purchase EMS systems which are easy to program (so programming capabilities will be fully utilized by facilities staff)
    - Fully train staff operating DDC and EMS systems so they can operate this equipment for maximum efficiency
    - Utilize and optimize use of EMS energy conservation programs, e.g.
        - Optimal start/stop
        - Night setback
        - Demand shedding
        - Remote programmed lighting control
- Fuel Switching
    - Consider converting electric space and water heating systems to natural gas
- Information feedback systems
    - Accessible display units that show energy use and savings can have dramatic results in energy use behaviors

Evaluating opportunities for natural gas-fired cogeneration and fuel switching from electric heating to natural gas requires a different mind-set when your ultimate goal is a reduction in your carbon footprint (as opposed to simply reduced energy costs). While cogen and fuel switching are typically regarded as methods for improving overall efficiency, on your campus these measures could decrease or increase your carbon footprint depending on the carbon intensity of your purchased electricity – so it bears analysis.

5.1.5 Performance Contracting

Energy performance contracting may be a critically important tool in your energy conservation bag of tricks. A good performance contract can allow your campus to do a decade or more’s worth of conservation in just a few years. Typically, these projects involve hiring an energy service company or ESCO, require little or no upfront money, and pay for themselves out of savings. Here are some guidelines for a good project:

- Be diligent and careful in selecting an ESCO – the success or failure of your project depends on it.
    - Choose an ESCO with ample experience on college and university campuses and a long list of satisfied customers.
    - Choose an ESCO which is selling professional services and not representing a manufacturer and selling specific products.
    - Pay careful attention to the people a prospective ESCO says it will assign to your project because one of the best guarantees of a good project is the caliber of the individuals assigned to the project team – be sure they know what they are doing, are easy to work with, and are very, very customer service–oriented.
    - If your decision to hire an ESCO is based on certain personnel being assigned to your project, obtain contractual guarantees that these key staff people will not be shifted to other jobs.
    - Insist on references for the team bidding on your project and not for another team within the ESCO or a previous iteration of the company.
    - Select an ESCO that will allow you maximum flexibility in contract terms (see below discussion of "cost plus" vs. "fixed cost," guaranteed savings vs. no guarantee, etc.).
    - Select an ESCO that welcomes campus participation in project design and construction.
    - Select an ESCO that will provide full transparency of all fees and overhead and profit mark-ups (and of course avoid excessive fees/mark-ups but recognize that higher ones are associated with the performance contracting industry compared to the fee structure of a conventional architecture and engineering firm).
    - To help you evaluate and choose an ESCO, consider hiring an independent expert consultant who is loyal only to you ("the owner") and understands how the performance contracting game is played.
- Projects should be comprehensive and thus incorporate a great number of varied energy conservation measures including quick payback projects that leverage or help pay for longer payback projects.
- Consider including solar and other renewable energy projects in your energy conservation performance contract and thus have the energy conservation measures pay for them.
- Make sure your school borrows the money to pay for the project so you can get the best rate vs. being required to use the ESCO's financing (which will probably include a mark-up).
- While you want to avoid high mark-ups, be careful about trimming them too far. You want the project to be "win-win" and have enough money in it for the ESCO to allow it to dig deep,

carefully study all your campus buildings, and consider all viable energy conservation measures – and not simply cherry pick the easy stuff.

- Consider doing your project on a “cost plus” instead of “fixed cost” basis so that you do not pay more than you have to – though be aware that the “cost plus” approach shifts some risk to you and will involve more facilities staff time as you will be involved in all decision-making.
- Avoid guaranteed savings and shared savings provisions because you have to pay extra for them and may end up squabbling later with the ESCO over whether the guarantee has been met and whether the savings split is fair. A better approach than guaranteed savings may be to verify that all the savings calculations for proposed measures are conservative and accurate and build into your project enough metering so you will know if it performed as advertised. Let the ESCO know you will publicize inadequate performance if that occurs.

Small campuses may be less attractive for ESCOs and increase the likelihood that projects may require some upfront payments or an earlier financial commitment to initiate a project. Check on state or utility incentives to help get funding for audits that are often the first step.

The ACUPCC and the Clinton Climate Initiative have partnered to promote energy efficiency retrofit projects at U.S colleges and universities using energy performance contracting. To help achieve that goal, these organizations have produced a Best Practices Toolkit: Energy Performance Contracting for Higher Education.

5.1.6 Aiming for “Deep Conservation”

In order to achieve significant GHG emissions reductions colleges and universities must think differently about energy conservation on their campuses. What is needed is not just an efficient campus but a *super-efficient* one. That means not just doing conservation but doing what might be called “*deep conservation*.” Even campuses that have already done extensive energy retrofitting and have exemplary energy conservation programs need to do more. If you’ve already reduced energy consumption in campus buildings by 25%, then try for another 10, 20 or 25%. Resting on one’s laurels should not be an option, especially if deep cuts in greenhouse emissions are envisioned.

To identify advanced strategies, techniques, and products for achieving deep conservation, your campus facilities unit may want to team up with interested faculty and students as well as an expert consultant or two and focus on one or more campus buildings in order to determine what is possible. Is a 40 or 50% cut in energy use possible and still have a livable, functional academic building? While constructing very low energy new buildings may be possible, the biggest, most important challenge for most institutions is figuring out how to significantly reduce energy use in existing buildings. A serious campus climate commitment is your excuse to give it a try.

Of course, at some point our efforts will bang up against the limits of what can be done in existing buildings and there will be no more practical retrofitting options to explore or exploit. In most cases, however, opportunities abound.

5.1.7 Key Role of Facilities Management in Energy Conservation

Energy conservation on campus is everyone's responsibility and a good program will get the whole campus community involved. Nonetheless, facilities management plays a key energy conservation role since maintenance staff control those pieces of equipment that use and can save the most energy. For this reason, effective campus energy conservation requires a 100% commitment by facilities management.

Not only can facilities staff do the most to save energy, they need to set a solid example for others on campus will never get on the conservation bandwagon and help out where they can. An inspired facilities organization will inspire others. A lackluster facilities organization will turn everyone off.

To do their job, facilities management needs adequate resources and staffing including an energy officer whose job is to identify and carry out projects, get others to do the same, and generally catalyze as much energy conservation activity as possible.

While the role of facilities in achieving energy savings is highlighted here, it is also true that facilities managers and staff play key roles in implementing other GHG emissions reduction strategies including on-site renewables, green power purchasing, and energy efficient green design for new construction.

Facilities staff cannot do their job unless they are supported and empowered by top campus leadership. Without that support, they will be constantly looking over their shoulders anticipating criticism if they go too far in saving energy and cause someone to be inconvenienced. For example, when faculty, staff or students complain that a space previously overheated (but now at the correct temperature) is no longer comfortable, facilities staff must be supported for having remedied a wasteful practice. Exceptions to the rule must be rare and based on unusual and valid circumstances. Obviously, campus leadership also must set an example and not ask to be exempted from campus energy policies.

5.1.8 Evaluating Energy Conservation Projects

As we consider deep conservation we must address barriers that stand in the way. Among these are inadequate leadership, funding, expertise, and organizational capacity as well as reliance on faulty project evaluative tools and an emphasis on doing projects with quick simple paybacks while ignoring those with longer paybacks. Deciding what evaluative tools, standards, and methods to use is important since your comparative evaluation of projects will help you decide which projects to do and when to schedule them. Deep cuts in GHG emissions require a different approach to project evaluation and more serious consideration of longer payback projects. (For more discussion of project evaluation and ranking, see section 6 of this guide)

Problems with Simple Payback

Prospective energy conservation projects are typically evaluated in terms of simple payback, i.e. installed cost divided by the annual savings – where paybacks of 4 or 5 years are often considered attractive and acceptable. The simple payback approach is perhaps *too simple* and may rule out desirable projects that have longer simple paybacks or other benefits. These projects are essential to meeting your emissions reduction goals.

Simple payback analysis *fails* to consider:

- Energy price inflation – thus it under-estimates the dollar savings potential of projects; moreover, as carbon taxes and peak oil kick in, the price of conventional energy resources will rise even quicker – thus magnifying this inadequacy of simple payback
- The lifespan of a project – thus it does not take into consideration the fact that projects which last longer will produce more savings after paying for themselves
- Other costs and benefits that are relevant to sound decision-making, e.g. maintenance saving or costs, impact on health or comfort, pedagogic value, etc.

How can problems with simple payback be remedied? One possibility is switching from simple payback to slightly more sophisticated payback calculations that factor in anticipated energy price inflation. Some "crystal-balling" is required here but reasonable assumptions about future energy prices can be made. Another possibility is extending your acceptable payback threshold to 10, 15 or 20 years – taking care not to extend it past the lifetime of proposed energy measures or projects. A more sophisticated approach is life cycle cost analysis.

Lifecycle Cost Analysis

Lifecycle cost analysis examines and weighs the costs of a measure over its lifespan. It can be used to compare the costs of an existing system over a retrofit one – thus demonstrating the benefits of a retrofit measure in a more comprehensive way than simple payback. It can also be used to compare two or more retrofit options.

A description of lifecycle cost analysis is available in the Whole Building Design Guide which notes that this type of analysis considers these costs/benefits:

- Initial Costs—Purchase, Acquisition, Construction Costs
- Fuel Costs
- Operation, Maintenance, and Repair Costs
- Replacement Costs
- Residual Values—Resale or Salvage Values or Disposal Costs
- Finance Charges—Loan Interest Payments
- Non-Monetary Benefits or Costs

The last category of benefits and costs shown above allows life cycle cost analysis to consider a wide range of other factors. For example, a lighting retrofit might save energy and energy dollars *plus* improve safety – where the latter improvement is very important but not easily quantified or stated in dollars. Similarly, an HVAC retrofit might save energy and energy dollars *plus* improve comfort and indoor air quality – which makes people happier, healthier and perhaps more productive, important factors not easily quantified or monetized.

With lifecycle cost analysis you can also consider altruistic factors, i.e. societal or environmental impacts that wouldn't otherwise figure into a simple dollar cost vs. dollar savings calculation. An example might be the impact of an energy conservation measure on climate, local air pollution, noise, or the fate of mountain tops in West Virginia that are now subject to destruction by coal mining.

The U.S. Department of Energy makes available life cycle cost analysis software developed by the National Institute of Standards and Technology (NIST). While your school may want to define its lifecycle analysis technique differently or more broadly, this Building Life-Cycle Cost Program might be a good place to start.

Factoring in the Avoided Cost of Unneeded RECs or Carbon Offsets

Colleges and universities that are committed to climate neutrality or sharp cuts in GHG emissions may eventually choose to mitigate remaining fossil fuel use and GHG emissions with purchases of green power or carbon offsets. It makes sense, then, especially for ACUPCC institutions, to credit energy conservation measures with the savings associated with those anticipated avoided purchases. This can be done in a lifecycle analysis. It can also be done in a modified payback analysis – though in both cases you will need to use an assumed cost for the value of the avoided REC or carbon offset. (REC is shorthand for renewable energy credit or certificate, which is generally what one purchases when obtaining green power; see section 5.4.2. of this guide)

While it is not possible to know the exact future cost of these instruments, you can estimate those costs by checking with existing vendors to identify a price to use in your calculations. For example, RECs on the national market generally cost 1 to 3 cents per kilowatt hour. TerraPass and the Carbon Fund are currently selling carbon offsets at $10 per ton of carbon dioxide emissions. While using these numbers may be misleading because the markets for both RECs and offsets will evolve (and prices will change), the principle still holds true, namely, that energy conservation can reduce the need to buy RECs or offsets and those avoided future purchases mean avoided future costs. If your school will not be purchasing RECs or carbon offsets for a few years, you can allow for that by excluding their avoided costs in your savings and payback calculations until the year you think they would kick in. This topic is discussed further in section 6.4 of this guide.

Incidentally, factoring in REC and carbon offset savings into lifecycle or payback analyses can and should also be done when financially evaluating a prospective PV or other type of on-campus renewable energy project – since those projects also reduce the amount of RECs or carbon offsets your school may need to purchase.

The ACUPCC Carbon Offset Protocol provides additional guidance on offset purchasing; also see section 5.9 of this manual.

Comparing Measures Based on CO2 Reduction Efficacy

It also makes sense to evaluate prospective energy conservation measures in terms of their relative efficiency or efficacy in producing GHG emissions reductions. To do this, projects can be compared in terms of a cost/offset ratio or, in other words, how much it costs to produce a metric ton reduction of carbon dioxide emissions ($/MTCO$_2$e/yr). This analysis can be done in terms of net present value to take into account the time value of money.

Care, however, should be taken not to focus initially only on those measures which have the most attractive cost/offset ratio because such an approach may make it more difficult to complete the less attractive measures at a later date. The same logic applies when comparing projects on the basis of payback.

See section 6.3 of this guide for further discussion on using cost/offset ratios to compare and prioritize projects.

5.1.9 Avoid the Short Payback Trap

It is often assumed that it makes most sense to start with energy conservation measures that are easiest to do and have the shortest simple paybacks, i.e. the proverbial "low-hanging fruit." The problem with this approach is that if you harvest all the low hanging fruit first, then all you have left is the high hanging fruit – and reaching that fruit can be pretty difficult since it has longer paybacks and thus appears to be financially unattractive.

The short payback or low hanging fruit trap can be avoided by combining the most cost-effective energy conservation measures with less cost-effective measures. This is typically done in comprehensive energy conservation projects. Lighting retrofits may have short paybacks while more capital-intensive retrofits like installing heat recovery systems or new boilers or chillers may not. If both types of measures are combined in the same project, the end result can be a relatively attractive combined payback and thus an overall project which is relatively easy to financially justify. This approach allows short payback measures to "leverage" or in essence finance long payback measures.

The strategy of combining short and long payback projects can also be used to finance renewable energy projects like photovoltaic arrays that may have very long and financially unattractive paybacks even after taking advantage of incentives that bring down project costs. In a large multi-million dollar comprehensive energy conservation project, conservation measures that payback relatively quickly can be used to finance a PV array that may payback in 25 or more years. Moreover, while the cost of a large PV array may be substantial if viewed in isolation, even a $500,000 system may shrink to insignificance when viewed in the context of a $10 or $20 million comprehensive energy performance contract.

The second way to avoid the short payback trap is to create a revolving fund that is funded by energy savings that are then available to fund later projects that have longer paybacks.

5.1.10 Revolving Funds

A revolving fund works by placing all or some of the savings produced by energy conservation projects and measures into an account that is then used to fund other projects. This same account could be the repository for an annual budgetary allocation from your administration to help finance your energy conservation projects. It could also be the place where energy incentive monies are deposited.

Since conservation is so important and funds for projects are generally limited, it will be necessary to protect the revolving fund from being raided for purposes other than conservation. A clear understanding of how this fund may be used is essential. For projects which are a mix of capital improvement and energy conservation, only the premium cost associated with maximizing efficiency should be charged to the fund. The revolving fund's manager should establish a set of criteria for evaluating eligible projects so that only the best projects which would otherwise not be done get funded from this source.

Another challenge in establishing and maintaining a revolving fund is turning "avoided costs" into real dollars when a budget crunch comes. When an energy conservation measure is employed, it does not produce a pot of money. Instead it produces savings or avoided utility budget costs. To fund your revolving fund, you may need an agreement with your chief budget officer that allows you to identify and transfer energy savings from the surplus in your utility budget caused by conservation measures. This may work well until energy prices unexpectedly rise (eliminating the ability of energy conservation measures to create a surplus in your utility budget) or if campus energy consumption is greater than anticipated because of an especially cold winter. Events like this can cause your utility budget to go into deficit mode – even though the conservation projects you implemented are nonetheless producing savings. Thus, when utility budgets go into the red, transferring savings into your revolving fund may be "politically" more difficult to accomplish. This problem can be solved by anticipating these circumstances and having an agreement in place to transfer savings irrespective of the condition of the budget.

For additional information about revolving funds, see *Creating a Campus Sustainability Revolving Loan Fund: A Guide for Students*.

5.2 Heating and Power Plant Solutions

In all likelihood, the largest single campus energy consumer is the campus power plant where vast quantities of coal, natural gas, or other fuels are burned to produce energy – in the form of steam, hot water, electricity, and/or chilled water – for the rest of the campus. Burning fossil fuels at this facility produces lots of GHG emissions and may be responsible for a large chunk of your school's carbon footprint.

Fortunately, there are effective ways to reduce GHG emissions emanating from campus power plants. A priority strategy is to reduce the amount of energy your plant is consuming by reducing its load. That can be done by making campus buildings more energy efficient and by reducing distribution system heat loss.

Just distributing heat across campus through an underground (hopefully well insulated) pipe system can consume 5-10% or more of the heat the plant produces. If you see snow melting above underground steam or hot water lines, they are not well insulated.

If your campus is heated by steam produced at your heating plant, a simple but effective way to reduce distribution losses is to reduce the pressure of steam leaving the plant to the lowest level consistent with adequate delivery of steam to all buildings and pieces of equipment. For example, your plant may be pumping out steam at 125 pounds of pressure when the "worst case" building or piece of equipment on campus demands steam at only 40 pounds. By reducing the pressure of steam leaving your plant to 40 pounds or slightly higher, plant operators may be able to meet all campus steam heating needs while substantially reducing heat loss from the steam distribution system since steam pipe conductive heat loss and the rate of steam leaks are both a function of steam pressure. Lower the pressure and those losses go down.

A second obvious strategy for reducing campus power plant GHG emissions is making the power plant itself more energy efficient. There are probably 100 ways to make heating plant boilers more efficient, many of which are described in *Boiler Efficiency Improvement*, a publication of the Boiler Efficiency Institute – a well known training organization that has trained thousands of campus boiler operators over many decades. An excellent resource for improving the efficiency of natural gas boilers is the Boiler Efficiency Section of the Energy Solutions Center.

5.2.1 Cogeneration

Cogeneration or "combined heat and power," is an option for coal, oil, natural gas or biomass heating or power plants. Cogeneration is the simultaneous generation of electricity and heat, thus increasing the efficiency of fuel use. A variety of technologies can be used to generate both electricity and heat including turbines and internal combustion engines with heat recovery.

Cogeneration tends to be most cost-effective when the price of purchased electricity (which is avoided through self-generation) is relatively high while the price of the fuel used by the cogenerator is relatively low.

The most cost-effective cogen applications are those where there is a constant year round demand for all the electricity and heat the cogeneration unit can produce. Thus it is important to match the electrical and thermal output of the cogenerator to campus loads on an hourly basis. To provide an adequate thermal load during the summer months, some facilities use absorption chillers which use heat to make chilled water for air conditioning.

In some regions, local electrical utilities may discriminate against cogeneration because they view any kind of self-generation of electrical power as direct competition for the electrical power they may generate or distribute and sell. The utility can discourage its customers from installing and using cogeneration by imposing a tariff or rate structure that assigns high costs to the "stand-by power" cogen facilities will need whenever their cogeneration units fail or are shut down for maintenance. These punitive tariffs can be reversed by lobbying state public utility commissions or state legislatures. The tariffs can also be avoided entirely by disconnecting from the electrical grid (sometimes called "islanding") though that tends to be a very expensive proposition because redundant equipment is needed to guarantee operation when some units are down.

While a properly sized cogeneration unit typically is very energy efficient, implementing cogen at any given college or university could decrease or increase the school's carbon footprint – depending on (a) the carbon intensity of the fuel used to cogenerate and (b) the carbon intensity of the purchased electricity cogenerated electricity replaces.

5.2.2 The Problem with Coal


Mountain Top Removal coal mining (Courtesy of Appalachian Voices)

Unlike natural gas or oil, coal is mostly carbon – so when it is oxidized or burned, the result is mostly carbon dioxide. Thus from a climate protection point of view quitting coal is critically important. That rule applies to coal burned in campus heating or power plants. It also applies to the embodied coal in purchased electricity.

Leading NASA climatologist James Hansen and others have argued that to effectively put the brakes on climate change we must stop burning coal except where carbon dioxide emissions are captured and permanently sequestered. Carbon capture and storage (CCS) is presently in its infancy and is not presently in commercial use. (See section 5.2.6 of this guide for more discussion of CCS.)

Of course, quitting coal is more easily said than done. There are at least two big hurdles – the potentially much higher cost of alternative fuels (e.g. natural gas, biomass, etc.) and the cost to build a new campus heating/power plant or retrofit an old one.

Many colleges and universities, especially those in coal states in Appalachia and the Midwest, have traditionally used coal for what seemed to be good reasons before we became aware of the problem of climate change. Coal is, after all, plentiful and cheap – though during the first half of 2008 increasing international demand caused the price of coal to double before returning to normal once the global economic meltdown occurred later in the year. Higher coal prices may return once the world economy gets back on track. Moreover, coal prices will definitely rise to much higher levels as effective cap and trade or carbon tax regimes are applied to coal to actively discourage its use. Coal mining presents a raft of troubling environmental and health issues as well. And as many facilities managers know, coal is dirty to handle and can have adverse health impacts on facilities staff – a reality campuses that burn coal may not want to admit for liability reasons.

So it makes sense to look at alternatives to coal burning – perhaps making plans to convert your power plant once the economy picks up and revenues become available. Schools in coal-producing regions of the country may want to expand their examination of alternatives to coal to include research on transitioning local communities away from coal mining and, if needed, direct assistance to workers and communities affected by this transition.

There can be a silver lining to quitting coal. Switching to a higher price heating fuel will increase the incentive your campus has to implement energy conservation measures to reduce your heating load. And those measures will further reduce your carbon footprint. In any event, schools committed to make significant reductions in GHG emissions with on-campus coal plants can't avoid this very difficult issue.

5.2.3 Alternatives to Coal

What fuel options besides coal exist for campus heating or power plants? The obvious traditional one is natural gas. Less obvious though more climate-friendly choices include biomass, landfill gas, and geothermal.

Natural Gas

Natural gas industry advertisements have told us for years that natural gas is clean and efficient. In fact, it is a fossil fuel and even burning it efficiently produces ample quantities of carbon dioxide that contribute to climate change. To avoid the worst consequences of climate change we will need to reduce our reliance on all fossil fuels including natural gas. Nonetheless, natural gas is the cleanest of fossil fuels from the point of view of conventional pollutants as well as carbon dioxide emissions. On a BTU basis (CO_2/BTU), natural gas produces about half the GHG emissions as coal. Thus, switching from coal to natural gas combustion is a step in the right direction though not a long term fix. While coal is regarded as cheap and plentiful, natural gas supplies are more constrained and natural gas has been relatively expensive until the recent economic downturn.

Natural gas can replace the use of coal in a campus power plant. It can also be used in new "satellite boilers" installed in campus buildings across the campus – eliminating the need for the central plant and its underground district heating system. Switching to multiple boilers may involve more boiler maintenance but it eliminates the heat losses associated with the power plant's steam or hot water distribution system. It also eliminates the need to repair or replace that distribution system – thus avoiding deferred maintenance or capital project costs.

Campus planning involving heating or power plant fuel choice should anticipate future carbon tax penalties. These penalties will close the cost gap between coal and natural gas. It is also important to note that natural gas can be burned more efficiently than coal.

Biomass

The new biomass-fired power plant at Middlebury College in Vermont (Photo credit: Brett Simison)

Biomass fuel consists of organic material such as wood chips, oat hulls, corn husks, etc. Finding a long-term reliable supplier with enough biomass fuel to operate a campus heating or power plants can be a challenge. Ensuring that the biomass is produced sustainably is also a challenge. Other issues associated with biomass are biomass' relatively low heat density (requiring greater volumes of fuel), the need for specialized handling equipment, and its air emissions and ash waste products. However, addressing the latter should be no more difficult than using coal.

Biomass is not only renewable but also theoretically carbon neutral because the carbon that's released into the atmosphere when biomass is burned can be captured and sequestered into new biomass fuel crops as that biomass grows. Sustainable biomass presumes that annual biomass production equals consumption and is accomplished without environmental damage, e.g. cutting down forests. Since some fossil fuel inputs are generally involved in growing, harvesting, chipping, and transporting biomass fuel, it can be argued that biomass is not actually carbon neutral despite often being regarded as such. Calculating the life-cycle net carbon emissions of biomass-based heating or electricity production would be a great project for students and faculty.

Sustainable biomass can include waste products like wood waste from furniture plants, urban tree trimmings, or clean wood extracted from a municipal solid wastestream, and agricultural crop waste. While the waste-to-energy industry sometimes claims that general municipal solid waste is an acceptable biomass fuel, it is not regarded as such by environmentalists because of the dirty air emissions and toxic solid waste by-products its combustion produces and because burning municipal solid waste generally undermines municipal recycling programs.

Before proceeding with plans to convert to biomass campus heating or power generation it is essential that a fuel availability study be conducted. While a consultant can be hired to perform this study, it could be a great project for students with support from faculty and facilities management staff. Students could study the net availability of suitable biomass resources within a given distance from campus. This research would examine existing resources as well as the potential biomass resource if a market for biomass were created by demand from your proposed plant. Students could identify sustainable forestry or crop practices that your school could require for biomass purchases including consideration of the Forest Stewardship Council's best practices. If you proceed with a biomass plant, once it is up and running students can study the supply chain to determine and evaluate what is actually happening on the ground. This is just one example of an operational step toward reduced carbon emissions that provides a unique and important learning experience for students. Your CAP should identify and utilize these pedagogic opportunities.

While converting your heating or power plant from coal to biomass may be a long-range strategy due to the costs involved, in the meantime – depending on boiler type – it might be possible to co-fire biomass and thus reduce GHG greenhouse gas emissions. Co-firing generally involves displacing some coal combustion by burning biomass and coal together. The National Renewable Energy Laboratory has published a useful factsheet on biomass co-firing.

Middlebury College provides a good example of biomass cogeneration while the University of Iowa provides an example of co-firing oat hulls.

Landfill Gas

Landfill gas is methane produced by the decomposition of garbage in landfills. Since methane is a powerful GHG gas which on a mass basis and 100 year time horizon has over 20 times the global warming potential of carbon dioxide, it is important that it not be vented to the atmosphere. Collection systems can be installed in landfills to harvest methane. It is then scrubbed and often burned on-site to generate electricity or both heat and electricity. Landfill methane can also be delivered elsewhere via pipeline. While burning landfill gas produces carbon dioxide, it also prevents methane emissions – and thus produces a net reduction of GHG emissions. While not readily available to all college campuses, landfill gas can be a suitable fuel for campus power plants or any kind of natural gas-fired boiler or cogenerator.

University of New Hampshire offers an example of campus cogeneration using landfill gas.

Geothermal

See section 5.3.5 of this guide for a full discussion of geothermal energy as a technology to replace campus power plants and as an option for heating and cooling campus buildings.

5.2.4 Reducing the Carbon Footprint of Oil Burning

Many sites have limited heating fuel choices and rely on fuel oil as a primary heating source. If cleaner burning natural gas is available nearby, the cost of connecting to it and upgrading boilers & burners to use natural gas can be calculated. A reduction in GHG emissions will be a certainty with this change because on a BTU basis (CO_2/BTU) natural gas emits 30% less CO_2 than does fuel oil. Also, it may be possible to burn natural gas – especially when cogenerating – more efficiently than oil, thus further reducing GHG emissions.

Where switching to natural gas isn't feasible, consider the use of #2 oil to replace the dirtier (but less expensive) #4 or #6 oil. On a BTU basis, #2 oil emits 7% less CO2 but emissions reduction will be greater than that because #2 oil does not have to be heated in storage (a requirement for #4 and #6 oils in colder climates to allow the oil to be pumped).

Of course, if you are in need of a new power plant or are prepared to replace your oil-burning boilers, then you can consider a wholesale switch to biomass, landfill gas or geothermal.

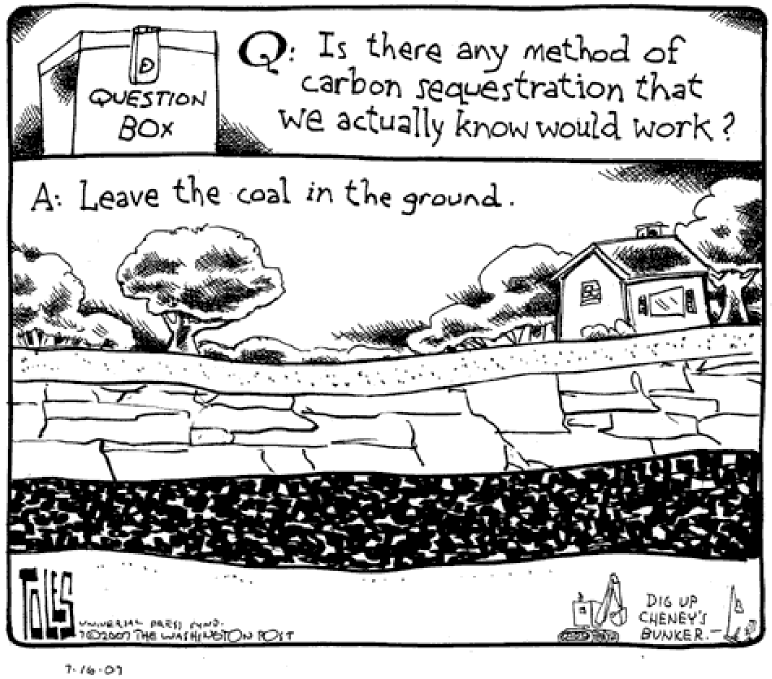
5.2.5 Should You Sell Carbon Offsets to Finance Power Plant Conversion?

Conceivably, marketable carbon offsets could be created by replacing a campus coal-fired power plant with a less carbon intensive fuel or technology such as biomass or geothermal. While the sale of offsets could help finance the conversion, it also would pass along credit for the carbon emissions reduction to the purchaser of the offset. If this were done, from a carbon accounting perspective there would be no net reduction in your campus carbon footprint. If your goal is to produce a genuine net reduction of global greenhouse gas emissions, then creating and selling carbon offsets from coal plant shutdown should not be on your agenda.

5.2.6 Carbon Capture and Storage

As previously mentioned, methods for capturing carbon dioxide emissions from commercial power plants and other large point sources are now being developed along with techniques for long term storage or sequestration of these emissions. Known as carbon capture and storage or sequestration – CCS may eventually be considered as a strategy for reducing carbon dioxide emissions from large campus power plants.

Carbon dioxide can be captured using pre-combustion, post-combustion, and oxyfuel technologies. Pre-combustion capture can be accomplished using gasification technology to gasify solid fuel (typically coal) prior to combustion and thus produce hydrogen for combustion and a relatively pure carbon dioxide waste stream for easy capture. Post-combustion capture of carbon dioxide can be accomplished using various types of chemical scrubbers that remove CO_2 from other combustion gases. Oxyfuel CO_2 capture works by burning the fuel in pure oxygen, thus creating a nearly pure CO_2 exhaust stream that then can be more easily captured.



Cartoon courtesy of Tom Toles

Theoretically, once captured, carbon dioxide emissions could be buried permanently in underground geological formations similar to those that contain natural gas. However, CO_2 leakage risks are not yet fully understood and a legal framework for CCS does not yet exist. While CCS may eventually become technically and legally possible, it is not a short-term solution and is likely to be very expensive. Further, economies of scale are likely to work against campus applications though conceivably schools that burn a lot of coal and are located in areas with appropriate geology might some day consider it.

Applied to a biomass power plant, CCS could produce a net reduction of atmospheric CO_2, i.e. be GHG emissions negative.

Campuses considering such strategies should be aware that much of the environmental community is very skeptical of CCS. They see it as a coal industry strategy for rationalizing new coal-fired power plant construction and continued coal-burning despite (a) the significant environmental and social consequences of mining coal and (b) the fact that CCS is not likely to be commercially available for a decade or more.

5.3 Install Renewable Energy Technologies on Campus

Conservation and efficiency can take us far but not all the way. Even after we have reduced our energy load to a bare minimum, we will still have to meet that remaining load with some form of energy. In order to achieve climate neutrality or deep cuts in GHG emissions, campuses will need to transition as much as possible to carbon-free renewable energy technologies – solar, wind, biomass, geothermal, and hydro (though the latter is pretty much tapped out in most regions). We can either build renewable energy capacity on campus or buy green power. This section discusses on-campus renewable energy sources for non-heating or power plant applications.

When performing an economic evaluation of these technologies, consider including in your analysis the dollar savings associated with avoiding future costs for RECs or carbon offset purchases. See Section 5.3.8 of this guide for resources on renewable energy financing options.

5.3.1 Photovoltaic Solar Electric Arrays

Many campuses are installing photovoltaic (PV) solar electric arrays. While rarely as cost-effective as energy conservation, PV becomes more cost-effective when conventional electric rates are high and ample incentives are offered by state government or local utilities.

Obviously, the amount of available sunlight is another important factor though PV can work well in all regions. Where there is less sun, more solar panels are needed to meet a given load. This adds cost and stretches out payback but it works. Where snow may cover panels during winter months, panels can be tilted to shed snow or PV array output can be pro-rated downward to allow for a number of weeks or months when output is reduced. The performance of grid-interconnected PV is generally measured in terms of annual power production and most PV production occurs during the sunnier summer months when days are longer and there is less cloud cover. In areas where winter days are cold and clear, angling panels to take advantage of those conditions becomes more important. While winter output will be less, PV panels actually have a higher sunlight-to-electricity conversion efficiency when cold.

There are a variety of financial models for installing PV on campus. Your school can design, purchase and install its own system – typically with the technical assistance of a consultant or supplier. The relatively high cost and long payback of this kind of investment can be tempered by incentive dollars that reduce the initial or "first cost" of the system. Another financing strategy is to include the cost of the solar energy system in a larger self-financing energy conservation program and, in essence, allow the energy conservation measures (and the dollar savings they produce) to pay for the solar.

A solar energy system can be installed on campus through a power purchase agreement (PPA) with a renewable energy power provider who will install and own a PV system located on campus. A PPA will oblige a school to purchase power from the PV system for a number of years at rates established by the contract. The primary advantage of this arrangement is that the school is not responsible for the installation, operation, maintenance, or cost of the PV system. Also, this arrangement may allow the energy supplier to take advantage of tax credits which may not be available to the campus.

Maximum output from PV arrays occurs mid-day on hot summer days – precisely the time when regional grids in many areas are under strain because of high air conditioning loads. At these times, hourly rates for electricity may be much higher than average rates. This coincidence suggests that an analysis of PV cost-effectiveness should be sophisticated enough to factor in the additional dollar savings associated with avoiding that very expensive conventional electricity. PV arrays can also reduce peak demand and peak demand charges. PV project simple paybacks tend to be long though factoring in these additional savings will shorten it somewhat.

In order to claim a CO_2 reduction from a campus-owned and operated PV system or from a PV PPA, you must own the renewable energy certificates or RECs associated with the output of your system. In the case of a PV system your campus owns, that means “retiring” and not selling them. In the case of a PV system installed under a power purchase agreement, to claim a CO2 emissions reduction your school must buy the RECs produced by the PV system. The REC purchase may be in addition to buying the actual power produced by the array. (See section 5.4.2 of this guide for an explanation of RECs.)

AASHE maintains a list of campus PV installations.

5.3.2 Other Solar

Other on-site, on-campus solar options include:

- Passive solar
- Daylighting
- Solar hot water

Not only can all three of these technologies be considered for new construction, all three can be either made to work or installed in existing buildings. For example, you may already have buildings with rooms or corridors with ample south-facing glass that allows solar gain during the winter months. This gain may be a nuisance now, causing localized over-heating. Building occupants may be fighting that sunlight with pulled down shades. Your maintenance staff may have solved the problem by installing reflective window film to block the sunlight from entering the building. An alternate approach would be to let the sunlight pass through the windows and put that heat to work by installing thermal mass to store it for use later in the day or by modifying the HVAC system so the heat is captured, transported, and used in another part of the building. Engineering or architecture students may want to study passive or active solar heating options for that kind of campus building as a class or volunteer project.

Similarly with daylighting, you may already have daylit spaces but are not taking advantage of their energy saving opportunity because of inadequate controls on electric lighting. Installing photocells or sensors may be all it takes to keep electric lighting off when daylight from the sun is adequate to illuminate those spaces. Facilities staff or students can survey the campus to look for opportunities of this kind.

Solar hot water systems can be more cost-effective than PV solar electric systems yet are generally less common. Why is that? Maybe it is because piping is harder to install than wiring and there ends up being more maintenance with solar hot water systems. Maybe it's because fewer incentives are available. Also, unlike PV (whose output can always be used by the building it's mounted on or by the local power distribution grid its connected to), solar hot water systems must closely match daily hot water production with daily hot water demand. And hot water needs may not coincide with those times when solar hot water systems readily produce hot water. On most campuses, hot water demand predominantly occurs in the fall, winter and early spring when the fall and spring semesters are in session. However, in many parts of the country solar gain is not ideal during much of that period: the sun is low in the sky, days are short, and there may be lots of cloud cover or snow. Also, while most campus buildings have hefty appetites for electricity, not all campus buildings have adequate hot water loads to justify a solar hot water system. Buildings with above average hot water needs include athletic facilities, student residences, and food service facilities.

While solar hot water presents some challenges, it is a viable option for campuses interested in demonstrating solar energy. If the "first cost" of such a system is daunting, consider a power purchase agreement with a solar provider that would build, own, and operate "your" solar hot water system while selling you its hot water output. Students and faculty can even study the possibility of using solar hot water technology for seasonal solar storage – collecting and storing solar heat collected in the sunny summer for use in the cold cloudy winter.

5.3.3 Wind Energy

Some colleges and universities have installed wind turbines on or near campus to meet a portion of their electricity needs. The huge size of the most efficient turbines, i.e. utility scale turbines whose blades reach as high as 400 feet, make them "out of scale" to the rest of a campus. These giant turbines are often better suited to be installed on the periphery of a large campus or on outlying campus property. Some campuses may own distant property and that too can be considered for wind turbine installation – though in that case getting the power to campus may involve additional delivery costs. It is generally financially advantageous to install wind energy capacity on the campus side of the electric meter.

There are a variety of wind turbine financing options to consider – from campus ownership to buying the output of an on-site turbine through a power purchase agreement – with advantages and disadvantages to each. If your campus is pursuing wind energy, it is important to design your project to take advantage of federal and state incentives, tax credits, and tariff mechanisms which are now in place and are being developed to promote wind energy as well as other renewable energy technologies.

As with PV, the campus must own the RECs produced by the turbines in order to take credit for GHG emissions-free power – though, ironically, it's the introduction of electricity from the turbine (not the RECs) which actually changes the mix of generation away from polluting fossil fuels (again, see section 5.4.2 of this guide for an explanation of RECs.)

Smaller turbines which can be mounted on buildings present another on-campus wind energy option. These can make a statement and may have educational value – though their output is likely to be very low given their small wind swept areas. If they end up not spinning very much or their trivial output becomes known, they won't encourage positive thinking about wind energy. An interesting article on this subject is "The Folly of Building-Integrated Wind" from *Environmental Building News*.

If your intent is to generate cost-effective electrical power from a wind turbine, then be sure to have a proper professional wind assessment done; it doesn't protect the climate to waste a lot of steel production putting an industrial wind turbine on an unsuitable site with little wind. This is an exceptionally wasteful mistake to make because the amount of power in the wind is a function of the cube of the wind speed. Thus, selecting a site which has even an additional meter/second in wind speed can make a huge difference in turbine output.

AASHE maintains a list of campus wind installations.

5.3.4 Biomass

See section 5.2.3 for discussion of biomass as fuel for campus heating or power plants. Also, students – with help from campus facilities management and relevant academic departments (e.g. chemical engineering) — may be interested in producing biodiesel on campus using waste fryer grease from campus food service or local fast food restaurants. Students at Oregon State University provide an example of the latter.

AASHE maintains a list of campus biodiesel fleets.

5.3.5 Geothermal

Geothermal energy takes many different forms. For example, in some locations it's possible to tap hot water or steam through deep wells and use that heat energy to directly heat buildings or generate electricity. While some colleges and universities can tap this renewable resource, most cannot. But all schools can consider geothermal or ground source heat pump heating and cooling systems. Typically these are applied to single buildings but they also can serve entire campuses and eliminate the need for central power plants.

Ground source heat pump (GSHP) systems rely on the more or less constant temperature of the earth below the frost line and the ability of the earth to store and release heat. Of course, these systems also rely on heat pumps which are mechanical devices that use refrigerant gases, compressors, expansion valves, and evaporator and condenser coils to move heat from one place to another. Heat pumps make refrigerators, freezers, air conditioners, and dehumidifiers work.

GSHP systems transfer heat in and out of the ground (depending on the season) by either an *open loop* pipe system that extracts and re-injects ground water or a *closed loop* pipe system that is sealed and contains a mixture of water and glycol to prevent its freezing. Heat is transferred into or out of the underground loop system by heat exchangers which are also connected to one or more water pipe loops within the building. Heat pumps tap into these interior loops, extracting or rejecting heat into them – depending on whether the heat pumps are in a heating or cooling mode. The interior space of the building gets heated or cooled by warm or cold air that is produced by the heat pump and introduced into each room via ductwork. A helpful schematic of the above process is available on the website of Canada's Office of Energy Efficiency.

GSHP systems require electricity to run conventional pumps, heat pumps (which contain electrically driven compressors), and fans. If this power is conventional, grid-supplied electricity, then GSHP should be regarded as an energy efficiency technology. On the other hand, if the electricity comes from wind turbines or another renewable energy source, then the GSHP system is an example of renewable energy technology, producing carbon-free heating and cooling. This latter approach makes new zero-energy/zero-carbon buildings possible.

The National Wildlife Federation provides examples of geothermal heat pump-heated and cooled buildings. Oregon Institute of Technology offers an example of geothermal heating and electricity production and Ball State University provides an example of GSHP replacing a coal-fired campus power plant.

5.3.6 Fuel Cells

Stationary fuel cells which generate electricity and heat are another potentially renewable option for campus installation. However, fuel cells powered by natural gas – which are now the norm – are neither renewable nor carbon-free. To use a fuel cell to produce GHG emission-free electricity and heat, a carbon-free source of hydrogen would be required. That could come from a hydrolysis process (which splits water into hydrogen and oxygen) that is powered by renewable, carbon-free electricity from either wind turbines or PV panels.

Fuel cells that use natural gas can function as an energy conservation measure, and in that capacity may reduce GHG emissions.

AASHE maintains a list of campus stationary fuel cells.

5.3.7 Maximizing the Educational Benefits of Renewable Energy Systems

Given the educational mission of colleges and universities, it is desirable to maximize the educational benefit of on-site renewable energy systems. This emphasis also helps compensate for the fact that in many cases these projects are very expensive, have longer paybacks, and produce less carbon mitigation than would energy conservation projects of the same cost.

First and foremost, a campus renewable energy system should be highly visible. While biomass-fired power plants and giant wind turbines are hard to hide, PV, geothermal, and fuel cell installation can be hidden from view and thus provide little awareness or educational value. Creativity should be employed to make these systems visible and noticed by the campus community – perhaps using tours, displays or glass walls showing inside building mechanical rooms where at least some components of these systems can be seen.

University at Buffalo's "Energy for the Future" educational display is an example of a campus energy display created to complement the installation of a PV array. The 73.5 kW roof-top array is visible from surrounding buildings and from a set of windows in the UB's Science and Engineering Library adjacent to the display. (Photo credit: James Ulrich)

In all cases, it is desirable to accompany an on-campus renewable energy installation with an education program or display. Such a display could include real-time metering and monitoring to demonstrate the performance of the system. This can be conveyed via a kiosk, energy dashboard, or website. A strong educational component contributes to the goal of introducing sustainability and climate change into the curriculum.

It may also be possible to design an on-site solar, wind or biomass system so that it can be used for student or faculty research. At technical and community colleges these systems can present opportunities for training – either during initial installation or for maintenance and monitoring afterwards. When used for this purpose, equipment components and model selection should mimic what students will encounter in the field.

5.3.8 Paying for Campus Renewable Energy Systems

The preceding discussion about on-site renewable energy options included some discussion of financing options. For more information on financing on-site renewable energy technologies, see:

- *The Business Case for Renewable Energy: A Guide for Colleges and Universities* by Andrea Putman and Michael Philips (2006)
- *Alternative Energy Economics* by Michael Philips and Lee White (2009)
- Database of State Incentives for Renewables and Efficiency

5.4 Buy Green Power

Producing on-campus carbon-free, renewable electricity is difficult, and producing enough of it to make a real difference is even harder. Purchasing green power represents an easier, potentially less expensive strategy for meeting electrical needs while reducing the campus carbon footprint. Buying green power is also a common strategy for institutions striving for deep cuts in carbon emissions or carbon neutrality. While campus electricity purchases can and should be reduced to a minimum through aggressive conservation, efficiency, and the installation of on-site renewable electrical generation, mitigation of the carbon emissions associated with remaining purchased electricity requires buying green power or carbon offsets.

The U.S. Environmental Protection Agency Guide to Purchasing Green Power is a useful green power resource. Also, the EPA's Green Power Partnership provides campus examples of green power purchasing.

5.4.1 Benefits of Buying Green Power

There are a variety of potential benefits associated with buying green power. Your school's green power purchases can:

- Mitigate the carbon emissions associated with conventional purchased electricity by bolstering the development of additional renewable energy generating capacity that shifts power generation away from reliance on fossil fuels
- Contribute to the construction of specific renewable energy generators (such as a new local wind farm) if green power is purchased through a long term contract with a specific developer
- Provide a financial hedge against price volatility of conventional electricity, especially if you purchase green power on a long term contract
- Demonstrate civic leadership
- Provide public relations benefit
- Increase campus morale
- Serve an educational purpose

5.4.2 What You Are Buying – RECs or Green Tags

Green power purchasing typically involves buying renewable energy credits or certificates, referred to as "RECs" or "green tags." These are purchased in increments of 1,000 kilowatt hours (1 REC = 1,000 kWh or 1 megawatt hour) and represent the "environmental attribute" associated with renewable power. RECs should be certified by an independent agency (e.g. Green-e) to guarantee their actual production from a qualifying renewable energy source and to insure that they are not double-counted and double-sold. Qualifying sources include solar electric, wind, geothermal, and certain types of hydro, biomass and hydrogen fuel cell-derived power.

RECs are sold on "compliance" and "voluntary" markets and typically cost 1 - 3 cents per kWh, a premium cost over and above purchased electricity. Price differences can be attributed to demand, location, provider, and green power generation source. Given the volume of institutional green power purchases, colleges and universities can expect better pricing than residential and small business owners.

Compliance markets are created by policies such as renewable portfolio standards that require electric utilities to supply increasing percentages of power from renewable sources. Colleges and universities participate in voluntary markets, i.e. pools of customers that voluntarily choose to go green.

While RECs are the most common vehicle for purchasing green power, there is some skepticism about them. Some argue that REC purchasers receive nothing of value other than bragging rights – despite REC certification regimes by Green-e and state public utility commissions. In many cases – because there is no requirement of "additionality" – it is not clear whether a given green power purchase causes or contributes to the development of additional renewable electrical generation, thus actually suppressing fossil fuel-fired electrical generation and reducing GHG emissions. Potential customers may wish to ask for evidence that their green power purchase will produce a GHG emissions reduction "in addition" to what would have occurred anyway.

Over time the renewable energy market may move beyond RECs, but for now campuses as well as business and residential customers interested in green power usually deal with RECs. Fortunately, there are strategies that can be used to increase the odds that your green power purchase really produces an environmental benefit. Some of these strategies are described in the next section.

5.4.3 Maximizing the Environmental Benefit of Green Power Purchases

Not all green power is equal. For example, if you are buying biomass-generated electricity, due diligence requires that you examine the source of fuel to insure that its production does not involve forest destruction or other negative environmental impacts. Also, not all green power is carbon-free. A case in point is biomass-generated power since fossil fuels are typically consumed in the process of producing, transporting and processing biomass fuel. Wind, on the other hand, is GHG emissions-free except for the fossil fuel used in making and installing the wind turbines themselves, a carbon debt which wind manufacturers say is paid back within a few months of operation. While these embodied energy issues are generally not considered in campus carbon accounting, investigating them would provide an interesting learning experience for students and faculty.

Hopefully, colleges and universities are buying green power not simply for bragging rights but are doing so out of genuine concern for sustainability. If your purchase of green power does not actually lead to the development of more green power capacity (and thus contribute to a shift in the mix of power generation away from dirty fossil fuels), then no reduction in GHG emissions has been achieved and no environmental benefit has occurred. Thus, it is important that schools consider, as an essential decision-making criteria, the likeliness that a given green power purchase will in fact leverage new renewable power development.

Let's see how this might play out in the real world. Perhaps your school could buy qualifying low head hydro power at a cheap price but that purchase is unlikely to motivate developers to build more hydro capacity because additional hydro opportunities are not available. If your school's other option is to purchase wind energy, whose RECs might cost more but whose purchase will stimulate the construction of the new wind farm, then this perspective says you should buy wind. One can easily imagine some difficult decision-making on campus given the challenges and costs associated with achieving significant cuts in GHG emissions. You could *claim* great progress in mitigating carbon emissions by buying a lot of cheap RECs but the GHG emissions reduction you are claiming would be *imaginary* if your REC purchases are not actually helping to shift the mix of generation.

Let's take this line of thought a few steps further. Are there ways of buying RECs that make it even more likely that that next wind farm, for example, is built? The answer is a resounding "yes!" The best way to leverage new wind capacity is to build that new wind farm yourself. The next best approach is to buy wind-generated RECs on a long term contract from a wind developer who is poised to build his or her next wind farm. With a long-term REC contract in hand a wind developer can secure lower cost financing, vastly increasing the odds that the next wind farm is built. That's the outcome we want.

You can further increase the odds that your green power purchase will increase renewable energy capacity by purchasing wind-generated green power on a long term contract specifically from a planned wind farm that is not yet built. This may seem counter-intuitive but this strategy is effective because it compels the developer to build additional renewable capacity in order to obtain your business. Your ability to leverage that "next wind farm" grows even further if you also commit to a long-term contract for the electricity output of the wind farm (the "commodity") as well as the RECs. This approach may also allow you to lock in flat or more level and predictable electricity pricing – thus providing a hedge against future electricity price volatility and hopefully real dollar savings over the length of the contract.

Buying green power can get complicated but the bottom line is this:

- As the renewable energy market evolves, colleges and universities as well as other customers will have new options for buying green power
- Smart buyers of green power will choose those options most likely to increase state, national, and global renewable energy supply

5.4.4 Complementing Green Power Purchasing with Conservation

Installing or buying green power and doing energy conservation are GHG mitigation strategies that can complement and synergize each other. It's obvious that conservation reduces your campus energy load and saves money. It may be less obvious that conservation also decreases the amount of potentially expensive renewable generation your campus would need to produce or green power it would need to buy in order to further displace fossil fuels and meet your climate goals. Plus conservation savings can be used to buy green power – thus offsetting those costs again! Eliminate waste and reduce your energy needs. There is a lot of magic in energy conservation!

5.5 Maximize Space Utilization to Avoid or Minimize New Construction

5.5.1 Wasting Space on Campus

While new construction is sexy and having a LEED Gold or Platinum building on campus certainly gives you real bragging rights, the reality is that each new building adds to your campus carbon footprint unless it is a zero-energy building or it replaces a building that used more energy. Zero-energy buildings may eventually become the norm but with very few exceptions they are not here yet. New campus buildings, even those that are LEED certified or better, may turn out to be energy hogs – and thus be responsible for significant increases in the size of campus carbon footprints, thus undermining campus climate action efforts.

Colleges and universities committed to reducing their carbon footprints need to look at new construction in a new way. They can save energy dollars and reduce carbon emissions by maximizing the utilization of existing space and avoiding new construction. While it may be difficult to imagine a president of a college or university resisting new construction (since new buildings are often viewed as legacy achievements), that's what is needed.

On many if not most of our campuses inefficient space utilization is the norm. The most desirable spaces may be intensively utilized and fought over while less desirable spaces are cast off and sparsely occupied. Over time, as new buildings are constructed and departments and offices move into glitzy, high prestige spaces, the areas they leave behind are taken over by existing personnel and offices. What happens is that everyone spreads out with the net effect of decreasing space utilization density. Ever greater areas are "used" while activity and output stays roughly the same.

The academic calendar itself may be inefficient. Consider that at many schools it is common to see beautiful campuses mostly barren of students, faculty and most academic programming for the entire summer – beginning in early May and stretching to late August. Meanwhile, because staff are still present and departmental offices are still open, all buildings are considered "occupied" and all HVAC equipment is running. This may be the way colleges and universities do business but from an energy and climate perspective it does not make sense.

The structural inefficiency of faculty offices deserves special mention. Faculty members generally have their own offices but these offices may be utilized only few hours a week during 15-17 week spring and fall semesters and be completely unoccupied otherwise – all the while these spaces are heated and cooled twelve months of the year as a consequence of building HVAC system design. This is no way to reduce your carbon footprint!

5.5.2 Strategies for Addressing Poor Space Utilization

There are a variety of ways to tackle these problems or, alternately, take advantage of these opportunities. Perhaps none are easy but all are possible. Here are some ideas:

- When a new building is proposed, first determine whether there is a way to meet the alleged program needs for the building by reconfiguring and better utilizing existing space.
- During break periods, especially intersession or the December holiday break, encourage or require everyone to take vacation time and put the campus in a shutdown mode as much as possible.
- HVAC modifications can be implemented for faculty offices so these spaces stop being heated, cooled, or ventilated when unoccupied (which is most of the time).
- If your school is committed to an enrollment growth scenario, it might be possible to accommodate many more students without new construction if you operate academic programs at full tilt year round and thus make better use of existing buildings over the summer.
- More aggressive scheduling including starting classes earlier, holding more of them in the evening, on Friday afternoons, or weekends can defer the need for a new building. (Since earlier classes may be resisted by students and faculty alike, they may need to be accompanied by rules for earlier bedtimes!)

The Society of College and University Planning (SCUP) offers a variety of resources for campus space utilization.

5.6 Design and Construct Only the Most Energy Efficient Green New Buildings

If your school is committed to new construction, a highly energy efficient green building will do the least amount of environmental harm while reducing lifecycle costs.

5.6.1 Green Design Strategies and Measures

There are hundreds of green design strategies and measures. These general principles are among the most important:

- Build small if at all
- Optimize site selection in order to preserve green space and minimize transportation impacts
- Orient building to take maximum advantage of sunlight and micro-climate
- Use energy as efficiently as possible
- Maximize the use of renewable energy
- Use water as efficiently as possible
- Minimize waste water and run-off
- Minimize impact of materials by using green products
- Design for a healthy indoor environment

Green design strategies, measures, products, specs, guidelines and examples can be found at these websites and others:

- American Institute of Architects, Committee on the Environment (COTE)
- BuildingGreen
- Collaborative for High Performance Schools
- Daylighting Collaborative
- Energy Star for Higher Education
- Green Building Resource Guide
- High Performance Building Database
- Net Zero Energy Buildings
- NYC High Performance Building Guidelines
- Oikos: Green Building Source
- Sustainable Buildings Industry Council
- UB High Performance Building Guidelines
- US EPA Green Buildings
- US Green Building Council
- Whole Building Design Guide

5.6.2 Green Design Process

The nature of the design process itself is critical. It is important to hire a design consultant with a proven track record in super-efficient green buildings that are not budget busters. Smart design can produce very green buildings with a low premium cost. The process should begin with the consultant leading a green design charrette with all stakeholders in order to establish strong low-carbon green goals for the new building.

Many a good design has foundered when the inevitable building budget crisis occurs. What typically happens when the design goes over budget (and this can happen in spades when the original budget was inadequate) is that the energy conservation and sustainable design features are sacrificed first. How to prevent that? One strategy is to anticipate the budget crisis and have already identified ways to bring extra funding into the project. Maybe a wealthy alumnus or alumna will want to make a special contribution to ensure that this project breaks new ground in efficiency and the use of renewable energy. You can also argue that if an important measure is on the chopping block – say, a heat recovery system – that could be cost effectively retrofitted through a performance contract after the building is constructed, then your school should borrow the money for this measure now and install it as part of new construction when that installation will be cheaper and easier.

It also helps to have strong backers on and off campus demanding an unwavering commitment to super energy efficient green design. While you may not get the kind of support you want from faculty (who may be distracted by the demands of teaching and research) or from professional staff (who may be muted by bureaucratic constraints), your ace in the hole are students. They are free to speak out and may be inclined to demand a super efficient building that really makes an environmental statement. Of course, it also helps to remind your administration that a failure to max out on new building energy efficiency will make it that much more difficult and costly to keep your climate commitment.

5.6.3 LEED Green Building Rating System

The U.S. Green Building Council has done a great service by advancing the concept of green buildings through its consensus-based LEED green building rating system. LEED stands for "Leadership in Energy and Environmental Design." A number of LEED certification systems have been developed. The one we are most concerned with here is LEED for New Construction (LEED-NC).

To be LEED certified, buildings must achieve a variety of prerequisites in these categories:

- Sustainable Sites
- Water Efficiency
- Energy and Atmosphere
- Materials and Resources
- Indoor Environmental Quality

Beyond prerequisites, credit points are awarded in varying amounts for the use of prescribed green design strategies in each of the above categories. LEED also encourages innovative design and may award additional credit points when innovative strategies are employed.

LEED green design rating systems, including LEED-NC, have undergone major revisions in 2009. The current version of LEED-NC, released April 27, 2009, is 3.0 which replaces version 2.2. LEED-NC 3.0 provides green building ratings based on achieving the required green design prerequisites and earning the following number of green design credit points:

LEED Certified	40–49 points
LEED Silver	50–59 points
LEED Gold	60–79 points
LEED Platinum	80+ points

LEED-NC Version 3.0 contains a number of improvements including:

- Prioritization of climate change by giving more points for green design strategies that decrease direct and indirect greenhouse gas emissions
- Introduction of points for green design strategies that address regionally important environmental impacts, e.g. water use in dry regions like the Southwest or storm water management in Buffalo, NY, where there are combined storm water and sanitary sewers
- Alignment of prerequisites and credits across multiple LEED rating systems

For our purposes, the first bullet point is most important. Thankfully, USGBC has now addressed criticism that LEED was not properly valuing energy efficiency and was missing the mark on climate change. Evidence of these LEED inadequacies were the many inefficient LEED-rated buildings with larger than necessary carbon footprints.

To address climate change, LEED-NC 3.0 substantially increases possible LEED points in these energy and climate-related categories:

- Optimizing Energy Performance (1–19 points out of 100)
- On-site Renewable Energy (1–7 points)
- Alternative Transportation – Public Transportation Access (6 points)
- Development Density and Community Connectivity (5 points)

While recognizing the importance of the above green design strategies, LEED-NC 3.0 proportionately reduces the number of LEED points available in the materials and resources and indoor environmental quality categories. These changes are appropriate and overdue.

Additionally, in LEED-NC 3.0 the minimum energy performance prerequisite has been upgraded. While the prerequisite previously required compliance with ASHRAE 90.1 2004, LEED-NC 3.0 now requires a minimum energy performance of 10% better than ASHRA 90.1 2007.

If your college or university is committed to significant GHG emissions reductions, achieving a LEED Certified or Silver-rated new building is probably inadequate. As your school approaches a new construction project, it's important to set your green sights high. This can be done by striving for LEED Gold or Platinum and simultaneously making a commitment to maximize credit points for those strategies that shrink the carbon footprint of the building the most, i.e. energy efficiency, use of on-site renewable energy, community connectivity, and public transit – precisely those credits USGBC has decided to weigh more heavily.

Of course, other LEED credits can also help reduce the carbon footprint of a new building, even if those emissions reductions are not captured by the GHG inventory process. For example, reduced water use or waste water production will reduce energy use regionally and thus reduce GHG emissions as well as produce other environmental benefits. New construction that involves reusing existing buildings or maximizing the use of certain types of green building materials and products will reduce embodied energy and thus reduce carbon emissions – albeit globally. Since our ultimate goal is saving the planet, pursuing these mitigation strategies is important even if your GHG inventory tool will not give you credit for the reductions.

Irrespective of the version of LEED-NC you are using, it is important to avoid the temptation to design a conventional (i.e. not green) building while cherry picking the cheapest, easiest credit points to "earn" a LEED plaque. Your goal should be to use a genuinely integrative design process to achieve a thoroughly sustainable design. If you pursue that goal diligently, and avoid green-washing, the LEED points and the rating you desire will be there.

Examples of campus green buildings are available from the ACUPCC and AASHE websites. AASHE site also lists campus green building policies. The U.S. Green Building Council's Green Campus Campaign also provides resources.

5.6.4 Architecture 2030 Challenge

In addition to requiring that all new buildings meet a certain LEED threshold (with X number of energy credit points, etc), your school may also want to consider the Architecture 2030 Challenge. Unlike LEED, Architecture 2030, which is supported by the American Institute of Architects (AIA), the U.S. Building Council and others, focuses specifically on reducing energy consumption and greenhouse gas emissions.

If your college or university commits to meeting the Architecture 2030 Challenge, it accepts these targets:

- All new buildings, developments, and major renovations shall be designed to meet a fossil fuel, GHG-emitting, energy consumption performance standard of 50% of the regional (or country) average for that building type
- At a minimum, an equal amount of existing building area shall be renovated annually to meet a fossil fuel, GHG-emitting, energy consumption performance standard of 50% of the regional (or country) average for that building type
- The fossil fuel reduction standard for all new buildings shall be increased to:
    - 60% in 2010
    - 70% in 2015
    - 80% in 2020
    - 90% in 2025
    - Carbon-neutral in 2030 (using no fossil fuel GHG emitting energy to operate)

Architecture 2030 provides average energy consumption performance data in KBTU/Sq.Ft./Yr by building type so that the 50%. 60%, 70%, etc. reduction targets are more precisely understood. The program states that these targets may be met by implementing innovative sustainable design strategies, generating on-site renewable power and/or purchasing (20% maximum) renewable energy and/or certified renewable energy credits.

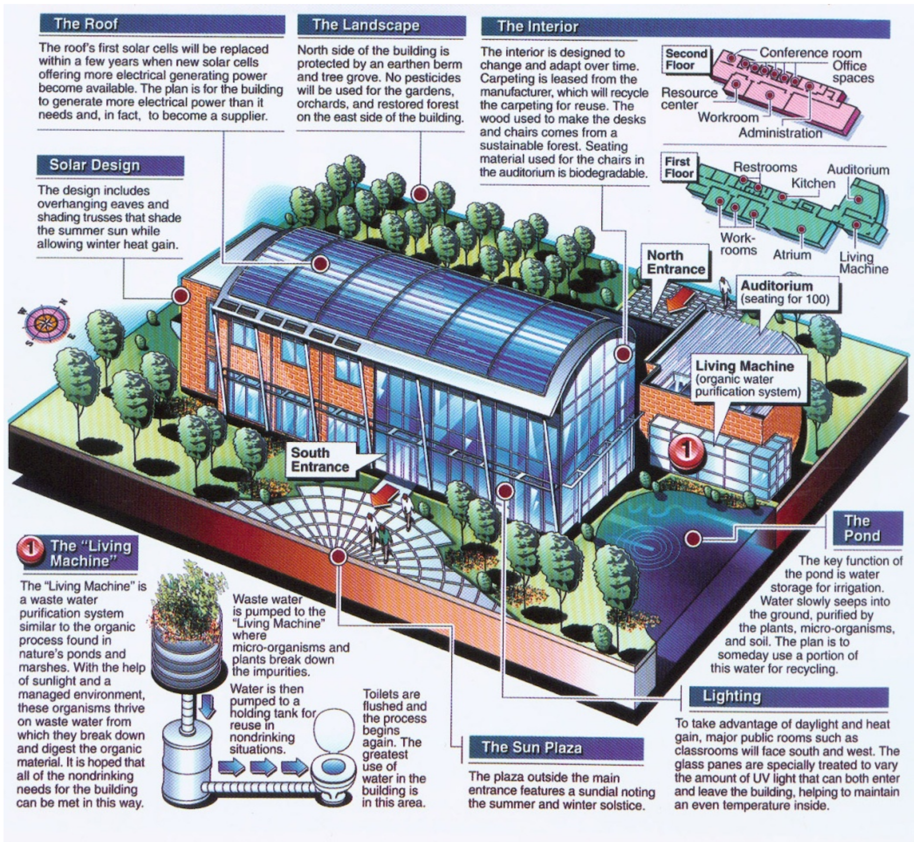


Photo by Frank Wiewandt for Oberlin College; Illustration courtesy of James Owens

Oberlin College's Adam Joseph Lewis Environmental Studies Center shows what is possible with green design. This energy efficient building runs entirely on solar energy (i.e. passive solar gain, daylighting, and photovoltaic-powered ground source heat pumps). The center makes extensive use of environmentally friendly materials and all its waste water is treated on site by a Living Machine operated and monitored by students.

5.6.5 Labs21 for Campus Laboratory Buildings

Laboratory buildings tend to be the most energy intensive and energy wasteful buildings on campus because of their 100% outside air ventilation systems, stringent temperature and humidity control requirements, 24/7 operation, and the energy consumed by environmental chambers, water purification systems, ovens, and other research equipment. Making new labs as energy efficient as possible is very important because their legacy energy costs and environmental impacts are so high.

The U.S. Green Building Council has deferred to Labs21, a federal program sponsored by the U.S. Environmental Protection Agency (EPA) and Department of Energy (DOE), for establishing guidelines for green design of energy efficient laboratory buildings. Labs21 builds on the LEED green building rating system, adding prerequisites and credits pertaining to health and safety, fume hood energy use, and plug loads.

To improve lab building design, Lab21 provides technical bulletins and best practice guides on numerous subjects including:

- Optimizing Laboratory Ventilation Rates
- Modular Boiler Systems in Laboratory Facilities
- Metrics and Benchmarks for Energy Efficiency in Laboratories
- Manifolding Laboratory Exhaust Systems
- Retro-Commissioning Laboratories for Energy Efficiency
- Efficient Electric Lighting in Laboratories
- Minimizing Reheat Energy Use in Laboratories
- Water Efficiency Guide for Laboratories
- Daylighting in Laboratories
- Energy Recovery for Ventilation Air in Laboratories
- On-Site Power Systems for Laboratories

5.6.6 Addressing the Cost of Green Design

Green design is generally believed to add cost to new construction projects. This premium, however, is often exaggerated. It is possible to design and construct green buildings with little or no extra cost. That becomes more challenging as the bar is raised for aggressively green, super-efficient buildings.

There are a variety of ways of eliminating or minimizing extra costs for green buildings. For example, in many regions, state or utility company incentives are available to cover costs associated with green design services or reducing the cost of specific energy efficiency and renewable energy technologies and products. Hiring an experienced green design firm can also keep costs in line. Moreover, it is possible to "tunnel through the cost barrier" and achieve big savings for less than the costs of small ones.

Tunneling through the cost-barrier is a concept popularized by the Rocky Mountain Institute and the book Natural Capitalism by Paul Hawken, Amory B. Lovins, and L. Hunter Lovins (1999). "Tunneling" requires a whole building design approach that takes advantage of the interaction of building systems. By optimizing some design elements and systems (e.g. orientation, windows, insulation), others can shrink or be eliminated (e.g. heating systems) – thus reducing costs instead of adding to them. A related concept is Factor 10 Engineering.

When discussing the cost of green buildings, it is important to distinguish between first costs (i.e. design and construction costs) and lifecycle costs. Life cycle costs include first costs plus the costs to operate and maintain a building for its lifespan – which in the case of a campus building may be 100 years. Additional increments of first cost incurred to make a building much more energy efficient may pay for themselves many times over in energy and possibly carbon offset savings over the life of the building. Payback, in the conventional sense, should become less important because a college or university will own and operate the buildings it constructs for such a long time horizon.

For more information on the cost of green buildings, see USGBC's list of research publications on cost analysis of whole buildings.

5.6.7 Some Potential Achilles Heels – Ventilation, Lighting, Windows

There are a few places where green design goals may conflict. Here are two examples – ventilation and lighting – plus a few comments about the tricky subject of windows and green design.

Ventilation Pros and Cons

Care should be taken when considering LEED Environmental Quality (EQ) Credit 2 – Increased Ventilation. Higher ventilation rates typically increase building energy consumption and thus GHG emissions because they require more fan energy and can substantially increase heating and cooling loads. But increased ventilation is a good thing from an indoor environmental health perspective, right? Well, yes, but it comes at a price and its benefit can be minimal.

Consider:

- New buildings are generally designed for ventilation rates appropriate for maximum occupancy, a condition which almost never exists
- A building whose ventilation rate is code compliant may be over-ventilated the vast majority of the time
- Providing ventilation over and above code requirements (as envisioned by LEED EQ Credit 2) may provide little or no health benefit while substantially increasing energy consumption and thus GHG emissions

There are ways to increase ventilation while minimizing energy and GHG penalties – for example, by installing heat recovery or using variable speed drives and air quality sensors to modulate air flows so that air volume (measured in terms of cfm or cubic feet of outside air per minute) is appropriate to actual occupancy. These technologies are steps in the right direction and should be used extensively but the net effect of increased ventilation is almost always greater energy use and thus a greater carbon footprint.

Direct and Indirect Lighting

Green designs tend to use indirect lighting which eliminates glare and lighting hot spots and may produce more comfortable lighting and thus increase productivity – all important pluses. However, lighting fixtures and designs of this type are generally much more expensive and less energy efficient in providing illumination on the work surface. As a result, indirect lighting may drive up material and energy costs while increasing the carbon footprint of the building.

There are number of ways to cope with the potential downside of indirect lighting. The first is to avoid indirect lighting and instead use conventional direct lighting systems, i.e. recessed troffers. These provide good light and, especially if equipped with high efficiency lenses, can be very efficient.

Another approach is to use indirect lighting fixtures sparingly or to provide a low level of background lighting and then rely on efficient task lighting to put light on the work surface. Note that lower average foot-candle levels may be acceptable not only because of the availability of task lighting but also because the light quality of new fluorescent lamps (as measured by CRI or color rendering index) is far superior to older fluorescent bulbs and is perceived by the human eye as brighter than foot-candle measurements would lead one to expect. It makes sense to take advantage of this and thus to design for lower foot-candle levels – which will produce energy and carbon savings.

Instead of prescribing in detail the kinds of lighting design and fixtures you want, you can give more latitude and require the designer to meet an aggressive performance standard. For example, you could require a building-wide average lighting wattage density of no more than 0.75 – 1.0 watt per square foot – asking the designer to err on the low side and take full advantage of task lighting, lighting controls, and daylighting.

Sensible, Efficient Use of Glass and Windows

It is common for new buildings, irrespective of LEED rating, to have lots of glass. Large windows, glass walls, and exciting atria can produce beautiful daylit spaces. But glass, unless properly specified and judiciously used, can also have a large energy and GHG penalty.

Daylighting designs should be computer-modeled to ensure that the electric lighting savings they produce are much greater than the additional heating or cooling loads/costs they impose. Also, as obvious as this is, it deserves mention: not all windows are equal in their performance. There is a tendency to think that if windows are Energy Star–compliant that is sufficient, but the Energy Star standard for windows is outdated and profoundly inadequate especially in colder climates.

Genuine high performance windows should be selected – and in cold winter weather climates that means triple glazed windows with double low-e coatings with center of glass U-values of 0.15 or lower. Window frames should be insulated with thermal breaks and utilize “super spacers” to insulate window edges. Where south-facing windows are serving a passive solar heating function during the heating season, they should be specified to have a Solar Heat Gain Coefficient as close to 1.0 as possible – otherwise they will block sunlight and substantially reduce insolation or solar gain. Architectural shading is required for south-facing windows to block direct summer sun entering windows, exacerbating cooling loads.

If you opt for operable windows, an indoor environmental quality benefit, a system should be established so that occupants know when they can open windows and when they need to be shut. Such a system would evaluate the enthalpy or heat content of indoor vs. outdoor air to determine when there is an energy benefit or penalty associated with open windows. Windows can be interlocked with HVAC systems so that heating, cooling, and mechanical ventilation systems are shut off when windows are open.

5.7 Transportation Solutions

For ACUPCC institutions, climate neutrality is defined to include reducing, eliminating, or offsetting the GHG emissions associated with the operation of fleet vehicles; student, faculty and staff commuting; and business air travel. Even schools which have not made a total commitment to addressing these emissions will be interested in minimizing them along with the other environmental, social, and public health impacts associated with these campus-related activities. Of the three, commuting generally involves the largest carbon footprint. Significantly reducing these emissions poses a huge challenge.

The Transportation section of AASHE's Resource Center has an abundance of resources on transportation solutions including an extensive listing of campus alternative transportation websites. The Transportation Demand Management Encyclopedia and the Transportation Demand Management and Telework Clearinghouse are also helpful resources as is *Transportation and Sustainable Campus Communities: Issues, Examples, Solutions* by Will Toor and Spenser W. Havlick.

5.7.1 Fleet Vehicles and Campus Buses

Facilities managers and staff can address GHG emissions associated with fleet vehicles in a variety of ways which include:

- Buying only the most fuel efficient vehicles
- Choosing the most fuel efficient vehicle appropriate to the task
- Using vehicles which run on alternative fuels like electricity, biodiesel or compressed natural gas whenever possible
- Implementing policies to reduce vehicle miles driven
- Implementing a no-idling policy

The latter is an issue on campuses where facilities staff leave their vehicles running much of the day during very colder winter months to keep them warm and comfortable even though they are only driving them a few minutes a day. You can see whether this is happening by direct observation or by analyzing data on vehicle mileage and gas fill-ups (if your facilities unit keeps this information). If winter mpg drops to single digits, it may be due to excessive idling.

Campuses may be in the habit of buying fuel inefficient vehicles for a variety of reasons. For example, it may be assumed, mistakenly, that all facilities staff need to drive around in trucks or four wheel drive vehicles. Or for state schools, it might turn out that these fuel-inefficient vehicles are on state contract at discounted prices, thus encouraging their purchase even when they are unneeded and environmentally destructive. Inappropriate incentives like these need to be reversed. In general, barriers to buying highly fuel efficient vehicles (and then driving them as *little* as possible) need to be addressed and overcome.

Electric vehicles, even those powered by a regional electric grid that is not especially clean, tend to be less carbon-intensive than standard gasoline-powered vehicles. Small GEM type electrics are better suited to warmer climates or to summer-only use in campuses with cold winters. Facilities staff could also ride bicycles to meetings on other parts of the campus if the dress code is relaxed. Wearing informal clothing also makes it possible to air condition less – another benefit to your "low carbon bottom-line."

Using biodiesel for fleet vehicles raises some issues. Remember that B20 biodiesel fuel is only 20% biodiesel and 80% conventional diesel fuel, and even the biodiesel portion is probably not fully carbon-free because fossil fuels have been consumed in its manufacture or shipping. Switching to biodiesel blends which are richer in biodiesel is desirable though can be problematic in colder climates due to the increased viscosity of biodiesel as the temperature drops. One solution might be to use B100 (100% biodiesel) during the summer months and switch back to B20 during colder weather.

Biodiesel is a good fit for campus buses as well as larger facilities vehicles. While most college and university facilities units will not be interested in manufacturing their own biodiesel (since it's an extra task and they are probably already short-staffed), some have been approached by students interested in seeing campus food service waste fryer grease converted to biodiesel to run campus buses or fleet vehicles. Creating a small campus biodiesel production facility would have significant educational value. It could be designed, operated, and monitored by students – perhaps majoring in chemical engineering – under faculty and facilities supervision.

Conversion of fleet vehicles to compressed natural gas generally requires the installation of a CNG refueling station on or very near campus. This can be an expensive undertaking – though might be subsidized by state energy offices that are promoting alternatively fueled vehicles or by local natural gas utilities interested in selling more natural gas. Duel-fuel CNG vehicles can be purchased or existing gasoline-powered vehicles can be kit-converted to CNG. Campus buses also can be CNG powered. If campus bussing is provided on contract by an outside vendor, then new contract language can be developed specifying that an alternative fuel must be used. That new language can be used the next time campus bussing service goes out to bid.

Operating a car, truck or bus on CNG will reduce GHG emissions by about 25% compared to gasoline operation. There can be substantial fuel cost savings associated with the use of CNG vehicles (in comparison to gasoline vehicles) but this benefit vanishes when gasoline prices are low and natural gas prices are high. Assuming gasoline and CNG vehicles operate at roughly the same efficiency, $2 a gallon gasoline roughly equals $7/MCF natural gas.

5.7.2 Commuting

The larger transportation problem is commuting. At most colleges and universities, commuters dominate and typically arrive and depart from campus in single occupancy vehicles – many with poor fuel economy. Commuting by students, faculty and staff may add up to many millions of miles of driving per year at larger schools – and thus represent a substantial part of the campus carbon footprint.

Here are some strategies for reducing commuting and its GHG impact:

- Raise awareness of transportation alternatives
    - Create an effective transportation climate change awareness program
        - Team up with your campus transportation office to create this program
        - Include messaging with billing statements for campus parking permits
        - Highlight the seriousness of climate change, the carbon footprint of commuting, strategies commuters can use to reduce GHG emissions, and your school's climate goals
        - Provide alternatives to single car/truck commuting
        - Encourage the use of high efficiency vehicles when car/truck commuting is unavoidable
        - Let your audience know about incentives for using alternatives
- Increase use of public transit by students, faculty and staff
    - Better publicize existing public transit options
    - Work with your regional transit authority to add public transit routes
    - Encourage your regional transit authority to equip its busses with bike racks
    - Increase the frequency of public transit service
    - Extend late night public transit service, especially on Friday and Saturday nights
    - Provide free public transit passes or subsidize public transit fare
    - Stop building new parking lots
    - Move suburban or rural campuses to downtown urban locations to facilitate the use of public transit! (OK, this is probably not practical but it highlights the potentially very large and difficult-to-ever-remedy carbon footprints associated with campuses built in locations not served or not easily served by public transit)
- Increase carpooling
    - Establish a rideshare program to safely match interested drivers and carpool riders
    - Provide incentives for carpooling, e.g. priority parking, reduced parking fees, etc.
    - Provide emergency ride home service for carpoolers who miss their ride
    - Stop building new parking lots
- Increase bicycling
    - Make campus bicycle-friendly
        - Establish bicycle-friendly campus policies that actively encourage and reward bicycling and don't penalize it (an example of the latter would be a policy that

    forbids students from locking their bikes to light poles or trees while not providing enough bicycle racks)
    - Create an extensive and effective network of campus bike paths
    - Address campus bicycling safety issues
    - Install or increase the number of secure bike racks on campus
    - Provide weather-protected bike racks and bicycle lockers
    - Establish an on-campus bicycle repair shop and free air pump
    - Equip campus buses with bike racks, and instruct riders how to use them
    - Create or join local bicycle sharing programs
  - Make bicycle commuting more practical
    - Work with local communities to improve and expand the network of local bike paths and bicycling safety
    - Create safe bicycling commuter routes to campus through the surrounding community, especially from areas with a high density of off-campus student housing
    - Provide on-campus shower facilities for bicycle commuters
    - Relax formal or informal dress codes to accommodate bicycle commuters
- Reduce on-campus driving
  - Make campus more bicycle and pedestrian friendly
  - Improve scheduling and routes of campus buses
  - Locate new buildings to encourage walking and bicycling
  - Minimize or don't provide additional parking for new buildings
  - Consider banning cars for on-campus resident freshman and other students
  - Provide resident students with a special parking permit that only allows them to park near residence halls
- Reduce the need to single occupancy vehicle (SOV) commute
  - Move electrons not people and vehicles
    - Increase telecommuting
    - Increase distance learning
  - Build more on-campus housing (which ironically will reduce your campus' commuter carbon footprint while increasing your campus housing carbon footprint)
  - Work to improve neighborhood safety and privately owned off-campus housing near campus in order to make it more likely that students living off campus will chose to live near campus
  - De-bundle transportation fees that package parking and bussing transportation fees all together so faculty, staff and students who do not bring a car to campus can pay less
  - Pay employees not to drive
  - Provide shuttle service to nearby off-campus student housing developments and neighborhoods
  - Create employee van pools
  - Allow compressed work weeks, i.e. 4 ten-hour days/wk instead of 5 eight-hour days/wk to eliminate one commute per week

        - Explore alternative course scheduling to reduce the number of days per week most students need to come to campus
- Re-focus campus parking policy
    - Stop building new parking lots and ramps
    - Redirect money which would be spent on new parking lots or ramps to "transportation demand management" measures that reduce commuting and save money compared to expanding on-campus parking
    - Begin charging for or increase the cost of on-campus parking
- Reduce the carbon-intensity of vehicles used for commuting
    - Encourage the purchase and use of highly fuel efficient personal vehicles through awareness and incentive programs (an example of the latter would be reducing parking fees for commuters who drive more fuel efficient vehicles)
    - Establish a program to allow or require students, faculty and staff to pay for their own commuting carbon offsets
- Other Strategies
    - Prioritize energy efficient low carbon transportation planning in campus master plans
    - Create a campus transportation committee charged with responsibility for shrinking the carbon footprint of campus commuting
    - Establish or contract with car-sharing programs/companies to make it easier for people to avoid car ownership (and thus drive less)
    - Contact elected officials and tell them we need a carbon tax! (This may seen farfetched and out of bounds but it's here to illustrate an important point, namely, that we need larger policy changes to help us significantly reduce our carbon footprints. Colleges and universities typically participate in the political process when it is in their interest to do so. This is such a case.)

5.7.3 Air Travel

Addressing the business air travel component of your school's carbon footprint involves setting up a mechanism to track official campus business air travel, calculating the GHG emissions associated with those flights, and then mitigating or offsetting the emissions.

The Clean Air-Cool Planet Campus Carbon Calculator is able to calculate and include air travel-related emissions in your campus GHG emissions inventory.

The simplest option you have for mitigating these emissions is encouraging less air travel. Providing easy access to teleconferencing would help make it easier and far cheaper for faculty and staff to connect with colleagues in other locations. A more controversial step would be to mandate less travel, though with budget cuts affecting schools nationwide there simply may be less money allowed for air travel anyway.

5.8 Other GHG Mitigation Strategies

5.8.1 Waste Minimization

It may not be intuitive, but waste disposal and waste management practices impact your school's carbon footprint. A big part of the reason is that throwing things away – just like every other activity – involves energy consumption and that typically means burning fossil fuels. Also, if garbage and trash are burned, there are additional releases of carbon dioxide – though some of those emissions can be mitigated or offset if the waste is burned in a waste-to-energy plant because such a plant displaces fossil fuel combustion.

If the end point for your campus garbage and trash is a landfill, methane will be produced through decomposition. On a mass basis, methane has around 20 times the global warming potential of carbon dioxide – so landfills can have a substantial climate change impact. This impact is reduced if the methane is captured and either "flared" (burned in the open atmosphere – releasing water vapor and carbon dioxide) or burned in a boiler or power generating unit to produce useful heat or electricity that displaces the fossil fuels that would otherwise be used to produce that heat or power.

Campuses can cut waste through waste reduction programs (buy and use less, reuse, etc.) and by improved recycling and composting programs. Recycling keeps waste out of both the incinerator and landfill. It also contributes to the manufacture of new products made of recycled materials which are more energy efficient to make and, thus, are responsible for less GHG emissions. Composting prevents organic waste (kitchen produce leftovers plus landscaping trimmings) from being needlessly transported to the landfill – plus, of course, it turns these waste products into a useful product that helps keep the campus green!

Participating in the annual Recyclemania competition is a great way to improve and boost recycling on your campus.

CA-CP's Campus Carbon Calculator will calculate the emissions associated with campus waste volumes, how that waste is disposed of, and the amount of recycling your school is doing. The Calculator will not, however, calculate the GHG emissions benefit associated with "closing the loop," i.e. using recovered materials to produce products with recycled content – though those energy and climate protection benefit are real nonetheless.

AASHE maintains a list of campus websites on waste reduction and recycling and a list of policies on campus waste minimization and recycling.

5.8.2 Embodied GHG Emissions in Products

As just pointed out, not all campus GHG emitting activities are captured by greenhouse gas emissions inventory tools. However, since our ultimate goal is to address the problem of climate change in as comprehensive and effective a way possible, it is important that all GHG emissions sources be identified and as many as possible mitigated irrespective of whether we can quantify or take credit for the benefits.

Since nearly everything that is purchased contains embodied fossil fuel and thus GHG emissions, purchasing policies and practices are of critical importance even though product-related GHG emissions and mitigations fall in the categories of "can't be quantified" and "can't be used for carbon emissions reduction credit." To reduce these indirect Scope 3 GHG emissions, colleges and universities can:

- Implement purchasing policies and practices that, well, discourage purchasing!
- Establish reuse programs
    - Swap shops or swap websites that facilitate the reuse of materials between campus and institution offices
    - Policies that make it easier for schools to give still-useful unwanted items away
    - Programs that allow students to donated unwanted clothing and other items on end-of-the-semester move out days
- Buy products which contain high levels of recycled content
- Buy locally produced products

Another way of addressing this issue would be to buy carbon neutral products. Already we see recycled paper and other products made with 100% wind power. This market is just beginning to develop. .

AASHE maintains a list of campus green purchasing websites. Two additional resources are the Responsible Purchasing Network and *Buying for the Future: Contract Management and the Environmental Challenge* by Kevin Lyons (2000).

5.8.3 Food Service and Food Choices

Another area of campus activity that can have a substantial GHG impact (though not quantified by your GHG emissions inventory) is campus food service and food choices. Mitigation strategies here include:

- Increase purchases of locally produced food
- Prepare food in more energy efficient kitchens
- Reduce waste, recycle and compost
- Encourage eating lower on the food chain, i.e. less meat

There are many reasons to buy locally produced food including benefits to the local farmers and the regional economy and establishing a connection between the food we eat and where and how it is produced.

Kitchen cooking equipment can be notoriously inefficient. Think industrialize-size toasters that are left on whenever the food service outlets are open – probably consuming enough electricity and producing enough waste heat to heat an average home. Think open-ended conveyor belt pizza ovens – constantly venting heat. Kitchens also typically have large ventilated hoods over stoves. These hoods pull a lot of conditioned air out of buildings where food service areas are located. If cooking occurs in campus buildings, its carbon footprint will be captured by your GHG inventory.

Composting pre- and post-consumer food waste reduces solid waste disposal, produces soil amendments for campus gardens, and can serve an educational purpose – especially if students are involved in setting up the program, collecting the compostables, and managing the compost pile.

In 2007 the United Nations Food and Agricultural Organization released a comprehensive report entitled *Livestock's Long Shadow* which documents the global environmental impacts of meat production. One eye-opening finding of this report is that livestock production is responsible for 18% of annual global greenhouse emissions – a larger slice of the "emissions pie" than the transportation sector. Thus, food choices and diet deserve at least as much consideration as transportation choices, and eating less meat becomes an important GHG mitigation strategy. However, some sensitivity is required when encouraging people to eat less meat or try a vegetarian diet because in our society food choice is considered to be a more private matter than, say, vehicle fuel economy or light bulb wattage. But whether we like it or not, the disproportionately large carbon footprint of a hamburger is just one more inconvenient truth about climate change. It's important that we educate ourselves and others about all the behaviors and activities that contribute to global climate change and encourage people to take action to reduce their climate impacts.

Clean Air-Cool Planet is in the process of developing a module for its Campus Carbon Calculator that will calculate the carbon footprint of campus food service, highlighting the need to address diet as well as operations.

AASHE maintains a list of campus websites on sustainable dining initiatives.

5.9 Carbon Offsets

5.9.1 The Role of Carbon Offsets

Internal GHG emissions reductions must be the first priority of colleges and universities committed to reducing their carbon footprint. However, despite our best efforts, in the short to mid-term, the majority of colleges and universities will be only partially successful in eliminating their GHG emissions. Remaining GHG emissions can be offset by purchasing financial instruments that help pay for projects which reduce GHG emissions elsewhere, i.e. not on our campuses, or by using our own resources to create these kinds of projects in the wider community. In addition to taking us those last steps in carbon reduction, carbon offsets may be used to meet interim CAP emissions reduction targets when good faith internal reduction efforts fall short. It's a simple concept. But the devil's in the details.

5.9.2 Projects that Can Create Carbon Offsets

Carbon offsets can be produced in a number of ways. For example, energy conservation and efficiency, fuel switching, renewable energy, and carbon capture and storage projects can prevent or avoid the release of GHG emissions into the atmosphere – and hence may produce legitimate carbon offsets.

Reforestation projects can remove carbon from the atmosphere and sequester it in biomass – at least temporarily – and hence may count as valid carbon offsets.

Capturing the methane produced at landfills and flaring it (burning it in the atmosphere to convert it to less harmful carbon dioxide) can decrease the GHG emissions impact of landfills – and hence may produce valid carbon offsets. As previously explained, on a mass basis methane is a much more powerful GHG than carbon dioxide; that's why it is advantageous from a climate protection point of view to flare methane even though the end result is an atmospheric release of carbon dioxide. It is even better – and more productive in terms of carbon offsetting – to burn the landfill-harvested methane in a boiler or turbine that generates electricity and useful heat, thus displacing the fossil fuels which would have otherwise been burned for those purposes. Such a combination strategy would increase the offset value.

The destruction of industrial refrigerants (CFCs and HCFCs, for example) and other climate-harming gases is also beneficial from a climate protection perspective – and thus may be another means of producing "carbon" offsets. In all cases, however, certain conditions must be met before these kinds of projects can be regarded as producing legitimate, valid carbon offsets

5.9.3 Defining High Quality Carbon Offsets

At present, the carbon offset market is in its infancy and buying offsets might seem a little like buying "a pig in a poke." If that phrase is unfamiliar, it means (as per the Wikipedia): "to make a risky purchase without inspecting the item beforehand." Another way of saying it would be "caveat emptor" (let the buyer beware). There is a great deal of skepticism about carbon offsets. For various reasons carbon offsets have been perceived as:

- Producing little or no real GHG emissions reduction benefit
- A way of excusing bad behavior or buying one's way out
- An example of green-washing

But with the right guarantees and third party certification carbon offsets can produce real emissions reductions, and in that case those who are responsible for creating or financing these reductions have the right to take credit for them.

The ACUPCC Voluntary Carbon Offset Protocol provides guidance for purchasing valid, high quality offsets. According to the Protocol, which can be used by ACUPCC and non-ACUPCC signatories alike, these offsets should be:

- Real
- Additional
- Transparent
- Measurable
- Permanent
- Verifiable
- Synchronous
- Account for leakage
- Registered
- Not double counted
- Retired

These attributes have technical meanings which are explained in the Protocol. While all of them are important, the concept of "additionality" deserves highlighting. Valid offsets must produce GHG emissions reduction "in addition" to what would have occurred anyway or as a matter of "business as usual." Carbon offsets will be viewed skeptically until the carbon offset market identifies convincing ways to demonstrate additionality.

A confusing offset condition is that of "permanence." This criteria does *not* require that the carbon offset be permanent in the sense of producing carbon reductions year after year forever. Quite the contrary. It is understood that the projects which produce carbon reduction will not last forever, and thus carbon offsets are time-bounded instruments. For example, your school's purchase of carbon offsets may make it possible for a wind turbine to be erected and operated – however, that turbine will only run and displace carbon emissions for a discrete number of years. Offsets produced by that turbine can't last longer than that.

The permanence criteria applies primarily to biological sequestration. Imagine that you have purchased carbon offsets based on funding a reforestation project. If the trees your offset money helped plant and care for are eventually burned down, the carbon sequestered in those trees over their lifetime is released into the atmosphere. Not only does the fire prevent further carbon sequestration by those trees but it actually *undoes* the carbon sequestration that was accomplished previously. Thus biological sequestration is fragile and uncertain. The permanence requirement is intended to speak to that. Carbon offsetting through tree planting minimally requires on-going lifetime care and protection of trees that are planted for that purpose. And if the trees' relative permanence cannot be guaranteed, offsets should not be claimed.

5.9.4 Buying or Creating Carbon Offsets

Schools can purchase offsets on retail and wholesale markets or create them by developing projects which result in emissions reductions. The latter option allows colleges and universities to work with groups and individuals in their own communities or in remote locations to create clean energy projects. The guidelines accompanying the ACUPCC Voluntary Carbon Offset Protocol provide helpful qualifying criteria for these projects.

When should you begin purchasing carbon offsets? Since there is a cost associated with carbon offsets, the natural tendency would be to delay buying offsets as long as possible. Delay would also allow the market to mature and become more reliable before jumping in.

A logical approach to timing the purchase of carbon offsets would be to buy them incrementally and in appropriate amounts to help meet aggressive interim or final GHG emissions targets that are not fully met because of insufficient internal emissions reduction efforts.

If you are planning to create your own carbon offsets by sponsoring clean energy projects in your own community or state, then work on these projects should begin much earlier than you expect to be able to claim the offsets. Of course, even if you are planning to simply purchase offsets from the market, research and planning in advance of anticipated purchase dates is essential.

For more information about carbon offsets, please see the FAQ section of the ACUPCC Voluntary Carbon Offset Protocol. Scroll down and see links to various recommended resources on carbon offsets. Also see Clean Air Cool Planet's *Consumer's Guide to Retail Carbon Offset Providers* – though this report is somewhat dated (2006).

5.9.5 Campus Forests and Lands as Carbon Offsets?

The search for cost-effective ways of off-setting campus carbon emissions may lead some colleges and universities to consider counting the carbon which campus biomass removes from the atmosphere and sequesters annually. Campuses with large forested land areas would seem to have a large offset potential. However, there is a big difference between forests which sequester carbon (they all do unless they stop growing, are cut, or burned) and forests whose carbon sequestration can count as a legitimate carbon offset. In order for campus biological carbon sequestration to count as a carbon offset that sequestration must be “additional” to what would have occurred anyway. In other words, it would be misleading to count the carbon which is sequestered in already existing forest land as an offset and subtract that carbon from your campus GHG emissions total. However, carbon sequestration of newly planted forest could be counted as an offset as could any additional carbon uptake associated with changes in forest management.

The issue of “permanence” also arises when we consider biological carbon sequestration. See section 5.9.3 for more details.

While there are legitimate barriers to counting campus biomass carbon sequestration as carbon offsets in your GHG inventory or taking credit for them in your CAP, it still makes sense to protect campus green space and forested land – for all the traditional environmental and social reasons and because of climate change. When trees are cut down, they are lost as a carbon sink. Moreover, even if the carbon sequestration associated with campus biomass cannot be counted as an offset, it is still OK to state in your GHG inventory summary or CAP that your campus has X amount of forested land and those trees are sequestering Y amount of carbon annually. Publicizing that kind of information may help campus environmental advocates protect campus greenspace when plans are unveiled to start cutting trees on campus to clear land for that next campus research building, dormitory, or apartment complex.

For more information on this complicated issue, see page 42 of the ACUPCC's *Investing in Carbon Offsets: Guidelines for ACUPCC Institutions*. Also see the Greenhouse Gas Protocol's *Land Use, Land-Use Change, and Forestry Guidance for GHG Project Accounting*.

6. PROJECT EVALUATION AND RANKING

Project evaluation and ranking is one of the most important parts of a CAP. This section discusses techniques and methods for undertaking these tasks. Also see sections 5.1.8 (Evaluating Energy Conservation Projects) and 5.1.9 (Avoid the Short Payback Trap).

6.1 Decision-Making Criteria

As the Section 5 of this climate action planning guide makes clear, there are many types of action your campus can take to reduce its carbon footprint. One of the most daunting tasks involved in assembling your CAP is evaluating and ranking possible projects and then deciding when to do what.

Typically, GHG emissions reduction projects are compared – and can be listed in a chart in your CAP – on this basis:

- Project cost
- Dollar savings (if any)
- Payback, return on investment (ROI), net present value (NPV), or internal rate of return (IRR)
- Carbon reduction
- \$/MTCO$_2$e (GHG emissions reduction efficacy)

There are, however, many other considerations which weigh in project selection decision-making. These include:

- Project lifecycle costs/benefits including consideration of maintenance costs/savings; impacts on safety, health, comfort, or productivity; capital improvement, etc.
- Availability of funding from various sources including campus budgets, borrowing, incentives from government and utilities, and grants from foundations
- Relationship to other possible energy saving or GHG emissions mitigation measures and opportunities for synergy
- Interaction with state or regional GHG mitigation initiatives (e.g. the Regional Greenhouse Gas Initiative which affects fossil fuel power generators of 25 MW or greater in 10 Northeast and Mid-Atlantic states)
- Potential to scale upward
- Transferability to other projects, schools, or the wider community
- Project lifespan
- Academic and research impacts
- Public relations value
- Organizational capacity to undertake and manage the project
- Alignment with campus capital development plan, strategic, and other plans
- Stakeholder support and enthusiasm

Some of the above decision-making criteria don't lend themselves to quantified data. But comparative information could be captured in a comprehensive matrix that could rank projects on the relevant criteria. Conceivably, most or all of the above decision-making factors could be considered in a comprehensive lifecycle analysis of prospective carbon mitigation projects and measures. (For a discussion of payback and lifecycle cost analysis for energy conservation projects, see section 5.1.8 of this guide.)

6.2 Calculating Project GHG Emissions Reductions

While you can use carbon emissions calculators to determine carbon emission reductions associated with specific projects, these calculations are easy to do and can also be done with a simple calculator or a spreadsheet of your own design.

To perform these calculations for energy conservation or renewable energy projects, the first step is figuring out how much energy they save. Well known engineering formulas can be used to calculate energy savings. Then, apply the GHG conversion factors to the amount of energy saved by fuel type to calculate the GHG emissions reductions they achieve as measured in kg or metric tons of CO_2.

CO_2 conversion factors for coal, oil, and natural gas are available here:

- U.S. EPA Carbon and CO_2 Conversions
- The U.S. Inventory of Greenhouse Gas Emissions (see page 2, "Reference Tables and Conversions)
- Climate Registry's General Reporting Protocol (see Table 12.1, page 74)

Here are a few examples to demonstrate how to work with these CO_2 conversion factors:

Reducing Coal Burning

Let's say your school implements a project which reduces anthracite coal burning at your campus coal-fired heating plant by 1,000 tons of coal annually.

$$1{,}000 \text{ tons} \times \frac{0.9072 \text{ MT}}{1 \text{ Short ton}} = 907.2 \text{ MT}$$

$$907.2 \text{ MT coal} \times \frac{2.122 \text{ MT CO}_2}{1 \text{ MT coal}} = 1{,}925 \text{ MT CO}_2$$

Thus this measure will reduce your campus carbon footprint by 1,925 metric tons of CO_2 annually.

Reducing Heating Oil Burning

Let's say your school implements a project which saves 1,000 gallons of No. 2 heating oil annually.

$$1{,}000 \text{ gal} \times \frac{1 \text{ barrel}}{42 \text{ gal}} = 23.809 \text{ barrels}$$

$$23.809 \text{ barrels No.2} \times \frac{426.1 \text{ kg } CO_2}{1 \text{ barrel No.2}} \times \frac{1 \text{ MT } CO_2}{1{,}000 \text{ kg } CO_2} = 10.143 \text{ MT } CO_2$$

Thus this measure will reduce your campus carbon footprint by 10.143 $MTCO_2$ annually.

Reducing Gasoline Burning

Let's say your school implements a project which reduces gasoline burning by 1,000 gallons

$$1{,}000 \text{ gal} \times \frac{1 \text{ barrel}}{42 \text{ gal}} = 23.809 \text{ barrels}$$

$$23.809 \text{ barrels gasoline} \times \frac{369.8 \text{ kg } CO_2}{1 \text{ barrel gasoline}} \times \frac{1 \text{ MT } CO_2}{1{,}000 \text{ kg } CO_2} = 8.809 \text{ MT } CO_2$$

Thus this measure will reduce your campus carbon footprint by 8.809 $MTCO_2$ annually.

Reducing Natural Gas Burning

Let's say your school implements a project which reduces natural gas burning by 1,000 MCF (1 MCF = 1,000 ft^3 natural gas).

$$1{,}000 \text{ MCF} \times \frac{1{,}000 \text{ ft}^3}{1 \text{ MCF}} = 1{,}000{,}000 \text{ ft}^3$$

$$1{,}000{,}000 \text{ ft}^3 \text{ natural gas} \times \frac{0.0546 \text{ kg } CO_2}{1 \text{ ft}^3 \text{ natural gas}} \times \frac{1 \text{ MT } CO_2}{1{,}000 \text{ kg } CO_2} = 54.6 \text{ MT } CO_2$$

Thus this measure will reduce your campus carbon footprint by 54.6 $MTCO_2$ annually.

Reducing Electricity Consumption

To convert purchased electricity savings into GHG emissions reductions, it is necessary to identify the CO_2/megawatt-hour conversion factor appropriate to your regional grid since the mix of power generation types and carbon-intensity of electricity generation differs from region to region. This CO_2/mWh conversion factor can be obtained by consulting the eGrid website (1 mWh = 1,000 kWh).

Let's say your school implements a project which reduces electrical consumption by 1,000,000 kilowatt hours (kWh) or 1,000 megawatt hours (mWh). Since the eGrid conversion factor depends on your state's electrical grid, let's say your school is located in Florida.

$$1{,}000 \text{ mWh} \times \frac{1{,}340.54 \text{ lbs } CO_2 \text{ (FL)}}{1 \text{ mWh}} = 1{,}340{,}540 \text{ lbs } CO_2$$

$$1{,}340{,}540 \text{ lbs } CO_2 \times \frac{1 \text{ Short ton } CO_2}{2{,}000 \text{ lbs } CO_2} \times \frac{0.9072 \text{ MT } CO_2}{1 \text{ Short ton } CO_2} = 608.07 \text{ MT } CO_2$$

Thus this measure would reduce your campus carbon footprint by 608.07 $MTCO_2$ annually.

Underlying these calculations is the relative carbon-intensity of various fossil fuels. Here is a comparison expressed in terms of GHG emissions per 1 million British Thermal Units or BTUs (heat content).

Anthracite coal	28.26 kg C/MMBTU = 103.62 kg CO_2/MMBTU
Bituminous coal	25.49 kg C/MMBTU = 93.46 kg CO_2/MMBTU
No.2 heating oil	19.95 kg C/MMBTU = 73.15 kg CO_2/MMBTU
Gasoline	19.33 kg C/MMBTU = 70.88 kg CO_2/MMBTU
Natural gas	14.47 kg C/MMBTU = 53.06 kg CO_2/MMBTU

From the above it is clear that coal is the most carbon and CO_2-intensive of fossil fuels – and thus a premium must be placed on reducing its use. Natural gas is the least carbon intensive of the fossil fuels with oil products in the middle range. Carbon units can be converted to CO_2 units by multiplying carbon units by 3.667. That conversion factor is based on the atomic weights of carbon (12), oxygen (16), and carbon dioxide (12 + 16 + 16 = 44).

$$\frac{\text{atomic weight } CO_2}{\text{atomic weight C}} = \frac{44}{12} = 3.667$$

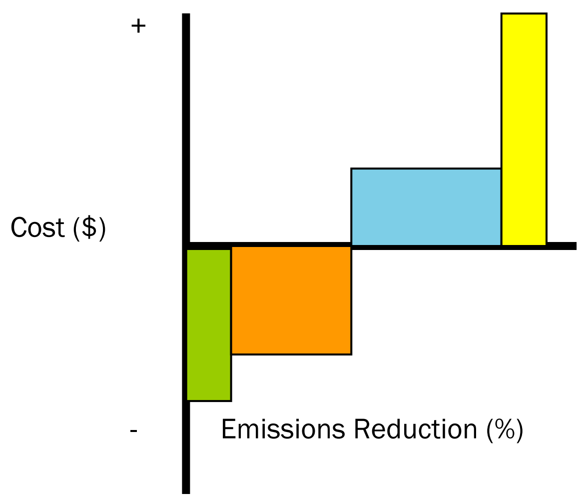
The Clean Air-Cool Planet Campus Carbon Calculator (Version 6) has a solutions module that can calculate the carbon dioxide emissions reduction associated with various GHG mitigation measures (see section 4.2 of this guide).

To better understand how to calculate the GHG emissions associated with the consumption of various fuel and electricity, see the U.S. Environmental Protection Agency's Clean Energy Calculations and References webpage. This resource contains numerous sample calculations.

6.3 Carbon Reduction Efficacy

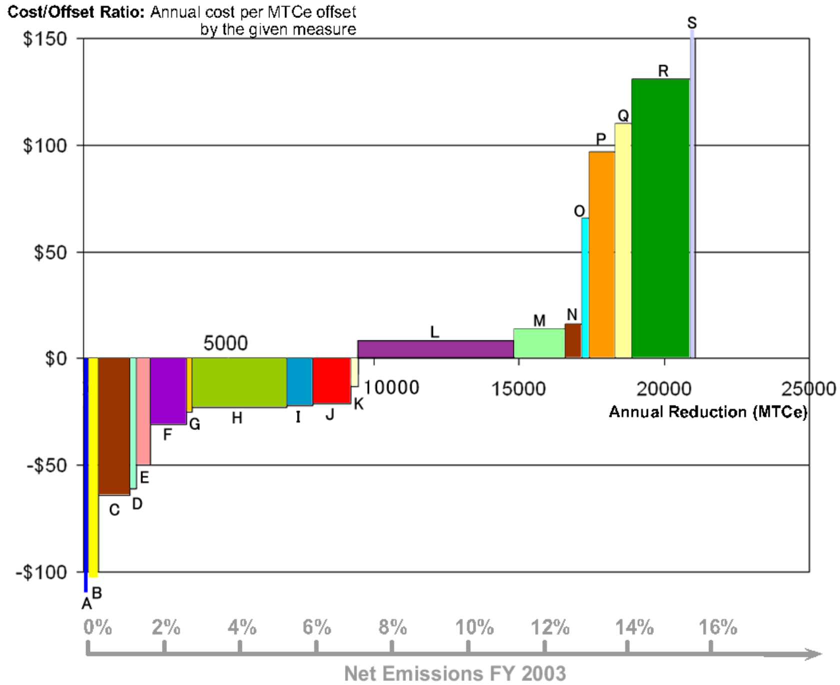
Let's take a closer look at the cost of a project in relation to its ability to produce GHG emissions reductions, i.e. $/MTCO$_2$e. This type of evaluation – which can be called carbon reduction efficacy – is important because it shows which projects produce the biggest bang for the buck in terms of carbon reduction.

The illustration below graphically shows how a $/MTCO$_2$e analysis of projects can be presented. The bars depict and compare four theoretical carbon reduction projects or measures. The two on the left side of the chart – represented by bars that descend below the zero line – have negative net present values per ton of carbon dioxide mitigated and thus produce overall dollar savings. The projects on the right side of the graph – represented by bars that extend over the zero line – have positive net present values and do not produce savings in amounts greater than their costs. The projects are arrayed from left to right in order of most attractive to least attractive in terms of their carbon reduction efficacy or cost/offset ratio. The width of each measure shows the overall GHG reduction that results from the measure.



This type of analysis and chart-making can be accomplished automatically through the use of the Solutions Module in Version 6 of the Clean Air-Cool Planet Campus Carbon Calculator – though the Calculator can only undertake these operations after you enter specific project data.

The next graph is from *Charting a Path to Greenhouse Gas Reductions* by Sam Hummel, former Environmental Sustainability Coordinator at Duke University. It shows specific projects under consideration by Duke when this study was undertaken in 2005. Several projects are identified by letter in the key just below the graph. Purchasing new high capacity buses (Measure A) would provide Duke with dollar savings at an attractive low $/MTCO$_2$ rate but not produce much carbon reduction. In contrast, reducing coal burning in Duke's power plant by burning more natural gas (Measure R) costs Duke money but will produce a large carbon emissions reduction.



Source: *[Charting a Path to Greenhouse Gas Reductions](#)*

Key for some measures shown on graph:

A – Purchase high capacity buses
H – Co-fire biomass in steam plant
L – Purchase wind power
R – Natural gas blend in steam plant
S – Install solar electric system

It is clear that carbon mitigation efficacy is an important decision-making criteria when evaluating and prioritizing carbon reduction projects and measures. However, as the discussion in section 5.2 of this guide makes clear, many other considerations may be equally important.

6.4 Factoring in the Cost of Carbon

The United States is in the process of developing a climate policy that seems likely to, in effect, put a price on carbon emissions either through a cap and trade mechanism or through a direct carbon tax which taxes fuels based on their relative carbon intensity. This long overdue policy will increase fossil fuel energy costs and in so doing provide needed price signals and financial incentives for all energy users, including colleges and universities, to reduce reliance on fossil fuels. This development is leading some schools to develop economic models that allow these anticipated additional carbon-intensity-based energy costs to be factored into project decision-making.

As carbon emissions are assigned a price ($/MTCO$_2$) the cost of fossil fuels will rise and the dollar saving benefit of energy conservation and efficiency or switching from fossil fuels to clean energy alternatives will increase – thus shortening paybacks and increasing the financial attractiveness of these measures.

While a crystal ball would be required to know exactly how the cost of carbon emissions (and thus the price of energy) will rise in the years ahead, research in this area has been done and policy analysts have estimated what the price of carbon will need to be to achieve various levels of national and global GHG emissions reduction. Thus, it is possible to "guesstimate" various carbon cost scenarios. Yale University and Cornell University are among the schools developing methods to take into account future carbon costs.

For example, Yale is using “low” (\$10/MTCO_2e), “medium” (\$50/MTCO_2e), and “high” (\$100/MTCO_2e) carbon cost scenarios when running net present value and life cycle cost analyses for prospective energy conservation or carbon emissions reduction measures. Since no one knows what the price of carbon will be in the future, this method is hypothetical but it does demonstrate the sensitivity of various measures to different possible carbon cost thresholds. And while Yale does not only use economic modeling to determine whether a given project is implemented, this methodology plays an important role.

As part of its CAP process, Cornell has commissioned a study that examines likely federal climate protection legislation in order to determine likely future carbon emissions costs and thus better define Cornell’s financial exposure. The study examines “soft,” “moderate,” and “stringent” U.S. policy options and also defines the fraction of Cornell’s carbon footprint likely to be subject to these increasing carbon costs. Each carbon cost scenario produces a curve of increasing carbon costs over time. These cost curves then can be factored into payback, net present value, or lifecycle cost analysis of prospective energy conservation and CO_2 emissions reduction measures. Also, since Cornell, as an ACUPCC institution, is committed to eventually achieving climate neutrality, carbon offsets will likely enter the picture. Since energy conservation or switching to renewables will reduce the eventual need for offsets, Cornell’s study can provide it with a means of estimating how much that future cost avoidance might be worth – so this savings can be factored into project decision-making.

7. SETTING GHG EMISSIONS TARGETS AND MEASURING PROGRESS

7.1 Your GHG Emissions Reduction Goals

Greenhouse gas emissions reduction goals are individual to each college and university. Even ACUPCC institutions, which have committed to achieving climate neutrality "as soon as possible," will have individualized GHG emissions reduction goals. In their CAPs, ACUPCC schools need to identify a date for achieving climate neutrality as well as dates for achieving interim emissions reduction goals.

Colleges and universities not participating in the ACUPCC need to define their GHG emissions goals not only in terms of emissions reductions targets and dates but also in terms of the categories of GHG emissions to be reduced. Conceivably, emissions reduction goals could be established separately for Scope 1, 2, and 3 categories of GHG emissions. ACUPCC signatories may also choose to state interim targets by emissions scope type.

In all cases, campus GHG emissions reduction goals should be challenging and they should encourage colleges and universities to demonstrate real leadership by committing to significant reductions and achieving the lion's share of them very quickly. Leading climatologists like NASA's Jim Hansen have said that the window for action is closing and that if we – as a species – do not make significant progress reversing GHG emissions trends soon, it will be too late to avoid the worst consequences of climate change. Thus, it is time for dramatic action. Campus climate action plans must be deemed failures if they do not produce the rapid response that is needed.

While comparisons with other institutions are not always appropriate or helpful, it's worth examining GHG emissions reduction goals established by other colleges and universities. That examination might give your climate action team some good ideas. Besides, there's nothing wrong with a little friendly competition to help save the planet. A list of campus climate commitments is available on the AASHE site and the climate commitments of ACUPCC signatories will be posted on the ACUPCC's online reporting system.)

What is a reasonable timeframe for ACUPCC schools to achieve climate neutrality? Given Hansen's plea, ten years seems about right if your goal is to demonstrate the kind of leadership that is needed now. That period is long enough to do big things yet short enough to be well within the careers of many or most of your CAP key players – maybe even your president. However, for most schools accomplishing climate neutrality within a decade would only be possible with a very heavy reliance on carbon offsets. This approach is unlikely to win favor unless the carbon offset market matures rapidly and reliable, credible offsets become available.

ACUPCC institutions need to consider many factors when establishing their climate neutrality dates. One the one hand, it is much more important to commit to large cuts in GHG emissions in the short term rather than get hung up in a theoretical debate or a lot of navel gazing about when eventual climate neutrality will be achieved. On the other hand, establishing an aggressive timetable for climate neutrality is likely to light a fire under an ACUPCC institution's climate action program, hopefully motivating strong and decisive action now – which is precisely what's needed. Of course, colleges and universities that have not signed the ACUPCC also may and should commit to large cuts in GHG emissions over the short term.

Since so much of the discussion about national climate protection policy and goals has centered on the need to achieve an 80% reduction in GHG emissions by 2050, there may be a tendency for colleges and universities to use that date as a target for achieving deep emissions cuts. The problem with that approach is that it would demonstrate little leadership. Imagine the colossal challenge of moving an entire nation to an 80% GHG emissions reduction by 2050. The only way we are ever going to get there is if true leaders step up to the plate and achieve far more than those cuts much sooner.

ACUPCC and non-ACUPCC institutions alike should establish GHG emissions targets that create tension and pressure to accelerate action. All too often we are counseled to be practical and patient. However, the climate crisis is so severe that we shouldn't be satisfied with a practical and patient campus climate action plan.

7.2 Using Forecasting and Backcasting Methods to Develop Scenarios

In establishing GHG emissions reduction goals and targets your CAP team may want to use both forecasting and back-casting methods.

Forecasting involves examining future options to reduce GHG emissions and determining from that analysis how soon you can implement them. A forecasting process involves identifying likely or possible GHG emissions strategies and projects, evaluating and prioritizing them, placing them on a timeline for implementation, and then calculating how much GHG emissions reductions these projects can achieve in successive years.

Typically, forecasting involves creating a number of scenarios with increasing levels of commitment. One scenario might be "easily do-able." Another, "more challenging." And a third representing an "all-out effort." More creative or entertaining language can be developed for these scenarios, such as the "No Brainer," "No Regrets," and "Take No Prisoners" scenarios from the *Oberlin College: Climate Neutral by 2020* report prepared in 2002 by Rocky Mountain Institute. Your planning team develops the scenarios based on various combinations of emissions reduction projects and green power and carbon offset purchases – from easily done to more challenging.

Back-casting operates in the reverse direction; it projects backwards. With back-casting your CAP team would hypothetically establish various dates for achieving your carbon emissions goals and then work backwards from each to see what would have to be done during the intervening years to achieve that level of reduction.

7.3 Finalizing Your GHG Emissions Reduction Proposal

Once scenarios are internally defined and analyzed, your CAP team should seek public comment from the campus community perhaps through a series of presentations or town meetings. The scenarios with accompanying GHG reduction trajectories could also be presented on your CAP website with an easy mechanism provided to solicit electronic comments.

Comments received through these feedback mechanisms need to be addressed by your CAP team. This process may result in the modification or abandonment of certain scenarios and targets.

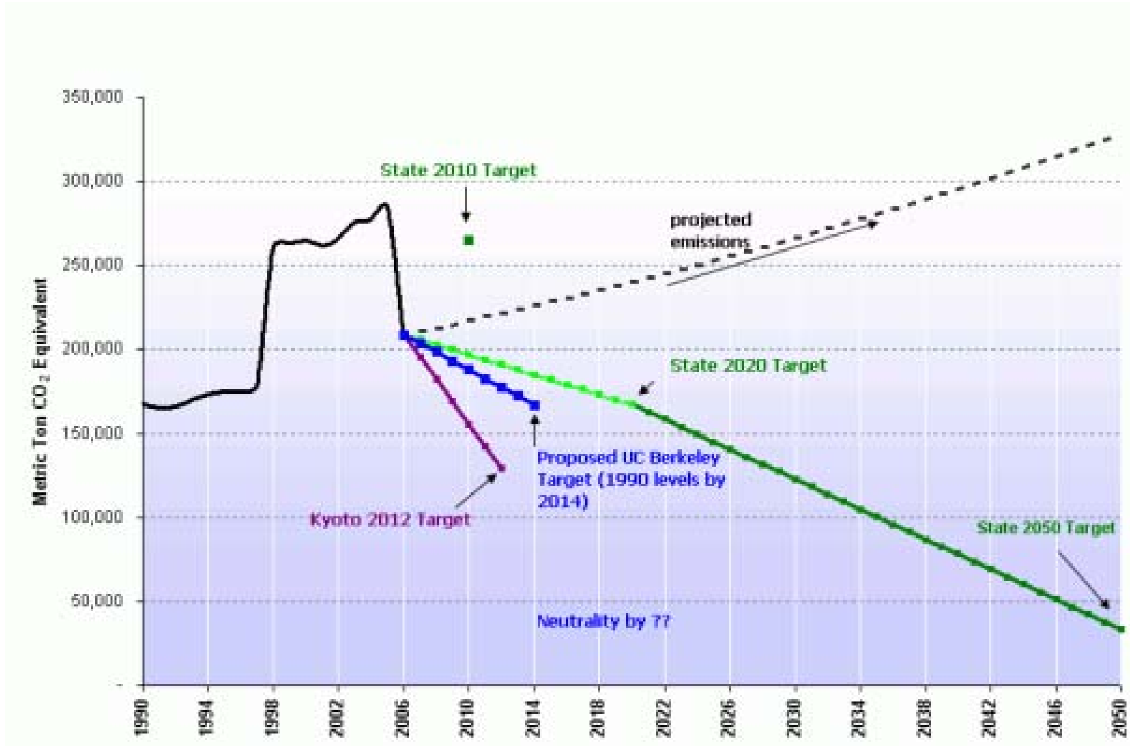
Once feedback is considered, your CAP team may wish to weigh all options again and then either go back out to the campus community for more comments or move directly to preparing a proposal for campus leadership. That proposal might be a specific scenario to achieve "X" reduction by "Y" date. Or it might be a prioritized list of different scenarios with different targets. In any event, your president and campus leadership should not be surprised by your CAP team's submittal. The CAP process can only work if your president and key campus leaders are involved and on-board each step of the way.

7.4 Additional CAP Components and Tools

7.4.1 Establishing Your Glide Path – Downward Trajectories and Interim Targets

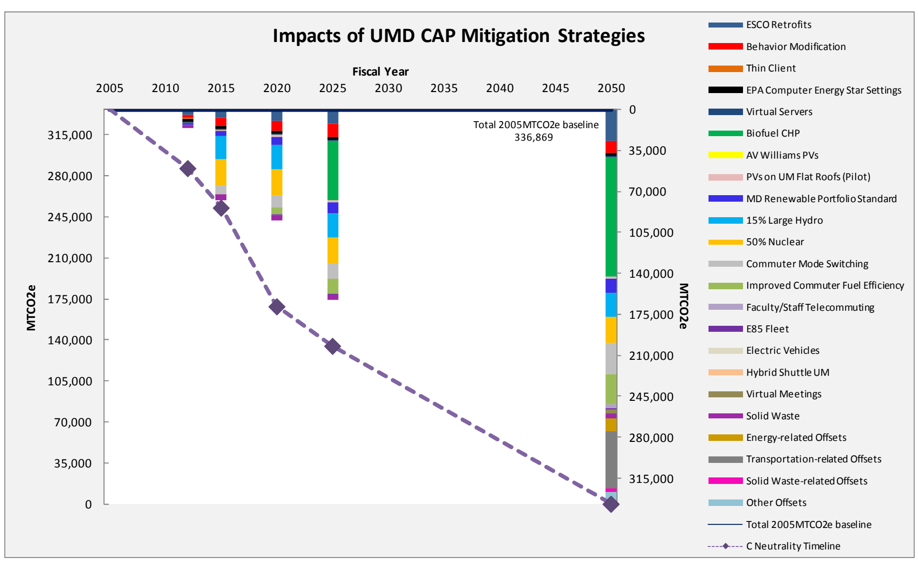
Getting to your carbon goal will be an incremental process involving a multitude of steps, measures, and projects. To help keep you on track, interim goals with accompanying dates should be established against which you can measure progress and see whether the trajectory you're on matches the one you should be on. To be relevant to the climate change danger we face, your glide path should be downward pointing on as steep a trajectory as possible.

Detailed GHG emissions reduction scenarios produce downward sloping emissions trajectories. These can be graphed to facilitate comparisons. The graph on the next page is from *UC Berkeley Climate Action Partnership: Feasibility Study 2006- 2007 Final Report*. It shows a business as usual trajectory of ever increasing emissions plus a number of other trajectories based on different targets or scenarios. This graph compares a UC Berkeley 2014 trajectory and target (blue line) with a State of California trajectory and target (green line). It shows that in the short term neither trajectory is as aggressive as that established by the Kyoto Protocol 2012 target (purple line). For detail on UC Berkeley's business as usual scenario (upward sloping brown line), see graph in section 4.7 of this guide.



Reprinted from UC Berkeley Climate Action Partnership Feasibility Study 2006- 2007 with permission of UC Berkeley

This next graph from the *University of Maryland Draft Climate Action Plan* shows a more detailed way of illustrating a downward emissions trajectory and interim goals. At different points in time this "waterfall graph" shows the role of various emissions reduction strategies in contributing to an anticipated decreasing emissions profile.



Courtesy of Heather Lair, University of Maryland

Once a given climate action plan and emissions reduction scenario is approved by your president and administration, its trajectory can be used to identify interim targets. Those interim targets become part of your CAP.

What happens if internal GHG emission reduction efforts are insufficient to meet an established CAP interim target? Your school has a number of options. It could:

- Buy carbon offsets so that the target is achieved
- Admit it missed the target and vow to ramp up efforts so that the next target is not missed
- Adjust its CAP interim targets so they become easier to meet

The latter option may seem "just being realistic" to some while others may call it "backsliding."

It's important that colleges and universities committed to addressing climate change set appropriate goals (see discussion in section 7.1 of this guide) and make good faith efforts to meet interim targets on the way to achieving long range GHG emissions reduction goals despite bumps in the road. Of course, there also may be pleasant surprises that enable institutions to meet interim-targets ahead of time and continue on an accelerated timetable.

7.4.2 Relative Measures of Progress

In addition to absolute reductions in GHG emissions, there are others ways to show progress or the lack of it, e.g. normalized or relative data such as:

- $MTCO_2e$/yr per net or gross square foot of building space
- $MTCO_2e$/yr per student
- $MTCO_2e$/yr per campus population (total of student, faculty, and staff)
- $MTCO_2e$/yr per heating and cooling degree days

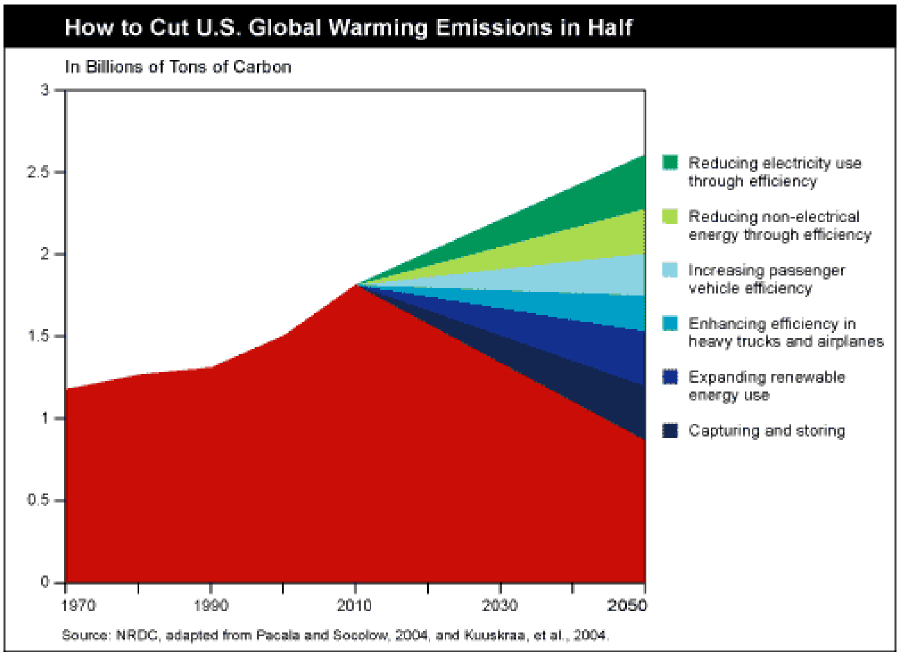
In all cases, you would hope these indices trend steadily in a downward direction.

Normalized or relative measures can be particularly helpful on campuses that are in an expansion (or contraction) mode. If your student body is growing or your school is constructing new buildings, normalized measures like GHG emissions per student or per square foot may allow you to show progress even when your overall GHG emissions are not shrinking very quickly or at all. Just remember that our collective overall human species goal is to significantly and quickly reduce GHG emissions in absolute terms. That's what we must strive for.

Note that when calculating GHG emissions per annual heating or cooling degree days, it is important that only the GHG emissions caused by campus heating or cooling energy consumption be adjusted. Non-heating and non-cooling-related GHG emissions caused by "baseload" energy use, e.g. lights, motors, and plug loads, must be excluded from this kind of analysis – or else the $MTCO_2e$/HDD or CDD data produced will be skewed and possibly meaningless. Clean Air-Cool Planet is attempting to modify its Campus Carbon Calculator to take this into account.

7.4.3 GHG Mitigation Wedges

In 2004, S. Pacala and R. Socolow published an article in *Science* magazine entitled, *Stabilization Wedges: Solving the Climate Problem for the Next Fifty Years with Current Technologies*. This article popularized the concept of GHG emissions reduction wedges. In their article, Pacala and Socolow proposed using seven wedges, each representing a GHG emissions reduction strategy capable of eventually reducing U.S. GHG emissions by 1 gigaton of CO_2e per year by 2054. Pacala and Socolow identified 15 technologically feasible wedges capable of achieving that kind of performance. Their discussion assumed an initial "business as usual" upward trajectory for U.S. fossil fuel energy use and GHG emissions. Pacala and Socolow's goal was merely to show how implementing seven wedges over this fifty year period could hold U.S. overall GHG emissions at a steady 7 gigatons. A wedge analysis can also illustrate strategies that can reduce emissions.



Reprinted from *A Responsible Energy Plan for America* with permission of NRDC, the Natural Resources Defense Council.

The graph on the right from the Natural Resources Defense Council shows the results of a wedge analysis adapted from S. Pacala and R. Socolow for achieving a significant reduction in U.S. GHG emissions by 2050 against a business-as-usual baseline of escalating emissions.

Pacala and Socolow defined and calculated their fifteen possible "wedges" in these categories:

- Improved fuel economy for cars
- Reduced reliance on cars
- More efficient buildings
- Improved power plant efficiency
- Substituting natural gas for coal
- Capturing and storing carbon from power plants
- Storing carbon captured at hydrogen plants
- Storing carbon captured at syn-fuels plants

- Substituting nuclear power for coal
- Substituting wind power for coal
- Substituting photovoltaic solar electric power for coal
- Substituting wind power-produced hydrogen for gasoline in hybrid cars
- Substituting biomass for fossils fuels
- Reducing deforestation and increasing reforesting
- Utilizing conservation tillage in agriculture

Obviously, these are all big ticket national policy items. Campus wedges would be defined differently – perhaps one for each mitigation strategy detailed in Section 5 of this guide or for different projects and measures. This graph from Cornell University uses wedges to illustrate the basic outline of Cornell's strategy for achieving climate neutrality.

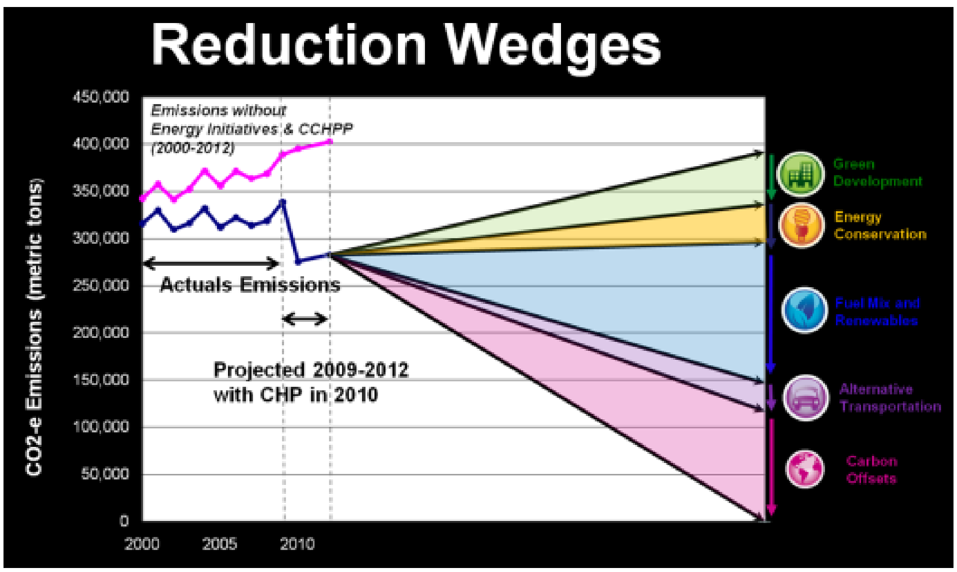


Image courtesy of Cornell University

Emissions reduction wedges are one tool of many that campuses can use to define, conceptualize, or present their climate action plans. The Solutions Module of the CA-CP Campus Carbon Calculator Version 6 contains a wedge analysis tool.

8. FINANCING CAMPUS CLIMATE ACTION

8.1 Dealing with Sticker Shock

At some point, most schools preparing a CAP will probably face "sticker shock." This is likely to occur when the cost of actually achieving significant GHG emissions reductions is initially estimated and better understood as a result of the climate action planning process. The reality is that avoiding the worst consequences of climate change is a huge undertaking, and it shouldn't surprise anyone that there are going to be real costs involved. On larger campuses, the costs of achieving deep cuts in emissions may amount to many millions of dollars and require substantial on-going costs. Balanced against those costs will be annual savings resulting from reduced energy waste and greater levels of efficiency.

Preparing the CAP can also be costly in terms of staff time. Dedicating existing staff to this process involves an "opportunity cost," i.e. the functions and benefits those staff will not be able to achieve because they are instead focused on planning for and achieving GHG emissions reductions. Some may see this as a negative. Those concerned about environmental responsibility and the fate of the Earth may have another view since shifting resources toward saving the planet will seem like a good thing to them. One group likely to be pinched for time is campus sustainability staff who will probably be asked to do more even though they were already stretched thin before the CAP process began. Their own personal sustainability may be at risk. Energy managers asked to do more and more may find themselves in the same boat.

Energy conservation and energy efficiency improvements tend to be the primary GHG emissions mitigation strategies that can save enough money to pay for themselves. While short payback energy conservation projects can produce "positive cash flow" (savings in excess of cost or debt service) that can be used to leverage and pay for other measures, the deep conservation necessary for achieving significant GHG emissions cuts will probably entail an acceptance of energy conservation measures with longer paybacks and less attractive economics. These will erode the prospects of positive cash flow and limit the ability of conservation projects to produce a cash stream capable of financing other GHG emissions reduction strategies.

As the real costs are better understood, it is important that campus climate planners and activists think carefully and creatively about financing options and develop an effective financing strategy for their CAP. They also need to be very strategic in rationalizing the costs that are involved. One way of doing the latter is to be deliberate and meticulous in pointing out (and quantifying if you can) the multiple benefits produced by a campus climate action commitment and program. These are real and important and include:

- Truly relevant public service on behalf of saving the planet for our children and future generations
- Graduating students who will be part of the solution to climate change and not be part of the problem
- Academic enrichment for students and faculty
- Improved recruitment and retention of new students and faculty who increasingly will be looking for colleges and universities that embrace sustainability and serious climate action.

- Productivity and maintenance benefits resulting from upgrades to the campus physical plant
- The possibility of attracting more research dollars for what will undoubtedly be a burgeoning field of study
- Substantial public relations and public image value
- A sense of relevance and pride from being on the cutting edge and among the leaders tackling the problem of climate change

The above, of course, is no substitute for a sound CAP financial plan but being clear about the important multiple benefits of this endeavor will take some of the bite out of discussions about the costs. A smart financial plan will prioritize cost-effective emissions mitigation measures, sequence and schedule them to maximize synergies and savings that minimize costs or allow some measures to pay for others, identify obvious and unusual funding sources, and use creative financing techniques to make serious climate action affordable.

8.2 Funding Sources

Strategies, projects, measures, and programs that reduce GHG emissions can be paid for by a variety of funding mechanisms including:

- Self-financing performance contracts
- Revolving funds that are replenished by savings generated by conservation measures as well as perhaps annual budget allocations
- Grants from government, foundations or business partners
- Energy efficiency and renewable energy incentives provided by government or utilities
- Borrowed money from tax-exempt bonds or other types of borrowing
- Financial instruments specifically designed to promote renewable energy development
- Alumni donations and other fundraising
- Student activity fees and graduating class gifts

The AASHE resource center lists some additional funding mechanisms which might be helpful.

Here are some sources of information about funding your CAP or parts of it:

- *Raise the Funds, A Student and Administrator's Guide to Funding Mechanisms for Campus Sustainability Initiatives* by Campus InPower in partnership with AASHE, Breakthrough Generation, Wild Gift, and Big Ideas @ Berkeley
- List of campus revolving funds from the AASHE website
- *The Business Case for Renewable Energy: A Guide for Colleges and Universities* by Andrea Putman and Michael Philips (2006)
- *Alternative Energy Economics* by Michael Philips and Lee White (2009)
- Database of State Incentives for Renewables and Efficiency

Affordability is a key factor that weighs heavily on whether a CAP actually gets implemented. This means minimizing costs while chasing all available dollars.

9. STRUCTURING YOUR PLAN AND GETTING IT APPROVED

9.1 Sample CAP Table of Contents

Here is a sample CAP table of contents:

1. Executive Summary – A brief summary of your CAP document for those who don't have time to read the full report
2. Introduction – Background information including a brief summary of the science of climate change and the basis of your climate commitment. This section could include a statement from your president and discussion of your school's green campus, energy conservation, and GHG mitigation efforts to date
3. Your Climate Commitment – A statement of principles and goals that addresses all aspects of your commitment including those pertaining to changes in academic and research programs and GHG emissions reductions
4. Education, Research, and Public Engagement – Plans to prioritize climate change and sustainability in academic programs for all students, in research activities, and in your institution's interaction with the wider community
5. Your Campus Carbon Footprint – The results and analysis of your GHG inventory, identifying major sources of emissions and describing your current GHG emissions trajectory
6. GHG Emissions Mitigation – Strategies for reducing GHG emissions (including those not captured and quantified by your GHG inventory). This part of your CAP may be very detailed and include a discussion of projects, measures, and programs that will reduce GHG emissions, how they were chosen, and a timetable for implementation
7. Barriers and Solutions – Barriers to implementation and strategies for overcoming them. This could be the place in your plan that anticipates and responds to criticism
8. Costs and Financing – Your CAP's cost estimates and financing plans plus discussion of efforts made and strategies employed to make the plan as affordable and self-financing as possible
9. Implementation Structure – How implementation will be managed and coordinated. Include mechanisms and schedules for revisiting and updating the CAP
10. Communications Strategy – Plan to encourage the kind of behavior change necessary to implement the CAP
11. Tracking Progress – A description of methods to be used to both track CAP progress and keep the CAP on track!
12. Next Steps –The near turn steps that need to be taken to begin the implementation process
13. Conclusion – Quick recap of your CAP, highlighting its main points, with a final explanation of why this work is so important

9.2 Improving the Likelihood of CAP Approval

The CAP team's first responsibility is producing the best possible climate action plan. But it's not just about producing a report; it's about gaining acceptance and approval for your plan so that it can be implemented. There are a variety of strategies that campus climate action planners, activists and organizers can use to increase the likelihood that their climate action plans will receive administrative approval. These include:

- Inclusion, Participation and Stakeholder Support – Include all interested parties, constituencies, and stakeholders in the creation of your CAP, address their concerns, thank them for their contributions, and ask them to support and "lobby" for the final product
- Transparency – Hold open meetings and make all planning documents readily and easily available to the public
- Continuously Involve the Administration – The last thing you want to do is blindside the administration whose approval the plan will need. Keep the president and other campus leaders continuously involved and informed as the planning and decision-making process unfolds. Ideally, the president and other top-level administrators will be integral and active members of the team.
- Identify and Address Barriers – By anticipating and thoroughly addressing institutional barriers (including cost and funding), your CAP has a much better chance of being approved
- Peer Review – Submit early and later drafts to a vetting process that involves peer review by technical experts as well as interested students, faculty, and staff throughout the campus. This may be time-consuming, but your plan will be improved by this process. And by giving others "a piece of the action," your plan will gain support.
- Build in Flexibility – Explicitly view your CAP as a living document or a work in progress open to revision. The plan could be reviewed and updated on a prescribed annual or every-other-year basis or when a critical need arises. Building in flexibility recognizes the vagaries of long term planning and will lift some weight off the CAP team's shoulders by alleviating the need to provide program and project details for outlying years and by providing the kind of wiggle room campus leadership may want in order to develop a comfort level with the plan.

10. IMPLEMENTING YOUR CAMPUS CLIMATE ACTION PLAN

10.1 Increasing the Chances of Implementation

College and university veterans know that it is dangerous to make assumptions or believe that things will progress the way they should. Key people come and go. Nasty politics can assert themselves. Budgets can crash. And the best laid plans of mice and men (and women) can go awry.

While all campuses work differently, in general CAP implementation is more likely if a high ranking professional staff member – with direct access to the president and other campus leaders – is assigned the task of managing implementation. This individual could chair a CAP implementation committee or delegate those responsibilities to a direct-report staff person who also handles CAP implementation day-to-day details. The implementation committee might evolve out of the planning committee and should remain inclusive and open.

Implementation is more likely to occur if progress (or lack of it) is regularly communicated to the administration and the campus community accompanied by efforts to maintain a high level of interest. On-going student interest and support is essential because students can more easily speak out than can staff members. Since students come and go on a regular cycle, educating and involving students will be an on-going process.

An annual progress report that is widely circulated and discussed is an important part of the implementation process. While such a report can be used by ACUPCC institutions to meet program reporting requirements, more importantly each time one is released it will shine a light on your school's climate action efforts and encourage renewed commitment. The report could contain an updated GHG inventory (the ACUPCC requires such updates every other year), a listing of measures and projects completed that year, and an assessment of whether climate commitment goals for that year were met. This should be an honest discussion and not just a PR piece.

10.2 Hold an Annual Climate Summit

An annual climate action summit is another helpful accountability mechanism for maintaining the commitment and achieving the targets and eventual long-term goals defined by your CAP. At the summit, your president can deliver a progress report to the campus community, have an opportunity to indicate his/her renewed commitment, and answer questions and respond to concerns. A series of panel discussions could be set up to report on progress in various mitigation areas as well as discuss difficulties that have been encountered and what is being done to overcome them. A nationally recognized expert keynote speaker could be invited to kick-off the summit by reminding everyone of the climate crisis we are facing and thus the importance of holding fast to or accelerating your campus climate commitment.

While it might seem like Earth Day is a good time to hold the summit, it's probably not because on most campuses the school year is nearly over in late April when Earth Day officially occurs. Instead, kick-off the school year by holding your campus climate summit in mid-September or October. Call it your campus Earth Day if you want. Or schedule it on Campus Sustainability Day, a nationwide event sponsored by the Society for College and University Planning and held in October each year.

10.3 CAP Flexibility and Revisions

Implementing a climate action plan is a learning process and thus requires a flexible approach which allows changes and incorporates lessons learned along the way. As previously explained, flexibility is important so that your CAP can respond to new conditions, technologies, and opportunities and thus stay current and maintain support. Revisions to the plan can be released or proposed each year when the annual progress report is issued or the annual summit is held or you could build into your plan a formal review and re-evaluation process every two or three years – perhaps timed to coincide with the dates your CAP establishes for achieving key interim goals. Revisions would be developed by the chief CAP implementing officer and the CAP implementation committee as a result of a transparent, participatory process. But be careful to avoid unnecessary backsliding.

Periodic reviews and re-evaluations of your CAP have another advantage. They provide additional opportunities for student involvement so that new classes of students can participate in the CAP analytical and planning process, maximizing the educational benefit of the endeavor.

10.4 What if Your President Leaves?

One danger or contingency all colleges and universities face is that a supportive campus president will leave and be replaced by a new leader who is not as interested in developing or implementing a CAP. If this happens, a lot of ground can be lost. Thus it is imperative that campus supporters of your climate commitment and CAP strongly insist that the selection process for new campus leaders include a climate action "litmus test." While all new college and university leaders can be expected to bring to their job a list of their own priorities, it is essential that climate protection and climate leadership be among their top concerns.

If despite these efforts the new president is less supportive, it is important that there is a broad and deep awareness and support of your campus climate action plan among faculty, students, staff, alumni, and trustees, so that any loss in momentum is minimal.

11. A PARTING THOUGHT FROM JIM HANSEN

"Science and policy implications are clear. Despite population growth and increasing demands for energy from developing nations, we must meet our energy needs, and, at the same time, dramatically reduce greenhouse gas emissions. This challenge is huge. In order to stabilize climate and avoid the worst consequences of global warming and climate change, we must reduce annual greenhouse gas emissions by 2050 to a fraction of present emissions.

College and universities have a critical leadership role to play by graduating students who fully understand the problem of climate change and are prepared to act by committing to achieve deep cuts in greenhouse gas emissions at the earliest possible date. These important efforts will inspire similar actions in other sectors of our society and create the momentum needed to get our political leaders and government on all levels to act before it is too late.

—Jim Hansen

Director of the NASA Goddard Institute for Space Studies and Adjunct Professor of Earth and Environmental Sciences at Columbia University's Earth Institute

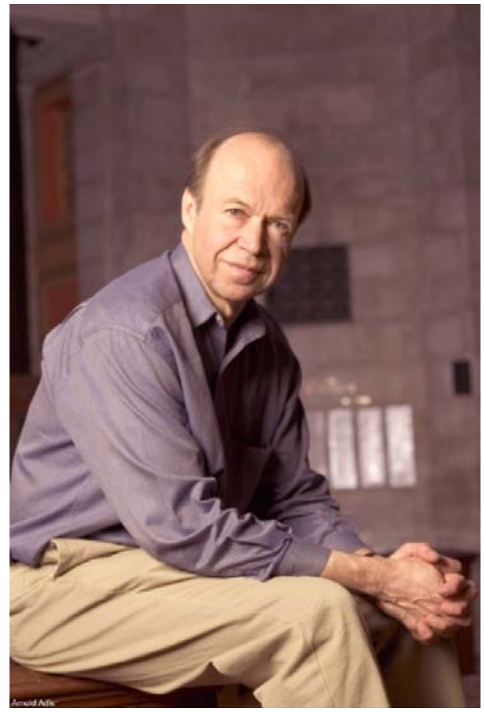


Photo courtesy of Goddard Institute for Space Studies

12. CAMPUS CLIMATE ACTION PLAN RESOURCES

Association for the Advancement of Sustainability in Higher Education (AASHE). AASHE, one of three supporting organizations of the ACUPCC, offers a monthly newsletter – the *ACUPCC Implementer* – for those involved in implementing the Presidents' Climate Commitment on their campuses. Anyone can subscribe. The AASHE site also contains numerous resources on campus climate action and many related topics. Especially see these sections:

- Climate action
    - AASHE Campus Climate Action Planning Wiki
    - Campus Greenhouse Gas Emissions Inventories
    - Campus Climate Action Plans
    - Campus Global Warming Commitments
    - Publications on Campus Climate Action
    - Climate-related Papers & Presentations given at AASHE 2008
    - AASHE Blog Posts on Climate
- Greenhouse gas inventories
- Energy
- Solar on campus
- Wind on campus
- Green buildings
- Transportation
- Waste reduction and recycling
- Greening curriculum
- Greening research

American College and University Presidents' Climate Commitment (ACUPCC)
This site contains numerous helpful resources including:

- ACUPCC pledge
- Reasons for signing
- Current list of signatories
- Supporting organizations
- *ACUPCC Implementation Guide*
- *Education for Climate Neutrality and Sustainability: Guidance for ACUPCC Institutions*
- GHG emissions solutions
- *ACUPCC Carbon Offset Protocol*
- ACUPCC Webinar series

Boldly Sustainable: Hope and Opportunity for Higher Education in an Age of Climate Change; by Andrea Putman and Peter Bardaglio; NACUBO,2009.

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

Campus Climate Neutrality – Yes We Can! It's a Big Challenge, But Here's How to Do It, Facilities Manager, March-April, 2009, APPA.

Clean Air-Cool Planet, provides the Campus Climate Action Toolkit and Campus Carbon Calculator. Also see CA-CP publications: *Getting to Zero: Defining Corporate Climate Neutrality*, 2008, and *A Consumer's Guide to Retail Carbon Offset Providers*, 2006.

The Educational Facilities Professionals Practical Guide to Reducing the Campus Carbon Footprint; Karla Hignite, principal author; APPA 2008. Available for free download.

The Green Campus: Meeting the Challenge of Environmental Sustainability; by Walter Simpson, editor; APPA 2008. A 350 page book that contains seven chapters on the climate change, the ACUPCC, and campus energy and climate action.

National Wildlife Federation Guide to Climate Action Planning: Pathways to a Low Carbon Campus; by David J. Eagan, Terry Calhoun, Justin Schott, Praween Dayananda; NWF Campus Ecology, 2008, 45 pages.

National Wildlife Federation Higher Education in a Warming World: the Business Case for Climate Leadership on Campus; by David J. Eagan, Terry Calhoun, Justin Schott, Praween Dayananda, NWF Campus Ecology, 2008, 60 pages

Reducing Greenhouse Gases and Achieving Climate Neutrality, APPA webinar by Walter Simpson, 2008.

Second Nature, is one of the three supporting organizations of the ACUPCC and its site contains many helpful resources.