Accelerating Campus Climate Initiatives

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AASHE
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- Association for Advancement of Sustainability in Higher Education
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Navigating This Book

In order to turn immediately to text that addresses the barriers, issues, and problems that you are encountering on your campus, please use the navigation pane, bookmarks tab, which will reveal summary versions of all barriers covered in this book, with links to each. The term "barriers" means both actual and perceived barriers to campus climate initiatives.
If you are reading hardcopy of this book and do not have access to the navigation pane, then refer below to the same summary versions of the barriers and their locations.
We recommend too that you read the Introduction, which describes issues surrounding campus climate initiatives and outstanding practices for effective climate action.

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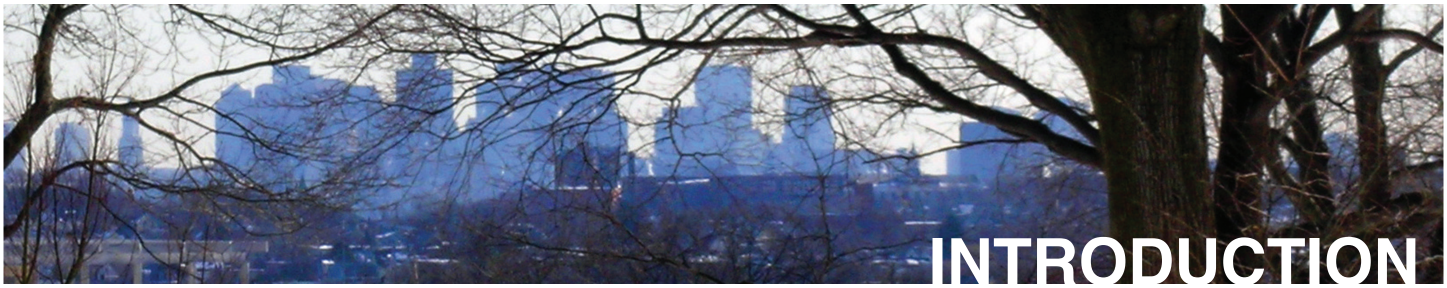

INTRODUCTION

This book offers practical information to those working to reduce greenhouse gas emissions from college and university campus operations. It describes a wide array of challenges or barriers to campus climate-mitigation efforts. More importantly, the book describes solutions to each barrier and often provides examples and resources.

Each barrier represents a real or perceived hurdle on many campuses. RMI compiled the list of barriers after speaking to dozens of individuals at institutions of all sizes and types. The solutions guide users around, over or through the barriers, and in some cases reveal that a perceived barrier is not so big after all.

The intended users of this book include sustainability directors, CFOs, presidents, students, faculty, and staff. But interest in the book can probably be characterized less by job description and more by personal commitment, by those who understand that there is now overwhelming evidence that human activities are changing the world's climate, and that the environmental and societal impacts of climate change are coming faster and more furiously than previously thought. Although campus officials may feel a sense of urgency, they are often frustrated that action to address the problem can be delayed by many barriers, especially concerns about cost.

Many readers will understand also that measures to reduce greenhouse gas emissions often pay for themselves and generate multiple campus benefits. Most greenhouse-gas emissions are linked to energy use. As energy prices fluctuate and budgets tighten, fiscal responsibility and climate-change mitigation become mutually supportive goals. Energy efficiency not only reduces emissions, it also saves money, reduces risk, and increases competitiveness. Its complement — renewable sources for electric power, heating fuel and transportation — also is economical in many circumstances. In fact, regardless of whether one accepts the preponderance of the evidence regarding global warming, the most effective climate-protection measures are actions we should be taking anyway to strengthen the economy and save money long-term in our institutions.

This book does not attempt to convince its reader that the climate crisis is real. Rather, it focuses on practical ways to overcome the barriers to efforts to reduce emissions that cause the climate crisis. Readers who would like to examine evidence of the human-caused climate crisis can refer to the website of the American College & University Presidents' Climate Commitment www.presidentsclimatecommitment.org/about/climate-disruption.

As people in the business of educating and inspiring students, campus climate leaders are attuned to the potential for synergy between greenhouse gas reduction and excellent teaching. Not only does carbon management make good business sense for the institution's bottom line, it also makes good educational sense for the institution's mission. In their book Boldly Sustainable, Peter Bardaglio and Andrea Putman assert, "We need to move from providing an education that focuses on specialization and making distinctions to a new kind of ecological, synergistic education that emphasizes interrelatedness." The opportunities for hands-on learning, real-world problem solving and teaching partnerships among different disciplines are enormous when on-campus projects, community projects and global-events related to climate change can all be aligned.

During the research for this project many dedicated and committed faculty members shared with us their course syllabi and ideas for interdisciplinary courses that incorporate climate considerations and service projects. The faculty members included professors of religion, English, history, economics, and, of course, physical sciences. We are excited and impressed by the array of creative ways in which these professionals are making their courses relevant, engaging and connected to wider campus and community goals.

Also, Peter Senge's *The Necessary Revolution* (pp 27-32). In one particularly dramatic passage, this consultant to major corporations says, " To stabilize CO_2 in the atmosphere at levels that minimize the threat of catastrophic consequences will require 60 percent to 80 percent reduction in emissions within the next two decades! We call this the 80-20 Challenge, the bell tolling the end of the Industrial Age."

This book was inspired and informed by an important group of people: the sustainability directors, facilities engineers, CFOs, presidents, students, professors, cooks, secretaries, electricians and more whom we interviewed in our visits to twelve campuses in late 2008 and early 2009. These are committed people — too numerous to name here — who daily take up metaphorical sledge hammers and bash away at the many barriers to their institution's efforts to reduce greenhouse gases. We intend that their spirited efforts, captured here as solutions to those barriers, will be amplified and replicated on campuses across the country. The twelve campuses they represent are:

- Colorado State University, Fort Collins, Colorado
- Furman University, Greenville, South Carolina
- Harford Community College, Bel Air, Maryland
- Lakeshore Technical College, Cleveland, Wisconsin
- Luther College, Decorah, Iowa
- Richland College, Dallas, Texas
- Tufts University, Medford, Massachusetts Unity College, Unity, Maine
- University of Minnesota at Morris, Morris, Minnesota
- University of Missouri, Columbia, Missouri
- University of Vermont, Burlington, Vermont
- Yale University, New Haven, Connecticut

We chose to visit these particular schools not based on excellent performance, though we found plenty of that, but because we wanted to understand and reflect the experiences of many different kinds of campuses.

This book is the result of a collaboration between Rocky Mountain Institute (RMI) and the Association for the Advancement of Sustainability in Higher Education (AASHE). More on the project that led to this book can be found in Appendix A.

Using this book

We have divided the book into five topic areas.

1. Climate action planning

And the most significant components of any climate action plan:

2. Buildings and utilities
3. Renewable energy
4. Transportation
5. Carbon offsets

Each of the five chapters includes a list of barriers to efforts to reduce greenhouse gas emissions. Following each numbered barrier is a description of solutions and, in some cases, examples and resources. Topics not included are solid waste reduction, procurement, and campus fleets because these areas comprise a small percentage of the emissions that campuses have counted in their inventories to date. Their exclusion does not imply that these topics are not important; and possibly they can be included in a future edition of this book.

Additionally, the book does not address climate-related curricula except as they relate to campus operations. Although climate curriculum is obviously of paramount importance, it is outside the scope of this book, except as noted where it connects to campus operations. An excellent resource on climate curriculum is available from the ACUPCC: Education for Climate Neutrality and Sustainability: Guidance for ACUPCC Institutions, which includes contributions from a wide range of campuses. "Education for Sustainability Principles," on page 15 of the guidance document, offers a succinct statement of the nexus of education and campus operations:

> The process of education would "teach what it practices," by complementing formal curriculum with active, experiential, inquiry-based learning and real-world problem solving on the campus and in the larger community. Creativity and innovation in students would be fostered to meet global challenges.

This book is for every person on every campus who has chosen to step forward and commit to solving the climate crisis.

Stepping forward

In 1776, the United States Declaration of Independence enumerated the injustices imposed by the King of England on its impertinent colonies in North America. When the signers pledged "our lives, our fortunes and our sacred honor," they stuck their collective thumb in the eye of the world's only superpower. They had no military; they didn't know how they would accomplish their goal. But they knew what had to be done and they stepped forward with remarkable courage. Similarly, when President Kennedy committed to putting a man on the moon by the end of the decade, no one knew how it could be done or what it would cost. But he stepped forward.

By September, 2009, 650 college and university presidents and chancellors had stepped forward to sign the American College & University Presidents' Climate Commitment.[1] Each of them could have played it safe, could have correctly said that climate is one of many campus goals, that the costs are unknown. But they displayed courage and visionary leadership that will be remembered.

Some may say that they were irresponsible for signing without a clear roadmap and enumerated costs. But critics would have to level the same accusation at the signers of the Declaration whose crisis, though more immediate, was no larger than our own.

[1] www. presidentsclimatecommitement.org/about/commitment

Fortunately, one can see this kind of courage at every level on college campuses. It's the facilities engineer who argues with the CFO for every new energy meter in campus buildings; students prodding an administration that has not acknowledged the campus's role in the climate crisis; and faculty members pushing reluctant colleagues to bring whole-system thinking to their classrooms — all people operating outside their comfort zones because of their commitment to climate.

That said, though understanding the climate challenge engenders the sense of urgency that leads to rapid action, many campuses and other large institutions are making substantial progress in reducing fossil fuel use simply because it makes good business sense.

Outstanding practices for effective climate action

As this book describes various perceived barriers to campus climate initiatives and their solutions, it suggests a wide array of specific practices to increase the effectiveness of your work. The following are several general practices that apply to virtually all aspects of climate and sustainability work.

Employ whole-system thinking to develop integrative designs

People who commit to reducing greenhouse gas emissions want action on their campus, and soon. Their climate programs, strategies, plans, and committees quickly develop lists of exciting projects, programs, and events. As you and your colleagues develop and expand your list and take action, it's critically important to understand that success will come not only from such lists, but also from a different way of thinking about buildings, utilities, perceptions, institutional structures, and all the other components of the system that comprises energy and your campus.

That different way of thinking is often called whole-system thinking. It can help you decide what should be on your list, how to effectively implement your projects, and the interrelationships among them.

This book contains many references to whole-system thinking, some of which are further developed in the text. These include such ideas as integrative design, correct sequencing, multiple benefits, resilience, and end-use/least-cost analysis. Although these concepts could dominate an entire professional degree program, and should be integral to most courses of study, a brief and useful summary can be found in Appendix B.

Whole-system thinking is not easy for any of us; we suggest you refer back to this appendix frequently. Consider explicitly employing whole-system thinking in your various climate action meetings and conversations. Consider it part of the learning process that any organization must pursue to succeed in its climate strategy.

Develop an understanding of campus technical systems

On campus, as everywhere, the world of practical science and engineering is characterized by its own culture, defined in part by technical expertise, professional experience and language. For climate-protection advocates without a technical background, the complex details of, for example, a campus energy system or the physics of the buildings it supplies can seem either beyond comprehension or too detailed and mundane. However, without the help and enthusiasm of campus experts in these systems (e.g., a facilities management team), you will have little hope of achieving aggressive climate goals. Therefore, non-technical staff should cultivate their curiosity in these topics, which will show technical staff that they are interested, supportive, and worth teaching. Non-technical staff can create a strong foundation for the hard work and collaboration that will be needed to make integrated progress toward a climate commitment by building good relationships with technical staff, encouraging them to teach you and other interested sustainability advocates on campus, and connecting them with a non-technical version of campus sustainability culture.

There are many excellent, introductory publications available that will help anyone learn enough to ask useful questions and become familiar with the language and techniques of the facilities management world. For a basic textbook and reference guide to help better understand technical concepts that campus engineers and trades people may bring up and the annual processes they may go through, see Facility Management by Edmond P. Rondeau, Robert Kevin Brown, and Paul D. Lapides (http://www.wiley.com/WileyCDA/WileyTitle/productCd-0471700592,descCd-tableOfContents.html... To keep abreast of some of how sustainability is framed in the facilities world, refer to the archives of Facilities Manager Magazine published by APPA (http://www.appa.org/FacilitiesManager/archives.cfm) and Sustainable Facility Magazine (http://www.sustainablefacility.com/CDA/Archives). Both APPA and Sustainable Facility also have extensive websites with many resources.

Identify non-climate benefits and seek wider support

Shrinking the campus carbon footprint can strengthen other, apparently unrelated aspects of higher education. For example, several studies have demonstrated the link between green aspects of school buildings and higher occupant satisfaction and performance. One such analysis, Green Schools: Attributes for Health and Learning demonstrates that student and teacher health, learning, and productivity are supported by quietness, dryness, cleanliness, good indoor air quality and thermal comfort, and well-maintained systems. A report from the National Academies Press, (2006), Green Schools: Attributes for Health and Learning (free download at http://www.nap.edu/catalog.php?record_id=11756).

Many aspects of the design, maintenance, and renovation of buildings that are required to achieve the results above are also associated with reducing fossil-fuel use. For example, students and employees who learn and work in daylighted spaces (with skylights, light shelves and other daylighting technologies) perform better, retain more positive moods, and are generally healthier than their counterparts in buildings that depend on conventional, electric light[2]. Also, an efficient building envelope reduces energy use, but it also makes the interior quieter. Therefore, in the earlier stages of an effort to secure wide campus support for green-building design or renovation, carefully consider the widest range of benefits that may be achieved by such design and collaborate with people interested in those benefits.

Adopt an integrated framework for prioritization and decision-making

Each barrier in this book is connected to three fundamental challenges that every campus faces: limited people hours, limited capital, and limited information. There will probably never be enough time, money or information to be certain that you are implementing the best solutions. Therefore, rather than aiming for perfection (which can often result in organizational paralysis), prioritize and implement the best possible solutions that time, money and information allow. And base your priorities on an integrated framework.

Such a framework can be challenging. For example, many decisions about changes in campus facilities are made without regard to their effects on the campus carbon footprint, the quality of sustainability education, or local energy and environmental issues. They are simply focused on cost or ease. That said, progress is being made; it is relatively common for decisions about campus mechanical systems and building projects to include some consideration of future utility and pollution permitting costs. Also, it is becoming more common for environmental impacts to be considered, in part due to the popularity of LEED certification and other green-building and energy-efficiency recognition programs.

In order to move toward a more integrative approach that includes climate considerations, consider using a decision-making matrix to, for example, identify priority projects related to mechanical systems and new buildings. On one axis of the matrix would be prospective projects. Listed on the other axis would be criteria that reflect your institution's mission and goals, including your carbon goals. To gain widespread support for use of this tool, include a wide range of campus stakeholders in the process of identifying criteria. For details on this matrix, refer to Appendix D.

Developing prioritization criteria can also be an important part of the campus master-planning process. Institutions that have incorporated sustainability goals into the master plan are often better prepared to efficiently navigate toward carbon neutrality. In many cases, master plans are static and end up on the shelf, rarely used; progress often feels disjointed and piecemeal. In contrast, where the master plan is continually updated, cited and consulted, planning is more likely to achieve widespread satisfaction.

Create a centralized repository of climate-project options

To achieve a cost-effective, well organized, and successful climate mitigation program, you need systematic analysis and prioritization of your campus-wide options for reducing carbon emissions. Begin with a central repository — a database, list, or filing system — that includes all options. Your facilities management department may already have something like this to track deferred maintenance and equipment replacement.

The structure and organization of your central options repository will depend on how your institution organizes budgets and from where budgeted funds will come. For example, if funding for climate mitigation comes from unrestricted sources, then you need a database that includes all prospective projects, regardless of the department that may eventually oversee each. Proposals for improvements to building envelopes and mechanical-systems will compete with other proposals for behavior-modification campaigns and energy-efficient office appliances.

A project manager or team can develop the central options repository by first creating a standardized format for information, distributing it to all departments, then collecting the standardized information for each potential project. Even if only a portion of the funding for each project will come from unrestricted sources, a central repository will enable better cross-institutional communication and teamwork among climate commitment managers. Refer to Chapter One: Climate Action Planning for more information, resources and examples of schools that have created these repositories.

Choose appropriate methods of economic analysis

In order to arrive at and implement the most cost-effective climate mitigation program over the long term, it is critical to choose a method of economic analysis that goes beyond simple payback calculations based only on incremental first costs and resultant annual energy savings.

Life cycle cost analysis (LCC or LCCA) methods (also known as whole-life cost or life cycle assessment), which take into consideration costs and benefits associated with projects and measures over the life of the project ought to be used when determining the comparative viability of projects and measures to reduce carbon emissions. In addition to operational cost savings arising out of energy expenditures, examples of life cycle costs and benefits include such factors as energy price escalation, equipment life and replacement cycles, frequency and costs of replacement supplies (filters, belts, bearings, etc.), and other considerations such as repair, operations and maintenance related costs and benefits. Other considerations with LCCA methods include the "time value of money," which generally results from two considerations – inflation, which is the diminution of future purchasing power, and opportunity cost, which is the cost of foregone investment opportunities or the cost of borrowed capital.

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[2] For more on the links between daylighting and human performance refer to *Daylighting in Schools: An Investigation into the Relationship Between Daylighting and Human Performance* (1999), Heschong Mahone Group, and *Analysis of the Performance of Students in Daylit Schools* (1996), Innovative Design. Both of these studies are available online at http://www.usgbc.org/DisplayPage.aspx?CMSPageID=77

Furthermore, consider and count all costs and benefits of a project to reduce carbon emissions, including upstream and downstream impacts on other systems and sub-systems. For instance, the true costs of such load-reduction measures as high-performance windows and high-efficiency lighting systems ought to be subsidized, in effect, by the reduced need for capacity in upstream systems such as cooling, electrical capacity and in some cases, on-site generation and even carbon offsets. Similarly, recognize the true costs of measures that do not create synergistic benefits and those that result in increased costs for other systems upstream or downstream.

Appendices C, D, and E contain tools that will help with your economic analysis.

Assess projects as packages, not as individual projects

To accurately count all costs and benefits and to avoid counting costs or benefits more than once, assess projects as packages instead of considering individual measures in isolation. For example, projects that "tunnel through the cost barrier" are often combinations of energy-efficiency measures, implemented in the right order to get an optimal mix of efficiency ingredients, which then results in downsizing, or in some cases, eliminating the need for expensive mechanical systems. In contrast, assessing one energy efficiency measure at a time often eliminates opportunities for financial synergy. For more on "tunneling through the cost barrier", see Appendix B.

Identify projects with attractive return on investment

Many projects to reduce carbon emissions from campus operations are expensive. Some people will insist that they are too costly for an institution whose mission is education, not energy. But, when analyzing such projects, consider also two additional factors that address their business value: Return on investment and tunneling through the cost barrier.

Return on investment (ROI): Although climate projects can be expensive, many offer significant return on investment. The term "investment" is offered here not as a metaphor (like "invest in the future"). Rather it is meant literally; energy efficiency projects save substantial amounts of money - enough savings that, purely as investments, their ROI competes well against many endowment investments. In fact, the investment performance of many climate projects is often strong enough that accompanying reductions in carbon emissions might be regarded as a bonus or positive side effect. For more on this topic, see section 2.21.

Tunneling through the cost barrier: Many people assume that a more energy-efficient building will be more expensive than a conventional one. It stands to reason: add more gadgets and the price goes up. But this is one of the many instances where integrative design offers happily counterintuitive solutions through whole-system thinking. This idea too is further elucidated in the discussion of barrier 2.21 and examined more completely in Appendix B.

Surprisingly, big savings can be easier and cheaper to achieve than small ones if the right combination of ingredients is combined in the right way, if an organization is structured to support this process, and if leadership does not allow its mental models to get in the way of attractive solutions. More information on mental models can be found in Appendix B.

Transform your campus community

The solutions described throughout this book have been developed with the whole-system in mind, for example, interrelationships between building-energy use and the sizing of heating and cooling systems. Your work will include adapting these solutions to your campus's particular system. But that system is not just hardware, it's also people — a wide array of individuals, each with their own set of aspirations, interests and assumptions.

For long-term success of your climate program, develop a campus-learning strategy that includes not only technical phenomena, but also organizational issues, which include the personalities. We offer this recommendation fully aware that, though some of these people will be a real pleasure to work with, others may be quite difficult.

Develop a circle of people who participate directly in your campus's climate work, people who will confer and carry out concrete tasks. Begin with those who have expressed their personal aspirations regarding climate, people who are unambiguously committed. As your work proceeds, expand the circle to include, not only people with whom you agree, but also influential stakeholders who may have concerns about how you approach solutions. Differing ideas may better inform and shape your program; their support may be valuable in sustaining it.

Take the time to develop mutual understanding of each collaborator's aspirations related to energy and climate. This may take place informally over coffee or in a task force meeting where you explore each participant's aspirations related to energy and climate. Using both contexts will create the strongest rapport. The group's conversations about personal aspirations will help bind the group when, later, differences of opinion inevitably arise.

Achieving integrative results from whole-system thinking is not straightforward. You can't expect to do it on your own, even if you are a genius. You need others with different skills, experiences and points of view. Taking advantage of their ideas through collaboration offers at least two critical benefits: inclusion of all parts of the system in the conversation and participants' support of the results of that conversation.

Collaboration is essential to whole-system thinking and to the success of your climate initiative. As Peter Senge suggests, it's the way that you get the whole system in the room. Effective collaboration requires patience, which is especially difficult with the limited time available to all participants and the urgency of the climate crisis. But with it, your efforts will reap more powerful outcomes. For a quick look at effective collaboration, see Appendix H. One excellent approach to moving organizations toward climate solutions is detailed in Senge's *The Necessary Revolution*. It explores ways to elicit collaborators' aspirations, develop collaborative conversations, affect change, and use systems thinking.

Building on the work of others

This book builds on the work of important organizations and authors who have spent years creating ideas, information and networks through which campuses learn from each other, push each other to do better, and collaborate on projects and creative solutions. Everyone working on campus climate initiatives should become familiar with these organizations and networks, and their resources. The importance of exploring their websites can hardly be overstated.

The Association for the Advancement of Sustainability in Higher Education (AASHE), Second Nature, and the National Wildlife Federation's Campus Ecology Program (NWF-CEP) have been driving forces in the establishment of a rich web of collaboration, shared ideas and learning among campuses. The American College & University Presidents' Climate Commitment (ACUPCC), for example, is supported by both Second Nature and AASHE. AASHE's Sustainability Tracking, Assessment & Rating System (STARS) – the first standardized, comprehensive assessment instrument for campus sustainability – resulted from a highly participative development process involving hundreds of reviewers and dozens of organizations.

Clean Air-Cool Planet (CA-CP) advises and supports many schools through the process of completing a greenhouse gas inventory.
The National Association of College and University Business Officers' (NACUBO's) latest publication, Financing Sustainability on Campus, provides an overview of the tools, resources, and public policies that colleges and universities need to markedly reduce, or neutralize, their carbon emissions.

The Sierra Student Coalition mentors student leaders and provides them with organizing and leadership development tools. Energy Action Coalition's Campus Climate Challenge, RecycleMania, and the Responsible Endowments Coalition, are all examples of student-led, collaborative approaches to furthering specific campus sustainability efforts.

RMI's research on campus climate initiatives also builds on the excellent work offered in recent publications by practicing sustainability coordinators and non-profit organizations. Appendix K includes extensive information, excerpts, and RMI notes from these excellent books.

Resources

Organizations:

American College & University Presidents' Climate Commitment
www.presidentsclimatecommitment.org

Association for the Advancement of Sustainability in Higher Education
www.aashe.org

Campus Compact
www.compact.org

Clean Air-Cool Planet
www.cleanair-coolplanet.org

Energy Action Coalition's Campus Climate Challenge
www.climatechallenge.org

National Association of College and University Business Officers
www.nacubo.org

National Wildlife Federation's Campus Ecology Program
www.nwf.org/CampusEcology

Recyclemania
www.recyclemania.org

Responsible Endowments Coalition
www.endowmentethics.org

Second Nature
www.secondnature.org

Sierra Student Coalition
ssc.sierraclub.org

Publications:

ìClimate Change 2007: Synthesis Report,î Intergovernmental Panel of Climate Change, www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf

Education for Climate Neutrality and Sustainability: Guidance for ACUPCC Institutions www.presidentsclimatecommitment.org/html/solutions_academics.php

ìProfitable solutions for oil, climate, and proliferationî Amory Lovins, www.rmi.org/images/PDFs/Climate/C07-08_ProfitableSolutions.pdf

Sustainability Tracking, Assessment and Rating System (by AASHE) www.aashe.org/stars/index.php

ìWhat can we do to fix the climate problem?î
Amory B. Lovins, 2006, www.rmi.org/images/other/Climate/C06-10_FixTheClimateProb.pdf

CHAPTER ONE: CLIMATE ACTION PLANNING

In our visits to twelve college and university campuses and in telephone interviews with other campus-climate practitioners, we heard many barriers to efforts to plan for climate action on campus. They are enumerated in this chapter — each followed by a discussion of solutions and, in many cases, examples and resources. Each barrier is stated in the book as it is perceived on campuses. Whether or not these perceptions are well founded is addressed in the text that follows each.

Each barrier is either (a) an issue that addresses the process of convening campus stakeholders to assess and recommend a portfolio of strategies to reach greenhouse gas reduction goals or (b), an overarching issue that cuts across topics addressed in the other four chapters of the book.

Perceived Barriers

1.1 There is insufficient capital for the climate action planning process

While implementation of a climate action plan can often require substantial upfront capital, development of the plan should not. If the plan is being developed in-house, the primary cost will be staff time, which may not require new expenditures. Although a sustainability officer could play a major role — for example coordinating the planning process — if your campus has no such position, you can still develop a plan. Involving students, who can help develop the plan as part of a course, as work-study positions, or as an independent study, can minimize staff time. The work could be shared across multiple courses. For guidance on ensuring that faculty and staff are able to allocate paid time toward climate planning, see section 1.7.

If you don't have staff or student capacity to produce a climate action plan, you will need to raise money to hire someone to lead the climate planning effort. Some institutions have found grants from private foundations to support campus climate work. Some government agencies, particularly state energy agencies, may also be able to offer financial support for your climate planning.

In the end, you may still need to seek internal funding. If you do so, remind relevant officials that such funding is necessary to achieve the commitment the institution has made. Strengthen your case by presenting data showing long-term cost savings from emissions mitigation. Also, describe all of the non-financial benefits, which are detailed in section 1.3. For additional guidance on building support from top administrators, see section 1.10.

Examples

University of Kansas, Lawrence, Kansas
While interest in and concern over climate change is high among students, faculty and staff at KU, the school has so far elected not to participate in such climate action commitments as the ACUPCC. Therefore, the opportunity to develop a climate action plan through a course-based approach in Spring 2009 became a practical way to provide both guidance for the University and a service learning-based educational experience for students.

The class included seven urban planning master's students taking a capstone course in environmental planning implementation and five Ph.D. students from a variety of academic disciplines who are trainees in an NSF-IGERT program at KU entitled C-CHANGE (Climate Change, Humans and Nature in the Global Environment). Three faculty members from Environmental Studies, Geography, and Urban Planning co-taught the course, bringing interdisciplinary expertise to bear on climate and energy issues. Students analyzed the climate action efforts of other campuses to glean lessons and best practices, conducted a greenhouse gas inventory for KU's main campus, and developed a final plan that they dubbed "CAP KU: Climate Action Plan for the University of Kansas." They presented their work at the end of the semester to an audience that included KU's provost, two vice provosts, a college dean, and a number of other interested individuals from across campus.

A number of challenges and opportunities are apparent from this course-based approach to climate action planning. One was gathering the necessary data to complete the GHG inventory. Without a mandate or other clear directive coming from the administration, some campus units were unable or unwilling to provide the required information. In addition, the confines of a 15-week course limited both this effort and the level of detail possible in the final plan.

The opportunities that this course presented, however, seem to outweigh the challenges. In general, students greatly enjoy the chance to work with a real "client" and to use real-world data in developing a plan such as CAP KU. More specifically, in the face of the university's reluctance to make a public climate action commitment, this approach offered four important benefits. It:

- Facilitated a deeper understanding of KU's climate impacts;
- Highlighted both positive efforts to reduce greenhouse gas emissions on campus and areas in greatest need of attention
- Offered short and long-range action steps, some of which may provide cost-savings for the university with a fairly short payback period
- Created a foundation from which future action can emerge.

While the CAP KU Plan has yet to be officially adopted by the administration, it has drawn considerable campus attention to issues that were previously and largely overlooked. The KU Center for Sustainability plans to build on this interest by refining CAP KU, gathering further input from the campus community, and seeking administrative support for implementation of a more comprehensive climate action plan.

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<u>Calvin College, Grand Rapids, Michigan</u>

For institutions of higher learning to seriously engage the challenges posed by climate change, a necessary first step is an assessment of carbon emissions and sequestration capacity. However, in these challenging economic times, most colleges and universities have little or no financial resources to commit to such an assessment. At Calvin College, we faced this predicament by addressing our campus carbon budget as a primary objective in a semester-long project of two combined classes, Engineering 333 (Design of Thermal Systems) and Biology 354 (Investigations in Plant Ecology).

To this interdisciplinary group of students, we posed the question, "What would it take to make our campus carbon neutral?" We sensitized the students to this topic with assigned readings, traditional classroom lectures and group discussions. We also implemented a carbon emissions trading simulation in which students and professors from both classes were allocated carbon credits for personal carbon-emitting behaviors. These credits were bought and sold in a simulated market.

In direct response to the campus carbon neutrality question, students worked in groups throughout the semester to generate an integrated carbon budget for our campus, complete with plans for how to balance the budget so that our campus could eventually become carbon neutral. The students' semester-long work, a detailed final report entitled "the Calvin College Carbon Neutrality Project" was presented in a public seminar with several administration and city officials in attendance.

This initiative benefited considerably from the involvement of the vice president for administration, finance, and information technology, who acted as the government in the carbon emissions trading simulation and as the customer for the Calvin College Carbon Neutrality project. His presence infused an element of authenticity to our efforts and heightened student motivation.

We realized numerous pedagogical, social, and institutional benefits from this classroom-based initiative. The experience reinforced our belief that interdisciplinary, service-learning experiences provide invaluable tools for preparing today's students to meaningfully address the significant environmental challenges that lie ahead. In addition, the students became actively involved in producing the first ever campus carbon budget, an effort that has established a legitimate and essential basis for the task of moving our campus operations in the direction of energy sustainability and carbon neutrality.

For a detailed account of this classroom activity, see Heun, M. K., D. Warners, and H. E. DeVries II. "Campus Carbon Neutrality as an Interdisciplinary Pedagogical Tool," Perspectives on Science and the Christian Faith. Vol. 61, No. 2, p. 85, June 2009.For classroom materials, presentations, and reports, see: http://www.calvin.edu/~mkh2/cccn/

By Dr. Matthew Kuperus Heun, Engineering Department
Dr. David Warners, Biology Department
Dr. Henry DeVries, VP for Administration, Finance, and Information Technology, Calvin College

Resources

AASHE's Climate Action Planning Wiki, "Staffing and Resources Issues," http://www.aashe.org/wiki/climate-planning-guide/institutional-structures.php#StaffingandResourcesIssues
provides some tips for adding staff and providing new resources to support climate planning.

Marcus Renner, the Environmental Center Coordinator at Fort Lewis College, described how he put together the College's climate action plan http://www.aashe.org/blog/piecing-together-cap-puzzle with a team of work-study students in an AASHE blog post.

A poster presentation from the AASHE 2008 conference entitled "Using a Class to Conduct a Carbon Inventory: A Case Study with Practical Results at Macalester College" http://www2.aashe.org/conf2008/abstracts.php#579
describes the experience of working with a class to develop a GHG inventory.

1.2 Campus leaders are unsure of what energy initiatives to consider and how to evaluate their options.

Campus leader are often overwhelmed by the abundant information available about campus emissions-mitigation strategies. The particular portfolio of energy initiatives that an institution chooses will depend on specific campus characteristics, circumstances, and culture. However, though there is no standard mix of clean energy solutions that works for every campus, one generalization holds true virtually everywhere: Energy-efficiency improvements are more cost effective than renewable energy sources. Said differently, reducing demand on the energy system is less expensive than adding more supply.

To develop your portfolio, brainstorm potential energy options with your climate action planning team. Include in that conversation campus facilities staff who may already have a list of ideas. Also, consult Chapter 5: "Greenhouse Gas Mitigation Strategies" of AASHE's Climate Action Planning Wiki and browse climate action plans from other institutions

Fully evaluating an emissions mitigation strategy can be a lot of work. Therefore, you may want set aside ideas that, after a little research, seem both unlikely to be economical in the near term and unlikely to result in significant emissions cuts. Later, each time you reevaluate your CAP, take another look at these projects and see if the situation has changed significantly since your previous assessment.

After you have a list of projects that pass your initial test, there are a several common cash-flow analysis tools you can use to evaluate prospective projects:

- Savings to investment ratio (SIR)
- Net present value (NPV)
- Internal rate of return (IRR)
- Life-cycle cost analysis (LCCA)
- Simple payback period (not recommended because it is insufficient)
- Discounted payback period (not recommended for isolated use because it fails to account for all of the savings that can result from a project)

Because all of these financial analysis tools are commonly used in assessing facilities projects, they are discussed in detail in that context in Chapter 2. For a discussion of the benefits of life-cycle cost analysis, refer to Section 2.3 and 2.4. NPV can be used to determine the cost per ton of carbon dioxide reduced, which is another helpful metric for evaluating project ideas. The Solutions Module in Version 6 of Clean Air Cool Planet's Campus Carbon Calculator can help with generating graphs of NPV vs. metric tons of carbon dioxide reduced (see link under "Resources" below). For a closer look at this type of graph and how it can be useful, refer to point 6.3 on carbon reduction efficacy in AASHE's Climate Action Planning Wiki (http://www.aashe.org/wiki/climate-planning-guide/project-evaluation.php).

Students talk climate at Richland College, Dallas, Texas.

Be sure to focus your attention primarily on your institution's major emissions sources, not just the energy issues that are most obvious. For example, if your campus fleet generates only a small fraction of your total emissions, it may not be worth spending time and resources to reduce these emissions in the first phase of climate action plan implementation.

That said, there may be another compelling reason to shift your campus fleet to electric, hybrid, or plug-in hybrid vehicles[3]: visibility. Cost-per-ton-of-carbon-dioxide-reduced may not be your only criteria for selecting energy initiatives. Another might be the degree to which a prospective energy initiative inspires longer-term commitment to reduction in the use of fossil fuels.

Although efficiency improvements are cost effective, when they are complete, they are virtually invisible, except on the bottom line. In contrast, an electric vehicle, wind turbine, or a solar-electric array for example, though less cost effective, will be obviously visible to most if not all campus constituents. The presence of a clear example of clean energy often helps change attitudes on campus.

For example, one campus that we visited had installed a wind turbine in a particularly prominent campus location. The turbine attracted so much attention that it became a symbol of the school. Accordingly, students, staff, faculty, and the community began to think of the campus as green. Then campus leadership reasoned that, if their campus was getting green, they should retrofit buildings with energy-efficiency measures. Therefore, it is not unreasonable to suggest that investment in the turbine was effective, not in isolation, but because it inspired a cost-effective retrofit program.

Visibility is one of several qualitative criteria that might be used to determine your campus energy strategy in addition to such quantitative measures as cost-per-ton-of-carbon-

[3] For more information on how to prepare your region for plug-in hybrid electric vehicles, visit http://projectgetready.com.

dioxide-reduced. After you've brainstormed energy-initiative ideas for a while, stop and identify the range of criteria that you will use on your particular campus. Along with the project co-benefits described in section 1.3, your criteria could include, for example:

- Risk inherent in undertaking the project
- Risk avoided by implementation of the project
- Relationship to other potential projects and opportunities for synergy
- Interaction with state or regional GHG mitigation efforts
- Potential to scale upward; transferability
- Organizational capacity to undertake and manage the project
- Alignment with campus capital development plan, strategic and other plans
- Stakeholder support and enthusiasm
- Availability of funding opportunities to support project implementation

After you've identified your criteria, return to your brainstorming. Once you have a list of options to consider, evaluate them against your criteria.

Examples

AASHE maintains a list of completed campus climate action plans http://www.aashe.org/resources/climate_action_plans.php
that are useful for understanding what emissions mitigation strategies other schools have considered and how they were evaluated.

Carbon Neutrality at Middlebury College: A Compilation of Potential Objectives and Strategies to Minimize Campus Climate Impact http://community.middlebury.edu/~cneutral/es010_report.pdf is an early campus effort to evaluate a large number of emissions mitigation measures using a standard format that incorporated uncertainty and co-benefits as well as financial indicators.

Resources

Chapter 5 of AASHE's Climate Action Planning Wiki, "Greenhouse Gas Mitigation Strategies," http://www.aashe.org/wiki/climate-planning-guide/mitigation-strategies.php
lists many possible emission mitigation projects. Also, Chapter 6, "Project Evaluation and Ranking," http://www.aashe.org/wiki/climate-planning-guide/project-evaluation.php discusses techniques for prioritizing these projects.

Section 2.1 of the Department of Energy's Greening Federal Facilities- An Energy, Environmental and Economic Resource Guide for Federal Facility Managers, "Decision Methods" http://www.wbdg.org/ccb/browse_org.php?o=36
explains a simple method for constructing a decision matrix that incorporates specific criteria according to your institution's values and weights each criterion appropriately. For an example of how this method might be useful to campus climate planners, see the Appendix D.

Chapter 3 of ENERGY STAR's Building Upgrade Manual, "Investment Analysis" http://www.energystar.gov/index.cfm?c=business.EPA_BUM_CH3_InvestAnalysis
explains several simple cash-flow analysis tools and their limitations.

Chapter 3 of the U.S. Navy's Economic Analysis Handbook (NAVFAC P- 442 Economic Analysis Handbook), "Basic Economic Analysis Techniques" http://www.wbdg.org/ccb/browse_cat.php?o=30&c=91
gives a clear, detailed explanation of several advanced cash-flow analysis techniques and the logic behind how the U.S. Department of Defense evaluates alternatives for managing facilities.

Chapter 5 of the U.S. Navy's Economic Analysis Handbook (NAVFAC P-442 Economic Analysis Handbook), "Benefit Analysis" http://www.wbdg.org/ccb/browse_cat.php?o=30&c=91 explains techniques for incorporating four types of additional benefits into your evaluation: direct cost savings, efficiency/productivity increases, other quantifiable output measures, and non-quantifiable output measures.

The Clean Air Cool Planet calculator http://www.cleanair-coolplanet.org/toolkit/inv-calculator.php
can create helpful charts showing the cost per ton of carbon dioxide reduced for each project under consideration.

1.3 Valuing climate project co-benefits so that they can be included in campus assessment of prospective climate projects.

Appropriately valuing co-benefits of prospective climate projects can be useful in prioritizing prospective climate projects and communicating the full range of benefits of those projects. Unfortunately, the value of various co-benefits can be subjective and there are no well established methods for establishing value of these factors. On the plus side however, this means that your institution can develop an approach that fits your particular circumstances. Co-benefits of your prospective climate projects may include:

- **New education and research opportunities:** Most strategies for reducing greenhouse gas (GHG) emissions provide excellent opportunities for education and research. For example, solar-electric panels on campus could be incorporated into a wide variety of courses such as physics, engineering, economics, psychology, architecture, and environmental studies. Also, each climate project could serve as the subject of research projects. Some institutions have even created new academic programs in connection with on-campus renewable energy applications.
- **Greater interest from prospective students:** Recent surveys by the Princeton Review indicate that two thirds of prospective students are interested in information on a college's commitment to the environment. About a quarter of the respondents said this information would "strongly" or "very much" contribute to their assessment

of a school. As a result, many major college guides are beginning to include information about their institution's sustainability performance. For more information, see "How do campus sustainability initiatives affect college admissions?" http://www.aashe.org/blog/how-do-campus-sustainability-initiatives-affect-college-admissions

- **Increased support from funders and donors:** Because many individual donors and foundations are passionate about sustainability, institutions with strong sustainability programs may have better luck raising funds. In just one example, the Kresge Foundation, a major funder of capital projects in higher education, recently announced that its consideration of proposals for building projects would include only those that meet or exceed LEED Silver standards. With the 2008 passage of legislation authorizing the creation of a "University Sustainability Grants Program" at the Department of Education, increased support will likely be coming from the federal government as well.
- **Improved employee recruitment and retention:** There is increasing evidence that, like students and funders, current and potential employees also value leadership on climate and sustainability issues. For example, a 2007 survey http://www.enn.com/top_stories/article/26396 found that a majority of Americans prefer to work for a company that has a good reputation for environmental responsibility.
- **Enhanced community relations:** A strong sustainability program can improve an institution's reputation in the surrounding community and may also provide opportunities for new partnerships with local government and businesses. Some institutions have found that committing to strong sustainability standards for new developments is necessary to gain community support for campus expansion.
- **Reduced exposure to price volatility in energy markets:** Volatility in energy markets has made appropriately budgeting for energy costs very difficult. Reductions in energy consumption and increases in on-campus generation of renewable energy both serve to reduce risk associated with price volatility. This is particularly important in light of likely increases in energy prices.
- **Better preparation for carbon regulation:** Actions taken now to reduce emissions will reduce the costs associated with compliance with legislation that places a price on carbon emissions.

Additionally, there are a variety of benefits that accrue to the general public rather than to the institution alone, for example, reduced local and regional air pollution, reduced habitat destruction and water pollution from fossil fuel extraction, and of course, reduced contribution to global warming.

It is very difficult to quantify these benefits in financial terms, so they are typically ignored in conventional financial analyses. In contrast, the costs of emissions mitigation activities are often much easier to quantify. This means that net benefit of emissions mitigation projects tends to be underestimated, resulting in an under-investment in such projects.
One way to address this issue is to attempt to place a dollar value on each of benefits and directly incorporate this into financial analysis. This is hard to do with any measure of certainty, but if you estimate the benefits conservatively and are transparent about your assumptions, you should be able make a compelling case that incorporating some estimate of the value of co-benefits is more accurate than omitting them altogether.

If you aren't comfortable assigning dollar values to these benefits, you could still quantify the co-benefits of emissions mitigation projects relative to one another by rating each project from one to ten, based on your criteria, perhaps using the categories of co-benefits listed above as a guide. If you average the scores assigned by individually by several knowledgeable people, the result should be a reasonable comparison of prospective projects. If some benefits are especially important to your institution, you might even weight the various benefits according to agreed upon institutional priorities and enter them into a decision matrix. (See resources below.)

Examples

Yale University
http://www.yale.edu/sustainability/climate.
Students enrolled in a graduate-level course at the School of Forestry & Environmental Studies completed one of the nation's first college greenhouse gas inventories. Then an energy task Force was convened in 2004, with representation from staff, faculty and students, to develop recommendations for a comprehensive university energy policy. From these early iterations, engineers in the facilities department, working with the Office of Sustainability, have continuously improved upon the monitoring of campus greenhouse gas emissions. In the fall of 2005, Yale announced a commitment to reduce its carbon footprint from stationary power sources: 10% below 1990 levels by 2020, a 43% reduction from 2005 levels.

When reviewing prospective building projects, trustees consider both return on investment and the cost of each ton of carbon dioxide that will be saved. As part of its carbon-focused evaluation process, the school has invested heavily in converting one of its on-campus power plants to cogeneration. Analysis indicated that converting the Sterling Power Plant would produce 13% of the reductions needed to meet Yale's 2020 climate commitment. The expensive conversion is a more cost-effective way to reduce greenhouse gas emissions than several smaller projects with lower up-front costs.
http://www.yaledailynews.com/news/university-news/2007/02/01/univ-announces-new-power-plant/

Princeton University
Princeton's goal is to reduce campus greenhouse gas emissions to 1990 levels by 2020. Like Yale, Princeton's carbon reduction strategy focuses mainly on its central cogeneration plant and energy-efficient building retrofits. When planners at Princeton conduct financial cost-benefit analyses on potential energy efficient designs and technologies, they include an internal voluntary carbon dioxide "tax" based on the average market value of a ton of carbon ($30-$40 per projected ton of equivalent carbon dioxide emissions in 2008-2009). This practice monetizes the environmental impact of each project

option and indicates on the balance sheet more savings for projects with high carbon-reduction potential.

Princeton is leading the exploration for effective climate action planning by publicly sharing information about this innovative financial-analysis method. The school will be prepared when a U.S. carbon market is instituted.

Resources

Section 5.1.8 of AASHE's Climate Action Planning Wiki, "Evaluating Energy Conservation Projects," http://www.aashe.org/wiki/climate-planning-guide/conservation-and-efficiency.php#EvaluatingEnergyConservationProjects
discusses factoring the avoided cost of unneeded RECs and offsets into project evaluation.

Section 2.1 of the Department of Energy's Greening Federal Facilities- An Energy, Environmental and Economic Resource Guide for Federal Facility Managers, "Decision Methods"
http://www.wbdg.org/ccb/browse_org.php?o=36
explains a simple method for constructing a decision matrix that incorporates specific criteria according to your institution's values and weights each criterion appropriately. For an example of how this method might be useful to campus climate planners, see the Appendix D.

Carbon Neutrality at Middlebury College: A Compilation of Potential Objectives and Strategies to Minimize Campus Climate Impact is an early campus effort to evaluate a large number of emissions mitigation measures using a standard format that incorporated uncertainty and co-benefits as well as financial indicators. http://community.middlebury.edu/~cneutral/es010_report.pdf

World Resources Institute offers a relatively simple Excel spreadsheet tool http://www.wri.org/publication/carbon-value-analysis-tool to help organizations incorporate the value of carbon emissions into energy-related investment decisions. Download the Carbon Value Analysis Tool (CVAT) and read more about it at

Research

A research project on the diversity and effectiveness of methods that schools are using to incorporate co-benefits into evaluation of climate projects has not been undertaken. At this stage in the national campus climate commitment process, it is still too early to accurately compile this type of research. Once a large number of schools have released and begun to implement their ACUPCC climate action plans, a project that surveys the methods used to assess co-benefits and subsequent satisfaction, monitoring and evaluation of the co-benefits may be worthwhile.

1.4 The sustainability director is overburdened with activities other than reducing campus emissions.

This barrier may be partially overcome by integrating these types of tasks. For example, develop curricula that also help generate emissions mitigation projects. Or, partner with professors in economics, engineering, and business on a class projects the evaluate emissions mitigation options. Since tackling climate change is such a big task, many other activities the sustainability staff may be pulled into can fit under the climate umbrella.

Of course, there are limits to this strategy. There are only so many hours in the week, and you may not be able to reorient many tasks to also support climate activities. If this is the case, then spread the word to others on campus. Perhaps the facilities manager or a faculty member could shoulder some of the work. In some cases, sustainability "coordinators'" responsibilities are framed literally; that is, they coordinate the work of others, rather than doing it themselves. Ultimately, in order to ensure that you have sufficient time for climate planning, you will need to prioritize your tasks or insist that your supervisors rank their relative importance.

If you can't free up enough time, advocate for hiring additional staff or a consultant to assist climate planning. Securing the funding to do so may be difficult; but it may be the only option if the institution cannot achieve its sustainability goals without adding capacity.

Resources

Education for Climate Neutrality and Sustainability: Guidance for ACUPCC Institutions http://www.presidentsclimatecommitment.org/html/solutions_academics.php provides guidance on the educational aspects of the ACUPCC and includes a variety of examples of academic courses that focus on reducing campus emissions.

Educational Facilities Professional's Practical Guide to Reducing the Campus Carbon Footprint (Sustainability Guide) https://www.appa.org//Bookstore/product_browse.cfm?itemnumber=519 from APPA provides a practical guide targeted at facilities professionals to assist them in working with campus stakeholders to plan and execute actions that move this institution toward its climate protection goals.

1.5 Trustees or regents regard a campus climate commitment as expensive, unrealistic, or detrimental to the institution's mission.

Building support among trustees will be more difficult without the support of the president. S/he can influence board members personally, help set the agenda for board meetings, and distribute information to trustees. Also, s/he may be able to identify potential allies on the board and strategize about how to get your proposal approved. For guidance on building support from the president and other top administrators, see section 1.10.

Working with the president or supportive board members, identify a champion for the climate message, someone credible or influential with board members; better, someone whose support for climate protection may be surprising or out of character. Then, work with the champion and other campus and board leadership allies to develop the climate message the will resonate most effectively with members of your board (see section 1.3 for some of the most common points). If, for example, your board is comprised primarily of local business people, then local job creation or economic development may be persuasive.

Certain campuses are executing excellent, long-term programs to reduce the use of fossil fuels motivated exclusively by cost savings; they don't mention climate. That said, cost cutting alone does not instill the sense of urgency that is required to respond adequately to the climate crisis. If your champion can influence your board to also understand the implications of climate change, they may also develop a sense of urgency that will push climate projects to head of the line when budget time comes around.

In the course of our research, we heard enlightening stories from college presidents who are both climate advocates and masters at the art of board chemistry. (For the purposes of this story, they shall remain nameless.) Each pursued a subtle, long-term and effective strategy of moving board policy inexorably toward climate protection, without overtly attempting to convince the board that climate crisis is real and anthropogenic.

At every stage of the strategy, including the first, any new project or policy is framed in the context of progress that has been achieved — not as the start, but as the next step. The success of each initiative is documented and celebrated.

Each strategy began with a relatively modest project, for example, an energy-efficient building retrofit, justified to the board by a broad interpretation of existing mission and policies related to, say, ethics, frugality, or a natural maturation of an innovative campus. Later, after reframing the results of those retrofits as, not only cost saving, but also carbon reducing, the president then elicits, from some external source, acknowledgement of campus progress in mitigating climate change.

As the accolades arrive, the president rhetorically steps aside and gives the board all the credit for farsighted, globally beneficial policies. The board experiences the pleasant satisfaction of being climate heroes. Later, it supports increasingly substantial efforts to protect the climate.

Examples

<u>Middlebury College, Middlebury, Vermont</u>
Getting to neutrality as a whole community
On the face of it, Middlebury College's recent commitment to achieve carbon neutrality by 2016 looked somewhat easy. It happened in the span of six months with strong support from throughout the campus. Underneath it however, was a

Climate Crisis Conversations

Persuading someone that the climate crisis is both real and caused by humans can be challenging. But the most important aspect of the message is the messenger. To be heard, one must be credible, dispassionate, and respectful. In contrast, zealous self-righteousness will not persuade skeptics.

One effective line of reasoning describes local climate-change impacts as they are being, or will be, experienced by the audience. For example, visual depictions of the inundation caused by certain increments of sea-level rise have proved convincing to incredulous leadership in low-lying coastal communities. In many areas, the effect of climate change on water supplies is credible.

Another efficacious approach to is to refer to expert judgment. The Intergovernmental Panel on Climate Change says: "Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global mean sea level." Also: "Most of the observed increase in globally averaged temperatures since the mid-20th century is very likely [>90% probability] due to the observed increase in anthropogenic [human-caused] greenhouse gas concentrations." Many people find IPCC statements convincing when first they understand two things: One, they are crafted by disinterested scientists, not environmental advocates. Two, scientists' livelihoods depend on their public statements being cautious and conservative. Those who make rash claims have short careers.

When speaking with trustees and other campus leaders, add credibility to your climate message by letting them know that the Association of Governing Boards of Universities and Colleges is a sponsor of the American College & University Presidents' Climate Commitment. Also, you could cite particular presidents who have signed the commitment. Further, you could name mayors who have signed the US Conference of Mayors Climate Protection Agreement. (Nearly 1000 had signed by August 2009.) And students can be effective advocates; you may wish to incorporate their voices into your message. Finally, refer to the many innovative climate change initiatives being undertaken by businesses of all sizes.

constructive "round robin" effort among trustees, students, administrators, and faculty.

It began when the trustees agreed in October 2006 to finance and build a $12 million biomass gasification system that would cut by half the college's annual use of 2 million gallons of fuel oil. That action effectively satisfied Middlebury's 2003 commitment to reduce its greenhouse gas emissions to 8% below its 1990 levels by 2012.

This inspired a group of students actively engaged in a wide range of sustainability initiatives to propose to the trustees at their December 2006 meeting a new goal - carbon neutrality by 2016. The trustees responded with support for the concept and asked the students to provide evidence that it was possible to achieve such a goal.

The students organized an advisory team of staff from facilities, environmental affairs, the treasurer's office, and other departments and a communications effort to spread the word. They quickly organized a winter-term course and solicited the agreement of the director of the environmental studies program to serve as faculty for the course. Building on the work of a 2003 winter-term course, they presented a report on how carbon neutrality could be achieved to the trustees in February 2007. The trustees responded positively to the report and asked the college vice president and treasurer to form a team to analyze the financial risks associated with the goal and to make recommendations at their May meeting.

A team of students, senior administrators, staff and faculty was formed to prepare the analysis. They also prepared a statement of support for a commitment to carbon neutrality by 2016, for which they obtained nearly 1,200 signatures from students, faculty members and departments, student organizations, and staff. These were collected into a spiral bound book that accompanied the final recommendations. This intense and fluid activity resulted in a unanimous resolution to achieve carbon neutrality by 2016 and Middlebury's signing the American College & University Presidents' Climate Commitment.

This effort succeeded for a number of reasons. First, it built upon earlier efforts to address climate change. Those earlier efforts deliberately involved students, faculty, staff administrators and trustees in learning about the issue of climate change and thoughtful inquiry about its significance and how the college should respond to it. Second, when such a bold goal was proposed the response was "show us how we could achieve it." That led to an extremely productive analysis of what the options were, where else they had been applied, what they cost, and what their payback periods would be. The process quantified the options and made it easier to judge what was possible and acceptable. Third, students accepted the responsibility to do the hard work necessary to show the goal was achievable. Also, they were smart to assemble a team of experts who could help and to find a way to receive course credit for their work. And finally, a significant effort was put into communicating and enlisting support throughout the campus, which engaged a lot of active supporters and helped create a strong sense of momentum and support. It also created a strong sense of efficacy, in which most people wanted the outcome to be "We did it!"
By Jack Byrne, Director, Sustainability Integration Office, Middlebury College

Resources

A Call for Climate Leadership: Progress and Opportunities in Addressing the Defining Challenge of our Time http://presidentsclimatecommitment.org/pdf/climate_leadership.pdf is a great summary of the case for higher education to lead efforts to address climate change. It shows how such efforts fit squarely into the educational, research, and public service missions of higher education.

Higher Education in a Warming World - The Business Case for Climate Leadership on Campus http://www.nwf.org/CampusEcology/BusinessCase/ by the National Wildlife Federation's Campus Ecology program makes the business case for tackling climate change on campus.

Chapter 3 of Boldly Sustainable: Hope and Opportunity in the Age of Climate Change http://www.boldlysustainable.com/01About.html by Peter Bardaglio and Andrea Putnam, "Gaining a Competitive Edge and Building Value" provides a well-researched overview of the business case for adopting and nurturing a visible campus sustainability strategy. This book is available for purchase from NACUBO and Amazon.

U.S. Environmental Protection Agency sea-level-rise maps. http://www.epa.gov/climatechange/effects/coastal/slrmaps.html

U.S. Conference of Mayors Climate Protection Center http://www.usmayors.org/climateprotection

1.6 The sustainability director is expected to produce a climate action plan with little support from others.

The expectation that a single person develop their institution's climate action plan goes against the advice of all the major guides to campus climate planning, all of which stress the importance of involving a wide array of stakeholders in plan development. For example, Nation Wildlife Federation's Guide to Climate Action Planning says "The climate planning process is invariably a team effort" and having broad representation in the process "can help ensure greater cooperation by nonmembers and increased likelihood of acceptance of the committee's recommendations." The report also notes that involving a variety of stakeholders "brings know-how and a range of valuable perspectives to the table." Similarly, ACUPCC stipulates that an institutional structure with staff, faculty, student, and administrator representatives should be created within two months of signing the commitment to guide development and implementation of the climate action plan.

The first step to overcoming this barrier is educating campus leaders who have this expectation. Provide them copies of the relevant sections of the Implementation Guide of the American College & University Presidents' Climate Commitment (ACUPCC) and other publications. Also, provide examples of committee-led planning processes from peer institutions. Descriptions of institutional structures related to climate initiatives at ACUPCC-signatory campuses are posted on the ACUPCC reporting system (http://acupcc.aashe.org/).

If the sustainability coordinator is unable to assemble a committee to share the climate-plan workload, then seek supportive faculty who can incorporate class projects related to the climate plan into their courses. Alternatively, find students who will produce a first draft of the plan under faculty supervision. Section 1.1 offers examples of climate action plans that were produced as class projects.

For guidance on ensuring that faculty and staff are able to allocate paid time toward climate planning, see section 1.7. In addition, sections 1.11, 1.12 and 1.13 include suggestions for ways to engage the campus community in climate planning.

Example:

Cornell University has created a page of frequently asked questions about their Climate Action Planning process that provides a good example of the participatory nature of a robust and useful climate plan. These questions may demonstrate to upper-level administrators the value of a committee approach.
http://www.sustainablecampus.cornell.edu/climateneutrality/frequentlyaskedquestions.cfm

Resources

Section 2.7 AASHE's Climate Action Planning Wiki, "Staffing and Resources Issues," provides some tips for making the case to add staff to support climate planning efforts.
http://www.aashe.org/wiki/climate-planning-guide/institutional-structures.php#StaffingandResourcesIssues

The Statistics and Data Views section of the ACUPCC Online Reporting System provides a synopsis of stakeholder-group representation on climate-action-planning committees at ACUPCC signatory schools. This may be useful in building the case and designing the structure for a participatory process at your institution.
http://acupcc.aashe.org/statistics-stakeholder.php

1.7 Faculty and staff are unsure if they can allocate paid time to climate action planning.

Like many barriers to climate initiatives, this one may be unintended. Overcoming it may be as simple as getting clarification from the relevant authorities and communicating the answer to interested parties. Assuming an official committee is developing the climate action plan or taskforce, time spent on this effort should be treated the same as service on any other institutional structure.

However, if participation in the climate action planning is not counted as service to the institution, you may need to appeal to your President or other authority to change the rules. An effective way to communicate this idea is to incorporate the climate commitment (or sustainability more generally) into job descriptions and/or annual performance reviews. While perhaps more difficult than simply changing the way climate work is counted, big changes like adding the commitment to job descriptions and performance reviews will likely drive a larger and more lasting impact. For guidance on building support from the President and other top officials, see section 1.10.

As a last resort, keep in mind that it is sometimes possible to incorporate planning into the work that certain people are already being paid to do. For example, a faculty member could choose to focus one or more of his or her courses on climate. As another example, an energy manager could incorporate avoided-greenhouse-gas-emissions and net-present-value-per–ton-of-avoided-emissions into the financial analyses required for energy projects.

Examples

Sustainability as part of staff job responsibilities

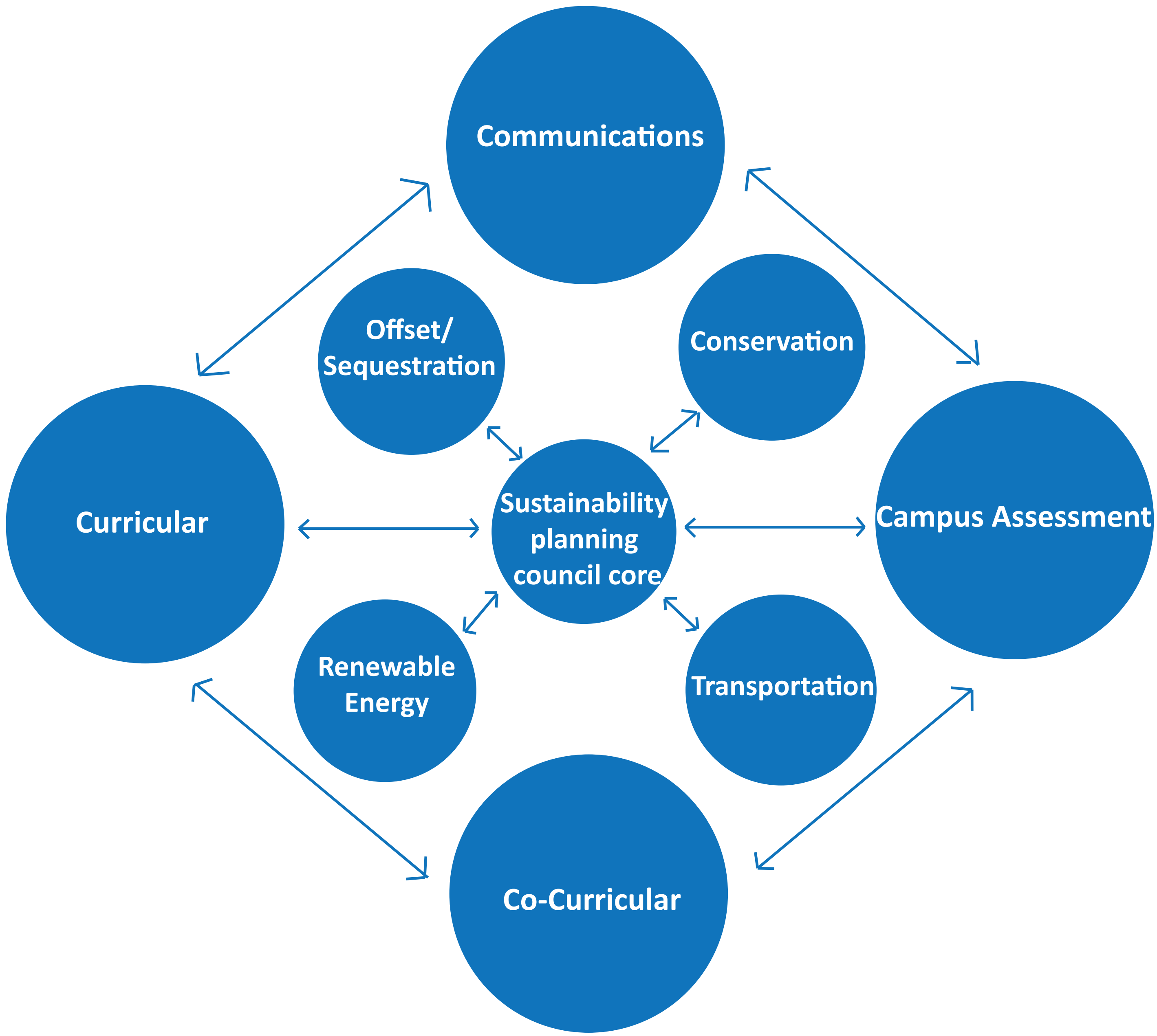
Unity College, Unity Maine
Consistent with a recommendation from its sustainability committee, the college decided in 2006 that each employee, including faculty, would be responsible for contributing to sustainability and that this responsibility would be added to their job description. Each major department is now required to produce a sustainability plan for its operations, including measureable objectives for reducing and managing natural resource use. Department heads must evaluate and report progress toward meeting their objectives. Although the practice of incorporating sustainability into job descriptions is controversial, Unity has set a precedent by institutionalizing annual sustainability plans and performance evaluation.

Research

Since the incorporation of sustainability into job descriptions and performance reviews is a relatively new phenomenon, little is known about the effectiveness of such efforts. Research is needed to better understand whether such changes have the desired impact, and what factors contribute to their success.

1.8 Green activities are less effective because they are uncoordinated and duplicative.

An inclusive climate action planning process can help overcome this barrier by convening representatives from across campus to collaborate on research and creation of a roadmap to climate neutrality. Another solution that has worked on many campuses is the creation of a "sustainability forum" open to any interested campus stakeholders, which meets regularly to share information and builds a campus network of collaborators. This approach can be stymied if the modera-



tor controls the meeting and dictates the agenda, which is not genuine collaboration. Therefore, the leadership and meeting facilitator must be genuinely welcoming and inclusive. Finally, the climate action planning process and sustainability forum can be supported by an online campus community with pages for each campus sustainability group, perhaps including blogs; and a central hub for announcements, comments, and questions.

Examples

Furman University
In order to coordinate involvement in the climate action planning process and sustainable initiatives, Furman University has created a unique organizational structure. The university's original committee for stakeholder engagement in sustainability planning consisted of 24 members who began meeting in 2005. When the group submitted its initial greenhouse gas inventory to ACUPCC, members realized that they needed to increase participation. In October 2008, the group expanded to become the Sustainability Planning Council (SPC), comprised of 124 faculty, staff and students. Each SPC committee includes students. The council is co-chaired by the provost, the director of Furman's David E. Shi Center for Sustainability, and a department chair, all of whom have administrative and faculty status. This structure facilitates communication and ensures that all campus sustainability efforts have a voice in the administration.

Working with the SPC and the Center for Sustainability in the spring of 2009, students created another coordinating body called Sustainable Connections, which promotes cooperation among all student-led sustainability initiatives. Sustainable Connections is an umbrella organization that maintains a web-based forum connecting fourteen existing student organizations.

Resources

Chapter 2 of AASHE's Climate Action Planning Wiki "Creating an Institutional Structure for your Climate Action Plan" contains useful information about how to convene a diverse climate planning committee. http://www.aashe.org/wiki/climate-planning-guide/institutional-structures.php

A recent article published in Sustainability: The Journal of Record titled "Research and Solutions: Institutionalizing Campus-Wide Sustainability: A Programmatic Approach" derives ten steps to institutionalizing and comprehensive sustainability program. These iterative steps were synthesized from the experience of three universities with relatively advanced, well-coordinated sustainability programs. The article was written by Shana Weber (the Director of the Office of Sustainability at Princeton University), Davis Bookhart (the Director of the Sustainability Initiative at Johns Hopkins University), and Julie Newman (the Director of the Office of Sustainability at Yale University. Source: http://www.liebertonline.com/doi/abs/10.1089/SUS.2009.9869

1.9 Our "low-hanging fruit" has been picked; future energy-efficiency projects will be expensive.

This can be a serious challenge at schools that have been working on energy efficiency for many years. It can be addressed short term in several ways described below, most of which focus on how one values and accounts for these efforts. However, in the long run this barrier will be overcome only when the fundamental nature of climate solutions is well understood by leadership and integrated into decision-making.

Many schools have not captured the savings that resulted from past energy-efficiency projects. One way to address this barrier is to develop a campus revolving loan fund that captures energy-efficiency savings and uses that money to finance future efficiency projects. Also, consider capturing some portion of the savings gained from earlier energy-efficiency projects, which are likely to be continuously saving significant amounts of money. Make the case that at least a portion of these savings should be reinvested in changes that will lead to additional savings. University of Buffalo, a long time leader in energy conservation, has incorporated this approach into its draft Climate Action Plan. (http://www.buffalo.edu/ub2020/environmentalstewardship/files/Draft_CAP_Apr7.pdf).

That said, there is so much efficiency potential on every campus that some short-payback energy-efficiency opportunities probably remain. Ensure that you've not missed less obvious shorter-payback opportunities. When you identify them, you might bundle them with longer-payback projects.

The business case for energy efficiency is improving over time. For example, certain efficiency measures may become more financially attractive when future regulations assign to carbon emissions a price that could substantially shorten the payback period for many emissions-mitigation projects. For campus leaders who don't regard climate as an important factor in campus budgeting, the risk of carbon regulation can be a more practical factor.

Calculations or perceptions of payback periods can also change when the risk of fossil-fuel price increases is included. These prices are inherently volatile and will almost certainly increase. In contrast, operations costs and debt service for ef-

The Payback Dilemma

Many campus sustainability directors are frustrated by what they see as a double standard in campus budgeting: Climate-mitigation projects are subjected to strict payback-period standards, while other projects are considered with no reference to payback. In effect, because climate-mitigation projects are also financially advantageous, they are subject to strict payback standards, while other projects that have no opportunity to payback are given a pass. In short, since climate-mitigation projects can pay back, they must pay back quickly.

During our visit to the University of Vermont, Gioia Thompson, Director of the Office of Sustainability, asked a question that was instructive to us. She pointed to the wall in a well-appointed meeting room and offered the following conundrum, "What's the payback period for that beautiful wood paneling?"

As a result of this dilemma, many sustainability directors are now seeking an even playing field in the competition for the campus budget. They assert that climate-mitigation measures are another manifestation of quality. They suggest that a more rational policy would be, "Our buildings are our legacy, part of the definition of who we are. Beauty and efficiency are both aspects of our high standard of quality. We build neither ugly buildings, nor buildings that damage the climate."

What can be lower quality than a pretty building that hastens the climate crisis?

ficiency and renewable energy sources are more predictable. Another worthwhile exercise: Quantify indirect financial benefits from emission-reduction projects and incorporate them into your analysis (as discussed in section 1.3). Some projects that initially seemed financially unattractive may emerge as excellent investments.

If you have not already done so, at some point you'll need to illustrate the connection between energy and your institution's mission, framed in the terms most salient to your leadership. Those might be education, research, cost, frugality, ethics, environment, sustainability, emissions or the survival of human civilization. This connection is crucial to developing a continuous program of emissions reduction, including projects with longer payback periods.

Investments in longer-payback clean-energy projects are in the future of every institution that has committed to continuous reduction of greenhouse-gas emissions and carbon neutrality. Sooner or later, your school must get into the practice of prioritizing clean-energy projects to get the most significant benefits and satisfaction given your limited resources. Appendix D is a decision-matrix methodology, adapted from the U.S. Department of Energy. Fortunately, the process of prioritization can build ownership in, and enthusiasm for, ambitious climate-action projects by campus leaders. By creating and utilizing a decision matrix that uses specific criteria that are important to your institution, you may be able to catalyze consensus for investment in high-value emissions-mitigation projects.

The decision matrix can be used in several ways: You can bundle several projects as if they were a single option. You could use it with no bundled options or different combinations of bundled projects. To learn and improve the decision-making process, you could compare some bundled options and some non-bundled options. At minimum, make sure relevant decision-makers are aware of the problems created by not bundling projects and how such an approach inhibits the large-scale, system-oriented programs that are necessary to achieve your institution's climate goals.

Research

There is a need for greater research and experimentation with mechanisms for using savings of high-return projects to fund the implementation of projects with lower return. Little research exists on how to establish such mechanisms and which mechanisms are most effective.

1.10 Lack of high-ranking institutional leadership on climate.

The value of active support by the campus president and other campus leadership cannot be overstated. Virtually everyone involved in your climate effort has too much to do and too little time. Explicit commitment by the leadership to climate-change mitigation, when repeated and reinforced by concrete rewards, pushes climate-related tasks closer to top of everyone's lists. Better, it makes them think differently about their role and responsibility to the school.

If your institution has already adopted a climate commitment but high-ranking campus officials have lost interest or providing insufficient support, assemble your more savvy allies to develop a concerted strategy to regain their support. In some cases, this may just be a matter of reminding the president and other top officials that their support is necessary for the institution to achieve the goals to which it is committed. If you haven't already done so, invite high-ranking officials to participate in the institutional structure that is implementing the climate commitment. Give them a personal experience of the victories, challenges, and the passion of those directly involved. If the president and other senior officials can't be full participants, invite them to attend important meetings or presentations. At the very least, keep them up-to-date with periodic progress reports. But make those reports as alive and vivid as possible. Use the communications technologies that students know so well.

Build positive personal relationships with top officials. For example, give them a useful gift, such as Boldly Sustainable: Hope and Opportunity for Higher Education in the Age of Climate Change by Peter Bardaglio and Andrea Putman. You might even ask a top official to mentor you. Such officials often have a strong understanding of how to make things happen on your campus and they can often give very helpful advice. At a minimum, be sure to praise any movement in the right direction by top officials. Positive feedback for small steps, will lead to bigger steps in the future.

Only as a last resort and after careful consideration should you publicly criticize the institution for not meeting its climate commitment. Students, community members, and the local media can be powerful advocates for accountability. However, while this tactic may help achieve short-term objectives through begrudging actions, it is not a good recipe for long-term success. Therefore, it is even more important to develop positive personal relationships with campus leaders following such an effort.

Example

<u>Northeastern University, Boston, Massachusetts</u>
In October 2006, a group of undergraduate and law students at Northeastern University in Boston formed the "Husky Energy Action Team" -- Husky for Northeastern's mascot, HEAT for short. HEAT was (and is) a member of a national coalition of campus groups participating in the "Campus Climate Challenge," a brainchild of the (brilliant) Energy Action Coalition.

HEAT's strategy its first year, lifted directly from Campus Climate Challenge organizing guides and HEAT's mentor organization, the Sierra Student Coalition, was to: 1) choose a year-end goal around which to organize, after first vetting it with the administration to gauge feasibility; 2) build student support around the goal (or "the Ask," in organizing parlance), peaking near the end of the semester; and 3) "win," that is, have the administration agree to implement HEAT's goal, in the process a) moving the campus closer toward climate friendly practices; b) building HEAT's organizational strength; and c) setting the stage for more effective organizing the following year.

Vetting and selecting an Ask, something HEAT's founders anticipated taking at most a month, took nearly five, and so the "end of the year goal" was selected just two months before the last day of classes. In the meantime, though, HEAT members organized student support for climate action. Five-hundred students turned out for screenings of An Inconvenient Truth and hundreds more turned out for talks and other events; thousands participated in an inter-dorm electricity usage reduction competition; the student newspaper published multiple letters and articles about HEAT and the need to reduce Northeastern's greenhouse gas emissions, including a front-page story on the C- grade Northeastern received from the Campus Sustainability Report Card; HEAT was featured in the Boston Globe; HEAT members met with employees of the Facilities Department and professors familiar with the issues or with the workings of the administration; and HEAT's Treasurer forged a relationship with a member of the University's Board of Trustees. HEAT also began to gather petition signatures, the first several hundred of which went straight into the recycling bin after the Ask was finally selected and the petitions had to be rewritten.

It was a young employee of Northeastern's Facilities' Department who finally took HEAT's prospective Asks to the head of Facilities and provided HEAT with his boss' feedback. HEAT ended up with three Asks, which were incorporated into a petition directed to the President of the University and the Board of Trustees: 1) develop a plan to track and reduce greenhouse gas emissions, eventually to zero; 2) LEED certification with an emphasis on the "energy and atmosphere" category; 3) purchase 50% of electricity from renewable sources by 2012. A member of the Board of Trustees hand-delivered a letter from HEAT to the University President outlining these Asks and requesting a meeting. HEAT members met with the Senior VP of Administration & Finance, second in command to the University President. Although HEAT's request for a commitment from the University by the last day of classes (only two weeks away) was determined by the VP to be unrealistic, he was interested in working with HEAT with the goal of making a commitment by the deadline to become a Charter Signatory of the American College & University Presidents' Climate Commitment (two months away).

From that point forward, HEAT focused all its energies on convincing the President to sign onto the ACUPPC. Just before HEAT's final event of the spring semester, a press conference at which HEAT was to present the President with over 5,000 student petitions, the President emailed faculty and staff that he had "decided to sign the American College & University Presidents' Climate Commitment, pledging Northeastern University's commitment to environmental sustainability."

Lessons learned:

- Organizing graduate and undergraduate students in the same group has tremendous potential. Undergraduate students often have more time available; graduate students often have skills and confidence that are useful in navigating the sometimes-intimidating world of school administrators. Law students, however, are nearly impossible to organize. The mentorship offered by the Sierra Student Coalition (SSC) was invaluable, as were the organizing guides published by the SSC Energy Action Coalition.
- The advice and support of a single professor, a single administrator, or a single facilities employee can make all the difference to the success of a campaign.
- Pay as much attention to the success and health of the organization and its members as you do to the work the organization is doing. A tremendously successful yearlong campaign that doesn't properly establish the leadership structure for the following year may soon fizzle out.
- Students can accomplish anything! Many students worked harder as members of HEAT than at anything they had ever done.

By Jennifer Wolfson, HEAT Founder
Northeastern University

Resources

A Call for Climate Leadership: Progress and Opportunities in Addressing the Defining Challenge of our Time is a great summary of the case for higher education to lead efforts to address climate change. It was written specifically for Presidents and other high-level campus officials and might be worth sharing with your administrators. http://presidentsclimatecommitment.org/pdf/climate_leadership.pdf

Higher Education in a Warming World - The Business Case for Climate Leadership on Campus by the National Wildlife Federation's Campus Ecology program makes the business case for tackling climate change on campus. http://www.nwf.org/CampusEcology/BusinessCase/

"DePauw University's Journey to the American College & University Presidents' Climate Commitment" describes how students and faculty at DePauw were able to convince their president to sign the ACUPCC and provides a variety of materials from their effort. http://presidentsclimatecommitment.org/html/documents/DePauwUni_PCCprocess.pdf.

1.11 Faculty and staff members don't understand climate and sustainability projects.

1.12 The campus community is not aware of the college's commitment to climate action.

1.13 Most students pay little attention to the campus climate initiatives.

Anthony Cortese, the President of Second Nature, offers the key solution to these barriers when he says, "Communication is to sustainability as location is to real estate"

There are many ways an institution can educate the campus community about its climate commitment and why it is important. Examples:

- Send regular updates to your president, and encourage him or her to incorporate information about the institution's commitment in his or her speeches, especially those that receive a lot of attention such as commencement, convocation, or the state-of-the-campus address. The more visible the president is in supporting climate action, the more other members of the campus community will pay attention to the issue.
- Incorporate education about the climate commitment in orientation of new students, staff, and faculty, as well as training for resident assistants.
- Set up an account for the climate commitment on Facebook and other social networking websites. Used regularly, these tools help communicate with a large network of student supporters.
- Work with the student newspaper and other campus publications to get coverage for the climate commitment and associated implementation efforts. If they aren't interested or aren't able to do so, offer to stories yourself. Alternatively, create a newsletter focused on sustainability and the climate commitment.
- Collaborate with the public relations office to distribute press releases announcing each new effort to reduce emissions and publicizing the institution's progress in meeting its commitment.
- Create peer-to-peer networks of students, faculty and staff with representatives from each residence hall and department. Regularly update these representatives on climate commitment progress and activities.
- When you achieve a major accomplishment, hold a campus-wide celebration, preferably with live music, food, and other enticements for broad participation.
- Work with the athletics department to offset the emissions or otherwise reduce the climate impact of big games. Describe these steps and the climate commitment in communication materials at the game.
- Integrate education about the climate commitment into such events as Earth Day, Focus the Nation, the National Teach-In on Global Warming Solutions, and Campus Sustainability Day. Use these events to release progress reports.
- Engage marketing and communications students in developing and implementing strategies to educate the campus community about the climate commitment and how they can help. Look for similar opportunities to involve students in other courses.
- Hold an event to develop wider participation, raise awareness, and raise money to support implementation of the climate plan.
- Fund members of the campus community to design and execute climate projects, which might integrate climate into the curriculum, student research, and clean-energy projects.
- Organize energy conservation or broader sustainability competitions between residence halls, Greek houses, departments, buildings, or other campus groupings. Make the winning prize meaningful to those who you want to participate.
- Reward sustainability leadership through a recognition program for individuals or departments.
- Make contribution to the climate commitment (or sustainability) part of the performance-review process for all faculty and staff. This will send a strong message about the importance of the climate commitment.
- Invite the campus community to contribute to the climate action plan by making drafts available for comment and by convening public forums for feedback. Established governance structures such as faculty senates, student governments, and staff councils can all be important allies in soliciting feedback from stakeholders.
- Hold a pledge drive to get members of the campus community to sign a commitment to take actions that reduce their greenhouse-gas emissions.
- Incorporate the climate commitment into the institution's major guiding documents such as the strategic plan and the campus master plan.
- Make sure your institution's climate or sustainability website is up-to-date, easy to use, and easy to find. Include a link to climate page on the institution's homepage.
- Document progress in implementing the climate commitment on a public blog.

You and your climate-commitment allies can best determine which of these ideas will be most effective on your campus. Different groups on campus respond to different messages. Therefore, adapt and vary your message for various audiences on campus.

Examples

<u>Furman University, Greenville, South Carolina</u>
The administration and faculty at Furman have been generally enthusiastic, supportive and engaged in campus green efforts at least since 2005. Sustainability has been a part of the school's strategic plan since the mid-1990s. Although a small fraction of students have also been interested — in fact the admissions office has noticed a recent trend of younger students choosing to attend Furman because of its burgeoning sustainability reputation —the majority of the student body was apathetic about climate action when the university undertook its first greenhouse gas inventory.

The leadership in many schools is concerned about the relatively small number of students engaged in campus sustainability efforts. Furman's President David Shi and other prominent administrators recognized that without deeper student involvement, the connection between the campus climate commitment and the institution's mission would be weak at best. The Provost stated "we will have failed our students if they come to Furman and aren't challenged to think through these kinds of issues." Therefore Furman increased formal and informal efforts to involve students in campus sustainability. Campus leaders regard the climate action plan as a natural maturation of the campus commitment to environmental stewardship and want students to understand that climate stewardship is not just a passing fashion. The campus has added a curriculum requirement that all students take a course on the relationship between humans and the environment, committed to using campus facilities pedagogically through its thirteen living learning laboratories (see http://www.furman.edu/sustain/academicsresearch/sustainabilitylivinglearninglabs.html), and endowed the Center for Sustainability to coordinate education and outreach across campus.

Furman's David E. Shi Center for Sustainability (CFS) and the Sustainability Planning Council (SPC) are engaging the wider Furman community in the climate action planning process through articles in the student newspaper and support for student-led sustainability initiatives. These efforts are paying off as students from all walks of life on Furman's campus are now getting involved. Before the engagement campaign began in earnest in the fall of 2008, the Vice President of Student Services noted that there is certainly an interest and sensitivity to sustainability and being good stewards [on the part of the students], but that doesn't play out in day-to-day activities, and it doesn't play out necessarily in how the students get engaged organizationally. Since then, student engagement and participation as increased. With facilitation from CFS, student interest in sustainability-focused internships and volunteer work is growing. In collaboration with Apple Inc., CFS created an opportunity for five students to produce a short documentary about the university's decision to be a charter member of the American College & University Presidents' Climate Commitment. The documentary is available online and can be viewed at http://www.youtube.com/user/thefurmanchannel#p/u/33/LJybM_Y_bDk

Furman's sustainability master planning process was guided by the 124 members of the Sustainability Planning Council (SPC), who represent a wide variety of stakeholders on campus (for a detailed description of the Sustainability Planning Council, see solution 1.10). While this group provided input from all areas of campus, more engagement of the community seemed necessary for a truly inclusive plan. In the fall of 2009, the SPC reached out to the campus community for feedback on the sustainability master plan and climate action plan. The plan was placed on an online discussion site where stakeholders could comment and discuss the plan online, and the SPC also held two open forums for the campus to attend and share feedback about the plan. Additionally, the chairs of the SPC attended a meeting of the Association of Furman Students (student government) to reach out to student leaders on campus and respond to feedback and questions from students. For a description of the SPC, see section 1.8.

Furman University's David E. Shi Center for Sustainability (CFS) coordinated a June 2009 Faculty Workshop for Infusing Sustainability into the Existing Curriculum. Seventeen professors representing 15 departments/disciplines participated in this ongoing peer-to-peer collaboration that is connected with a similar—and simultaneous—faculty workshop at Middlebury College. The workshop focused on how faculty can incorporate sustainability issues into pre-existing classes across a number of disciplines; the workshop included faculty from departments across the university, including such disciplines as military science, history, and earth and environmental sciences. Contributed by the staff of the David E. Shi Center for Sustainability

Contributed by the staff of the David E. Shi Center for Sustainability

<u>The University of Missouri, Columbia, Missouri</u>

There are small enclaves of sustainability engagement in the Mizzou student body, faculty and staff. The administration is supportive of environmental sustainability and climate action in general. The campus has a long-standing, sophisticated energy-efficiency program, as well as an organized campus planning process characterized by wide participation and awareness on the part of staff members in all departments. When it comes to communication and facilitation of connections between green initiatives across campus the administration has often relied on students to lead the charge on coordinating actions. The University's Chancellor described his impressions of the following student group by saying "I can't really improve on what our student leaders are doing. If you meet these students, they're committed, they're articulate, and they're effective in getting organized, organizing others, and calling attention in the right ways."

Sustain Mizzou is a non-profit student group that advocates for environmental sustainability at the University of Missouri. Since it's founding in February 2004, it has grown from ten students that did a few events during the semester to an organization of roughly 75. The group now works on 14 projects throughout the year as well as a large number of collaborative events, advocacy and education outreach. Some of the organization's projects include:

- Tiger Tailgate Recycling, in which volunteers educate MU home football game tailgaters about recycling and collect recyclable material, 74 tons of in the past four years;
- RecyclInk, a partnership between Sustain Mizzou and MU General Stores that provides ink cartridge recycling on campus;
- Successful lobbying for a solid waste and recycling coordinator to be created on campus; Creating and promoting a $1 per student per semester sustainability fee;
- Collaborating with Campus Dining Services to make their operation more sustainable.

Three Sustain Mizzou practices sustain the organization and its successes: leadership development, leadership transition, and an "evolution not revolution" approach to advocacy.

Sustain Mizzou regards its continuous leadership development as essential to sustaining itself through rapid student turnover. Current leaders involve newer members in every step of an event or advocacy project. They regard every activity as an opportunity for learning. A pattern of individual growth has emerged in Sustain Mizzou: Younger students join the organization and participate as volunteers. After a few events, a young student may talk to an executive member about taking on more responsibility. After the student has held one of the easier leadership positions for a while, they look for more challenging positions such as an executive position or leadership of a bigger project. As they build both experience and confidence, their ability to lead the organization quickly improves. Soon, they are helping younger students get involved.

Leadership transition: A few simple steps allow Sustain Mizzou to function effectively even as its leaders graduate and leave. Seniors do not serve as president of the organization. Rather, they remain involved to support a younger student's presidency. Each year, students complete transition worksheets on projects. These worksheets help to evaluate the project's success and to prepare future leaders to run the project more effectively.

Sustain Mizzou members regard their "evolutionary not revolutionary" approach to advocacy as central to their success. Where another approach might be to rally in protest or demand that administrators fix a problem, Sustain Mizzou prefers to collaborate with administrators to identify solutions that are easy to implement along a path toward a larger goal. Once steps have been identified collaboratively, Sustain Mizzou helps to bring about success. This approach eases administrators' workload, builds rapport between students and the administration, and invests participants in the success of the project.

By Patrick Margherio, Former President of Sustain Mizzou
University of Missouri Class of 2010

Resources

The "Co-Curricular Education" section of AASHE's Resource Center contains an assortment of resources related to engaging students in sustainability, including a list of peer-to-peer sustainability education programs and a video series with best practices for organizing sustainability competitions in residence halls.
http://www.aashe.org/resources/co-curricular_education.php

A presentation from the AASHE 2008 conference entitled "Making it Personal: Targeted Outreach Climate Change and Energy Conservation" describes how the University of Colorado Environmental Center has been able to engage a wide variety students on climate issues and includes some example promotional materials. http://www2.aashe.org/conf2008/abstracts.php#541

Research

Beyond anecdotal evidence, the effectiveness of the activities listed above is not well known. Research could document the results of such activities and identify best practices.

1.14: Campus decision makers distrust carbon offsets and renewable energy credits.

Carbon offsets and renewable energy credits are likely to come up in development of plans for meeting any ambitious climate goal, especially if your institution has signed the ACUPCC and is aiming for climate neutrality. Solutions for overcoming the barriers associated with RECs and offsets are covered in Chapters Three and Five. For purposes of this section, it is worth noting that a climate plan need not require purchase of offsets from national markets. In fact, with improved technology, shifts in behavior, and changes in utility policies and portfolios, it is at least theoretically possible that offsets won't be needed even for climate neutrality in the long run.

1.15 Campus leaders are concerned that embarking on a climate action plan now will preclude recognition for earlier investments.

First, a history of energy management and conservation is a valuable asset for any school embarking on a climate commitment. Since ACUPCC signatories are working towards zero net emissions (as opposed to achieving a percentage reduction by a specific date), those institutions that have a long history of reducing emissions should find it easier to meet the end goal than those just starting. Prepare for cross-departmental participation in the climate planning process by publicly recognizing that the hard work of the facilities and utilities departments has already begun to pave the way to campus climate neutrality. Also, before the president officially signs the ACUPCC, consult with the facilities department about their previous energy work and their thoughts on the climate commitment.

Schools have the option to collect and report historical energy and GHG data in the ACUPCC online reporting system, which is a good way to get recognition for progress that has already been made. If past data is not readily available or your campus cannot spare the resources to compile historical data for the GHG inventory, then summarize past efforts in press releases and in the ACUPCC completed-inventory narrative. In conjunction with posting historical information online, issue a press release and hold a public presentation describing your institution's history with energy conservation and your future plans to meet a climate commitment.

Examples

For an example of a campus that has highlighted its past progress in the ACUPCC online reporting system, see the University of Vermont at http://acupcc.aashe.org/. From the "Supporting Documentation" section at the bottom of their ACUPCC GHG Report, download the public presentation that was given at the University of Vermont when this data was released.

CHAPTER TWO: BUILDINGS AND UTILITIES

Energy use in buildings contributes 80 to 90 percent of campus GHG emissions.[4,5,6] Therefore, reducing energy use in your buildings is of paramount importance. And because existing buildings outweigh new building construction on virtually all campuses by far, they are the lynchpin of campus climate mitigation. Fortunately, by using the right approach energy use in existing buildings can be reduced cost-effectively by 30-50 percent.

In our visits to twelve college and university campuses and in telephone interviews with campus-climate practitioners at other campuses, we heard many barriers to efforts to reduce fossil-fuel use in campus facilities. They are listed and numbered in this chapter — each followed by a discussion of solutions and, in many cases, examples and resources.

Each barrier represents a real or perceived hurdle on many campuses. The solutions guide users around, over or through the barriers, and in some cases reveal that a perceived barrier is not so big after all. The first two barriers are so closely related that similar solutions apply to both.

Perceived Barriers

2.1 Due to lack of capital, whole-system energy-efficient retrofits seem impossible; incremental improvements are the norm.

2.2 Limited debt capacity prevents comprehensive energy-efficient retrofits, even those with attractive payback, because debt is already tied up in new buildings or the central plant.

On its face, lack of capital seems to be the ultimate conversation stopper, preventing any further consideration of such initiatives as energy-efficient building retrofits. But, if campus stakeholder remain open minded, internal conversations focusing on two areas can often change institutional perceptions of investment opportunities and capital availability. The first area is integrative design, which can result in more effective use of capital. The second is the range of financing options, some of which may not be well known on campus.

Take the right steps in the right order.

Integrative Design

As counterintuitive as it may sound, an energy-efficient building retrofit need not necessarily cost more than conventional renovation. In fact, if it's designed in an integrated fashion and implemented at the right time, it may even cost less.

Two sets of factors converge to turn this improbable idea into standard operating procedure: timing and design. Regarding timing: Plan your energy-efficient retrofits to coincide with your schedule of major system renovations in particular buildings, that is, both aesthetic and functional upgrades, and retrofits of such major systems as windows, roofs, lighting, and HVAC (heating ventilation and air-conditioning). In this context, energy-efficient systems will not all be new budget line items. Moreover, by combining all systems that need to be replaced in the near future into one retrofit master plan, the incremental capital costs of higher performance equipment can be paid for in the capital savings associated with downsizing other equipment (e.g. HVAC).

But in order that the energy-efficient retrofit compare favorably to the conventional renovation, each system must be designed with the others in mind, which is another way to suggest integrative design (a.k.a. whole-system design). Example: If you replace all conventional lighting with efficient and better-designed lighting, less heat is added to the building because efficient lights are much cooler, and generally fewer, better-located lights are used. If you allow only efficient electronics (e.g. computers) and appliances, all of which are

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[4] http://www.upenn.edu/sustainability/energy.html

[5] http://www.climate.unc.edu/GHGInventory/bldgfootprint

[6] http://www.sustainablecampus.cornell.edu/climate/inventory.cfm

now readily available, you also add less heat to the building by reducing plug loads. Similarly, if you install efficient windows or add insulation when you carry out major repairs on the roof, these measures can dramatically reduce demand for heating and cooling, which allows you to downsize the new HVAC equipment, which in turn can reduce the total cost of the retrofit to be comparable to, or even less than, the cost of a conventional renovation. More importantly, these whole-building approaches yield deep savings every month when the utility bill is paid. This attractive return on investment stands in stark contrast to conventional renovations, which generally offer no direct financial return.

Tunneling Through the Cost Barrier at Adobe

A quick preview of what you'll find about Adobe's headquarters: After rebates totaling $389,000, the net cost of all aspects of the company's energy and environmental retrofit was $1.11 million. But Adobe now saves $1.2 million each year in reduced energy operating expenses, which translates into a 121 percent return on investment and an average payback per project of 9.5 months. Even without the rebates, this is an extraordinary business success story.

The improved performance went beyond energy systems. Domestic water use was reduced 22 percent, irrigation water was reduced 76 percent in what is now certified at the Platinum (highest) level under LEED for existing buildings. Adobe also diverts 94 percent of the solid waste generated from this building. And this retrofit took place on a relatively new building, not one scheduled for renovation.

Adobe spent $1.4 million on energy-efficiency measures that save $1.2 million per year.

When budgets are especially tight, there's a strong tendency to conduct renovations incrementally — HVAC this year, lights the next, then the roof, etc. Hopefully, the aspects of integrative design, emphasized throughout this chapter, demonstrate clearly that the incremental approach is an ineffective way to spend limited funds. Worse, it mitigates less carbon if any.

A key component of the integrative design process is to take the right steps in the right order, which applies to both new construction and retrofit projects. This approach is described below. Also, see "Checklist for Integrated Review Process" in Appendix C for a more detailed description of the "right steps in the right order."

Seek multiple benefits from single expenditures.

Rocky Mountain Institute has helped build or retrofit numerous buildings by applying a whole-system, least-cost end-use efficiency framework, which drives radical, cost-effective energy efficiency. This approach requires the following steps:

1. Define clearly the end-use, that is, the need or service required. A whole-system approach contrasts sharply with a conventional approach that would first define the amount of energy or equipment needed.
2. Reduce loads on the system. Identify passive load-reduction measures before active ones (e.g., shading, daylighting, etc.) in order to decrease energy requirements for the end-use defined in the first step.
3. Maximize benefits that can be achieved from interaction among systems, for example, reduce lighting-power density in order to reduce cooling load, which in turn allows reduction of cooling equipment size.
4. Design systems for efficiency, for example, reduce hot-water distribution losses by locating hot-water uses in the building to minimize the total length of pipes that will be used.
5. Meet the now vastly reduced loads efficiently, that is, use the most efficient equipment available. (Note that this where many people start. As a result, they miss all the saving opportunities that emerge when pursuing the first four points.).
6. Use controls strategies that minimize energy use when energy is not required, for example, occupancy sensors, scheduling controls, and key-card energy controls.
7. Use on-site sources of energy (e.g., solar electric, cogeneration, etc.) where possible and feasible, which can be much smaller due to load reductions achieved in steps one through six.
8. Buy carbon offsets if necessary, the amount of which also is vastly reduced by load reduction.

According to the National Association of Energy Service Companies:

”An ESCO, or Energy Service Company, is a business that develops, installs, and arranges financing for projects designed to improve the energy efficiency and maintenance costs for facilities over a seven to twenty year time period. ESCOs generally act as project developers for a wide range of tasks and assume the technical and performance risk associated with the project. Typically, they offer the following services:

- develop, design, and arrange financing for energy efficiency projects
- install and maintain the energy efficient equipment involved
- measure, monitor, and verify the project's energy savings
- assume the risk that the project will save the amount of energy guaranteed

These services are bundled into the project's cost and are repaid through the dollar savings generated.”

www.naesco.org/resources/esco.htm

To benefit from interactive effects among systems, conceptualize and implement this framework with the whole building in mind. In essence, even though you implement your work in stages, design each stage based on a larger energy master plan for the entire building, which spans different systems and their implementation timelines, which in turn achieves the most cost-effective savings possible.

An intuitive way to save costs with integrative design is to use another whole-system design principle: Identify multiple benefits that can be achieved with single expenditures. This principle requires that designer look beyond their individual professional silos. A case in point is a building developed for Stanford Department of Global Ecology. The philosophy of the design team was that each member would design his or her particular element (e.g., lighting or structure) with the whole building in mind, which required an understanding by each member of the fundamentals of all elements of the building. As the team examined multiple benefits of the emerging design, the distinction between the functions of the individual elements began to blur. Team members who would have been working separately, were instead working together to design the same element. Through integrative design, they achieved 72 percent energy savings at no added capital cost.

Another benefit achieved by green buildings is building-user satisfaction. “One of the best-kept secrets in the green building field is that office workers, teachers, and students love green buildings. They attend work and school more regularly, are sick less often, and are more productive when present. In terms of financial return, these increases in occupant productivity often outshine any savings on utility bills.[7]

“The state of California commissioned Capital E, a green building consulting firm, to analyze the economics of 33 LEED certified buildings in the state. The study concluded that certification raised construction costs by $4 per square foot, but because operating costs as well as employee absenteeism and turnover were lower and productivity was higher than in non-certified buildings, the standard- and silver-certified buildings would earn a profit over the first 20 years of $49 per square foot [average $2.45/year], and the gold and platinum-certified buildings would earn $67 per square foot.”[8]

To reinforce the power of integrative design, see also

- The Introduction (“Employ Whole-System Thinking to Develop Integrative Designs”)
- Section 2.16
- Appendix B regarding “tunneling through the cost barrier”
- Startling numbers from a real example: Adobe corporate headquarters described at bet.rmi.org/our-work/cas-estudies/affiliate-case-studies.

Alternative financing

The second area of conversation that can be useful to capital planning is alternative-financing, which includes operating leases for energy-efficient HVAC equipment, energy perfor mance contracting, incorporation of financial incentives, and grant seeking. These approaches may be used in combination with one another or individually depending on the context, policies and leadership of your particular campus.

Operating Lease Agreements

An operating lease agreement can be an effective way to finance an energy-efficiency retrofits or equipment upgrade capital or debt capacity is limited. Generally, such a lease is most advantageous when it can be framed so that energy savings from the leased equipment are commensurate with the financing charges. Commercial leasing corporations, management and financing companies, banks, investment brokers, or equipment manufacturers may offer these agreements.[9]

“There are two ways of accounting for leases. In an operating lease, the lessor (or owner) transfers only the right to use the property to the lessee. At the end of the lease period, the lessee returns the property to the lessor. Since the lessee does not assume the risk of ownership, the lease expense is treated as an operating expense in the income statement and the

[7] Pike Research, Energy Efficiency Retrofits for Commercial and Public Buildings, (2009) p. 7

[8] Lester Brown, Plan B 3.0, p. 223

[9] http://www1.eere.energy.gov/buildings/commercial/financing.html

lease does not affect the balance sheet. In a capital lease, the leassee assumes some of the risks of ownership and enjoys some of the benefits. Consequently, the lease, when signed, is recognized both as an asset and as a liability (for the lease payments) on the balance sheet. The firm gets to claim depreciation each year on the asset and also deducts the interest expense component of the lease payment each year. In general, capital leases recognize expenses sooner than equivalent operating leases."[10]

"Under an operating lease, the lessor owns the equipment and rents it to the lessee for a fixed monthly fee. At the end of the lease term the lessee may be able to purchase the equipment (usually for fair market value), extend the lease, negotiate a new lease, or return the equipment.

Operating leases are simple, funded out of operating budgets, and may be ideal for shorter-term projects or projects in which owning the equipment is not desirable. Payments are usually lower than for capital leases and are 100 percent tax deductible (with a capital lease only the interest portion of the payment is deductible)."[11]

Energy Performance Contracting
Energy-efficient building retrofits can be financed through an energy performance contract (EPC) with an energy services company (ESCO). Such firms work with clients to plan, finance, implement and monitor integrated energy-efficiency upgrades to one large building or a portfolio of buildings. Under an EPC, the ESCO takes on the financial and technical risks of implementing all agreed upgrades and is charged with proving expected savings by monitoring the project once it is operational. Importantly, debt associated with the projects need not be recorded on the client's books, but can instead be taken on by the ESCO.

Designed well, an energy-efficient retrofit can cost less than conventional renovation.

The campus repays the ESCO over the life of the contract (generally 10 to15 years) usually by keeping the utility budget constant and redirecting saved utility dollars to repay the debt. Once the contract term is complete, all savings resulting from the retrofit accrue to the institution.

Consider, however, that your school may be able to secure a better interest rate than an ESCO. Therefore, it may make more sense to finance the project directly. In such a case, repayment is assured by an ESCO guarantee that project savings will be sufficient to pay the finance costs. In the event that project savings do not materialize, the ESCO is contractually obligated to pay the difference.

Navigating the ESCO negotiation process can be challenging. Many campus administrators worry that ESCOs will take advantage of them or use the energy performance contract to sell of ESCO-branded equipment. They feel more comfortable doing business with the ESCOs that are not also in the business of manufacturing and selling HVAC equipment and controls systems.

Design each system with the others in mind.

Fortunately, excellent resources are available to assist campuses with the ESCO search, selection and negotiation process. With contributions from RMI and many other industry experts, the ACUPCC and the Clinton Climate Initiative (CCI) recently released the ACUPCC Energy Performance Contracting Best Practices Toolkit and it is available for download at www.presidentsclimatecommitment.org/html/solutions_cci.htm. The chapter on "Critical Issues in Developing and Undertaking and Energy Performance Contract Project" summarizes necessary issues to consider in drafting a contract. Also, it details each of the typical phases of project development: stage setting, procurement, investment grade audit, implementation, measurement and verification and beyond. The chapter on "Energy Performance Contracting Financing Options" describes several approaches to securing funds including cash, bonds, capital lease agreements, operating lease agreements, receivables purchase agreements, and tax-exempt lease purchase agreements and summarizes key tradeoffs to consider between these various approaches.

The contract structure used for a major retrofit of the Empire State building represents best practice, which is used by other leading real estate owners. Notably, it made significant use of time and materials contracting with caps, precisely to avoid a contractor padding his numbers to avoid risk.
http://www.esbsustainability.com

Revolving Loan Funds
A growing number of campuses are setting up revolving loan funds to provide capital for energy-efficiency projects on campus. The explicit function of these funds is to provide no- or low-interest loans for projects with good economics.

While the implementation of projects financed from revolving loan funds is generally incremental, the principle of a continuous flow of self-perpetuating capital from one project to the next links each increment with all the others, resulting in a more sophisticated, whole-systems approach to project finance. One of the most famous quotes about revolving loan funds came from Lawrence Summers, former president of Harvard University, at Harvard's first conference on campus sustainability in 2006: "The best investment in the University is not the endowment but the Green Loan Fund."[12]

[10] http://pages.stern.nyu.edu/~adamodar/New_Home_Page/AccPrimer/lease.htm
[11] ENERGY STAR Building Upgrade Manual – Chapter 4 – Financing http://www.energystar.gov/index.cfm?c=business.EPA_BUM_CH4_Financing
[12] http://www.thecrimson.com/article.aspx?ref=513157

The Harvard Campus Green Loan Fund has loaned out $11.5 million to over 150 projects and generated $4 million in savings since its inception in 2001 and has generated an average 27% annual return on investment (ROI).[13] Although many campuses cannot set aside $12 million for a revolving loan fund as Harvard has done, the concept also applies to smaller energy-efficiency endowments. For example, students at Macalester College created the Clean Energy Revolving Fund (CERF) in 2007 to fund energy-efficiency projects on campus. Through effective organizing and publicity, initial donations to the fund were generated from unlikely sources. In just two years, the fund has been capitalized with close to $100,000 and has successfully funded several projects including insulation of student housing, purchase of efficient refrigerators, and lighting retrofits.
http://www.aashe.org/documents/resources/pdf/CERF.pdf (describes Macalester fund's development)
http://www.greencampus.harvard.edu/loan-fund

For more on revolving loan funds see Appendix I.

Incorporation of Financial Incentives
Utility companies, local and state-level non-profits, and all levels of government may offer opportunities to lower the cost of energy-efficiency upgrades. Informational conversations with your state energy office and your electric utility is an effective way to discover rebate offers, low-interest loan options, grant matching programs, and other ways to bring down the cost of efficiency upgrades.

The Database of State Incentives for Renewables and Efficiency (DSIRE) — maintained by Department of Energy, the North Carolina Solar Center, and the Interstate Renewable Energy Council (IREC) — is an excellent source of information about incentive programs from the federal and state-level governments. It provides initial information and contacts for incentive programs that may be useful for your campus. Use DSIRE online at http://www.dsireusa.org/

Targeted Programs, Low-interest Loans, and Grant and Gift Seeking
Philanthropic and government interest in climate protection is on the rise. In the past year, new programs have been developed at the state level to connect colleges and universities to funding for energy-efficiency and green building. One example is the New York State Energy Research and Development Authority's (NYSERDA) new "Focus on Colleges and Universities" program, which provides technical assistance and identifies financial incentives to help public and private institutions in New York fund their energy and environmental objectives.[14]

The American Recovery and Reinvestment Act of 2009 (ARRA) resulted in provision of significant funding for the DOE's State Energy Program, some of which is being allocated to energy-efficiency upgrades on college and university campuses. North Carolina used some of the ARRA funds to create a revolving loan fund to provide no- and low-interest loans to colleges and other eligible organizations. New Hampshire will use some of the funding to cover up-front costs of energy-efficient retrofits at thirteen colleges and universities.

Federal appropriations for operations-based energy projects at colleges and universities are also becoming more common. The number of higher education institutions receiving earmarks has grown steadily since the 1990s, rising 28% from 2003 to 2008 alone[15]. "Earmarks are noncompetitive grants directed by Congress to specific constituents, including colleges and universities, usually in lawmakers' own districts or states. This practice — sometimes called pork-barrel spending — is controversial because it bypasses normal competitions for federal grants.[16]"

The practice of using earmarks to fund academic research in particular is controversial because scientific research proposals that seek earmark funding do not have to go through the usual rigorous, peer-review selection process, which is meant to ensure fair competition and to provide funding only to the highest quality proposals. Although less controversy surrounds earmarks for campus infrastructure improvements, earmarks to independent colleges for campus improvement projects may generate controversy, especially if tangible, societal benefits are unclear. Here are a few selected examples of Congressional earmarks for building energy-efficiency improvements at colleges and universities in 2008:

- Association of Vermont Independent Colleges: $1,476,000 for the Zero Energy Vermont College Campaign, to perform energy audits and improve campus energy efficiency and to design of a near net-zero building on the campus of Burlington College
- New York Institute of Technology at Central Islip: $492,000 for energy-efficiency initiatives
- University of Louisville, Kentucky: $393,600 for a sustainable-buildings project
- University of North Alabama: $984,000 for energy-conservation measures, including solar-energy systems for academic buildings

Private funding sources are also showing interest in climate protection programs at colleges and universities. The Environmental Grantmakers Association held a series of dialogues about the role of philanthropy in advising and promoting sustainability in higher education.[17] Some funders are also becoming more attuned to environmental impacts and co-benefits of their grant programs. Beginning in June 2010, the Kresge Foundation, a long time funder of new buildings for higher education, will restrict its higher education capital challenge grants to colleges and universities building environmentally sustainable facilities. The foundation now includes climate-change mitigation or adaption as one criterion in its consideration of proposed projects. Attention to energy-effi

[13] http://www.greencampus.harvard.edu/loan-fund
[14] http://www.nyserda.org/highered/default.asp
[15] http://chronicle.com/free/v54/i29/29a00101.htm
[16] Searchable database of Congressional Earmarks for Higher Education, 2008, through The Chronicle of Higher Education at http://chronicle.com/stats/pork/index.php
[17] http://www.ega.org/events/index.php?op=view&eventid=47669

cient operations is likely to become more of an emphasis for funders, especially those interested in how their money can contribute to the long-term durability of the institution.

Examples:

University of Vermont
Energy efficiency measures at UVM have reduced electricity use by at least 5% and avoided the need for a significant amount of heating fuel since 1990. In 1992, a $275,000 revolving loan fund was established by the university trustees, to support initial efficiency efforts, followed by bonds totaling $2.5 million for energy efficiency and conservation. Projects include:

- Scheduling controls for temperature and ventilation on most major buildings.
- Lighting upgrades to T-8 or compact fluorescent bulbs in all major buildings. Incandescent bulbs are no longer installed on campus.
- Campus vending machines were retrofitted in 2003; eighty Vending Misers™ power down their lighting and cooling systems after 15 minutes of inactivity, preventing an estimated 176,000 pounds of CO_2 emissions per year.
- All washing machines were replaced with Maytag Neptune high-efficiency washers that each save up to $150 per year.
- Exit signs in every campus building were fitted with LEDs.

University of Minnesota, Morris
In 2004, UMM began acting on its sustainability target by constructing a 1.65 megawatt wind turbine. The 230-foot turbine provides UMM with 5.6 million kilowatt hours of power each year and is the first large-scale wind research turbine at a U.S. public university. In 2008, the University used funding received from the State of Minnesota to construct a biomass gasifier and steam boiler.

UMM hired McKinstry to perform a thorough analysis of the campus' energy supply and demand, which included evaluating campus energy supply-side options; identifying demand side reductions; creating a plan for an energy education and awareness system; and formulating a plan for actively managing energy production, storage, and consumption.
McKinstry's completed energy analysis of UMM resulted in the development of the Carbon Management Tool, an interactive predictive tool that visually demonstrates impacts and interactions between a multitude of conservation, energy storage, and supply side options.

"McKinstry used the tool to help us identify a self-funding project with a 14-year payback," says Lowell Rasmussen, UMM's Vice Chancellor for Finance and Facilities. "Not only has this resolved the campus' chilled water shortage, but it will reduce our carbon emissions by more than 80% by 2010. This will allow us to purchase carbon offsets for the remaining carbon footprint, and achieve our goal of becoming carbon neutral."

Carbon Management Tool (Whole Systems Approach, non-proprietary ESCO)
http://www.businesswire.com/portal/site/google/?ndmViewId=news_view&newsId=20090429005920&newsLang=en

Five College Consortium
Other approaches to financing include developing co-operatives or other shared arrangements. The Five College Consortium — composed of Amherst, Hampshire, Mount Holyoke and Smith Colleges, and the University of Massachusetts at Amherst in Northampton, Massachusetts — share an energy manager. The salary of the energy manager comes from the conservation savings. The energy manager's primary responsibilities include identifying and implementing cost-effective ways to reduce fossil-fuel and electrical-energy consumption. For more information, contact Todd R. Holland, Energy Manager, Five Colleges, Inc. , thollandpe@fivecolleges.edu

Additional campus examples
http://www2.presidentsclimatecommitment.org/documents/ccitoolkit/Energy_Performance_Contracting_Financing_Options.pdf
http://cepm.louisville.edu/Pubs_WPapers/practiceguides/PG21.pdf

Verizon Communications
In 2001, Verizon launched a statewide program to reduce energy use in its facilities by 5%, as compared to energy use in 2000. The company invested approximately $4.3 million using operating-lease funding. Due to lack of capital, projects were paid through use of operating-lease funding made available from Verizon Credit. Operating lease payment terms were structured so that monthly energy cost savings exceeded lease payments, yielding immediate positive cash flow, extending through lease completion.
http://www.fypower.org/pdf/CS_Biz_Verizon.pdf

Adobe Headquarters, San Jose, California.
Although not from a college, this example is compelling for anyone considering and energy-efficient building retrofit. After rebates of $389,000, the net cost of all upgrade projects was $1.11 million. Better yet, Adobe now saves $1.2 million per year in reduced energy operating expenses, which translates into 121 percent return on investment and an average payback per project of 9.5 months. The $1.4 million renovation budget was distributed across 64 separate improvement projects, in areas that included:

- Interior and garage lighting
- Energy load management
- Efficient water fixtures
- Weather-based irrigation
- Mechanical system sequencing
- Measurement and verification
- Waste generation management

http://bet.rmi.org/our-work/case-studies/affiliate-case-studies.

Resources:

Financing Sustainability on Campus, by the National Association of College and University Business Officers (2009) provides an overview of the tools, resources, and public policies that colleges and universities need to markedly reduce, or neutralize, their carbon emissions.

Energy Performance Contracting for New Buildings
http://www.rmi.org/images/PDFs/BuildingsLand/D04-23_EleyPerfCntrEFRpt.pdf
Energy Performance Contracting model by the Building Owners and Managers Association and the Clinton Climate Initiative
www.boma.org/RESOURCES/BEPC/Pages/default.aspx

Campus Revolving Loan Fund Guidebook, written by Timothy Den Herder-Thomas and Asa Diebolt in the spring of 2007 while at Macalester College, provides steps for creating a Revolving Loan Fund and case studies of successful Revolving Loans Funds across the country. www.aashe.org/resources/pdf/CERF.pdf

"Dedicated Revolving Loan Fund for Environmental Projects" is case study of the Harvard Green Campus Loan Fund http://www.epa.gov/ne/assistance/univ/pdfs/bmps/Harvard-RevolvingLoanFund1-8-07.pdf

Energy Star "Building Upgrade Manual" (http://www.energystar.gov/index.cfm?c=business.bus_upgrade_manual), see "Staged Approach to Building Upgrades" (http://www.energystar.gov/index.cfm?c=business.EPA_BUM_CH1_Intro#SS_1_2_2)

Revolving Loan Funds
Harvard Green Loan Fund www.greencampus.harvard.edu/gclf
AASHE: http://www.aashe.org/resources/rlfs.php
Iowa: http://www.public.iastate.edu/~nscentral/news/2008/jun/livegreen.shtml

Green Fees
Campus Climate Challenge – (Penn. State Green Fee) http://www.aashe.org/highlights/digest07.php
Tennessee Cluster of Student Green Fees http://www.etsu.edu/environmentalstudies/ice/greenfee.htm
Christian Universities http://www.cccu.org/news/news-ID.492/news_detail.asp
College of William and Mary http://greeningwm.com/green-fees_pass2.html
Green Fee Coalition, Florida http://www.floridagreenfee.com/
TGIF – California Student Sustainability Coalition – UCLA http://www.tgifla.org/

2.3 As a result of strict divisions between capital and operating budgets, funds allocated for operations and maintenance of a new building cannot be used for up-front capital investments that would reduce operating costs over the entire life of the building.

As established throughout this chapter, integrative design to achieve energy efficiency will achieve significant operational costs for the life of the building. Although, in some cases, design features to achieve efficient energy use can actually save capital costs (section 2.16), in other circumstances, additional capital is required to achieve optimum efficiency. When those latter circumstances are coincident with a strictly limited capital budget, decision makers may chose to eliminate energy-efficient aspects of the proposed design. This "value engineering" is seldom done well. The result is often unnecessarily high operating costs for a very long time, a burden that will be carried by future administrators and carbon emissions that need not have occurred. Often the skipped design elements are installed only a year or two later, at much higher costs, when new cash becomes available, which, in the end, is a failure of the financial managers' original planning.

If you find yourself in this situation, consider the alternative financing described in section 2.1. Also, develop a lifecycle cost analysis (LCCA), as described in section 2.5. If these paths do not bear fruit, convene a high level conversation to discuss your LCCA and explore the possibility of breaching the wall between capital and operating budgets. Consider the feasibility of using a portion of today's operating budget to increase the efficiency of the new building and avoid significant operational costs in the future, a one-time expenditure to save ongoing costs.

Whole-building energy modeling and lifecycle costing are crucial parts of the building design process. These, along with the integrative design process, will help to ensure that you are investing in a building with lasting value to the campus. To learn more about the integrated design approach and the integrated team process, refer to the Whole Building Design Guide: http://www.wbdg.org/wbdg_approach.php

2.4 Campus business officers are uncertain about what payback calculations methods and time periods to use when approving design plans for energy-efficient retrofits of existing facilities.

2.5 Short payback times impede investments in more efficacious projects.

Because it is easily applied and easily understood, simple payback is an attractive metric. However, though simple, it's inadequate for such costly and complicated investments as campus building retrofits and when planning the long-term investments required for climate action. Unfortunately, simple payback is commonly overused and overvalued on college and university campuses, just as it is in many businesses.

Simple payback focuses solely on how long it takes to recoup the initial investment. It does not incorporate information about a project's profitability, long-term potential for generating additional savings, or present value. Unless the central decision-making objective is to rapidly recapture invested funds, simple payback is not a useful method to assess projects. More comprehensive metrics should be chosen for determining where to invest limited resources toward carbon neutrality or other long-term carbon goals.

Financial analysis methods that account for long-term profitability and potential future effects on campus carbon management are more appropriate for assessing projects that will move the campus toward carbon reduction goals. For example, lifecycle cost analysis (LCCA) is a whole-systems approach to assessing long-term financial benefits of a variety of projects. It accounts for net present value of capital, future revenue/savings that projects can generate, and all costs and benefits over the life of the project.

Since it gives a more comprehensive and accurate picture of cash flow over the project's entire life, LCCA is more difficult to calculate than simple payback. However, it significantly reduces investment risk by providing more complete information for expensive project options. The Whole Building Design Guide, an online library of tools and resources is an excellent source of information about life cycle cost analysis. It includes a link to download free building lifecycle cost (BLCC) software from the Department of Energy that conducts economic analyses of various projects using LCCA. (See "resources" below.)

Here too is another teaching opportunity: Economics, business and engineering students will be better prepared for their careers if they have opportunities to learn and practice such methods as LCCA while in school. Therefore, working with a class or a student intern to use resources provided by the Whole Building Design Guide supports both education and emissions reduction.

In conjunction with LCCA, there are several other metrics that will give a clearer picture of the benefits and costs of each project option than would be provided by simple payback. These include savings-to-investment ratio (or savings benefit-to –cost ratio), internal rate of return, and net savings (or net benefits).

The following paragraph briefly describes each of the methods/metrics above with a concise discussion on the advantages and usefulness of each[18]:

- **Lifecycle cost analysis (LCCA)** – looks at the total cost of a design choice, including first- cost, operation, maintenance and repair costs, financing costs, and the serviceable life of the design. This is particularly suited for comparing multiple design choices that may have different first costs.
    - **Lifecycle cost (LCC)** – the total discounted dollar costs of owning, operating, maintaining, and disposing of a building or building system.
    - **Levelized cost** – the present value of the total cost of an investment, converted to equal annual payments.
    - **Net present value** – the net result of an investment, expressed in today's dollars; the present value of future cash flows minus the present value of the investment minus any associated future cash outflows.
- **Net savings (NS) or net benefits (NB)** – time-adjusted savings or benefits less time-adjusted differential costs, as compared to a base case; the option with the highest NS will also have the lowest LCC.
- **Return on investment** – the income an investment provides in a year
    - **Adjusted internal rate of return (AIRR)** – annual yield from a project, taking into account reinvestment of interim returns; useful when evaluating two or more design options.
    - **Internal rate of return** – the annual yield from a project, usually expressed as a percentage of the total amount invested; the compound rate of interest which, when used to discount cash flows of an alter native building system, will result in zero net savings (net benefits).
    - **Rate of return on investment** – same as the internal rate of return.
- **Savings to investment ratio (SIR)** – a ratio of economic performance computed from a numerator of discounted energy and/or water savings, plus (less) savings (increases) in other operation-related costs, and a denominator of increased initial investment costs plus (less) increased (decreased) replacement costs, net of residual value (all in present-value terms), as compared with a base case; useful when evaluating two or more design options.
- **Simple payback** – the length of time needed to pay back the initial capital investment, usually expressed in years. This is the simplest form of cost-benefit analysis, and is suitable for small projects and general discussion. Simple payback does not take into account costs or savings beyond the first cost, so is limited in use for more intensive capital investment projects.

Some suggest that including human resource savings in calculations can strengthen the payback picture. Many studies have pointed toward significant occupant-health and productivity benefits. Including these factors in your case, however, may elicit unnecessary and counter-productive arguments about the strength of the evidence of such benefits. In sharp contrast, the business case developed through this chapter is beyond debate.

That said, if you would like to take a closer look at human resource savings, the green building industry now has data for estimating decrease in absenteeism, reduced turnover, and increased productivity. These numbers suggest recurring, long-term savings and may be significant when applied to both staff and students. Since employee salaries far outweigh

[18] http://www.fypower.org/pdf/fincalculators.pdf

construction costs, a 1.5% increase in productivity during the payback period can equal 15% of the cost of construction, and that's at the low end of productivity benefit estimates. A recent study released by Michigan State University (Singh & Syal, 2009) suggests reduction in health problems (including allergies, depression, asthma, and stress) of as much as 25%.

Resources

Additional studies human related to resource savings can be found at:
http://www.cap-e.com/ewebeditpro/items/O59F3481.pdf and http://www.chartwell.org/UserFiles/File/Greening_America_s_Schools.pdf
http://www.cap-e.com/ewebeditpro/items/O59F3259.pdf

The Better Bricks website includes a compelling examination of simple payback and LCCA, which includes a description of the types of projects that are appropriately analyzed by each. http://www.betterbricks.com/track.aspx?link=graphics/assets/documents/BB_CostAnalysis_WWW.pdf

The Whole Building Design Guide includes many useful synopses of economic analysis methods and tools for energy conservation projects. Here is a list of a few of the most relevant:
Detailed description of LCCA and with links to manuals and other in-depth publications: www.wbdg.org/resources/lcca.php
Overview of BLCC analysis software and link to download the software for free from the Department of Energy: http://www.wbdg.org/tools/blcc.php

There is also a "quick" version of the BLCC software for less-detailed analysis: http://apps1.eere.energy.gov/buildings/tools_directory/software.cfm/ID=97/pagename=alpha_list

A transparent, spreadsheet adaptation of the BLCC software, that follows the BLCC procedures, is also available for free download from http://www.doe2.com/, along with supporting documentation.

Example:

Since the University of Vermont established an energy policy in 1990, projects in energy efficiency and smarter energy use have avoided an estimated $1.6 million in electricity costs in 2003 alone. UVM's Energy Management Office in the Physical Plant Department oversees these projects. Funding comes from a $125,000 revolving load fund established in 1992, from bonds in 1995, 1998, and 2002 totaling $2.5million, and by taking longer term and life cycle costs into account in new building construction. The efficiency projects have been conducted with assistance from the Burlington Electric Department (Under Efficiency Vermont) and Vermont Gas Systems, which provide rebates and technical assistance for energy efficiency and conservation.
http://www.uvm.edu/energy/?Page=Energy%20Efficiency%20Projects.html

2.6 The campus lacks the in-house expertise to analyze energy-efficiency opportunities.

A false start and mediocre outcomes can deflate campus enthusiasm for energy efficiency. Detractors may even suggest that weak outcomes demonstrate that energy efficiency is not worth the investing the school's limited resources. Therefore, it's crucial to start out on the right foot. If you don't have in-house capacity to thoroughly analyze campus energy-efficiency opportunities, then hire outside expertise in order to produce results that inspire even greater investment.

For assistance in conducting a rigorous baseline energy audit of your campus, start by contacting your state energy office, which may be interested in collaborating, especially with community colleges, to get the word out about their programs. These programs often provide advise on selecting energy auditors. Some even offer resources and energy audits at below market rates.

Also, engage your energy utility companies. Many provide on-site energy audits, follow-up reports, and guidance on financing and implementation, though often not with a prevailing whole-systems mentality as advocated here, because they are executed by contractors under tight time deadlines.

Consider partnering with an engineering school, whose students and faculty might conduct energy audits as a teaching opportunity. These audits could be used to verify the results of a professional energy audit. Also, you may find a consultant who can work with students to conduct audits, which would cut costs and provide educational co-benefits.

Consider contracting with an energy services company (ESCO). Often, this is done most cost-effectively through an energy performance contract (EPC). (See details on ESCOs and EPCs under section 2.1.) Although ESCOs may provide an effective way to implement energy efficiency measures, campuses should understand the potential pitfalls associated with working with ESCOs. As part of the federal economic recovery program, many states are encouraging performance contracting, offering advice and support to public sector entities that are good candidates for upgrades.

Although ESCOs are helpful for assessing energy saving opportunities related to HVAC systems and lighting, in many cases their focus is primarily on "low-hanging fruit," that is, savings opportunities that offer relatively short-term return. Some may focus on selling clients particular hardware in which they have an interest.

Often ESCOs are less interested in efficiency measures with payback periods longer than five to seven years — measures that would offer adequate returns on investment to such clients as campuses, who will own their building for extended periods.

Also, ESCOs seldom focus their attention on efficiency measures that they are not best positioned to implement or that take longer to diagnose and creatively address, for example, opportunities to improve building envelopes, reduce energy use through saving water, and educate building occupants to conserve. That said, some ESCOs work with their clients to incorporate these larger opportunities into the finished program. However, for this to happen, the client must set up the program to emphasize comprehensive (whole-system) energy master-planning approaches aimed at achieving the deepest cost-effective savings possible over the long term.

Resources

A variety of software programs are available for tracking utility bills and comparing energy use in campus buildings against other similar buildings. They are fairly straightforward to use; some are free, some for sale. Facilities staff, perhaps with support from accounting students, can use one of these programs to enable the energy auditing process and reduce the time that a consultant may need to spend gathering data. For more information about performance indicators that you can track on campus yourself and supporting software options refer to the brief guide, Tools for Energy Efficiency in Campus Buildings, in the Appendix F.

Research:

Although building resource information visualization has been lagging behind in the information revolution, a few technology development firms are filling this gap by providing effective data visualization "dashboards" with features and interfaces tailored to the needs of building owners, operators and occupants.

Most of these products provide energy and other resource-use feedback for building occupants (distinct from building energy management and control systems applications). Better, a number of these products include enhanced visualization to aid building management.

There are several ongoing research efforts in this area[19]. Also, a few universities are developing similar dashboards to track and compare energy use data on campus; examples include University of California at Berkeley[20] and Arizona State University[21].

Some products that are commercially available today include:

- Quality Attributes' GreenTouchscreen and iBPortal dashboards[22]
- Lucid Design Groups Building Dashboard[23]
- Small Energy Groups Pulse Energy Management Software suite that includes modules featuring a dashboard, a facility manager and an executive reporting application[24]

Richland Community College.

- Agilewaves' Resource Monitor and Building Optimization System[25]
- Quality Automation Graphics' Energy Dashboard[26]

Examples

Campus Housing Energy Efficiency Retrofit Program
CHEER achieves energy conservation in college and university housing and dining facilities through student auditing and energy efficiency education. Financial incentives based on student-led retrofits and the program's professional auditing and technical assistance service delivers cost-effective, long-lasting energy and demand savings. http://www.seiinc.org/89-campus-housing-energy-efficiency-program.html

Strategic Energy Innovations and Quantum Energy Services and Technologies has partnered with private California universities, state and federal agencies and technology partners to design and implement campus residence hall energy-efficiency demonstration projects. Based on varying campus characteristics and needs, CHEER has been adapted to fit differing contexts; three case studies (Student Energy Audit Program, University of Redlands Merriam Hall Green Residence Hall Demonstration, and Harvey Mudd College Green Dorm Project) are described in detail in a document available at http://www.seiinc.org/seiblog/wp-content/themes/sei/documents/CHEERCaseStudy.pdf

19 http://www.cbe.berkeley.edu/centerline/winter2009.pdf
20 http://enviro.berkeley.edu/node/2767
21 http://cm.asu.edu/
22 http://www.qualityattributes.com/
23 http://www.luciddesigngroup.com/
24 http://www.smallenergygroup.com/
25 http://www.agilewaves.com/
26 http://www.qualityautomationgraphics.com/

Example of Public Assistance Program:
Energy Efficiency Partnership
This partnership provides personalized on-site technical assistance to public schools, hospitals, colleges and universities, which includes:

- Analysis of utility bills and other building information to determine energy and cost utilization indices of facilities
- Recommended maintenance procedures and capital energy retrofits; design and monitoring of customized procedures to control the run times of energy-using systems
- Informal on-site training for building operators and maintenance staff; follow-up visits to assist with the implementation of the recommendations and to determine savings associated with the project
- Development of an overall Energy Management Policy
- Assistance with the development of guidelines for efficiency levels of future equipment purchases

Services include an analysis of systems for code and standard compliance in areas such as cooling system refrigerants used, outside air quality, and lighting illumination levels. http://www.seco.cpa.state.tx.us/sch-gov_partner.htm

Example of Utility Company Assistance Program:
Pacific Gas and Electric
Through its energy management programs for colleges and universities, PG&E can help decrease energy use and costs by implementing energy-efficiency programs and measures. Lower energy costs leave more funds to meet your campus's educational goals, redirect millions of dollars each year into facilities, professors' salaries, computers, and more, simply by using energy efficiently and by installing energy-efficient equipment. For example, energy-efficient lighting and heating, ventilation and air conditioning (HVAC) systems typically reduce annual utility bills by an average of 20%.

Services include:

- Energy audits (on-site energy audit, integrated energy audit, targeted energy audit)
- Savings by Design, incentives designed for new school construction and modernizations
- Retrofits, incentives designed for smaller projects in existing campus buildings
- Rebates for existing campus facilities' equipment
- Retro-commissioning to optimize the energy efficiency of the equipment on your campus
- Campus housing energy solutions
- Demand-response programs
- Self-generation program
- Climatesmart™ carbon offsets

http://www.pge.com/mybusiness/energysavingsrebates/incentivesbyindustry/education/empcandu/

Example of Graduate Student Assistance:
University of Colorado at Boulder
The University Memorial Center renovation and LEED-EB process was modeled by a graduate student in the college of engineering and applied science for her thesis. Graduate students in building science programs at local universities may be able to help small colleges, community colleges, and technical schools with assessment of energy-efficiency opportunities as part of their thesis work. Developing relationships with engineering and architecture professors in state is often an effective way to gain in-roads and propose thesis projects that may interest their students.

Resources

"Tools for Energy Efficiency in Campus Buildings" in Appendix F.

The Energy Star program provides guidance for increasing energy efficiency in colleges and universities. The link to the pamphlet below provides "low-cost measures" and "cost-effective investments", various Energy Star resources, and suggestions on how to talk about energy efficiency. http://www.energystar.gov/ia/business/challenge/learn_more/HigherEducation.pdf

See http://www.betterbricks.com/DetailPage.aspx?ID=518 for a table that summarizes the capabilities of several software tools that help with utility bill tracking, benchmarking and trend logging.

A more comprehensive list of utility evaluation tools compiled by the U.S. Department of Energy's Energy Efficiency and Renewable Energy Program can be found at:
http://apps1.eere.energy.gov/buildings/tools_directory/subjects.cfm/pagename=subjects/pagename_menu=other_applications/pagename_submenu=utility_evaluation

2.7 Demand for more space is so pressing that campus planners and administrators will not delay their planning process for new facilities in order to incorporate integrative design for energy efficiency.

Administrators and facilities personnel are constantly dealing with requests for more and better space as programs grow and shrink with changes in enrollment, scheduling and curricula. But before planning a new building or addition, conduct a comprehensive space utilization analysis to examine the effective use of existing space, such as classrooms, laboratories, or offices. Such an analysis can provide the basis for a persuasive facility reuse and expansion strategy that will be supported by campus stakeholders, especially if they took part in it.

Such studies record and quantify existing-use patterns, that is, who (what group, department, or class) is using which rooms, at what time duration, and at what capacity for each day of the week. They lead to more efficient use patterns, which may avoid new construction or clarify and justify the need for additional space. Your results may be even more persuasive is your data is tested against peer comparisons or normative standards.

Once the decision is made to remodel a building or build a new one, a threshold understanding is essential: Just as your comprehensive space utilization developed a high level of confidence regarding what to build, an integrative design process will ensure the optimization of how it's built. And this is not just convenient rhetoric. In fact, the design profession has discovered that the additional time required for integrative design is more than made up in reduced coordination and construction time, which results from clear construction documents and decreased change orders during the construction phase.

This phenomenon and related issues are described well by the American Institute at Architects. http://wiki.aia.org/Wiki%20Pages/Integrated%20Project%20Delivery.aspx In particular, note the "Emerging Trends" section.

2.8 Due to lack of swing space, energy-efficient retrofits seem impossible. Instead, incremental, piece-meal improvements are the accepted norm.

Confronted by the genuine challenge of lack of swing space, campus leaders may tend to default to easier, piece-meal energy-efficiency improvements. But those who understand the remarkable power of whole-system retrofits (section 2.1), should prepare flexible and creative responses to this challenge by dealing with the entire campus, not just its buildings, as a whole-system.

Consider the options enumerated below and develop a swing-space[27] plan the works for your unique circumstances. Most important, confide in building occupants regarding the reasons for the retrofits and collaborate with them regarding best combination of ways to accommodate retrofits. Begin that conversation with the following ideas and develop your own:

1. *Use available space more efficiently, including that owned or leased by employees:*
   a. If allowed to telecommute and work flexible hours, some employees will be enthusiastic about temporarily vacating their buildings.
   b. Faculty and staff who will be displaced from their usual offices by a retrofit, but who must work on campus at least some of the time, may use office space freed up by employees in unaffected buildings who are allowed to telecommute and work flexible hours.
   c. Displaced employees may be able to share office-space on alternating days with employees in unaffected buildings who are also allowed to telecommute and work flexible hours.
   d. Some displaced employees might use newly created communal office spaces.

   Online communication systems, video conferencing, instant messaging, IP phones, and online project-management systems can enable telecommuting.

2. *Schedule renovations during campus vacations:* Although this is a widespread approach, it too requires flexibility and adaptation. Many staff members are year-round employees and some faculty members use their offices during campus vacation. However, the number who stay is often relatively small. As a result, they may be able to accommodate the construction disruptions more easily using some of the methods described above.
   Also the relatively small number of students who remain on campus during vacations may be consolidated into a few residential buildings, freeing up vacant dormitories for renovation.

3. *Create "new" spaces:*
   a. Investing in modular swing space to accommodate a series of retrofits over a number of years can be a cost-effective and time-saving. Those unfamiliar with modulars are often surprised to learn of the diverse array of classroom and office spaces now available.
   b. For residential space:
      i. Work with local property management companies to establish attractive bulk rental pricing
      ii. Enter into temporary contracts with under-utilized local hotels
      iii. Convert student lounges temporarily into student rooms
      iv. Alter large student rooms to accommodate additional students.

4. *Schedule renovations* during semesters when student body is smaller or when more students are studying abroad.

Whatever combination of the above solutions you adopt, foster cooperation on the part of the occupants of buildings undergoing retrofits by:

- Planning well ahead in order to minimize disruptions and dislocations;
- Collaborating with building occupants during planning and implementation of changes;
- Informing occupants about the plans and the changes as they take place;
- Assisting faculty and staff in moving office equipment and materials to temporary spaces; and
- Including in staff and faculty job descriptions the need to accommodate retrofits — in effect, change expectations; make the potential for disruption less surprising and more commonplace.

[27] Swing space is a building used to house users of a certain building while that certain building is undergoing renovation.

Examples

Evergreen State College, Olympia, Washington
A group of modular buildings at Evergreen has been set up on campus to accommodate displaced offices while buildings are being renovated. College employees and students rotate in and out of the buildings, which are affectionately called "Geoduck Village" after the school's marine mascot, based on space needs and renovation schedules. The use and acceptance of modular buildings is nothing new at Evergreen. In 1971, a series of modular housing units were built and originally designed as a temporary housing solution. However, "The Mods" have continued to be used as student housing and are desired for their more residential feel than the residence halls.

University of Massachusetts, Amherst
When demand for on-campus housing exceeds supply at U Mass Amherst, creative solutions are employed to house all the students. Common areas and lounges within residence halls are converted into secure student rooms and supplied with the same amenities that are provide in the permanent rooms, including beds, desks, phone and internet connections, and door locks. When really pressed for space, students are temporarily assigned to hotel rooms in the Campus Center Hotel, recently renovated at the heart of campus within the Campus Center-Student Union Complex. While both of these solutions are considered temporary, they give the University flexibility in accommodating students until permanent spaces are found.

Resources

National Clearinghouse for Educational Facilities provides a resource list on portable classrooms and modular construction. Available online at: http://www.edfacilities.org/rl/portable.cfm

2.9 Regulations and approval processes for retrofitting historic buildings with energy-efficiency measures are complicated and arduous.

A commonly held assumption is that historic preservation and energy efficiency necessarily conflict. But the two can be made compatible if the suggestions in this section are followed.

When renovating an historic building, include historic preservation consultants and building-design professionals in the earliest stages of an integrative design process. For more information on the integrative design process, refer to the Whole Building Design Guide (http://www.wbdg.org/wbdg_approach.php).

Develop a strong collaborative relationship with your state's historic preservation officers (SHPO) in order to make them part of the solution, instead of part of the problem. They work with many historic buildings and bring a wealth of experience to the table. Assign a facilities staff person to serve as historic preservation specialist and liaison to the SHPO. This person also should coordinate preservation grants and outreach. Convene an annual meeting to review planned historic-building projects on campus, which would include the SHPO, campus sustainability coordinator, landscape manager, and plant/facilities manager to take advantage of cross-program benefits.

In the request for qualifications (RFQ) and request for proposal (RFP) stages of your project, specify that the chosen design firm must have experience improving the environmental performance of historic buildings. Also, provide motivation for innovative solutions to satisfy aggressive energy performance goals and stringent historic preservation goals.

Many historic building were designed before the era of cheap energy with such climate-responsive features as awnings, natural ventilation, and skylights. Over time, unfortunate renovations covered, blocked, or eliminated these features. Look for opportunities to restore them. Learn how to take advantage of thermal mass in historic masonry buildings.

Assess landscaping; for example, have heritage trees that shaded the building been lost? Landscape restoration and enhancement is a low-cost energy saver for low-rise buildings and improves campus aesthetics.

Accept that, unless seriously deteriorated, window replacement may be one of the hardest energy measures to justify financially. Explore options to re-glaze, rehabilitate, and re-film existing windows for better payback and architectural integrity. Tie window replacement or refurbishment to upcoming HVAC system upgrades, so the load reduction benefits from high performing windows are captured when it is time to replace aging HVAC systems

Make the case for introducing on-site renewable energy generation that is clearly modern, reversible, and located on secondary facades or roofs.

Solicit students from historic-preservation graduate school programs, on campus or from other campuses, to research technical options, and provide documentation for grant submittals.

Develop an understanding of the Secretary of the Interior's Standards for the Treatment of Historic Properties and how they are interpreted. (http://www.nps.gov/history/hps/tps/standguide/)

Participate in historic preservation symposiums and conferences that present campus case studies on historic-building energy retrofits. Learn from other organizations while networking with the SHPO staff.

Participate in next steps of the Pocantico Proclamation, which is a call to action by the preservation community to provide both guidance and participation in addressing climate change as influenced by the built environment. (www.ncptt.nps.gov/pocantico-proclamation-on-sustainability-and-historic-preservation)

Examples

College of William and Mary
One of the oldest historical university campus buildings in America is the Sir Christopher Wren Building (designed between 1695 and 1699) at the College of William and Mary in Virginia. The renovation of this building and other campus historical buildings was arduous and expensive. The university worked closely with architects and contractors to design the renovation and equipment and structural changes that would both ensure historic integrity and reduce operations costs. The project included upgrade of archaic mechanical, electrical and plumbing systems, as well as insulation and stabilization of exterior brick and masonry work. The renovation was particularly expensive due to extraordinary repairs and a strict policy to protect historic materials.

Despite renovation difficulty and expense, the Wren building remains an active part of the campus and is far more manageable than before renovation. Testament to the building's sustainability is the fact that it is functioning well after three centuries. The many different specialists that worked on this renovation believe that teamwork was key in the success of the final product.

University of Michigan, Ann Arbor
The Dana Building of the School of Natural Resources and Environment (SNRE) is a large, 100-year old historical building that, after it was retrofitted, received LEED Gold in construction and performance. It was renovated to create office and classroom space and to optimize its energy performance. Designers increased usable space 20% without expanding the building footprint by adding a fourth floor and replacing the courtyard with offices and classrooms.

SNRE values drove the greening of Dana. The process started with a planning committee of faculty, staff, and students that reflected the school's participatory culture. They aimed for construction and performance goals that would reduce construction debris and waste, increase resource conservation and efficiency, use renewable resources, and improve the quality of the interior space.

The committee pursued its goals throughout the process, from design to material selection. For example, they included fluorescent lamps, radiant cooling and insulation, roof-mounted photovoltaic panels, and a 4,000 square-foot atrium skylight covering the courtyard addition, which reduces the need for artificial light by daylighting interior workspaces.

Guggenheim's second floor classrooms at Colorado State University obtained LEED Silver Certification.

Mechanical and electrical systems were tailored to individual workspaces through digital control Water-efficiency features include low-flow fixtures, waterless urinals, and composting toilets. Also, native plants minimize water use. The committee's sustainable materials policy reused as much material from the old building as possible and the other materials used were either renewable or recycled materials. Notably, the windows from the renovated courtyard were donated to a local nonprofit and diverted more than 3,000 pounds alone from the landfill.

Sarah Lawrence College
The 2008 renovation of Warren House residence hall at Sarah Lawrence maintained the building's original structure and historical appearance. This small-scale retrofit included insulation, energy-efficient kitchen appliances, a 500-gallon rain catchment tank, and a solar hot water system. Additionally, residents of Warren House, now called Warren Green, agree to maintain an eco-friendly and aware environment.

Resources:

An article titled "Historic Preservation and Green Building: A Lasting Relationship" written by Tristan Roberts and published in Environmental Building News in 2007 summarizes several examples of successful green historic renovation projects and may serve as an inspiration to campus decision makers. It is available for download at www.preservationnation.org/issues/sustainability/additional-resources/HPandGreenBuildingArticle.pdf

Sustainable Historic Preservation, Whole Building Design Guide, 2008, contains the following points: Historic buildings are inherently sustainable. Preservation maximizes the use of existing materials and infrastructure, reduces waste, and preserves the historic character of older towns and cities. The energy embedded in an existing building can be 30% of the embedded energy of maintenance and operations for the entire life of the building. Sustainability begins with preservation. Historic buildings were traditionally designed with many sustainable features that responded to climate and site. When effectively restored and reused, these features can bring about substantial energy savings. Taking into account historic buildings' original climatic adaptations, today's sustainable technology can supplement inherent sustainable features without compromising unique historic character. http://www.wbdg.org/resources/sustainable_hp.php

The National Trust for Historic Preservation website. http://www.preservationnation.org/issues/sustainability/

As this report nears completion, federal legislation is pending that would make significant funding awards available to improve the energy performance of existing buildings, with awards covering the highest proportion of retrofit costs targeted for buildings listed in or eligible for listing in the National Register of Historic Places. The American Clean Energy and Security Act of 2009, pending at the time of this publication, could provide $2.5 billion to states annually from FY2010-FY2013 for retrofits that improve building efficiency. The awards would be made through state energy offices. The amount of each award to a building owner would be dependent on the overall percentage of improved efficiency.

2.10 Academic departments have little incentive to conserve energy when they do not control their utility budgets. Similarly, students may not be motivated to manage their energy use if they don't see the bill for it.

Discussed in section 2.14, sub-metering is a key enabler of conservation behavior. Billing departments for their energy use, based on accurate measurement in each department's space, motivates energy conservation by fostering financial ownership of their energy consumption, especially if all or a portion of savings achieved through energy conservation are returned to the thrifty department's budget.

However, because energy was so inexpensive until recently, few campuses sub-meter by department or floor. Many do not even meter individual buildings. (This is not to suggest that colleges and universities are unusually wasteful; few corporations and governments sub-meter their many buildings. So, lessons learned on campus have many applications, for example in campuses' host communities.)

Without meters measuring energy use in the various departments' specific spaces, it is impossible to accurately bill those departments for their utility use. When meters measure energy use for individual buildings, it is possible to estimate each department use, based on the percent of the building each occupies. But the resulting numbers would not account for one department's particularly intensive end-uses (e.g. laboratory fume hoods), or another's profligacy. As a result, on most campuses, department heads see no connection between energy and their financial resources because energy use does not affect departmental budgets.

Therefore, in order to develop market mechanisms, and to encourage energy accountability and competition for energy conservation, discrete metering is essential.

Periodic or real-time feedback on a building's energy consumption can spark the competitive spirit and curiosity of building occupants. A growing number of campuses hold annual energy competitions among residence halls as a way to engage students in conservation. These competitions require meters, at least at the building level. The building that consumes the least energy on a per student basis is rewarded with recognition and some kind of celebration. Some schools are also issuing awards to faculty and staff for reducing energy waste and improving energy efficiency in their buildings.

Setting up a system of volunteer building representatives can foster communication between the facilities department and building occupant. Ongoing interest in energy issues can be supported and nurtured. For an example of an effective building representatives program see the example of Tufts Eco-Ambassadors in section 2.15.

Personalized warnings or citations for wasting energy can also be effective, especially when delivered by students. Also, when building occupants sign a pledge to participate in energy conservation and select specific actions, they tend to hold themselves accountable. When a pledge lacks measurement and feedback mechanisms, it may be less effective.

Examples

Harvard University
In conjunction with a comprehensive installation of metering equipment across campus, Harvard has implemented a new utility billing system that charges departments based on their actual energy use. The new software system, called Energy Witness®, provides real-time energy use information that enables continuous monitoring of steam, electricity, and chilled water. Anyone with a Harvard ID and PIN can log into the system to access reports on current and historical energy use for any metered building on campus. Additional data can be sorted and displayed, depending on user needs, including energy costs, energy baseline information, and greenhouse gas emissions. Since energy costs are allocated based on accurate consumption data, rather than estimated based on square footage, efforts to conserve energy are immediately rewarded in lower utility bills.

Luther College, Decorah, Iowa
The spirit of competition was elevated in order to encourage energy conservation at Luther College. Through a student-led initiative that was supported by faculty and staff, a long-standing rivalry between Luther College and Wartburg College was extended beyond the athletic fields into a head-to-head competition to reduce the most overall energy usage. For one month, each school tracked its electric and natural gas consumption and compared those figures with usage from the previous year. At Luther, this Energy Challenge was conducted in coordination with a month long program of educational events and activities, including electricity and water fairs, room audits measuring energy use, a film series, presentations, and another energy competition between the floors of each residence hall.

Although the Energy Challenge ended in a tie, with Luther winning out in gas consumption and Wartburg in electricity use, the competition was considered a success by both schools for raising the level of energy awareness. Representatives from each school who participated in the energy tracking efforts learned how complex and challenging it can be to track energy use and campus carbon footprints. The focused competition with one other school fueled creative promotional and educational campaigns, such as "Turn off Wartburg", which encouraged people to turn off the lights. Building on the existing rivalry sparked additional excitement and motivated people to make extra efforts to find changes they could make to reduce their own energy consumption.

University of Colorado at Boulder
CU Boulder gives annual awards to employees who take on the responsibility of reducing energy consumption in their buildings. The volunteer building proctors can receive the Buff Energy Star award (and its associated $1,000 cash bonus) if they complete all of the program criteria:

- Conduct an energy audit with staff from the Office of Campus Resource Conservation
- Implement energy-saving actions identified in the energy audit
- Post educational materials in the building and take an active role in communication and encouraging resource conservatiom
- Reduce energy consumption by 5% from the previous fiscal year

Specific activities that have resulted in energy savings have included turning off lights when not in use, enabling power-management features on computers, relying on more daylight, and reporting energy waste to the campus conservation hotline. While these may seem like small efforts, the cumulative impact has been significant. Since the program began in 2004, the combined efforts of the Buff Energy Star program participants has resulted in a total energy savings of more than 1.7 million kilowatt hours, a total cost savings of some $205,000, and a total reduction of more than 3.5 million pounds of carbon dioxide emissions. Details of the program can be found at: http://www.colorado.edu/facilitiesmanagement/about/conservation/energystar.html

University of California, San Diego
After repeatedly noticing lights left on at night in campus buildings, students in the Green Campus Club at UC San Diego decided to take action. They began conducting weekly late-night patrols of administrative, lab, and housing buildings and citing specific instances of energy waste with "Power Fouls." When lights, computers, or other office equipment were found left on, a Power Foul citation was posted next to it identifying the infraction, the location, and the date, as well as contact info and resources for learning about energy conservation. The Power Foul Patrols have been successful in raising awareness and changing energy-wasting behavior, as evidenced by a reduction in the number of notices they leave in particular buildings throughout the year. A similar idea has been implemented at CU Boulder where a telephone hotline and email inbox have been set up for the campus community to report energy-waste complaints.

Tufts University
In 2001, the Tufts Climate Initiative (TCI), a staffed environmental education program that was a pre-cursor to the Office of Sustainability, started a new program to engage undergraduate students in learning about environmental issues and actively greening their dorms. Through this effort, the Eco-Representative Student Program model was born (Eco-Reps). Student Eco-Reps met bi-weekly to discuss topics ranging from recycling to climate change. At each meeting, the students received project sheets listing activities to organize in their dorms over the following two weeks. The Eco-Reps were each paid a stipend for their participation in the program and given enough flexibility to be creative in their peer-to-peer outreach efforts. Based on Tufts successful pilot program,

the Eco-Reps model has now been widely adapted at schools around the nation.

Tufts has recently gone one step further and created a similar program for staff members in various departments. The Eco-Ambassadors program aims to spread green thinking on campus by empowering office representatives to communicate about sustainability initiatives and encourage conservation behaviors. In the first year of this peer-to-peer education program, 2008, fourteen Eco-Ambassadors from administrative and other offices attended regular meetings and led green initiatives in their offices. The program also includes field trips, movies, workshops and learning sessions that are open to all Tufts staff members. One of the Eco-Ambassadors with whom we spoke in 2009 was grateful to the Tufts Office of Sustainability for creating the program. She had been trying to encourage conservation behaviors in her office for some time but has found that her cohorts are more likely to participate now that there is an official Tufts initiative backing her efforts.
http://sustainability.tufts.edu/?pid=106

Resources

Oberlin Campus Resource Monitoring System as an example of a well-developed, annual dorm energy competition: http://www.oberlin.edu/dormenergy/

Journal Article from International Journal of Sustainability in Higher Education: Peterson, J.E., Shunturov, V., Janda, K., Platt, G., & Weinberger, K. (2007). Dormitory residents reduce electricity consumption when exposed to real-time visual feedback and incentives. International Journal of Sustainability in Higher Education, 8:1, pp. 16-33.

Furman University HVAC

2.11 Students, faculty and administrators may not find energy-efficiency projects as attractive as more visible renewable-energy projects.

As a result of the relative invisibility of energy-efficiency projects, students, faculty and administrators may not prioritize such improvements over such visible projects as wind turbines or solar collectors.

We regard this as a marketing problem for which we have seen no clear solution. The reality is that energy efficiency is not an overtly tangible phenomenon that one can see and feel. Saved energy is more abstract than consumed energy. Most hybrid vehicles look no different than their more profligate counterparts. A retrofitted building looks different only at the margins and only to people who know where to look. Worse, only a small portion of the public understands that a significant portion of the climate crisis can be mitigated through efficiency. As a result, efficiency is seldom as appealing to the public as renewable sources.

Fortunately, this marketing problem is far more manageable on a campus than in the nation at large. Well presented, efficiency costs and benefits can be understood by the small and sophisticated population of campus stakeholders. In order to abate carbon in the most cost-effective manner, their understanding is crucial. Only when one has reduced the energy use in buildings to the extent feasible through efficiency, should one consider other options such as on-site generation, green power purchases, or carbon credits — all of which will reduced in scale, once efficiency measures are in place.

It's incumbent on all climate-mitigation advocates to find ways to communicate this message to their particular campus stakeholders. Lack of understanding does not change the fact that saving (or not using) energy is the cleanest and most abundant means of climate mitigation available. It's cheaper than buying any form of energy including wind and solar. And "state-of-the-shelf" technology is available right now. It doesn't depend on some promising future scientific breakthrough.

One effective way to make energy use, and by implication energy efficiency, visible is through the installation of "dashboards" that help visualize building energy use. A few technology development firms are filling the gap in resource-use visualization by providing effective data visualization "dashboards" with features and interfaces tailored to the needs of building owners, operators and occupants. Most of these products are aimed primarily at providing resource-use feedback for building occupants and operators. These have been described under research, in section 2.6.

Research:

This is an area in which further research — or better said, development — by social scientists and artists could be extraordinarily beneficial: Finding ways to make energy efficiency more tangible and perhaps visible to the general public and

Empire State Building.

to key stakeholders. One promising direction is to emphasize comfort rather than, or in addition to, energy savings; properly insulated and daylit buildings are more comfortable.

2.12 Heating and cooling equipment is oversized and therefore operating in inefficient regimes. Improvements to building efficiency will reduce demand for the equipment making its operation even less efficient.

Older buildings often include oversized chillers and boilers that waste energy in part because they are not operating in their design regime. These inefficiencies would be compounded, or if the equipment was right-sized, created by sensible building-efficiency and load-reduction measures.

This in another area in which there is significant potential for cost and carbon savings. Before launching any significant work on boilers and chillers, consider the respective lifecycles of the various inter-related building and HVAC systems. Consider how those systems have been controlled (often badly) and how they are actually operating. Consider impacts from upstream systems and impacts on downstream systems, especially in terms of potential to reduce cooling or heating loads. Also, synchronize replacement cycles to determine if the best option is replacement with down-sized equipment or retrofits enabling better performance under part load (e.g., variable frequency drives [VFDs]) or even in some cases no-fits – making the equipment unnecessary.

Considered in isolation, chillers that are more than ten years old are often candidates for replacement or refurbishment; those less than ten years old are good candidates for refitting with more efficient VFDs. However, if other building systems that contribute to cooling load (e.g., envelope, equipment, lighting) are being upgraded around the same time frame (+/- five years), then the chiller might be a candidate for replacement (or shutdown if there is more than one) in order to significantly reduce cooling capacity. Conversely, campuses with central chiller plants might explore the relative economics of upgrading poorly performing, high-load buildings rather than expanding the plant when new buildings require additional capacity.

The same part-load benefits are available for boilers: Combustion air blowers on boilers typically operate at constant speeds even though the boiler firing-rate might vary based on loads. Usually, a damper is modulated or inlet vane positions are varied in order to vary the amount of air drawn by the blower. It is more efficient to vary the speed of the blower instead, by installing a VFD on the combustion air blower fan. Specific circumstances are important of course, for instance sometimes it may be more expensive to install VFDs, especially if inlet vanes exist.

Examples:

Although several of these examples are obviously not campus buildings, each provides powerful evidence of the efficacy and business value of energy-efficient retrofits. The business people who approved these retrofits may have been even tougher than your campus CFO.

<u>One America Plaza, San Diego</u>
Retrofit of two 1,000-ton chillers with 1,000 HP VFDs in this San Diego office building is estimated to yield $500,000 in annual energy savings with a 2.5 year payback, which is to ~1.5 years with rising electricity prices:
http://www.automatedbuildings.com/news/sep01/art/abb/abb.htm

<u>The Mirage, Las Vegas</u>
Retrofit of two of six 1,320-ton chillers with VFDs at Las Vegas resort to save $264,000 annually in energy costs:
http://www.allbusiness.com/energy-utilities/energy-utility-regulation-policy/12777938-1.html

<u>University of Texas at Austin</u>
Retrofit of 150,000 lb boiler with VFD yields $500,000 in annual savings:
www.abb-drives.com/StdDrives/RestrictedPages/Marketing/Documentation/Documents/LVD-EOFC01U-EN_REVA_WEB.pdf

Duke University, Durham, North Carolina
Variable frequency drives (VFDs) installed on two feedwater pumps and on three boilers' induced draft fans have produced a $44,286 annual electricity savings:
http://www.duke.edu/sustainability/campus_initiatives/energy/steamplant.html

Empire State Building, New York
The owner of this iconic skyscraper, which is currently undergoing a multi-year capital upgrade program, is carrying out a deep energy retrofit in sync with renovation plans. The energy-efficiency building-retrofit program will save 38% of the energy use, or ~$4.4 million with an effective simple payback of 3 years for the added cost of energy efficiency measures. Integrative design yields 2 to 3 times the savings that are usually found cost-effective in energy-efficiency building-retrofit projects. Over 6,500 of the building's windows will be remanufactured on site into super-windows that cut the winter heat loss by two-thirds and the summer heat gain by half. Coupled with high-efficiency lighting office equipment, this reduces the building-wide cooling load by a third (~38%). As a result, aging chillers can be reduced and rebuilt in place instead of being expanded and replaced with bigger ones, thereby saving capital that helps pay for the other improvements.

Resource:

Introduction to Variable Frequency Drives:
http://oee.nrcan.gc.ca/industrial/equipment/vfd/index.cfm?attr=24

2.13 Metering energy performance is not a priority.

To some people, committing limited campus capital to installing meters may seem off purpose. A meter won't reduce carbon emissions, while using the same money to install efficiency measures will.

Although this point of view seems reasonable, it is short-term thinking that, over time, will mitigate less carbon per dollar invested. As the adage goes, "you cannot manage what you do not measure." Unless energy performance is measured and documented, there is no way to manage for improvement. Three primary factors drive campus interest in metering energy use in buildings: behavior, evidence, and targeting.

Behavior: Providing building users with feedback on their energy use consistently changes their behavior. Despite keen interest in energy, most of us have very little idea of the how much energy each of our activities actually consumes. We don't know how much it costs, for example, to leave a light or a television on. Most important though: when we do know the numbers, we tend to conserve. For example, various studies have shown a reduction in home energy use of 4 to15% through use of home energy displays.[28]

[28] Jan Borstein, Karen Blackmore (2008) In-Home Display Units: An Evolving Market.

If you've driven one of the new generation of hybrid automobiles with an instant dashboard reading of fuel efficiency, you've already experienced this phenomenon. Drivers with these dashboard devices consistently report making an effort to reduce fuel consumption. Meters offer feedback, a critical element of whole-system thinking: System intelligence requires feedback. Conversely, a system without feedback is genuinely ignorant.

Some campuses take a market approach to reduce energy use. They use a charge-back system in which each department is billed for its actual use instead of the more typical approach in which all departments are charged a common fee for energy use. Most important, these same schools reward departments for conservation by crediting them for energy savings. Like individuals, groups of people with a common goal will save energy when they understand their use and are rewarded for saving. Such an approach, however, requires metering of each department's facilities, which requires a meter for each building and sub-metering where individual buildings house multiple departments.

One technique used on many campuses to reduce energy use in dorms is energy-use competitions. Such a contest requires meters on each dorm or even on each floor of each dorm.

Evidence: A second compelling motivation for metering buildings is to provide unequivocal evidence that a continuing retrofit program will offer outstanding return on investment. Meters give you the capability to measure and verify actual savings by tracking energy use before and after an energy-efficient building retrofit, which can be accomplished with relatively inexpensive meters on each building.

It is interesting to note that the budget for sustainability coordinators in some cities relies heavily on savings generated by energy efficiency, often evidenced by meters.

Targeting: Metering helps achieve the best performance with the least expenditure. Your facilities team will use meters to better understand building systems, notice when something is malfunctioning and when there are abnormal readings that require investigation. They will target the specific areas where energy savings and GHG reductions can best be achieved, so you can confidently spend your limited money well.

If you don't feel a need to alter behavior by displaying energy performance on each building, you can save money by purchasing portable loggers that your facilities team plugs into each building, analogous to the way your mechanic reads your car's computer.

Determining what to meter and the best way to meter depends on your particular circumstances and your reasons for metering. It requires the advice of someone familiar with the wide range of options, possibly campus facilities staff. If such a person is not available on staff, then a consultant may be required. It's well worth investigating the new systems for sub-metering that are coming out every day. (See research)

Gregg Coffin, University of Missouri's power plant manager in the plant's control room.

Using the data: We heard from a few engineers who install these metering systems. They said that some campuses are not using the data generated by their systems. Facilities teams just keep doing what they did before meters were installed. The campuses installed the hardware, but didn't institutionalize use of the newly acquired data. The lesson is clear: Metering is useful only if staff institutionalize its use.

Examples:

Mount Holyoke College, South Hadley, Massachusetts
The Kill-a-Watt Energy Conservation Competition at Mount Holyoke is one of the nation's longest running programs for reducing college students' ecological footprints. Each month, $100 is awarded to the dorm that most reduces its energy use compared to the same month the year before. http://www.mtholyoke.edu/offices/es/10715.shtml

Bowdoin College, Brunswick, Maine
This school purchased Kill-A-Watt meters for most of it dormitories. By presenting their Bowdoin ID card, students, faculty, and staff can check Kill-A-Watt meters and instructions. http://library.bowdoin.edu/news/kill-a-watt.shtml http://www.p3international.com/products/special/P4400/P4400%E2%80%90CE.html

2.14 Campus leaders think energy management systems are prohibitively expensive.

Energy management systems (a.k.a. building automation systems) allow campus engineers to monitor equipment for wasted energy and to program mechanical systems for efficient use. Additionally, they provide accurate and regular data on energy consumption for different building end-uses. These systems generally pay back rapidly on a campus with a facilities management department that carefully uses of the system to balance energy use and identify investment opportunities for further increases in resource efficiency.

As with the best of whole-systems investments, these sophisticated systems can offer multiple benefits from single investments, including security, comfort, safety (fire and carbon monoxide monitoring), and energy efficiency.

Although security and safety aspects are generally well known, the comfort aspect may not be fully understood by those unfamiliar with building operations. The campus facilities team can describe in exhaustive detail the ongoing complaints it receives from occupants in one area of the building who are too cold, while those in another section complain of the heat. On many campuses, it's not unusual to see windows open in the dead of winter.

Facilities teams are often caught between irate faculty and a building that can't deliver comfort to everyone. Unfairly, they take the blame for poorly designed buildings. Spending all day rushing from problem to problem and disappointing building occupants through no fault of their own, they can become discouraged. In contrast, facilities teams in schools with energy management systems and efficient buildings are enthusiastic about their work; because they are able to actually solve people's problems, they know they are regarded as competent.

And the comfort issue is also an energy-consumption issue: Frustrated occupants often bring in their own portable heaters and coolers, which are extraordinarily inefficient and burden the building's plug load. Energy management systems can go a long way to solving these issues.

A wise approach is to install energy meters over time and supplement them with control systems, beginning in buildings where metering shows energy consumption to be most intense. Incremental installation of these systems can be effective if a process or master plan is established from the outset to ensure compatibility and computerized communication between systems across campus.

Finding the Capital
There are a few creative ways to finance the installation of metering and control systems when up-front capital is not available. Energy Service Companies (ESCOs) can incorporate

Low-bid Pitfall:

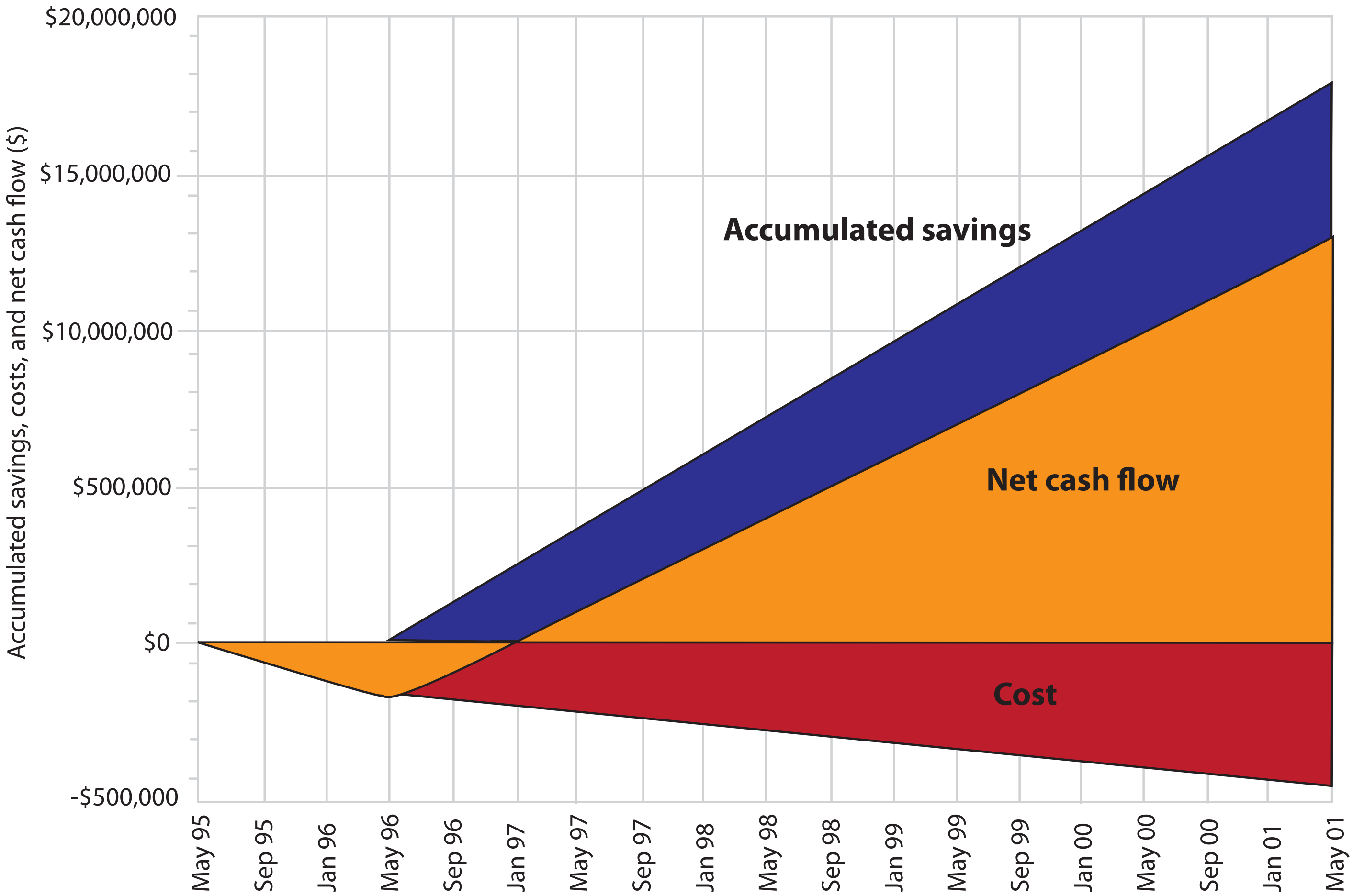
Total Design Fees

÷

Average hourly rate

=

Time spent on your project by the design firm



Accumulated savings and net cash flow from the Texas A&M campus-wide metering system.

installation into an Energy Performance Contract (EPC) in which the ESCO helps secure third-party financing for the up-front cost. Banks and third-party financiers offer these loans at attractive rates because ESCOs provide a savings guarantee and will pay any shortfall that may occur, which ensures that the customer will have a cash stream, which in turn significantly reduces risk of default

Each leaky building can be transformed from a burden to a business opportunity.

In some cases, utility companies may be willing to install more extensive meters at no cost to the campus, although though this practice is not yet very common. Today, utilities are pursuing significant federal and state funding to deploy advanced metering infrastructure. If utility-owned meters are not an option for all campus buildings, there may be rebates or other incentives for meter and control installation.

Demand-response (DR) is a relatively new concept that describes a relationship between the utility and the user. It refers to changes in electric usage by end-use customers from their normal consumption patterns in response to changes in the price of electricity over time, and to incentive payments designed to induce lower electricity use at times of high wholesale market prices or when system reliability is jeopardized. It need not inconvenience users; the relationship can be set up so that, for example, a water heater or air conditioner can be turned off remotely for, say, 15 minutes. Or such loads as air handlers can be coordinated so that all are not operating at any one time, which is called "load rolling."

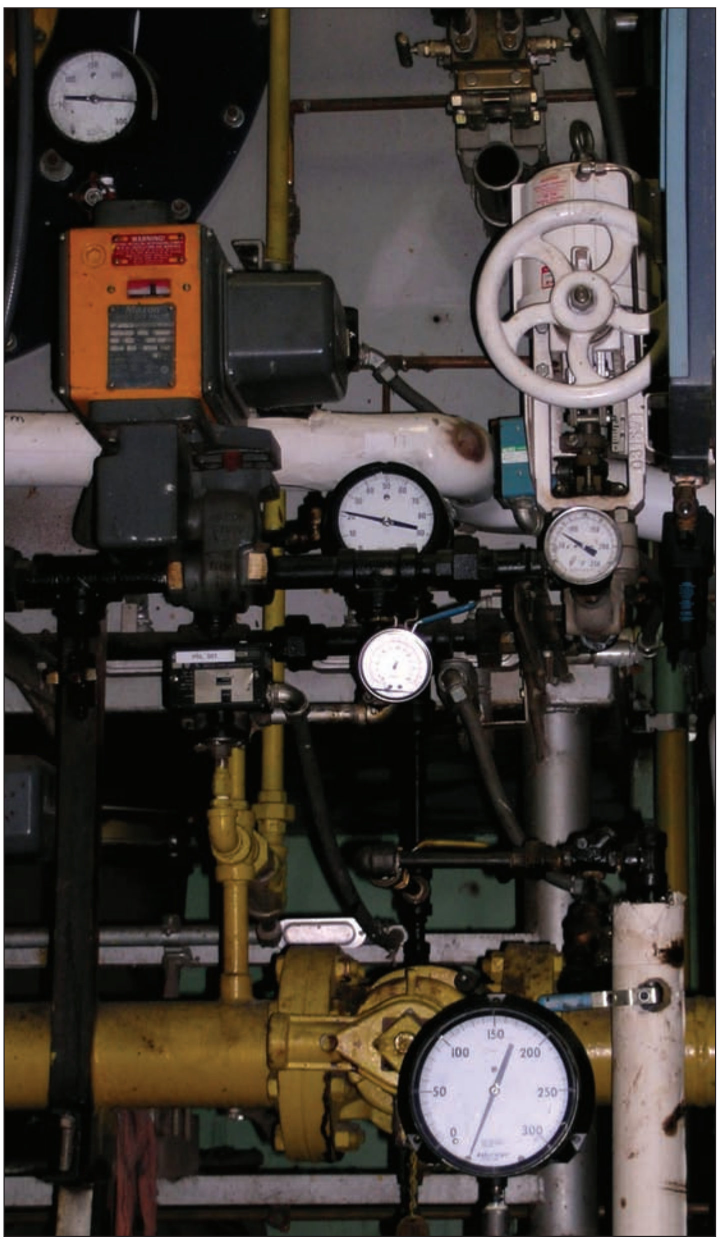
Using DR, utilities and DR aggregation companies pay campuses to reduce electricity usage during times of peak demand. That reduction is automated by campus building control systems in order to avoid inconveniencing campus users. By entering into a DR contract, the institution reduces peak electricity demand and the need for new fossil-fuel power plants. Also, it secures new revenue streams, helps protect the local region from brownouts, and helps stabilize regional electric rates.

Examples

University of Missouri at Columbia

Since 1990, Mizzou has relied on metering and automated building control systems to prioritize projects for their award winning energy management program. Since inception, the program has saved $32 million in energy costs, achieving on average a 1.6% reduction in annual energy consumption. Without the metering and control systems that have allowed engineers to monitor opportunities to cut energy usage, the program would not have produced these results. Over a number of years, the facilities management department outfitted several buildings with computerized controls and installed building-level steam, electricity, chilled water and water meters for every building on campus.

Here's one way in which Mizzou's sophisticated system has paid off: The campus has achieved a favorable payback by installing air-handler controls at the room level in zone-controlled buildings — which also gives the facilities team the capacity to ensure comfort throughout the building. They were able to do this, in part, because they have the expertise to design controls for each building, and to install and program the controls themselves. Also, they have a long-standing, pre-negotiated contract with Johnson Controls to purchase new control equipment at a low price. In-house expertise and a bulk-purchasing contract were both established early when the university committed to installing an extensive controls system throughout campus. Both have significantly lowered the cost barriers to installing the control system.



Harvard University

The Green Campus Loan Fund (GCLF) at Harvard provides up-front capital to cover the cost of metering systems and other energy-efficiency projects in campus buildings. In order to qualify for a loan, a project must have a projected payback of less than ten years. Since metering with real-time feedback to building users is an effective way to track and reduce energy usage and produce cost savings, the GCLF has funded and recouped savings from these types of projects.

While tunneling through the cost barrier is easier to achieve in new building design, similar whole-system savings can also be achieved in existing buildings by planning energy-efficiency retrofits to be part of systems replacement cycles.

Texas A&M University

In the mid-1990s, the university invested in a campus-wide energy-metering system. The overall cost of installation for 600 meters was approximately $1.2 million. Based on the expectation that metering would empower campus engineers to achieve large energy savings in the near term, campus officials justified taking the up-front capital for the project from the future operating budget where the financial benefit would be realized. The metering data quickly lead to decisions to tune the central plant and re-commission some buildings for an additional investment of approximately $1.8 million. The investments in this successful metering system generated over $15 million in savings by 2000. http://www.sustainablefacility.com/Articles/Feature_Article/972fcc4d8de38010Vgn VCM100000f932a8c0____

Resources

Sub-Metering Energy Use in Colleges and Universities: Incentives and Challenges- A Resource Document for Energy, Facility and Financial Managers from the U.S. Environmental Protection Agency's ENERGY STAR®: This resource report provides an overview of the business, engineering and management benefits of sub-metering, suggestions on how to overcome cost barriers, cost estimates for electricity submeter installation on a college campus, two case studies, and a list of electricity sub-meter system manufacturers. http://www.energystar.gov/ia/business/higher_ed/Submeter_energy_use.pdf

An advanced metering pilot project in Europe demonstrated that consumers used 5% to 15% less electricity as a result of direct feedback about their electricity consumption.[29]

[29] Darby, Sarah. Making it Obvious: Designing Feedback into Energy Consumption. The Environmental Change Institute, University of Oxford, 2001

New LEED building with lights on despite full daylight

Another pilot conducted by Hydro One, an Ontario, Canada, utility, found that average energy consumption dropped by 6.5% when customers had access to real time monitoring.[30]

New England's Best Management Practices for Colleges and Universities series, "Energy: Sub-metering Campus Buildings" http://www.epa.gov/ne/assistance/univ/pdfs/bmps/SCSUSubmetering1-8-07.pdf gives a description of how sub-metering was essential to identifying energy-saving opportunities and quantifying potential benefits at Southern Connecticut State University. Available at

Research

Although metering at the building-level is generally considered cost-effective and beneficial for campus energy management programs, more research is needed to verify the benefits of sub-metering within a building.

The industry of low-cost, wireless building control systems is growing rapidly. In a few years these systems may become more commonplace. Keep an eye on research underway by Arch Rock[31], Google.org, Tendril and others, often using the Zigbee low-power-wireless standard, in the area of small, inexpensive energy measurement and management systems.

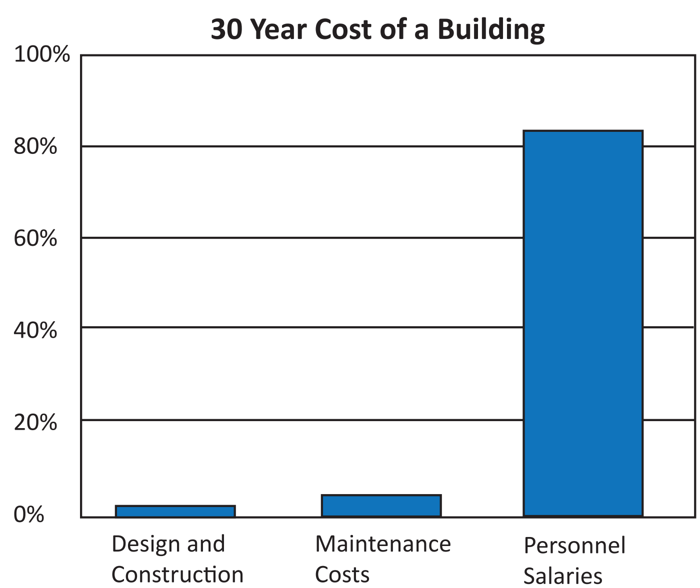
2.15 Buildings are seriously out of balance due to haphazard additions of internal walls. As a result, the facilities staff does not have time to plan ahead; they spend most of their time responding to complaints and fixing immediate problems.

Where buildings have been allowed to become so dysfunctional that the facilities department is primarily responding to complaints and problems, outside help is needed: Contract with a re-commissioning agent to test and balance buildings, beginning with those that require the most attention due to complaints and urgent repairs. In some cases, re-commissioning may be a service that your existing facilities management team could provide or assist, which will reduce consulting costs. For the longer term, you may want to considering hiring someone with, or training existing staff to develop, re-commissioning skills.

Like energy retrofits, re-commissioning is literally an investment that offers a financial return. And it generally pays back relatively quickly. It offers two ways to save: first, by reducing energy waste in the affected buildings and, second, by increasing productivity of the facilities department. In some cases, it may be possible for employees in some unbalanced buildings to work from home while the facilities department addresses the problems.

To prevent incremental building alterations from causing this situation to recur, develop a formal review process. It would include assessing impacts of alterations on building comfort and energy use, communicating with building occupants, tracking work plans, and denying requests that compromise building function. An engineer should be included in the process of redesigning any space. Also, installation of automated building control systems will expedite maintenance of mechanical systems (for more on this topic see section 2.14).

Ongoing, two-way communication between building occupants and the facilities department can contain and reduce concerns and complaints from building occupants. When occupants have regular access to information about building operations including options for improving their comfort, reasons for discomfort, reasons for changes in the building, and answers their questions they tend to be more tolerant and cooperative, which will improve efficiency of response to complaints, which, in turn, will free up time to focus on strategies for reducing campus emissions.



Over a 30-year period, initial building costs account for about 2% of the total, while operations and maintenance costs equal 6%.
Source: Sustainable Building Technical Manual

[30] Hydro One, The Impact of Real Time Feedback on Residential Electricity Consumption: The Hydro One Pilot, March 2006.
[31] http://www.archrock.com/products/

Examples

University of Missouri, Columbia
The Energy Management Department of Campus Facilities has established a formal energy conservation program. As part of the program, staff work to reduce campus energy use and lower the overall cost of supplying energy to the campus. Staff skills employed across campus include design, installation, and maintenance of building automation systems, as well as testing, adjusting, and balancing of HVAC systems. Mizzou estimates that they can conduct these commissioning activities on both new construction and renovation projects in-house at about half the cost of hiring an outside contractor.

Tufts University
The Eco-Ambassadors program educates staff members about sustainability issues and connects them with campus resources and programs. Employees in the Office of Sustainability noticed that, while students had access to information through their classes and clubs, staff didn't have similar opportunities to learn about environmental issues and actions. Staff members were considered an important target audience because they're less transient than students and, therefore, have greater potential for implementing lasting changes at Tufts and developing a culture where sustainability is the first thought, not just an afterthought.

Kroon Hall, Yale School of Forestry & Environmental Studies, is seeking LEED Platinum.

Davis Center at University of Vermont is the first LEED Gold student center in the U.S.

Volunteers in the Eco-Ambassadors program participate in a series of educational events, including presentations, discussions, and field trips, on topics such as energy use and management, recycling, green purchasing, and campus-wide sustainability initiatives. They then work to communicate what they have learned to their colleagues and implement actions to make their workplaces more sustainable. Participants may also apply for small grants through the program to get their own initiatives started. By participating in the program, the Eco-Ambassadors themselves become resources on sustainability within their offices or departments. Details of the program can be found at http://sustainability.tufts.edu/?pid=10&c=16

Yale University , New Haven, CT
Until relatively recently, the building design process at Yale, like most schools, was fragmented and linear; environmental design ideas were often characterized as expensive extras. But more recently, as the campus planning and design process has become more integrative, senior engineers and planners describe a noticeable shift and a palpable change in the attitudes of financial administrators. The university assembles a design team to collaborate before a building's design process even begins. Sustainability design charrettes are a regular part of the planning process for new buildings and renovations. Financial decision makers are including slightly higher predictions for energy price escalation (approximately 5% as opposed to the 3% rule of thumb). One engineer cited two reasons in particular for these marked changes: economic success of earlier LEED buildings measured by return on investment; and strong support from Yale's president.

Yale planners assess prospective energy-efficiency measures in the context of all the systems in a building. Rather than looking at the simple payback or the return on investment for any one component, they consider the effect of a given measure on necessary investments over the 80-year life of a building. For instance, when choosing between a variable air volume system (VAV) and a displacement air system, they do not insist that their choice pay back in less than ten years. Instead, they seek a system that will be reliable, durable, and energy-efficient.

To support major renovations, Yale charges an annual, internal "tax" to each department based its building square footage. This capital replacement charge helps the university avoid the trap of deferred maintenance backlogs that burden so many institutions. The funds collected are set aside and used for building system overhauls, which are set at around 40 years for classroom and office buildings, and 30 years for scientific laboratory buildings. For a break down of the avoided emissions, capital costs and bundled simple paybacks for Yale's technical greenhouse gas reduction measures refer to http://www.yale.edu/sustainability/GHGReductionMeasures1.pdf

Resources

The following links contain a host of commissioning resources, including guidelines, sample request for proposal, sample reports, case studies, etc. for both new construction and existing buildings:
http://www.nyserda.org/Programs/Commissioning/default.asp
http://www.peci.org/CxTechnical/resources.html
http://www.green.ca.gov/CommissioningGuidelines/default.htm
http://www.sce-rcx.com/rcx_resources.html
http://www.cacx.org/resources/commissioning-guides.html

Cliffs Cottage at Furman University is *Southern Living* magazine's first sustainable Showcase Home.

2.16 Campus decision-makers view energy-efficient building design as expensive and unnecessary.

Some decision-makers say, "Green buildings are a nice idea, but costly and not part of our mission, which is to teach students, not act like an energy company."

A building designed for optimum energy performance need not necessarily cost more if it's well designed. In fact, with new buildings, it may often cost less than conventional practice because the cumulative effect of load-reduction and energy-efficient design features can be the radical downsizing or even elimination of heating ventilation and cooling systems.

But a building designed for those accustomed to conventional design, the above statement may seem counterintuitive. Conventional thinking would have us choose a few of several possible energy-efficient design features to include, for example, daylighting, glazing, lighting, HVAC controls, shading, economizer, and insulation. Using the typical "value engineering" approach, we would consider the cost and simple payback period of each of these features separately. Because the payback periods of some features are short, while others are longer, we may choose only the former. We might reason that each increasingly expensive energy-efficient feature would achieve diminishing returns on our investment. The result of our seemingly reasonable choice: A building with permanently high utility costs.

If, instead, we approach this challenge from a whole-system perspective, we would consider the cost of all load-reduction and energy-saving features in light of the savings they can help us achieve — not just in operating costs, but also in capital costs. Here's the clincher: In many cases, the cumulative effect of the energy-saving features is to downsize or eliminate such systems as perimeter heating or air-conditioning, which, in some cases, will save more capital than the cost of all the energy-saving features. These relationships are best understood through whole-building energy modeling.

Setting aside the question of objective costs, there are two additional reasons that designers and builders often charge campuses more for green structures: First, these professionals are not well versed in energy-efficient design, so they charge the client for their learning process. Second, because many people believe that such buildings are more expensive, the market often tolerates premium prices. In effect, they charge more because they can get away with it.

Therefore, to keep the price of your energy-efficient building down, demand high performance standards and ensure that your requests-for-qualifications go to firms that are well versed and experienced in green design and construction. In the short term, this may result in local contractors failing to secure certain campus contracts. But very soon, they will understand that the market has changed and update their services accordingly.

One rural college presidents told us that, as a result of the college demanding higher energy performance for new campus buildings, local designers and builders have upgraded their services and are successfully offering green design and construction to the wider local market. Therefore, campus demands for high performance building is not only good for the campus' bottom line, it's good for local economic development.

One way to avoid surprising local contractors with new high-performance standards is to announce your green intentions well ahead of your request-for-qualifications. You might even invite them all to a meeting where you share your new standards and the reasons for them. Further, if compatible with your curricula, you could offer classes in energy-efficient design and construction.

To ensure quality in the energy-efficient building you ordered, commissioning your new building is essential. Put simply, building commissioning is the process of ensuring that all the subsystems for HVAC, plumbing, electrical, etc. are operating as designed. To many people, building commissioning may sound redundant and costly. But, in fact, commissioning generates benefits similar to those described above — sometimes in capital costs, most commonly in operating costs, and also in avoided costs of future redesign and equipment recalls. In one of his early building projects, one RMI architect used the services of a commissioning authority who discovered during the final adjustment phase that an outside air economizer was running on exactly the opposite sequence of what was intended, i.e., instead of progressively opening up to 100% open when the outside air temperature was below a certain threshold (in a cooling-dominated climate), it was progressively closing down to that point. In other words, it was 100% open when the outside air temperature was the highest and fully closed when the outside air temperature was the lowest— so effectively it was a cost "maximizer" of sorts, not an "economizer." In less than a year, this discovery alone saved more than the cost of the commissioning services.

One subtle, but crucially important aspect of this barrier to campus climate initiatives is the mental model that many campus leaders hold regarding campus buildings: After years of gut-wrenching budget conversations about the effects of inexorable energy-price increases on operations and maintenance costs, many of today's campus leaders find it nearly impossible to regard their buildings as anything but massive financial burdens. Ironically, their predecessors likely once regarded campus buildings simply as assets, especially the particularly beautiful and historic structures.

Because mental models tend to blind even very intelligent people to the facts, this particular mental model is a significant barrier to campus leaders hearing the pragmatic business case for investing in energy efficiency. It's hard for them to hear that these investments are not metaphorical but literal that they offer genuine and attractive financial returns, far better returns than campuses are currently receiving on their investments. In fact, each leaky building on campus nearly every one can be transformed from a burden to a business opportunity that every smart campus leader can put to work to achieve the campus' mission, especially in these tough economic times. As a bonus, these investments also strengthen the local economy by putting people back to work improving the efficiency of campus buildings. (Read more about mental models in Appendix B.)

The Emergency Economic Stabilization Act of 2008 (P.L. 110-343) extended and amended many tax incentives offered for businesses, utilities, and government, including financing and incentives for state and local governments to reduce greenhouse emissions, and for builders and developers to build efficient buildings or to improve existing buildings. In the case of public buildings, the designers get the $1.80/sq. ft. tax break, instead of the building owner. In large educational facilities, this can be a significant tax credit for the architects and engineers.

2.17 Difficulty in finding qualified firms to design and construct cost-effective, green-building projects.

To find experienced professionals who will deliver a building designed and built on whole-system principles, you may need to cast your net farther and wider. If your region lacks a healthy supply of qualified design professionals, consider a broader search, perhaps to surrounding states. Also, encourage a team relationship between out-of-town firms and local firms, which can be a learning opportunity for local firms. At first, your wider search my result in fewer local contracts, but local professionals will soon learn that there is money to be made in green buildings.

The Request for Qualifications (RFQ) and subsequent interview process is the time to ensure you will be working with an experienced design firm with the skills needed to oversee high performance design, LEED certification, and construction — and here's the critical point — without significantly increasing the capital cost of the building.

At this early stage, some would choose a competitive-fee proposal process. But this approach would have two effects: First, the chosen design firm may save costs by spending the minimum amount of time on your design, thus forfeiting at least some of the integration between disciplines that often leads to integrative design. Second, the chosen firms may feel compelled to cut corners, thus forfeiting quality. How much would be saved by this process? Professional design fees associated with buildings are about 1-2% of the total cost of ownership of that building over a 30- to 40-year period. Since your institution will pay for the results of their design solution for, say, 50 to 100 years, this is not the place to pinch pennies.

Campus leaders who avoid the pitfalls of low-bid design services do so by using a Qualification-Based Selection process (QBS), which is a widely recognized approach to selecting the most qualified firm, and subsequently negotiating a scope of services, and appropriate fees that best meet the needs of the campus.

Established by the U.S. Congress through the Brooks Act, QBS is used by public agencies for procurement of architecture and engineering services for public design and construction services. Through this process, selections are based on qualifications, not fees.

Factors critical to a successful QBS process are:

- Convening a knowledgeable selection committee,
- Drafting a detailed request for qualifications (RFQ),
- Highlighting the major objectives and purpose of the project, including clear selection criteria in the RFQ,
- Maintaining integrity and an objective position throughout the selection process.

Most selection committees review all of the submitted qualifications and individually score the submittals based on the established criteria. Afterwards, the committee convenes for discussion and final ranking of all firms. Typically three to five firms are invited to interview for the project, which includes presenting their team and their approach to achieving your project goals. Following interviews, the selection committee scores and ranks the firms and invites the most qualified firm to submit a fee proposal.

At this point, the committee and the design firm should discuss the importance of the project's energy and environmental performance and the possibility of using performance contracting to reward better performance (see "Energy Performance Contracting" in section 2.1). Discussing performance contracting options with the design firm will help assure that the motivations of the two parties are aligned and that the right incentive structures are in place to foster desired results.

After the selected design firm submits fees for the desired scope of services, if the campus is unable to come to acceptable contract terms, the campus invites the second highest-ranking firm to submit it proposed scope and fees. This process continues, if needed, until an acceptable balance of qualification, scope of services and professional fees is reached.

Many states have adopted their own versions of the Brooks Act, and utilize a QBS process for procurement of professional services. Each state's version of QBS can be found through a web search of "qualifications-based selection" and your state's name. The American Institute of Architects (AIA) has a good issue brief on QBS at http://www.aia.org/aiaucmp/groups/aia/documents/pdf/aias078887.pdf.

In 1985, American Institute of Architects completed a comparative study of the architect- and engineer-selection systems in the states of Maryland and Florida. The study concluded that the Maryland system, which used price as a major factor in selection (in addition to qualifications), resulted in costly time delays and was significantly more expensive to administer than the traditional qualifications-based process used in Florida. In recognition of the cost and inefficiency, the State of Maryland changed its selection system to QBS procedures in April of l985. Copies of the AIA study, Selecting Architects and Engineers for Public Building Projects: An Analysis and Comparison of the Maryland and Florida Systems, are available from the AIA government affairs department and an electronic version of the same can be viewed here: http://www.acec.org/advocacy/committees/pdf/study.pdf.

Forty-six states have a QBS law in place, with forty-four of these states that mandate QBS for state contracts.[32] Several universities, especially those governed by their system, use QBS. Some, like the University of Illinois[33] and the University of Florida[34] have published QBS policy documents.

Examples

In 1979 Maine adopted a QBS law covering the planning and design of state and public school projects. The law empowered the Bureau of General Services to develop procurement regulations for these projects. The University of Maine system began using the QBS process of selecting design professionals approximately five years prior to the state's adoption of the QBS law.

Every project that has been built at the University of Maine since 1972 has gone through this process. Richard A. Eustis, P.E., facilitator of the Maine QBS program, formerly with the University of Maine, indicated that the QBS process has been very successful and beneficial for the University. He compares the lack of broad scale uptake for the QBC process comparable to eating french fries. We have all developed bad habits from an early age and that makes change more difficult. It is much easier to repeat the old way of doing things, even if there is clearly a better way.

Resources:

Energy Performance Contracting for New Buildings
http://www.rmi.org/images/PDFs/BuildingsLand/D04-23_EleyPerfCntrEFRpt.pdf
Energy Performance Contracting model by the Building Owners and Managers Association and the Clinton Climate Initiative
www.boma.org/RESOURCES/BEPC/Pages/default.aspx

There are many good resources on QBS, including general information, studies, state materials and tools/guides for QBS procurement on this webpage of the American Council of Engineering Companies (ACEC): http://www.acec.org/advocacy/committees/qbs.cfm

QBS Guides to select the highest qualified design/project teams, including sample documents needed during the course of this process, can be found at http://www.acec.org/advocacy/committees/pdf/qbs_guide.pdf and http://www.qbswi.org/docs/A-EQBS.pdf
http://www.cspe.com/FunctionalAreas/GovtAffairs/ga07.htm

[32] http://www.acec.org/advocacy/committees/pdf/qbs_matrix.pdf
[33] http://www.uocpres.uillinois.edu/docs/UI/manual/QBS.pdf
[34] http://www.trustees.ufl.edu/policies/06_16.pdf

2.18 Campus is distant from a major metropolitan area and does not have a ready, local supply of labor and skills to implement green construction.

Every college campus is an important part of its host community's economy. Particularly in a small community, its relative economic influence is so significant that it can profoundly affect local economic activity and business practice.

> ***Each LEED credit offers another opportunity for integrative solutions and savings.***

If your rural institution is shifting its building policy toward energy efficiency, local builders may not yet have developed the skills and knowledge to respond adequately. If they are surprised by a request for proposal with new green specifications, their proposals may be unsatisfactory and you may end up with outside contractors and higher costs.

However, if you anticipate this situation and inform local builders of coming changes long before an RFP is issued, the result can be positive for both the school and local builders. For example, as you are developing green policies, you might invite local builders to lunch and engage them in a conversation of green buildings about imminent changes in your building specifications.

You might bring in experienced green contractors to provide seminars on green-building materials, equipment, and techniques. Also, manufacturers of some green-building materials offer training that you could host on campus. For example, structural insulated panels are often used in energy-efficient construction. Although their assembly is not difficult, local contractors may need instruction. Fortunately, manufacturers offer classes.

If yours is a community college, you could offer green-building and renewable-energy classes for local carpenters and plumbers. If you're not a community college, you could partner with the nearest one to provide such classes, maybe on your campus.

Once local contractors acquire necessary skills and knowledge, they'll begin to sell those green-building services in the wider community. Your policies to reduce campus greenhouse gas emissions could transform the entire community's building practices. You might seek ways to partner with the local community on town-gown clean energy initiatives, for example, consider creating a nonprofit community energy services company.

Once local people understand the value of energy-efficiency retrofits, the community's stock of inefficient buildings could be the foundation for local economic development. Energy efficiency in a local community is a straightforward way to create local jobs, reduce local costs, and increase the local economic multiplier effect, regardless of whether the community is expanding — good news for any small community.

Example:

Watch for an emerging project in Oberlin, Ohio. One of the nation's renowned environmental educators and clean-energy advocates, Oberlin College environmental-sciences professor, David Orr is planning a "carbon-neutral, fully-sustainable and profitable green arts district," that will link the greening efforts of the town and the college.
http://blog.cleveland.com/metro/2009/10/qa_with_oberlin_sustainability.html

2.19 The administration regards LEED certification as an unnecessary expense.

Administrators often say, "We're designing this building to be as green as LEED. Why should we pay yet another contractor tens, even hundreds, of thousands more just to do the paperwork for LEED certification. We'll do it right our way; we can then say we've designed the building to meet LEED requirements."

LEED (Leadership in Energy and Environmental Design) certification is not the only way to achieve high-performance buildings that minimize their negative effects on the climate. But because LEED was designed by building professionals, not regulators, it is a very effective way to achieve these goals that doesn't require the building owner to reinvent the green-building wheel.

According to U.S. Green Building Council: LEED is an internationally recognized green building certification system, providing third-party verification that a building or community was designed and built using strategies aimed at improving performance across all the metrics that matter most: energy savings, water efficiency, CO2 emissions reduction, improved indoor environmental quality, and stewardship of resources and sensitivity to their impacts. (www.usgbc.org/DisplayPage.aspx?CMSPageID=1988)

Possibly the most important point to make to campus leaders who are unfamiliar with LEED is that there are many benefits of the process besides a plaque on the side of the building. First, it's not a checklist, like a set of regulations. Rather it's a design process. It was developed to enhance and expedite the design process, and to establish common standards for defining a green building.

Design process: The design of most buildings is often a cumulative, barely coordinated result of independent decisions made by dozens of design professionals and stakeholders — from landscape architects to lighting engineers — from one set of future users to another. In effect, each stakeholder sets his or her specifications and piles them on top of the other's requirements with no opportunity to integrate systems or

LEED Gold certified Lory Student Center at Colorado State University.

eliminate redundancy. In contrast, the LEED process compels the designers and stakeholders to collaborate to achieve the various LEED credits available.

A few years ago, RMI was part of a design team for a new campus building that would house two departments, each of which had already indicated its parking requirements: One department indicated that it needed X parking spaces, while the other said it required Y spaces. Normal design would have resulted in X+Y spaces. But in its efforts to achieve a LEED rating, the team convened representatives of the two departments. In the course of a long conversation about many design features, the conversation came around to the topic of LEED credits related to parking capacity. It emerged that one department needed certain spaces at times when the other would have empty spaces. This realization resulted in a detailed conversation about scheduling parking spaces, which identified ways to reduce the parking lot by 100 spaces, allowing more room for open space and landscaping, and saving significant capital that could be used for improving the quality of other systems.

That conversation among designers and future users was a simple example of whole-system thinking, which is best driven by collaborative conversation, which in this case was driven by the LEED process.

Another RMI building client said that he wanted his building to achieve high performance in energy, water, and indoor air quality, but that he was not interested in the additional burden of LEED certification. However, as the design process proceeded, his architect, who had a deep understanding of LEED, documented the results of the building's design in order to demonstrate to the owner that he got what he wanted in the three areas in which he was interested. Interestingly, this documentation was the same information required for much of the LEED certification requirements. Eventually, the architect convinced the owner that, with only a little more work, the building could also achieve LEED certification. The owner, design and construction team got really excited about this prospect, worked together effectively and achieved LEED Gold.

Standards: If a building owner wants a high performance building, how can she be sure that the design team delivers it? People newly introduced to the idea of green buildings will often say, "We have a green building: We have high-tech windows," or we have a green building, we recycle," or some combination of unquantified, undocumented claims. Neither the owner nor other stakeholders can know what they're actually getting.

In sharp contrast, LEED sets common performance standards. Unlike prescriptive regulations that required certain technologies and techniques, LEED allows the designer to find the least costly, most innovative ways to perform. Standards help ensure the building owner that she is getting what she asked for, not just clever anecdotes from the designers.

Bluntly stated, campus leaders cannot reasonably claim their building is "designed to meet LEED requirements" unless the design and execution process fully documents its various green aspects — the kind of documentation required by LEED. For example, LEED requires energy modeling to inform low-energy design, a commissioning agent to ensure systems are operating as intended, and measuring the amount of materials in its building that came from within 500 miles.

Here's a crucial point for campus decision makers who want green buildings, but are unfamiliar with the LEED process: Completing that process, much like complying with codes and meeting an owner's design requirements, isn't significant additional work for the designers and builders. Rather, it simply requires gathering appropriate information and calculations, from already available data, to demonstrate compliance with requirements.

This question — to LEED or not to LEED — may eventually become moot: As LEED knowledge in both the design and construction community have grown, fees for the management and application of LEED have also declined. In fact, there are firms today that will include the management of LEED as a basic service, for no additional fees. Competition is driving toward a marketplace in which LEED is part of standard service, even a minimum requirement.

Example:

LEED certification offers additional benefits to a college or university. As a measurable indicator of sustainability, it attracts certain donors and it is a magnet to many students. Having completed its fourth and fifth LEED certified buildings in August 2009, Colby College has more LEED-certified buildings than any private college in Maine. During the design process, the college received donations specific to such green features as a geo-thermal system for air-conditioning.
Link: http://www.colby.edu/news_events/press_release/leedgold.cfm

2.20 LEED-Silver certification is enough for our campus leaders.

Deciding to aspire to a lower level of LEED certification may seem to be a way to avoid the time and cost burden of fulfilling additional requirements while still achieving, and being acknowledged for, being green in a measureable way. For example, a campus building-design team might review all the various potential LEED credits, identify those that seem particularly burdensome, sets those aside, and instead focus on achieving credits that appear less burdensome.

On its face, this seems a reasonable approach: Give up on the LEED credits that seem too burdensome. But like many seemingly reasonable ideas, it is based on an assumption that is not well founded, the mental model that Platinum is a greater financial burden. (Read more about mental models in Appendix B.)

Yes, each potential LEED credit requires effort and documentation, but it also offers additional opportunities, which generate savings in many cases. That's why the people who created LEED — people who are building professionals, not regulators — included each LEED credit: because each offers another opportunity for integration of systems and solutions. So, when deciding whether or not to seek certain LEED credits, in addition to considering cost of doing so, also measure avoided cost, for example, the avoided cost of parking spaces cited in 2.23.

As discussed in 2.21, the most lucrative opportunity to save capital cost in buildings is in energy design. An aggressive, integrated approach to energy design that begins with passive strategies, and continues with efficient systems and fuel sources, can often eliminate or reduce the need for certain equipment and systems required for code-compliant minimum design. In contrast, the lower you target your LEED score, the easier it is to ignore entire categories (e.g., water or most of energy) in the rating system, the less integrated the design becomes, and the less opportunity there is for savings. This is why targeting LEED platinum can, with an integrative approach and a smart team, cost less than LEED silver. That which gets measured gets better.

And regarding that smart design team: Engaging people around challenging goals, possibilities, and vision is different from normal problem solving because it sparks each team member's passion. They pursue solutions to individual problems as part of a larger vision. In contrast, a low-level goal such as LEED silver may lack the challenge that will motivate the team. When mediocre goals are selected, designers spend their time talking about what they are not going to do on a project, rather than inspirational targets. They try to "buy" the lowest cost LEED credits, which defeats the whole concept of integrative thinking that drove LEED originally. Peter Senge calls this "Seeing opportunities for innovation versus being less bad."[35]

The LEED question is another example of the critical importance of unambiguous climate commitment by campus leadership; it offers the design team a clear and inspirational path. For example, the vast majority of cost-of-ownership decisions are made before construction even begins. The number of decisions made on any given building project is staggering: Hundreds, even thousands, of decisions are made for each drawing sheet in a set of construction documents, which means that thousands of design, material and construction related decisions will be made with or without your direction. Although you can't be there to address all the questions, to

[35] The Necessary Revolution by Senge, Smith, Kruschwitz, Laur and Schley (p 298)

get the result you desire, campus climate goals must be clear and repeatedly discussed, reinforced and specified. Designers respond to the owners needs; the more often these needs are expressed, measured and documented, the more likely it is they will be achieved.

As a bonus, projects that are awarded LEED platinum certification receive a rebate for all certification fees. The rebate applies to projects that certify using LEED for New Construction, Existing Buildings, Commercial Interiors, Core & Shell, and Schools. Projects that certify under future versions of LEED (excluding pilot projects and LEED-for-Homes projects) also will be eligible. This rebate does not apply to registration fees, appeal review fees, and any additional fees required to expedite LEED certification.

One last note on building performance: In addition to LEED Platinum, a key measure of a building's success is people's reactions to it: What do people think of the spaces they inhabit or visit? This question can be answered through comprehensive post-occupancy evaluations to determine the effectiveness of lighting, thermal comfort, acoustics, way-finding and other elements, which give campus leaders and designers the information needed to better inform future designs. When made in existing buildings, these evaluations are opportunities for campuses to identify and prioritize current needs, which can then inform the drafting of a capital (or buildings portfolio) improvement plan.[36] As an added bonus, LEED awards a point for administering these surveys (thermal comfort verification). And finally, evaluations will enable campus leaders to see how occupant satisfaction (and even health and student performance) within LEED Platinum buildings is typically higher than non-certified buildings. (Kats, Gregory [2006] "Greening America's Schools: Costs and Benefits" www.cap-e.com).

Examples

Oregon Health & Science University, Portland

The university project team leveraged synergistic relationships between building systems in its design of the Center of Health and Healing in order to "tunnel through the cost barrier" to greater operational savings and reduced capital costs. The complex building balances performance, occupant comfort, and civic responsibility, all at a decreased overall cost. Innovative and integrated systems were used throughout the following areas:

- Efficient building envelope
- "Right-sized" mechanical systems
- Green roofs
- On-site solar electric and solar thermal
- On-site sewage treatment
- Groundwater reclamation
- Building analysis tools
- Public amenities

By using strategies such as return air plenums instead of ducts, pre-cooling the building at night, and reducing the size of air handling units based on the design of a more efficient building envelope, the engineering team was able to reduce the capital MEP (mechanical electrical and plumbing) budget by $4.5 million and realize a 61 percent energy savings ($600,000 decrease in annual operating costs). Ownership of the on-site sewage treatment facility by a third-party vendor along with reduced municipal fees generated enough savings to make the rainwater/ groundwater system cost-neutral.

Unity House, Unity College President's residence, earned LEED Platinum in 2009.

Future science center at Richland College, LEED Platinum is expected.

[36] See the Berkeley Center for the Built Environment for an example of such evaluations, at http://www.cbe.berkeley.edu/research/survey.htm

Is LEED Enough?

The text above addresses important questions related to campus efforts to pursue various levels of LEED certification. However, LEED certification does not ensure that the building will necessary achieve significant carbon-emissions reduction. On the contrary, by securing high ratings in LEED categories other than energy, one can attain even LEED-Platinum without having achieved the levels of carbon reduction necessary to mitigate the carbon crisis.

It's easy for institutional leaders to get caught up in reaching such an important objective as LEED certification and forget their overarching goal of significant carbon reduction, which can be achieved by pursuing the elements of integrative design described in this chapter.

To what extent of reduction is possible with integratie design? RMI and its partners have designed hundreds of buildings over the past 27 years, typically saving 35-70 percent of energy on retrofit and 50–90+ percent in new installations with 0–7 year paybacks for each type.

Building Type: Medical office high-rise, laboratories, educational spaces, surgery suites, parking, retail, swimming pool, 16-stories, 410,000 sq. ft. (38,000 sq. m.)
Total Project Cost: $100 million (land excluded)
Capital Cost Savings: $3.5 million projected (Of the total $4.5 million saved from MEP, they spent $1 million on renewable energy and an onsite "living machine" for sewage treatment [http://en.wikipedia.org/wiki/Living_machines, www.livingmachines.com].)
Occupancy: 600 staff, 4,500 visitors per week
Recognition Status: LEED for New Construction v2.1 Platinum

<u>University of Denver</u>
Reducing environmental impact and prioritizing occupant comfort were prerequisites for the Frank H. Ricketson, Jr. Law Building, which conforms to required university aesthetics while setting new standards for campus construction, through:

- Extensive daylighting
- Energy efficient lighting with control systems
- Efficient water fixtures
- Reuse of infiltrated groundwater for irrigation
- Local materials
- Diversion of construction waste

The diligent use of recycling, regional materials, waste management, and energy and water conservation transformed an ordinary campus construction project into a model of resource efficiency. Energy efficiency measures helped to reduce annual building energy costs by 39 percent, while water efficient fixtures helped to reduce annual building water consumption by 39 percent. Compared to a similar University of Denver building, the College of Law is currently saving the University over $111,000 annually in utility costs (electricity, gas, water, and sewer).

Building Type: Academic, 4-stories, 210,000 sq. ft. (19,500 sq. m.)
Recognition Status: LEED for New Construction v2.1 Gold
Occupancy: 730 staff, faculty, and students
DOE Climate Zone: Zone 2 (6,000 HDD, 600 CDD)

<u>Lewis and Clark State Office Building, Jefferson City, Missouri</u>
This four-story, 120,000 sq. ft. (11,000 sq. m.) office building built in 2005, which houses ~380 employees of the State of Missouri's Department of Natural Resources, was the first LEED Platinum rated government building in USA. This project was delivered on time, at no net increase in capital costs, while achieving ~50-55% energy savings, or ~$80,000 per year as compared to the prevalent ASHRAE 90.1 Standard for building energy performance. An integrative design process was the key to achieving this, starting with optimization of the building orientation, aspect ratio and envelope configurations first. These strategies, coupled with an optimized design for deep daylighting as well as a high-performance building envelope (wall and roof insulation and glazing), resulted in the elimination of a perimeter reheat system and a significant reduction in the cooling system capacity, which effectively paid for the passive load-reduction measures.
http://bet.rmi.org/our-work/case-studies/commercial/state-of-missouri--department-of-natural-resources.html

Video clips of these examples: http://bet.rmi.org/video/case-study-videos.html

Resources:

Rocky Mountain Institute. (2009) "University of Hawai`i at Mānoa William S. Richardson School of Law: Addressing Barriers and Opportunities for High Performance Building Design"

Center for the Built Environment, University of California, Berkeley http://www.cbe.berkeley.edu/research/index.htm.

National Renewable Energy Laboratory, Buildings Research http://www.nrel.gov/buildings/.

Barnett, Dianna Lopez and William D. Browning. (2004) A Primer on Sustainable Building. Rocky Mountain Institute. http://www.rmi.org/store/pdetails46.php?x=1&pagePath=00000000,00000032,00000105

Kats, Gregory (2006) "Greening America's Schools: Costs and Benefits." Available at www.cap-e.com. [Accessed Dec. 2008]

U.S. Department of Energy High Performance Buildings Database. http://eere.buildinggreen.com/. Note that visitors can search by the building type, "higher education," to find case studies of high performance buildings.

Green Footstep. Available at http://greenfootstep.org. Free online tool for the pre-design through occupancy phases of a building project. Generates a report of carbon emissions for a single building project (new or retrofit), including site development, construction, and lifetime operation. Displays in real time the carbon emissions impact of changes in building energy use, on-site renewable energy, off-site carbon investments, and other design elements.

Climate Consultant 4. Available at http://www2.aud.ucla.edu/energy-design-tools/. Free software for the pre-design and conceptual design phases of a building project. Provides users with climate data and high performance building strategies appropriate for that climate.

RETScreen. Available at http://www.retscreen.net/ang/home.php. Free software for the life cycle cost estimate and sizing of on-site renewable energy and other technologies.

Whole Building Design Guide. Available at http://www.wbdg.org/. Provides extensive list of tools for life cycle cost analysis and building design.

A revealing study by Davis Langdon found that "....there is no significant difference in average cost for green buildings as compared to non-green buildings." This study includes sections on academic and laboratory buildings. Its three findings were:

1. Many [building] projects are achieving LEED within their budgets, and in the same cost range as non-LEED projects.
2. Construction costs have risen dramatically, but projects are still achieving LEED.
3. The idea that green is an added feature continues to be a problem."

Davis Langdon. (2007) "Cost of Green Revisited: Reexamining the Feasibility and Cost Impact of Sustainable Design in the Light of Increased Market Adoption" http://www.davislangdon.com/USA/Research/ResearchFinder/2007-The-Cost-of-Green-
Revisited/

See also the United States Green Building Council website http://www.usgbc.org/, which provides an extensive list of studies on environmental, economic, and health and community benefits of green buildings. In particular, follow the link "Research Publications" on the webpage http://www.usgbc.org/research for updates on various topics related to green buildings in general and on the costs of green buildings in particular.

2.21: Zero energy buildings are not considered

The future will be carbon-constrained, by default or by design. Those who develop the capacity early to design for zero carbon will be the high-performance suppliers and service providers of the future. Students who prepare for a zero-carbon future will be the winners in the new economy.

Innovative campuses can demonstrate these future opportunities, in part, in the design and management of their buildings. Although the idea of zero energy may sound like science fiction to those unfamiliar with green buildings, net-zero energy performance can be cost-effective if the building project is designed and executed correctly, that is, using integrative design, taking the right steps in the right order, and using life-cycle cost analysis for judging investment performance — as discussed throughout this chapter

A progressive and genuinely committed institution can make the case of going beyond LEED and seeking net-zero energy use in buildings by combining the risks of continuing to emit carbon with teaching opportunities, and the fact that net-zero energy use can be achieved cost-effectively.

Examples:

Sonoma State University
Completed July 2001, the Environmental Technology Center (ETC) is an interactive and integrative 2,200-sq. ft. lab building where faculty, students, and community members work together in research training, academic study, and collaborative environmental projects. ETC is "a building that teaches." With the help of the National Science Foundation, California Energy Commission, and numerous other public and private funders, Sonoma State University used a collaborative design process to create this example of sustainable design.

ETC was designed to use 80% less energy than buildings built to minimal compliance with California's Title 24 requirements. It achieved this through the use of such energy-efficient techniques as a tight building envelope, thermal mass, shading, and other features. ETC includes a 3-kW rooftop photovoltaic (PV) system that is tied to the grid and is a net energy exporter.
http://zeb.buildinggreen.com/overview.cfm?projectid=247

Oberlin College, Oberlin, Ohio
Completed January 2000, the Adam Joseph Lewis Center for Environmental Studies is a 13,600-sq. ft building housing classroom and office space, an auditorium, a small environmental studies library and resource center, a wastewater-purification system in a greenhouse, and an open atrium.

The Lewis Center is an all-electric building and was designed with maximum energy efficiency in mind. It generates its own on-site electricity through a roof mounted 60 kW PV system and a 100 kW PV system located over the parking lot. Because of this, it is a net zero energy building.

Although the building opened in 2000, modifications continue as the energy performance of the building is studied and is better understood. The building is part of an academic program and consequently has experimental aspects that are being evaluated. In addition, improvements will be made as new technologies become available.
http://zeb.buildinggreen.com/overview.cfm?projectid=18

Resources:

High Performance Buildings Database—Zero Energy Buildings:
http://zeb.buildinggreen.com/

US DOE Net Zero Energy Commercial Building Initiative:
http://www1.eere.energy.gov/buildings/commercial_initiative/

Green Footstep: An online assessment tool for reducing carbon emissions from building projects:
http://greenfootstep.org/

Carbon Neutral and Net Zero: How Soon Can We Get There?
http://www.betterbricks.com/DetailPage.aspx?Id=947

2.22: The beauty of a building is irrelevant to climate issues. In fact, the costs of making a building more beautiful may preclude design features that reduce GHG emissions

Because people cherish a beautiful building, it is less likely to be torn down in a relative short period. Preserving a building saves significant embodied energy, thus reducing GHG emissions. In contrast, think of how eager we are to demolish many glass and steel monstrosities.

Now imagine those places or spaces inside, around, or near a building that inspired you, even if only for a moment. Good design influences our lives in many ways, including fostering a sense of pride and identity, improving our physical and mental health, improving access to services, fostering equality and community and creating real financial value and wealth. Also, good design saves us from the cost of bad design.

A Midwestern U.S. college recently elected to demolish its thirty-something-year-old student union for a shiny new one. The 1970's era union was a reflection of its time: inward focused, limited windows, and a bunker-like design. No one wondered why the students hated it. Removing it was likely an easy decision.

If this building had been designed for people and community (as a union should) and not as an apparent bomb shelter, it would likely still be there today. Its embodied energy would have been preserved and emissions would have been avoided.

When buildings are demolished, we lose the embodied energy that was invested in raw material extraction, transport, manufacture, assembly, installation, disassembly, and deconstruction or decomposition. Although quantifying this energy is still an inexact science, most researchers would probably agree that retrofitting a fifty-year-old building rather than demolishing it reduces emissions generated by construction and materials by approximately half.

CHAPTER THREE: RENEWABLE ENERGY

Renewable energy is one of the most visible statements of a campus's commitment to sustainability and climate action. Although often comparatively expensive, renewable energy is gaining momentum across the United States as technology costs continue to fall and state renewable-portfolio standards require electric utilities to invest heavily in wind turbines and other renewable electricity generation. Although high first costs often present significant challenges to large-scale renewable-energy projects, options are available for colleges to develop projects that provide valuable benefits and an attractive economic case.

Renewable energy offers the potential to partially or even completely offset a campus's carbon footprint. Beyond environmental advantages, renewable energy provides such additional benefits as educational opportunities, favorable publicity, and a hedge against rising fossil fuel prices (potentially accelerated by carbon pricing schemes).

A variety of renewable energy resources are available to meet college energy needs. The principal options include:

- Wind (individual turbines and large wind farms)
- Solar electric (rooftop or ground-mounted photovoltaics)
- Concentrating solar power (in centralized desert applications)
- Solar thermal for hot water (rooftop and wall-mounted),
- Geothermal energy for heat pump loops
- Biomass generation, waste-to-energy systems, and
- Landfill gas

In combination with renewable energy technologies, colleges should also seek opportunities to improve energy efficiency, as discussed in chapters two and four. Despite the fact that efficiency is usually the most cost-effective energy resource, more visible renewable energy projects can overshadow efficiency programs, even out competing them in the budget process. That said, renewable projects also can build support for a program that includes both efficiency and renewables. Thus, an integrative approach to efficiency and renewable energy can offer a stronger program than either strategy in isolation.

On-site versus off-site

The first major decision for renewable energy investment concerns the location and financial mechanism for development. On-site systems offer several benefits, notably visible commitment to clean energy and proximity to electricity loads. Off-site systems allow the campus to optimally site facilities and take advantage of economies of scale.

There are a variety of models to purchase on-site or off-site renewable energy. Table 1 summarizes several of the trade-offs between these options.

- **On-site development** – Renewables can be developed on site under ownership of the college, utility, or third-party.
- **Green power programs** are renewable power products available through the existing utility or a competitive power supplier. They charge customers a slightly higher rate to purchase electricity generated by renewable resources.
- **Power purchase agreements (PPA)** are contracts between a customer and a developer to buy power for a predetermined rate over a set time period. These agreements help developers fund projects by reducing revenue risk, enabling them to finance high capital costs.
- **Renewable energy certificates (RECs)** represent the environmental attributes of electricity from a renewable energy source. By purchasing a REC, a customer purchases the green qualities that are associated with renewable energy, such as reduced greenhouse-gas emissions, but does not purchase the electricity associated with the generation.

Off-site renewable options may make sense for many colleges, as they offer several advantages as noted above. Check with local utilities and renewable energy developers to learn more about opportunities to enroll in green power programs and identify PPA opportunities. Renewable energy certificates are addressed in greater detail as part of the offsets discussion in chapter five. The remainder of this chapter addresses on-site renewable energy projects.

For a university or college, there are a number of significant challenges to acquiring on-site renewable energy at a large scale. A successful renewable energy project requires thorough preparation and planning, close attention to economic impacts and financing opportunities, and close collaboration with utilities and community stakeholders. This chapter describes solutions to commonly perceived barriers in each area.

Getting Started
Many colleges have never built renewable energy systems. Developing a project, large or small, can be a significant investment of time and resources. To get the project development process moving forward, one must often address the actual and perceived barriers described in sections 3.1 through 3.3. Solutions require colleges to take a step back and look at their needs from a high level in order to choose systems that best meet those needs.

Perceived Barriers

3.1 Insufficient in-house expertise to develop renewable energy projects.

Although, to develop a renewable energy project, your college will need to collaborate with a wide range of external companies, your college also needs a capable internal team with practical knowledge and experience. Building a strong network of internal and external contributors to lead renewable energy projects is essential to success.

A. Build a team with technical and process expertise.
A team with experience driving renewable energy projects is needed to make technical decisions and to navigate the confusing array of financing options, interconnection requirements, and project development hurdles. Although students can help, an accountable high-level team must drive the process, manage student involvement, and coordinate a team representing campus stakeholders. If you don't have that expertise in-house, then as so many schools have, you'll need to select one or more faculty or staff people to commit to developing knowledge in this area, leading the effort, and working with outside consultants and companies. At minimum, you must have someone in-house to ask the right question and understand how to assess the answers.

B. Engage external experts to help with specific challenges.
Local renewable energy businesses and information sources, and peer institutions can offer useful insights into high-potential technologies and relevant case studies. Reaching out to them can unearth free information and data that can inform technology choices and financing approaches.

Many companies can supply potential customers with no cost or low-cost, off-the-shelf energy-resource assessments. Energy Service Companies (ESCOs) increasingly offer renewable energy systems as part of their energy performance contracting business. As a result, they have expertise in assessing the economic benefits of renewable options for their clients. An exploratory call with an ESCO that specializes in combining energy-efficiency measures with renewable technologies is a useful way to gather information about renewable energy options for a college campus. (More on ESCOs in section 2.1.)

Examples

University of Vermont
Student-funded clean-energy funds are becoming a popular way to spur development of renewable energy projects on campus. In 2008, after over a year of planning, the UVM's Board of Trustees approved a student proposed Clean Energy Fund (CEF). Income is generated by a $10 per semester fee assessed to full-time students, which generates about $200,000 annually to finance new clean energy projects on the UVM campus and beyond. The vice president for finance and administration oversees expenditures with advice from a clean energy advisory committee comprised of students, faculty, staff and administrators.

Despite fifteen years of progress in sustainable energy, new UVM students are often surprised at the lack of visible signs of progress. The CEF counters this impression, providing students with a means to be involved in clean energy. They can propose new projects, join the CEF advisory committee, or attend advisory committee meetings.

An unusual aspect of UVM's model is that a panel of external experts advises the advisory committee. Comprised of engineers, financial professionals, and UVM planners, the panel offers feedback and suggestions for improvement. This organizational structure is meant to ensure that the university has expertise needed to accurately assess feasibility, costs, benefits, and risks associated with potential clean energy projects.
http://www.uvm.edu/~sustain/?Page=cef/CEFabout.html&SM=cef/CEFmenu.html

University of Minnesota Morris
UMM is a small school with limited in-house expertise in renewable energy. Despite these limitations, the school is a campus leader in wind and biomass power. Much of UMM's success in renewable energy is due to the many partnerships and collaborative projects in which they are engaged.

The University of Minnesota West Central Research and Outreach Center (WCROC) and the USDA North Central Conservation and Research Laboratory (Soils Lab) are both located in Morris, across the street from UMM's campus. These three organizations have teamed up to form the Green Prairie Alliance, a research triangle to help educate, train and lead the region in sustainable, renewable energy initiatives and conservation. They are collaborating on scientific research into wind energy, using a 1.65 MW wind turbine they have constructed on site.

The wind turbine will supply 50% of UMM's electricity when the term of a power purchase agreement (PPA) with the local utility company is up. They also have a biomass gasification project to investigate the feasibility of using such locally available feedstocks as corn stover and other agricultural residues to fuel the UMM central heating plant and an associated absorption chiller. The Soils Lab is conducting research to assess the ecological impacts of harvesting agricultural residues for energy and will help UMM to determine their biomass feedstock purchasing schedules with local farmers.

UMM's Vice Chancellor of Finance and Facilities Lowell Rasmussen serves on the higher education committee of the American Council on Renewable Energy (ACORE). UMM's relationship with ACORE began as a result of the campus' pioneering wind turbine project. Joining ACORE is an excellent way to tap into expertise around renewable energy technologies and share your campus experience with others. Lowell summarized his advice for campuses starting down the renewable energy path (excerpted from a 2008 AASHE interview available at http://www.aashe.org/blog/aashe-interview-series-lowell-rasmussen-university-minnesota-morris): "Most campuses are communities within communities. Understand the energy use and renewable energy resources within your communities. Think differently about energy, energy use and energy waste. Understand who your stakeholders are, and how energy use impacts them. Renewable energy stakeholders may be both within the campus community and within the local community. Establish an environmental plan, a carbon master plan, a capital plan and an academic plan to promote sustainability. Listen to your students--a recent survey indicated that 13% of the entering freshmen consider sustainability in choosing their college campus."
http://renewables.morris.umn.edu/

3.2 Difficult to choose best technology.

3.3 Renewable energy technologies may cause unanticipated environmental or operational problems.

With many renewable energy technologies available, deciding which option is the best fit for your campus can be a significant challenge. Instead of choosing a specific technology early on, seek options that best match your goals and opportunities.

Considerations for different renewable energy program options

Consideration	On-site generation	Off-site generation		
		Green power purchase via utility	Direct power purchase agreement (PPA)	Renewable energy certificates (RECs)
Degree of time and commitement required for implementation	Mid to high	Low, if green power option available through utility	Mid to high	Low to mid
Need for capital investment	Depends on financing model	No	No	No
Ability to hedge fossil-fuel price risk	Yes	Yes	Yes	No
Public relations benefits	Yes	Yes	Yes	Yes
Time scale for realizing benefits	Long	Varies depending upon availability of green power	Varies depending upon availability of green power	Immediate

Power Purchase Agreements (PPAs)

Power purchase agreements (PPAs) are important tools to secure financing for renewable energy. They are contracts in which a customer (a consumer or a utility) commits to buying a certain amount of energy for a predetermined price and time period. From a campus perspective, a PPA can be relevant in three distinct forms, in which the campus:

- Contracts with a third-party system installer who bears the upfront installation cost and sells power to the campus. Addressed in the financial section of this chapter, this approach is used by SunEdison and many other solar installers.
- Contracts with a large-scale developer to buy renewable energy from an off-site project. In most independently operated electricity markets, a large consumer can bypass the utility and contract with an independent power producer under a PPA to buy energy, which is still delivered and paid for via the utility's infrastructure. For more information on this form of PPA, see discussion of off-site clean energy purchase options in chapter 5.
- Contracts with the utility and acts as the supplier in a PPA. The on-site renewable energy system provides power to the utility under contract for a pre-established price and time period. This is applicable to larger renewable developments that exceed net metering limits or rely on a long-term contract to secure financing.

Evaluate campus needs and primary goals of renewable energy projects.
Your investment in renewable energy is a strategic decision, which requires careful identification of goals. For example, is your goal to offset the campus's entire carbon footprint, to offset a certain fraction, to increase energy security, to be an early adopter of emerging technologies, to educate, to provide long-term low risk returns on investment, or some combination of these alternatives.

The University of Minnesota Morris is investing in wind power and local biomass.

Investigate on-site and near-site renewable energy resource availability.
Each type of renewable energy resource is appropriate to a particular set of circumstances. While solar energy is widely available, wind resource quality, hydropower and ocean energy are highly site specific.

A wind-resource site assessment may be needed to evaluate sites you have in mind. The fact that locals notice that the wind blows a lot in a certain location, does not necessarily mean that that site will be appropriate for a turbine. An initial, low-cost estimate can be made by setting up anemometers to measure wind speed for 3-6 months. Collected data can be correlated with long-term data from a nearby wind monitoring station or airport to estimate average available wind power. Several states now have anemometer loan programs through their energy offices. Correlating and assessing the data could be a project for a statistics class, while collecting the data could be a project for geography or meteorology students. It may be possible to find a local wind turbine installer who already has access to site-specific data or would be willing to check the results at little to no cost.

Baker Village student housing at Luther College includes geothermal heating and cooling.

Consider all available renewable energy technology options and evaluate potential costs, environmental impacts, and other positive and negative impacts.

In addition to such widely considered technologies as solar electric and wind turbines, evaluate less common technologies that may offer additional advantages. In addition, consider indirect impacts of renewable technologies.

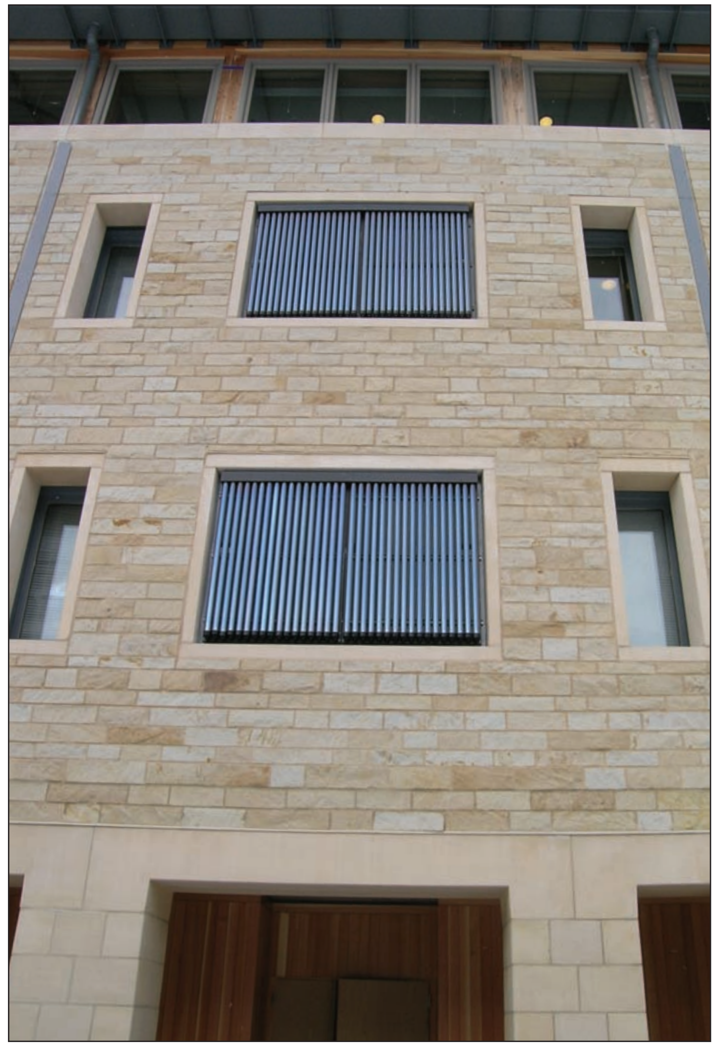
- **Conduct high-level economic assessments of technologies**

  A rough economic assessment and comparison of several renewable technologies can be achieved at little to no cost to the institution. In many colleges, environmental policy, economics, business and engineering students in an interdisciplinary class or independent project could perform and document the assessments. Alternatively, these assessments could be conducted by sustainability or facilities staff, by a consultant, or by a team of students, faculty and staff with a consultant advising and giving feedback.

  A careful assessment of renewable energy technology options should compare the net present value of each technology, based on a consistent set of costs and benefits, in addition to consideration of non-financial costs, benefits, and risks. Since many of the factors that strongly influence investment decisions are difficult to forecast accurately, assessments should compare technology costs and benefits under a range of scenarios. Such scenarios should include varying rates of fuel and electricity price trends. Other variables include installation costs, regional weather patterns, accessibility of government incentives, availability of grants and rebates, geology, and related siting and interconnection costs.

- **Consider non-generating technologies such as solar-thermal hot water and ground-source heat pumps**

  Technologies such as solar thermal and geothermal may offer high potential and fewer barriers to implementation than wind or photovoltaic because they don't require utility interconnection. Solar hot water and geothermal heat pumps are often still eligible for federal, state, and utility incentives, grants, and rebates. Solar hot water systems provide hot water for use in dorms, bathrooms, or kitchens, among other applications. Rooftop and wall-mounted systems are cost-effective in many regions of the U.S.



Solar thermal collectors integrated into facade, Kroon Hall, Yale.

  Ground-source, or geothermal, heat pumps use the moderate temperatures of the subsurface to provide heat in the winter or cooling in the summer for buildings. Since heat pumps can operate much more efficiently when moving heat to or from the relatively constant subterranean temperatures than to the more extreme atmospheric temperatures, geothermal heat pumps can be more than twice as efficient as conventional heat pumps.[37] Although geothermal heat pumps have significant installation costs due to the underground piping loops that must be laid, financing and rebate programs may be available to reduce costs significantly.

[37] "Your Home: Geothermal Heat Pumps." US Dept of Energy; Energy Efficiency and Renewable Energy. http://www.energysavers.gov/your_home/space_heating_cooling/index.cfm/mytopic=12640

- **Evaluate local economic and environmental impacts of renewable energy**
  In addition to financial analysis, potential side effects of renewable energy technology options should be considered. For example, biofuels and biomass power systems depend on local agricultural resources. Issues concerning long-term fuel availability and impact on the local economy and environment should be addressed at the start of a project. Biomass resources are sustainable resources in many cases, but as the recent boom in ethanol production has demonstrated, economic and environmental advantages are often ambiguous or questionable. In addition, on-site combustion technologies may be detrimental to local air quality due to emissions of criteria pollutants.

Once a rough comparative assessment of a variety of technologies has been compiled, choose the renewable generation technologies that offer the best combination of emissions mitigation and cost-efficiency. However, before committing to particular technologies, pay for a more detailed professional assessment.

Example

<u>Luther College</u>
This small, rural, liberal arts school in Decorah, Iowa does not have in-house technical experience in renewable energy. Despite this limitation, the institution has made significant progress in assessing renewable energy technologies through the work of committed finance administrators, facilities staff, and professors who taught themselves a great deal about the benefits and limitations of wind and geothermal energy. In addition, Luther also drew on expertise from local community members, such as a retired banker who is now an investor in community wind projects. Careful research, relationship building, and enthusiastic faculty members resulted in lower consultant costs, successful geothermal installations, and major progress toward financing a campus wind turbine. For more Luther's wind project, see examples in sections 3.4, 3.5, and 3.6. Geothermal systems with ground source heat pumps were installed in the new Center for the Arts and in a residence hall. The geothermal system in the residence hall paid back the up-front installation costs in only two years

But in 2003, prior to this progress in renewables, Luther made a $1.5 million investment in energy efficiency through an energy performance contract with its electric utility company, which reduced the college's electricity consumption by 23 percent, heating fuels consumption by 16 percent, and carbon footprint by 14 percent. Savings turned out to be even greater than expected. The College used some of the savings from its energy efficiency projects to pay consultants to assess its renewable energy potential.

Financing a Renewable Energy Project
Because renewable energy technologies generally have high upfront costs that are paid back by savings over time, project financing is often the largest hurdle to renewable energy development. Sections 3.4 through 3.6 describe interlinked barriers for which there is a common set of solutions.

3.4 Renewable energy projects are expensive.

3.5 Campus administrators regard renewable energy as a poor investment if the project has a long payback period.

3.6 As non-profit entities, colleges do not qualify for federal tax incentives, which often are critical enablers of cost-effective renewable energy.

Good News: With the right combination of rebates and incentives, financing structures, and experienced installers, many renewable energy systems are cost-effective today. Better, costs continue to decline.

A range of financing solutions is available to address cost barriers. The following are ways to reduce up-front costs and better quantify the advantages of renewable energy. In addition to the solutions described below, many financing strategies for energy efficiency described in section 2.1 apply also to renewable energy.

A. Take advantage of rebates and incentives
To promote investment in efficiency and clean energy, a variety of local and national rebates and incentives are available for renewable energy projects. Utilities, state agencies, and the federal government offer many of these incentives. The DSIRE website (see "resources" below) is a good starting point for identifying applicable programs that reduce the cost of a renewable energy project. Some rebates and grants are relatively simple to secure. The following list identifies additional considerations.

Contract with a third party developer/owner to capture tax incentives
Many of the most lucrative incentives for renewable energy are offered as tax credits — either as a production tax credit (PTC), which offers a credit for each kilowatt-hour of energy generated — or as an investment tax credit (ITC), which offers a credit based on initial system cost. In general, the PTC is used to subsidize wind energy at the rate of 2.1 cents per kilowatt-hour, while the ITC is available for photovoltaic systems at the rate of 30% of system cost. Obviously, tax credits are available only to tax-paying entities. Therefore, lacking the benefit of tax credits, colleges (along with other non-profits such as museums, churches, and schools) must use innovative financing and ownership models to benefit from these subsidies. In many cases, project developers can apply for the tax credits and pass the savings along to the college. This is increasingly possible due to 2009 updates to the federal tax credit programs that allow applicants with small tax burdens to receive full credit in the form of grants.

Issue Tax-Exempt Bonds
As non-profit institutions, universities and colleges can issue tax-exempt bonds for projects that they own and operate. Such bonds offer a large source of low-cost financing. In some cases, on-site renewable installations developed and owned by a third-party are also eligible to issue tax-exempt bonds.

Apply for Clean Renewable Energy Bonds (CREBs)
The U.S. Energy Policy Act of 2005 established interest-free bonds for public universities, other government entities, and co-op utilities to invest in renewable energy. These bonds provide annual interest in the form of federal tax credits to bondholders. As of 2009, $2.4 billion has been allocated to the CREB program, which is mostly offered in $1 to $5 million increments to qualifying projects. For universities that qualify for this program, CREB funds can be used to finance all or part of the cost of renewable energy projects.

B. Finance through power-purchase agreements with a third-party business
Businesses that finance renewable energy projects at no up-front cost to customers have become increasingly prominent. Such companies as SolarCity and SunEdison offer financing packages that let the customer lease a photovoltaic system or buy power under a fixed-term power purchase agreement. In either option, the customer's monthly costs are designed to be less than business-as-usual utility costs. For larger systems, many developers can finance an installation under a signed PPA contract with the college that obligates the campus to buy the renewable electricity at a predetermined rate for 15-25 years.

C. Instead of basing decisions on payback periods, consider renewable energy as a low-risk investment
Many proposed renewable energy projects struggle to gain support and momentum due to long payback periods. However, at a basic level, simple payback (which compares initial cost of the project to annual savings) is a poor metric to evaluate the economic case for renewable energy. Simple payback calculations ignore the cost of capital and financial returns that accrue beyond the payback period. Net present value and internal rate of return more appropriately capture lifecycle value. (For a deeper discussion of payback, see sections 2.4 and 2.5.)

Since renewable energy systems displace monthly electricity costs, they are attractive investments providing long-term low-risk returns. Despite this fact, investments of endowments in efficiency and renewables are uncommon. An exception is Carleton College, which used a loan from its endowment to fund a wind energy project, which, at 8%, provided the same return on investment as its 5-year average endowment returns.[38]


Lakeshore Technical College, Cleveland, Wisconsin.

[38] Phillips, Michael and Lee White. "Alternative Energy Economics." Business Officer. *NACUBO*. February 2009.

Performance contracts can be used to reduce the risk of designed savings not materializing. Energy service companies (ESCOs) increasingly offer renewable energy projects as part of packages that include energy efficiency upgrades. ESCOs guarantee a predetermined level of performance.

D. Consider indirect benefits of renewable energy development

Renewable energy offers secondary benefits. Although they may be difficult to quantify for a financial analysis, these benefits are very real.

Education opportunities

Wind turbines, photovoltaic arrays, and other renewable technologies offer numerous teaching opportunities. For large universities with engineering schools, research projects benefit from access to actual performance data. For smaller schools and community colleges, renewables offer rapidly expanding opportunities for job training. As described in the introduction to this chapter, many colleges that have installed wind or solar systems have experienced increased interest in these programs and become leaders in energy education.

Student and faculty recruiting

Benefits are not constrained to those who teach or study renewable energy. On-site renewable energy is a highly visible statement of a college's commitment to a low-carbon energy strategy. It sends a clear message to potential students and staff that the college is doing its part to support clean energy.

E. Develop an investment package that includes efficiency and renewable energy.

Energy efficiency can be a major enabler of renewable energy. Efficiency reduces electricity loads, allowing a renewable energy system to be downsized, which results in a more favorable business case for the renewable system. A program that bundles renewable energy with efficiency upgrades offers a far more powerful investment case than one that proposes renewables alone.

Examples

<u>Luther College</u>

In 2005, Luther College led the formation of a private corporation, Luther College Wind Energy Project, LLC, which, unlike a non-profit college, could apply for an Iowa state wind energy production tax credit. As a major investor in the LLC, Luther would pay for a large portion of the installation of up to 2.5 MW generating capacity in wind turbines. Equity investors in the LLC would sell the power they produced under a power purchase agreement (PPA) and collect the production tax credits. Luther would retain the renewable energy certificates (RECs) generated by the turbines in exchange for providing the tax credit to the corporation's other equity investors. After ten years, ownership of the turbines would flip from the LLC to Luther and the college could use the wind energy on campus.

However, when we visited Luther's campus in the Fall of 2008, the project had been held up for several reasons: With the 2008 shift in the economics of wind power in Iowa (due to approval of higher PPA rates and rising costs for conventional electricity), Luther was competing with many private wind farm developers. Turbine manufacturers were not keeping up with the demand. The college could not locate a wind turbine manufacturer that would sell just a single turbine. Meanwhile the national economic downturn was discouraging investors and equity for the LLC began to dry up. The college also considered issuing tax-exempt bonds to fund installation of a turbine, but trustees were not willing to add debt to the books in a sour economic client. Then, in the fall of 2009, the LLC was awarded a $500,000 grant and a $1,302,385 loan from the U.S. Department of Agriculture's Rural Energy for America Program (REAP). The Luther College Wind Energy Project is now well capitalized and will be able to move ahead soon.

<u>Lakeshore Technical College, Cleveland, Wisconsin</u>

In order to train students in wind-turbine maintenance, Lakeshore Technical College (LTC) erected a small wind turbine (65 kW) in the summer of 2004, which took advantage of the campus' prime wind location near Lake Michigan. The turbine was the first piece of Lakeshore's strategic initiative to lead the region in the education, integration and demonstration of emerging energy technologies.

Because its turbine was erected to carry out LTC's academic mission, payback was not important. The project was supported through a public-private grant partnership with Seventh Generation Energy Systems (a non-profit organization working at the grassroots level nationwide to plan fund, develop and maintain wind and solar energy systems), We Energies (a for-profit utility company), Wisconsin's Focus on Energy (a statewide coalition of businesses and public service agencies that works to advance energy efficiency and renewables). The cost to install the turbine was approximately $250,000; additional funds were used to support associated curriculum development.

The following school year brought much excitement and attention around LTC's new focus on renewable energy. The turbine is obvious from the nearby interstate. A local high school student enrolled in one of the first wind technician courses and was trained to climb the turbine. The story was picked up on a national newsfeed with a picture of young woman climbing the turbine. Local manufacturing companies called LTC to ask if they were training students to manufacture turbines. Ideas for expanding the renewable energy technician programs were a hot topic of discussion between faculty and local employers, and were eventually incorporated into the 2006-2009 strategic plan.

The momentum carried over to LTC's work with the local community. LTC faculty wind champions worked with local organizations and energy businesses to provide community wind and solar energy seminars. The year ended with LTC receiving the 2005 Innovation Award from the Interstate Renewable Energy Council (IREC) for the campus' wind energy site.

Solar thermal collectors, installed on the White House by Carter, removed by Reagan, now on Unity College Cafeteria.

The LTC wind movement generated interest and concern about energy consumption on campus. In 2004, LTC formed an energy management committee to reduce consumption. The committee included facilities staff, management staff, faculty, and administrators. Among other measures, it prompted a lighting retrofit. LTC's president credits the committee with the 19 percent reduction in energy consumption. The Wisconsin Technical College System recognized LTC with energy performance awards in 2006 and 2007.

The educational attributes of demonstration-sized renewable energy installation can often be enough to secure funding from interested donors. In the words of LTC's Dean of Trade and Industry: "If the only driver were operations, we would not have photovoltaics or wind turbines." The momentum generated by the first turbine spiraled into stronger energy management on campus, installation of two demonstration photovoltaic arrays, two larger wind turbines, a Wind Energy Technology Associate Degree Program (the first two-year wind program in Wisconsin), and other courses and community programs on renewable energy technologies.

Colorado State University
CSU Pueblo has a 1.2 MW solar farm on campus land that is owned and operated by BP Solar. All construction, maintenance costs and interconnection negotiation costs were covered by BP Solar and by rebates from the local utility company. The campus provided guaranteed demand for the power and the land on which to site the installation. CSU has an exclusive contract to purchase the solar power from BP Solar at rates comparable to those of the local utility. http://www.colostate-pueblo.edu/news/releases09/003.htm

University of Minnesota Morris
In addition to a biomass gasification facility installed in 2008 and a wind turbine in 2005, the UMM has secured funding for two more wind turbines and a steam turbine to generate electricity in their biomass plant. It is one of a few colleges nationwide to take advantage of federal Clean Renewable Energy Bonds (CREBs). UMM learned to break up costs in order to receive funding because the IRS is likely to fund smaller requests for funding first. The school was denied funding in 2005 when they applied for CREBs to finance the full cost of erecting several $3.5million turbines. Later UMM successfully received a $1.6 million dollar CREB toward a second on-site

$3.6 million turbine. The university will provide the bonding capacity for the remainder of the costs.

The Mille Lacs Band of Ojibwe tribe approached UMM with a request to learn about wind technology. Following their long-standing tradition of supporting Native American tribes in the region and beyond, UMM decided to work with the Mille Lacs Band to secure the financing for a third turbine. Campus leaders helped the tribe apply for a $1.6 million CREB to finance a turbine in Calloway, Minnesota. UMM also applied concurrently for a $1.6 million CREB to finance the same turbine. Both requests were granted, so the turbine will be erected and the generated power will be sold on the regional electric grid. The two partners, UMM and the Mille Lacs Band, will split the revenue. UMM will use their share to fund sustainability initiatives on campus.

Resources

Online Database of State Incentives for Renewables and Efficiency (DSIRE). This website, a project of the North Carolina Solar Center and the Interstate Renewable Energy Council, is an excellent resource for information on federal and state incentives and regulations. http://www.dsireusa.org/

"Alternative Energy Economics," an article by Michael Phillips and Lee White, was published in the February 2009 issue of Business Officer, the monthly magazine of the National Association of College and University Business Officers. This article outlines many financing approaches available to colleges, particularly in the light of the added constraints of the 2009 credit crunch. It addresses clean renewable energy bonds, governmental and private activity bonds, endowment fund loans, private-sector tax incentives, performance contracts, renewable energy hedge agreements, and power prepayments. http://cmsdev.nacubo.org/nacubo/x1734.xml.

Engaging Stakeholders

Even a fully designed and financed renewable energy development may encounter significant hurdles before it can come online. Campus planners must work closely with utility and community stakeholders to ensure that new energy systems will reliably integrate into existing electric grid infrastructure and comply with local codes and regulations. Consider sections 3.7 through 3.11 to help avoid potential derailments to your renewable energy project.

3.7 Net metering programs may not apply to, or may not be available for, large renewable energy systems.

Net metering programs allow customers who generate electricity to meter the flow of electricity to and from their facility through a single, bi-directional meter. The primary benefit of net metering is that customer-generators earn kilowatt-hour credits at full retail, not wholesale, rates. Under standard net metering rules, when customers generate more electricity than they consume, the utility carries the generation credit over to the next billing period as a kilowatt-hour credit. These programs allow customers with renewable generation to size their systems to meet their annual consumption by sending and drawing power from the utility as needed.

The applicability of net metering to your campus depends on your particular state's regulatory framework and the policies of your electric utility. Over recent years, most states have implemented some form of net metering standards. As of fall 2009, only five states lacked any form of net metering: Alabama, Alaska, Mississippi, South Dakota and Tennessee[39]. In some other states, net metering is not available in rural co-ops and municipal utilities. Campus program developers should visit the DSIRE website (see "resources" below) for more information on the availability of net metering programs, as they are a key factor in determining the economic feasibility of renewable energy.

A. Coordinate with net metering programs when applicable

Net metering programs vary by state and even by utility. To ensure that your college can collect credits from selling electricity to the utility, net metering caps should inform system sizing decisions. Caps vary geographically; updated information can be found at the DSIRE and IREC resources described below. If systems are larger than net metering caps or net metering programs are not available at all, the renewable energy plant will be less cost-effective, because the college will be unable to collect value from electricity provided to the grid.

B. Size renewable generators to match peak output with electricity load in order to maximize economic value (if net metering is not available)

If net metering is not available, renewable energy can still be an option. Since colleges consume large quantities of electricity, it may not be necessary to send excess power to the utility. If renewable energy systems are sized so that peak renewable energy generation never or rarely exceeds campus loads, the energy may all be used on site. In this case, a campus can capture direct benefit for its renewable energy in the form of avoided electricity purchases. Alternatively, electricity storage technologies could be installed to store on-site generated electricity for use during times of high demand.

Resources

Database of State Incentives for Renewables and Efficiency (DSIRE). This website, a project of the North Carolina Solar Center and the Interstate Renewable Energy Council, is an excellent resource for information on federal and state incentives and regulations. http://www.dsireusa.org/

Interstate Renewable Energy Council's (IREC) Connecting to the Grid project has a variety of materials to help distributed energy projects navigate the interconnection process, including resources on net-metering programs. http://www.irecusa.org/index.php?id=31

[39] IREC "Connecting to the Grid" Project: State and Utility Net Metering Rules for Distributed Generation (updated July 2009), http://www.irecusa.org/index.php?id=33

3.8 If the project-financing plan depends on an agreement to sell power to the electric utility, the campus must engage the utility in a complex negotiation process.

Colleges that intend to sell power to their local utility under power purchase agreements must engage in negotiations to determine the terms of the contract. Variables such as duration (usually 15 to 25 years) and future escalation or de-escalation of rates have a large impact on the value of the agreement to the campus. Negotiations in which utilities are the power purchasers can be particularly complex. Not surprisingly, utilities have substantial expertise in this field. The best approach to address these challenges is to collaborate with experienced advisors and project developers.

A project developer will have the experience to deal with these issues. It is critical for colleges to engage experts to help them through this process.

- Hire a lawyer with experience in drafting power purchase agreements with the chosen utility company
- Other institutions, businesses, and people with experience negotiating PPAs with your utility can provide useful advice
- Connections with other colleges and universities: Discussion through the green-schools list and other networking devices can help solicit useful advice from campuses that have entered into PPAs
- Renewable energy advocacy groups, particularly those that promote small and community wind projects, often have useful advice and publications. Local or regional groups may have specific advice about working with your chosen utility company.
- Legal educational organizations now offer teleconferences, webinars and trainings on renewable energy project contracts and laws. In addition to being useful for the institution's legal counsel, participation in these types of programs can benefit students considering careers in energy law, policy or business.

Resources

Windustry's Community Wind Toolbox: Chapter 13 discusses Power Purchase Agreements and what to consider during negotiation with the entity that will purchase power. Available at http://www.windustry.org/CommunityWindToolbox

The Rahus Institute published *The Customer's Guide to Solar Power Purchase Agreements* in 2008, which explains the basics of negotiating to purchase solar power from a third-party owner. The guide is available on the website of California Solar Center at http://www.californiasolarcenter.org/sppa.html

Samples and templates of Power Purchase Agreement contracts are available from many sources online, for example Natural Resources Canada: http://www.retscreen.net/ang/power_purchase_agreements.php

The appendix of The Business Case for Renewable Energy: A Guide for Colleges and Universities by Andrea Putnam and Michael Phillips (2006) contains a template power purchase agreement.

3.9 Utility interconnection requirements can add substantial time and cost to renewable energy projects.

3.10 Campuses generally do not own grid infrastructure, so they must connect to the utility system if on-site renewable energy is to be used for multiple buildings

Most large renewable energy projects must be linked to existing electric grid infrastructure. Typically, these systems are owned by local utilities and regulated by a complex array of state, regional, and federal utility commissions, reliability organizations, and system operators. Interconnecting new generation of any size to the transmission and distribution system must meet rigorous criteria. For small photovoltaic systems, the process is relatively standardized; for large wind developments, fulfilling interconnection requirements can take over a year and cost hundreds of thousands of dollars.[40]

Projects with just one or two wind turbines, generally less than five megawatts, may be able to benefit from a streamlined interconnection process if they are distributed and feed power directly into the lower-voltage distribution grid. This avoids the need to build or expand a substation to connect to high-voltage transmission grids.

Interconnection criteria vary widely between utilities, states, project size and types of generation. Work with your utility and reference the DSIRE website (see Resources in section_3.7 above) as a starting point to understand project-specific interconnection requirements and permit costs.

A. Engage outside assistance to prepare an interconnection study
For large renewable energy projects, especially wind farms, working out interconnection agreements can be a challenging and complex. As with other utility system interactions, engage experienced help to navigate this process. In addition, involve your local utility very early in the process to build a good relationship and understand restrictions, regulations, and preferences while the project is still in the early planning stages.

B. Consider sizing distributed generation projects to the constraints of a distribution grid. As a general guideline all projects with a generating capacity of less than 15 percent of the utility's circuit (the particular transformer in the local sub-station that serves the college or university) are exempted from an interconnection study requirement. This guideline has been adopted as a federal rule applicable to interconnec-

[40] "Chapter 14: Interconnection – Getting Energy to Market." *Windustry Community Wind Toolbox*. http://windustry.org/CommunityWindToolbox

tions to federal government utilities, and by several states. The guideline is a widely accepted standard that is endorsed by the utilities trade association, the Edison Electric Institute.

Such distributed technologies[41] as photovoltaic systems can be installed on building rooftops and net-metered to feed power into the utility infrastructure with no interconnection study requirement. The utility still owns and maintains the distribution infrastructure, which likely will not require additional investment to accommodate photovoltaic systems whose power output is largely coincident with building energy loads. In these cases, the photovoltaic system can actually provide benefits to the utility's grid, by reducing peak loads and potentially improving power quality.

Resources

The Business Case for Renewable Energy: A Guide for Colleges and Universities by Andrea Putnam and Michael Philips (2006) discusses interconnection agreements in Chapter 6: "Doing the Deal: On-Site Generation."
Windustry's Community Wind Toolbox: Chapter 14 discusses Interconnection requirements and processes. Available at http://www.windustry.org/CommunityWindToolbox

"Planning, Financing and Interconnecting a Wind Turbine Project on a College Campus" (webinar archived at http://www.ecw.org/mwbuildings/streamed.php#121107)

A number of useful resources, including model interconnection contracts and a technical application guide for interconnection are available from the National Rural Electric Cooperative Association at http://www.nreca.org/PublicPolicy/ElectricIndustry/dgtoolkit.htm

The Interstate Renewable Energy Council (IREC) has a set of Model Interconnection Standards for Small Generator Facilities that may be suitable to guide the interconnection process without conducting an interconnection study. They are available at www.irec.usa.org/connect/modelrules.pdf

IREC maintains a database of state interconnection standards for distributed generation. It is available from http://www.irecusa.org/index.php?id=33.

The Environmental Law & Policy Center is working with some states in the Midwest to develop statewide interconnection standards to streamline and simplify the interconnection process and associated costs. Learn more at: http://elpc.org/category/clean-energy/interconnection-standards

3.11 Campus constituents and local stakeholders may oppose renewable energy projects for aesthetic reasons.

Although many argue that it is important to see where our energy comes from or that renewable energy technologies are beautiful, others contend that solar panels and wind turbines detract from the beauty of the landscape, a college campus, or a particular building.

Renewable energy advocates on a campus with a centrally located coal-fired power or steam plant might respond by suggesting that a wind turbine must be less displeasing than smokestacks or mountains of coal. But because these kinds of aesthetic considerations are subjective, they are difficult to overcome directly.

This aesthetic division may be inherent, just as some people like a certain piece of public art, others do not. However, renewable energy systems have positive environmental impacts that offer proponents a logical counter-argument to those who object on aesthetic (and sometimes environmental) grounds. However, to be effective, such arguments must be made with genuine respect for aesthetic or environmental objections. Also, such a discussion is best framed as part of a larger campus conversation about climate, which can broaden support for on-site renewable energy sources.

Many campuses can push the envelope on renewable energy development since they often have independent decision-making processes. Unlike individual houses, which are often subject to local land-use regulations and to the aesthetic criteria of homeowners' associations, college planning departments have more latitude to consider innovative technologies. That said, the campus community can also be diverse with many differing opinions about aesthetics, the environment, and the climate crisis.

Examples abound of renewable energy projects that were initially opposed by a vocal minority, but which ultimately became widely accepted. Many wind turbines have even become campus icons.

Critical to success of on-site renewables projects is a transparent proposal process with regular stakeholder meetings that engage potential opponents. From the earliest exploration of ideas and consideration of sites, the process should include regular outreach to students, staff, and the wider community. At every juncture, the purposes of the proposed project should be reinforced and alternative perspectives should be acknowledges, respected, and even accommodated through variations in the original plan.

[41] Distributed technologies are smaller in scale with lower cost and lower financial risk. Also, because they are located near where energy is used, they don't incur the energy losses of the electric grid.

CHAPTER FOUR: TRANSPORTATION

Although designers and builders expend significant effort ensuring that buildings use as little energy as possible, on many campuses, energy used for driving to and from campus may well exceed the energy savings realized by green buildings. For an average office building in the United States, commuting by office workers accounts for 30% more energy than the building itself uses. For an average new office building, built to modern energy efficient codes, transportation accounts for more than twice as much energy use as building operations.[42] These data illustrate that any large organization is responsible not only for the obvious energy use of it buildings, but also for the energy use of getting its community to and from those buildings.

Emissions from commuting by students, faculty and staff generally make up a much larger percentage of the campus carbon footprint than emissions from campus-business travel (e.g. athletics, recruiting, international travel, and research). Therefore, it may make sense to focus limited resources on changing commuting patterns, which is the primary focus of this chapter. Long-distance travel is briefly addressed at the end of the chapter. Transport of goods and services to campus is not covered.

An integrated campus climate action plan would address alternatives to single-occupancy vehicles (SOVs) through campus policies related to public transit, carpooling, car-sharing, walking, bicycling, and especially, changing SOV enablers such as inexpensive parking. As you develop your campus transportation strategy, consider the following:

- Draw from the outstanding transportation demand management (TDM) practices of others, many of which are summarized in Transportation & Sustainable Campus Communities by Will Toor and Spenser Havlick. Others are detailed in the TDM Encyclopedia by the Victoria Transport Policy Institute (http://www.vtpi.org/tdm/tdm12.htm).
- Institutionalize an annual survey of student commuting patterns. Do the same for faculty and staff commuting. And design your strategy to fit these different audiences
- Disseminate information about sustainable transportation campus-wide.
- In particular, establish an on-campus sustainable-transportation information desk to provide support, customized advice and informational materials to students, faculty and staff.
- Manage student privileges to minimize private vehicle use, ideally encouraging the elimination of vehicle ownership altogether.
- Provide an integrated portfolio of transportation alternatives such as car sharing, bike sharing, campus area shuttles, and weekend express shuttles to support mobility on-campus, as well as to-and-from.
- Incorporate sustainable transportation into campus master planning process

The National Resource Defense Council's (NRDC) approach to reducing climate pollution from the transportation sector rests on a "three-legged stool" of cleaner cars, cleaner fuels and reductions in vehicle miles traveled (VMT).[43] By breaking the larger puzzle of commuting down into these three areas, campus advocates can design a manageable initiative for each of the three "stool legs" (see chart on following page).

Campus Commuting

Perceived barriers to reducing emissions from commuting can be framed in four categories that will be addressed in this chapter:

- Cost of alternative transportation programs (sections 4.2 - 4.4, & 4.7)
- Partnership with off-campus agencies (4.1, 4.8, 4.9)
- Commuter and traveler motivation (4.10 - 4.13)
- Communicating with commuters (4.10, 4.11)

[42] Calculations done by *Environmental Building News (EBN)*; "Driving to Green Buildings: The Transportation Energy Intensity of Buildings"; Alex Wilson with Rachel Navaro, September 1, 2007

[43] http://www.nrdc.org/energy/ene_08062501.asp

To generate financial and popular support for alternatives to commuting, frame the issue in the larger context of the campus community.

Reframe transportation as an equity issue
The campus may forge partnerships with local transportation agencies to find ways to use funds more efficiently. By sharing costs for new routes that fill student transportation needs, both the campus and the transit agency may be able to accomplish their goals at a savings. Unlike private routes that serve only students, additional public routes promote more consistent ridership and generate additional revenues to maintain and expand the system. Sections 4.1 and 4.9 discuss partnerships with transit agencies.

If reliable, convenient public transit were in place, an institution that is concerned about keeping costs low for students could provide free transit passes (perhaps subsidized in part by the local transit agency) and charge for parking. Many commuter schools are concerned that some students are unable to rely on public transportation due to tight schedules that include jobs, family and school. Perhaps these schools could provide financial aid for student transportation.

Some students may decline the free transit pass and rely solely on parking. In these cases, the money that the school would have paid for a transit pass could be applied to parking. Other students may rely on transit most of the time, but park some of the time. To address these cases, the cost of daily parking might be reduced to a certain number of uses per semester.

To discourage carbon emissions, the cost of daily parking passes should exceed the average amount the school pays for each transit roundtrip. Students who are unable to pay more in order to park all the time, would apply for financial aid. Subsidies could be provided based on such factors as employment, family schedule, and financial need. Revenues brought in from parking could then be used to partially fund the free transit passes for students.

Communicate that parking is expensive and unnecessary
The provision of parking enables reliance on single-occupancy vehicles, exacting more cost in terms of land, maintenance, and environmental impact than its value. Where parking is inexpensive or free, and easy to access, private cars are an attractive way to get to school. Although we are not suggesting wholesale elimination of parking on campus, conventional assumptions about parking are just that; sections 4.2 to 4.4 provide progressive approaches to parking for university communities that actually improve campus access and mobility when implemented in concert with integrated alternative transportation programs. Sections 4.5 and 4.6 include ideas for community colleges in particular.

Provide commuters with more attractive options
Reward commuters for using alternatives: One approach that has proved successful in reducing commuter emissions is to reward faculty and staff for choosing to walk, bike, carpool or use public transit. While cash rewards may be the most effective, increased flexibility, meal discounts, and other incentives also motivate commuters. Such ideas as carpooling and car sharing have been around for so long that many people regard them as worn out. But recent innovations and increased interest in these areas are scoring big successes. See Sections 4.4 and 4.11.

Telecommuting and distance learning
Consider encouraging students to eliminate commuting entirely. E-learning has soared in popularity over the past few years. Nearly one in four students take at least some college courses online, up from one-in-ten in 2002. There are plenty of programs to choose from. According to the DOE, 88% of public four-year colleges offer distance education.[44] President Barack Obama pledged $500 million for online courses and materials as part of a multi-pronged plan to expand college access, funds which should spur more innovation in support of the e-learning trend.

If students want better preparation to join the mobile workforce of today, e-learning may be particularly appropriate. Many companies require employees to enroll in e-learning courses while on the job to keep current on the rapidly evolving skills and knowledge.

Additionally, over half of U.S. companies allow some form of telecommuting. This is not surprising given studies of remote workers at American Express show that they can be 30-40% more productive.[45] Employers are beginning to understand that increased agility, reduced costs and enhanced business continuity can flow from encouraging telecommuting, actually strengthening a business' competitiveness and resilience while removing large capital and operational costs from the bottom line. Gartner Dataquest estimates that 25% of US employees worked from home, at least once a week in 2007. Another study estimates that 33 million Americans are employed in roles appropriate for telecommuting; removing these commuters from daily travel could drive down oil imports by 25% and reduce carbon emissions dramatically, with the added benefit of increased productivity.

Examples in section 4.5 discuss telecommuting and distance learning further.

Predict and prepare for growth in the future
There is no simple, fool-proof solution to the challenge of funding alternative transportation. Like climate change itself, this is a complex challenge for which a variety of options will have to be combined in creative ways that fit the circumstances of each locality. Since every campus is unique, with a unique set of local resources to draw upon, the portfolio of appropriate alternative transportation options that each campus nurtures must also be unique.

Several factors determine which alternative transportation modes, vehicles, and fuels will be appropriate for a campus. Average commute distances, use of highway or local roads,

[44] U.S. Department of Education, National Center for Education Statistics (2008). Distance Education at Degree-Granting Postsecondary Institutions: 2006–07 (NCES 2009-044)

[45] *Home Warriors;* The Economist, July 25, 2008

proximity and access to mass transit, and availability of re-fueling infrastructure are all key considerations.

Transportation considerations are part of an institution's strategic infrastructure and long-range master planning should guide decisions, accounting for a university's growth expectations, as well as the possible future scenarios for fuel prices and transportation options. Careful long-term investments in transportation options will help make the university robust in the future.

4.1 Public transit agencies are unwilling or unable to cooperate on public transit solutions to campus-commuting challenges.

When such a barrier arises, it's easy to assume that the transportation agency is just protecting itself or that its leadership cares little for your campus's community issues. Although such assumptions may be well founded, testing them will be well worth your time.

Start by developing personal relationships with the key decision makers in the transit agency. Take them to lunch. With genuine interest, ask them about issues confronting their agency. Develop an understanding of the factors affecting their service and their decisions. Their knowledge will

Examples of initiatives that fit into each of these three categories

	Cleaner Cars	Cleaner Fuels	Reduced VMT
On-Campus Initiative	Provide better parking locations for high fuel-efficiency vehicles Sponsor tire pressure checks for student vehicles before holiday breaks	Build a vegetable oil processing operation where the campus community can bring raw oil and purchase processed oil Use bio-diesel or electricity for all campus buses and shuttles Provide public charge points in prime parking locations for plug-in electric vehicles	Provide free passes on regional transit for all employees and students Develop and sponsor easy access to campus-wide technologies that allow people to connect for carpooling (e.g. Zimride)
Local Partnership Initiative	Partner with local goverment to prepare the region for electric vehicles	Host community events to educate commuters about regionally appropriate, clean fuel options	Organize effort to advocate for legislation that provides incentives or mandates for transit-oriented development and mass transit funding

probably inform your efforts. You may be able to offer suggestions and support, though be circumspect about offering your ideas; be careful not to appear to be telling them how to run their business.

If you employ active listening in your conversations (Appendix G) they will soon understand that you appreciate their situation. That's the point at which you can begin to effectively suggest ways in which your respective resources and needs might be better coordinated (e.g. some campus buses also transport non-campus people).

Look for other potential partners, maybe hospitals, retail associations, or other large employers, who may also be interested in alternatives to single-vehicle commuting.

When you've developed strong rapport with the agency people and other potential partners, you can begin to work with them to develop creative solutions. You might convene a workshop of key well informed people from each of the potential partner organizations to work through their various needs and how they converge for mutually advantageous solutions - solutions you may not have considered without the help of the others. Chapters seven and ten of The Necessary Revolution[46] will be helpful in thinking about how to proceed with such a partnership conversation.

The kind of partnership you will be developing can be very attractive to such funding agencies as your state and federal departments of transportation or other local, state and federal agencies. Together, you might even take the bold step of initiating a measure for the local ballot.

At last resort, if you seem to be getting nowhere in your attempts to work with the local transportation agency, consider hiring a mediator.

[46] Peter Senge, Bryan Smith, Nina Kruschwitz, Joe Laur, Sara Schley, *The Necessary Revolution* (New York, Doubleday 2008)

4.2 The campus has more than enough parking spaces and does not plan to invest in any new parking facilities. We cannot reallocate money that was set aside for parking investments to go instead toward managing campus transportation demand.

4.3 Because low tuition and fees are paramount, campus leaders regard student fees for on-campus parking as unacceptable. As a result, students have very little incentive to find alternatives to commuting in a single occupancy vehicle.

4.4 Using parking revenues to finance alternative transportation programs is unsustainable; as the alternatives attract more riders, revenues for the alternatives decline.

The crux of issues 4.2 to 4.4 is the need to finance campus alternative transportation systems with sustainable revenue models, which could include diverse sources. Also, these barriers reveal that traditional sources of money for alternative transportation, revenues from parking permits or the parking budget, are not always perceived as viable.

Cited early in this chapter, the Toor/Havlick book summarizes a variety of options for funding transit passes:

- Student fees, which usually requires a vote by the student body
- General fund, though there is often great competition for this money
- Parking revenue, which may be politically difficult, especially where parking has been free
- Charges to auxiliary departments, essentially a "head tax" with which separate departments cover the cost of transit passes for their employees
- User fees, which may secure approval most easily, buy may have less impact.[47]

A dedicated student fee to cover the cost of transit passes for all students is the most common revenue source, more common than the use of parking revenues. The amount that a college or university generally pays to a transit provider for each student is significantly lower than the amount an individual student would pay to purchase a pass directly. Thus, by paying for this service through a student fee, students who use transit achieve significant savings. The argument against student fees arises from the concern that all students will pay the fee but that not all students will use transit. But this argument is equally valid for other types of student fees. For example, all students pay for the athletic facilities but not all students use them. Overall, the distribution of student fees tends to balances out when each student chooses to use some of the services that have been paid for by all students.

[47] *Transportation & Sustainable Campus Communities* by Will Toor and Spenser Havlick, 2004: 111-112

In the long run, it is usually more difficult to secure money from the general fund or from parking revenues than to create a designated fee or fund for transit. Because transit will have to compete with other needs for general fund money every year, the general fund may be an unreliable source. Also, as fuel prices increase and more people decide to ride transit, parking revenues are likely to decrease, making this a somewhat unpredictable source of funds. That said, both of these sources are often helpful for getting a transit program started or for supplementing revenues from fees. While each has it drawbacks, they should not be overlooked as possible funding sources.

While a universal fee is more likely to result in increased transit ridership, user fees and fees from auxiliary departments may be a good option for funding passes for faculty and staff, especially when funding passes for all employees is not financially feasible.

There is often political opposition to harvesting money directly from people who don't rely on transit. Selling transit passes in combination with parking privileges may help to alleviate this concern to some degree. For example, one package may offer an unlimited transit pass with twenty days of parking per semester and another package may offer a transit pass for three days a week and parking for two days a week. In the long run, consider incorporating transit passes into employee benefits packages to encourage increased ridership.

However, when one places transportation in the larger context — the whole system of the campus community — the means to more efficiently use available money often emerges. For example, in areas with well developed public-transportation systems, students and faculty may not be aware of the personal savings they could generate by limiting car use and ownership. If a convenient, multi-pronged transportation program were available through one monthly fee for car sharing, bike sharing, emergency rides, and public transportation, students and faculty may find that they could actually get where they need to go for less money.

Examples

There are precedents for reducing or eliminating parking subsidies (for maintenance and administration costs). This effectively raises parking fees, but not to fund alternative transportation directly.

Emory University
Funds subsidizing faculty and staff parking at Emory University were reallocated to support free and low-cost transportation alternatives. These alternative transportation options are also funded by outside sources, including grants, university discretionary funding, and public-private partnerships with local groups and local/state/federal government support. The parking rates paid by employees are used solely to cover the costs of providing parking, including operations and parking-structure debt service. The parking rates themselves are not used to subsidize other transportation initiatives. http://cliftoncommunitypartnership.org/view/faqs/view_cat/&catid=8

Colorado State University
Similarly, CSU does not subsidize parking with general funds because of state law, which says, "Parking on state property must, by law, pay for itself." That means that students, employees and visitors who park on surfaces built and maintained by CSU have to pay to park. Parking Services does not receive university funds; it operates solely on revenue from permit sales, meter parking and parking fines. That revenue goes back into building and maintaining parking spaces and enforcing parking regulations.

A campus flyer on parking fees provides the following information, ìCosts are going up: The simple cost of maintaining parking spaces has been on the rise, outpacing the current Parking Services revenue. Since 2003, the cost of asphalt alone has increased about 25 percent.

During fiscal year 2006-07, total revenue is estimated to be about $3 million from all sources, including fines, permits, visitor permits and meters. This budget covers the cost of lot repairs, construction and maintenance, and the cost of managing and staffing the campus parking operation. http://police.colostate.edu/parkingfees.pdf

California State University
At CSU, Sacramento, the physical parking spaces themselves were re-allocated. Carpool parking spaces are available for students and employees on the first floors of certain parking structures and lots. The carpool must be registered with the parking department and a carpool permit displayed. To support those interested, the university website links to a free carpool matching system exclusively for Sacramento State students, faculty, and staff. Success statistics for the program are at http://www.csus.edu/aba/utaps/sustainability.html

Use tax-free "transportation fringe benefits" to incentivize transit use, vanpooling, and other options among employees.

Colorado State University
Employers can allow employees to use pretax dollars to pay for transit passes, vanpool fares, and parking. SmartTrips™ provided assistance and incentive to employees at CSU, Fort Collins, to forego the escalating traffic congestion on and around campus. SmartTrips™ helped the University Parking Services and Hartshorn Health Services provide an employee transportation benefits package. The package included a free Guaranteed Ride Home Program, DriveLess Challenge incentive program, PassFort bus passes and carpool/vanpool matching services. Employees also receive information on how to get around town and campus without driving.

"It's important to give employees options for their commute to CSU and implement alternative transportation programs as a benefit to them. We want to do our part to improve our quality of life and encourage alternative transportation," said Cindy Leinweber, Assistant Director for University Parking Services.

In 2002, surveys showed that 10% of the 6,950 faculty/staff and student employees participated in SmartTrips™ programs, with 54% of those participants reporting a change in their travel habits. Data showed that 15.3% more participants shifted from driving alone to other modes such as bicycling, walking, carpooling, teleworking and riding the bus. Employees who changed their travel habits saved 453,284 miles over one year, reducing traffic congestion and parking problems around campus significantly.

Note: Beginning in 2009, employees can be reimbursed up to $20 per month for biking to work. The Emergency Economic Stabilization Act of 2008 (P.L. 110 343), added qualified bicycle commuting reimbursements to the types of qualified transportation fringe benefits. http://www.smarttrips.org/business/businessCaseStudyDetail.aspx?caseStudyID=10

4.5 Academic administrators question the efficacy and quality of distance learning.

Distance learning, also called online learning and e-learning, is growing in popularity. Although some faculty members do not accept the value of distance learning, demand and support for it is becoming more widely accepted. In a 2008 survey of chief academic officers, nearly 80% agreed that online courses meet student needs for flexible access, and almost 60% agreed that it is the best way to reach particular students.[48] Research on the topic of online learning has shown that it can be at least as effective as traditional classroom lectures and discussion sessions. When interactivity and personalized learning styles are incorporated into online learning modules, many students perform better than they do in traditional classroom settings. For more on the effectiveness of distance learning, see the resources listed below.

Distance learning is less carbon-intensive and often more cost-effective than traditional classroom learning. In terms of energy consumption and carbon dioxide emissions per student, online courses are significantly more efficient and better for the environment than traditional classroom courses. The difference is even greater for courses at commuter schools. One study considered differences in paper consumption, computing, travel, accommodations, and campus site impacts between online courses and classroom courses and found that the latter three have the largest impact on carbon emissions.[49] Additionally, the cost of energy for classrooms operations is high; when buildings are inefficient the cost can be much higher per student than it would be for an online course.

Many community colleges, where enrollment is on the rise, do not have enough classroom space to accommodate the increased demand for courses. Online learning is a way to save the costs of building new facilities. For students who would otherwise commute to campus, distance learning can also offer significant cost savings. The State University of New York system provides an online calculator to help students determine how much they can save by taking classes online: http://sln.suny.edu/sln_dlcalculator.html

Concerns that faculty and administrators commonly raise against online learning include:

- The cost of course development is too high
- Online courses add significantly to faculty's work load
- Faculty do not have the technical skills they would need
- Online teaching is inferior to face-to-face teaching

These concerns can be valid where an online teaching program is not yet set up and supported adequately. However, each concern has been remedied in schools with high-quality online course programs that have been underway for a few years. For advice on "Online Learning: Reaching Out to the Skeptics" read the article with this title, by Thomas Benton in the Chronicle of Higher Education (http://chronicle.com/article/Online-Learning-Reaching-Out/48375/). Benton emphasizes the importance of collaboration between faculty, technology staff, and librarians. He also recommends that courses include both classroom time and online time.

For specifics about how to manage the costs of online course development, read "Online Course Development: What Does it Cost?" by Judith V. Boettcher in Campus Technology (http://www.campustechnology.com/Articles/2004/06/Online-Course-Development-What-Does-It-Cost.aspx?aid=39863&Page=1). Boettcher outlines three phases of online learning programs: institutional launching, infrastructure and course model development, and institutionalization and refinement. Since the field of online learning is now in the third phase, schools just beginning to launch a program can progress smoothly through the first two phases by drawing on the experience of other schools. Just a few years ago, the path would have included more confusion and have required more staff time.

Even classes with regular, in-person meeting times, can include online learning to improve student comprehension and performance while reducing environmental impact. This hybrid approach can help alleviate faculty concerns, reduce the number of classroom meetings with their associated costs and emissions, and reduce paper and energy use for photocopying.

As mentioned in section 4.3, an increasing number of businesses are incorporating e-learning into their employees' professional development and training. Therefore, students who have experienced online learning will better succeed in the workplace than those who unfamiliar with online learning.

Examples

<u>Gas price volatility and affordability of education</u>
With the rise in gas prices in 2008, enrollments and requests for online programs spiked for community colleges and universities across the country. Savings in travel costs became selling points in marketing materials for online programs,

[48] Allen, I. Elaine and Seaman, Jeff (2008). Staying the Course – Online Education in the United States, 2008. Available online at http://sloan-consortium.org/publications/survey/pdf/staying_the_course.pdf

[49] Towards Sustainable Higher Education: Environmental impacts of campus-based and distance higher education systems. Summary and full report available online at http://www.nwf.org/campusEcology/climateedu/articleView.cfm?iArticleID=76

such as the State University of New York's Learning Network, which provided an online calculator to help students determine how much money could be saved from taking courses from home.

"Blended" courses are experiments in mixing in-person sessions with online meetings. "Instead of coming to class three times a week, you might only need to come two times a week if you have a blended program," said Frank Mayadas, director of the Alfred P. Sloan Foundation's grant program for online education.

The University of Phoenix did not report an enrollment spike due to gas prices, its courses are already designed to minimize drive times. Courses meet once a week for four-hour sessions and textbooks and library services are delivered online. "I wouldn't want to say we built anticipating the gas crunch," said William J. Pepicello, Phoenix's president, but it had less impact on the Phoenix since "we have a wide variety of virtual services."
http://chronicle.com/article/Gas-Prices-Drive-Students-t/964/

Resources

Zhang et al. (2004). "Can E-learning Replace Classroom Learning?" Communications of the ACM, 47, 5: 75-79. http://portal.acm.org/citation.cfm?doid=986213.986216

Callaway, Ewen (2009). "iTunes University Better than the Real Thing." New Scientist, 18 February, 2009. http://www.newscientist.com/article/dn16624-itunes-university-better-than-the-real-thing.html

4.6 Because we are a non-residential school, commuting causes most of our carbon footprint.

The nature of student life at most community colleges and technical schools positions these campuses to be pioneers in the challenge of tackling emissions from commuting. Without focusing on carbon emissions, these schools are already associated with reduction of vehicle miles travelled. For example, proximity to home and work is often one of the major reasons that students elect to attend specific commuter colleges in the first place. Further reductions cannot be made in a vacuum but instead require cooperation and collaboration from community partners, potentially including transit authorities, planning agencies, local employers, sponsoring organizations and voters.

Community colleges are local centers of leadership. Those that have made a public commitment to the reduction of carbon emissions have taken an important step as leaders in addressing the climate crisis. In order to make progress toward reductions from commuter vehicles, campus leaders will need to build coalitions and advocate for local partnerships. It will help if the community also makes a public commitment to reducing greenhouse gas emissions. It can be a natural progression that climate momentum at the local college facilitates municipal commitments and planning sessions to reduce carbon emissions, especially for smaller cities and towns. Getting students involved in climate-related service projects with community partners is often an excellent way to coax this progression. Chapter 5 goes into more depth about the types of partnership arrangements.

Your strategy for reducing commuter miles travelled should have two central tenets: increasing access to convenient, commuting alternatives and providing incentives for people to use the alternatives. Here are several components to consider for each of these central tenets:

Increasing access to convenient, commuting alternatives

- Serve student employment centers
- Offer virtual services to support telecommuting
- Offer distance learning
- Offer bicycle-sharing programs
- Offer car-sharing programs
- Install bike share stations
- Install covered bike racks

Providing incentives for people to use alternatives

- Understand the price elasticity among students to switch from driving to public transit and car-sharing; and structure incentives accordingly. Base research is critical as campus layout is not homogenous. Understanding the socio-economic situation on campus is essential to designing effective incentive programs.
- Create a promotional competition among classes, teams, or fraternities and sororities to use more bikes, transit, carpooling, and walking
- Create a scholarship fund with points earned by transit use, walking and bicycling
- Promote ridesharing by giving parking pass discounts and premium parking spots to carpoolers
- Reward students with free or discounted alternative transportation if they pledge to reduce or give up automobile use (see Ripon College's Velorution - http://www.ripon.edu/velorution/index.html)

4.7 Campus administrators oppose use of campus funds or students fees to offset carbon emissions generated by commuting.

Carbon offsets are an excellent way to reduce an institution's overall carbon footprint. Chapter five offers an overview of carbon offsets and the means to offset GHG emissions through these financial tools. If administrators are thoroughly informed about offsetting then they are more likely to agree to purchase them.

Administrators looking for offset funding can consider allocating some or all revenue from parking and traffic violations. Money collected from campus parking and traffic violations is often used to fund campus transportation programs. Designation of a percentage of each parking-ticket revenues to pay for carbon offsets would both manage the campus carbon footprint and raise awareness of carbon emissions from driving. Because commuting generates this revenue, there may be more support for using it to remedy problems caused by commuting. Also, since charges for violations are generally accepted, using the revenue from these charges to pay for carbon management does not constitute an additional charge to students or employees.

In many cases, when purchasing carbon offsets, the purchaser can choose what sort of offset program those offsets go to support. If a campus is purchasing offsets to offset their own transportation emissions then they might be interested in making sure those offsets go to support a transportation emission mitigation program. An example of this is College of the Atlantic's purchasing of offsets to help reduce carbon emissions at truck stops throughout the United States (http://www.carbonoffsetsdaily.com/press-release/college-of-the-atlantic-to-help-reduce-truck-stop-emissions-15765.htm).

Currently there are not many examples of institutions developing specific plans to fund and mitigate transportation carbon emissions through offsets. This is an area where interested institutions have the opportunity to participate in public discussion, take the initiative to experiment, and lead in coming up with viable solutions.

Resources:

The American College & University Presidents' Climate Commitment Voluntary Carbon Offsets Protocol describes limitations, nuances and questions to be considered when campus programs have the opportunity to generate offsets. (http://www.presidentsclimatecommitment.org/resources/guidance-documents/offset-protocol) Note that colleges abiding by this protocol generally cannot use RECs to offset emissions from transportation since RECs are used only to offset emissions generated by the electric grid. Chapter 5 of this guide gives more examples and discussion of RECs and offsets. Infrastructure Barriers.

4.8 The campus has no access to public transportation.

When public transportation is not available there are still a number of ways to encourage students and employees to reduce their individual vehicle miles travelled. Bicycling and walking can be attractive and safe options in communities where streets near campus are less busy. In contrast, where the streets are busy and crowded, students and employees may relish the opportunity to ride on a campus-operated shuttle instead of driving (reference section 4.9). By demonstrating that shuttles, carpooling, and bike sharing programs can be successful even in rural and suburban areas, campuses can lead the way to public discussion and support for transportation alternatives in the wider community.

Car-sharing programs that offer occasional use of a car for errands and local trips have also become popular with students because they alleviate the need to bring a car to campus. Many campuses now have partnerships with Zipcar and other car-share providers (Daren Everson, "Zipcar Goes to College," The Wall Street Journal, August 22, 2007. http://online.wsj.com/article/SB118773675721104581.html).

For faculty, staff and other daily commuters, carpooling can offer a viable alternative to driving alone. Carpooling programs work especially well when carpoolers are given such incentives as closer parking places, discounts at local businesses, discounts and rebates on parking passes, occasional free parking, and access to emergency rides.

With a bit of creativity, logistical knowhow, and marketing, these alternatives to driving single-occupancy vehicles for daily commuting and student trips can succeed. Many students are pleased when a school provides viable alternatives because they regard owning and maintaining a car as an expensive hassle. Offering express shuttles to nearby cities and other popular destinations, and providing rides to distant homes can alleviate the need for students to bring a car to campus.

As for human-powered transportation, an increasing number of campuses have begun to provide bicycle-sharing programs. The basic idea is to provide bicycles to the campus community for personal transportation at little or no cost to users. There are several variations of these programs, including electronic bike sharing, bike collectives, bike libraries, bike rentals, and bike promise. The program that works best is dependent on such factors as campus location, student population, and proximity of local bike shops and their willingness to participate in a bike-sharing program. The University Bike Programs website has excellent information and best practices on these different types of programs (http://www.universitybikeprograms.org/). Successful adoption of such programs depends mostly on the availability of bike parking (preferably covered), availability and ease of bike service, low or no participation cost, and safe and plentiful bike paths.

The Yellow Bike Project (http://c2.com/ybp/) was Portland, Oregon's original 1994 program to provide people with access to free bikes. It was the first community bicycle-sharing program in the United States. Since then, a number of cities and college campuses have adapted Portland's idea to their circumstances. The general idea is that bikes are collected from donations or purchased in bulk at a low cost, painted with a signature color or pattern, and provided free of charge to members of the campus community. In some cases, students and employees are required to check the bikes out using their campus ID (electronic bike sharing). In others, students who pledge to leave their car at home may be given a bike for the semester (also called bike promise). In a third approach, bikes are kept at outdoor stations where anyone can borrow and return them (basic bike-sharing). For an incomplete list of bike-sharing programs in North America see http://www.universitybikeprograms.org/wiki/index.php?title=List_of_Bike_Programs.

A successful bike-sharing program requires a system for registering, tracking, repairing, and checking bikes for safety. It also should have an information system to help educate

Luther College recently started a bike share program that allows students to check bikes out of the library.

users about bicycle maintenance and general riding safety. Also a mechanism for continuity in running the program is essential. In many cases, students create these programs and student groups who are piloting such a program will need a long-term staff partner to help manage the ongoing administration. Michigan State University's MSU Bike's (http://www.bikes.msu.edu/) bike-sharing program is a great resource for general bike-sharing program information, such as safety, parking, leasing, and servicing.

Examples

Targeted shuttles operated by the campus to connect to nearby cities and towns can be effective.

University at Buffalo, The State University of New York
For the 2009-2010 academic year, UB's Parking and Transportation Services is operating a pilot "Express Bus Home" service on select weekends and holidays. The service provides transportation from campus to one stop in three neighboring cities and a direct service to Penn Station in New York City. It is available exclusively to UB students, faculty, and staff, who can also purchase one additional ticket for a friend or family member. The university contracts the charter service with D&F Travel, Inc.

"UB has had such great demand from parents and students for rides home on weekends and for holidays," said Maria Wallace, Director, UB Parking and Transportation Service. "We are excited that we found a way to meet student demand while decreasing our campus community's reliance on personal vehicles."

At the end of the pilot year, the program's success will be evaluated and extension of the service decided upon. (http://sas.buffalo.edu/beconnected/general/new-ub-car-free-express-bus-home-program/)

Princeton University, Princeton, NJ
Princeton provides the "TigerTransit" shuttle to students and supports its operating costs. Partial matching funds from New Jersey Transit—expected to scale back in the coming years—helped initiate the program, which services the Princeton campus and surrounding community. The fleet runs on B20 biodiesel and incorporates bike racks, enhanced accessibility features, and a GPS tracking system with a web interface.

"Information is key. By making transfers, people could really get around this town," said Borough Administrator Robert Bruschi, "A really specific need is being addressed by this vehicle." http://www.princeton.edu/transportation/tiger-transit.html
http://www.towntopics.com/oct1409/story1.php

Northwestern University
Northwestern also employs positioning technology in their shuttles. Associated Student Government Vice President Tommy Smithburg said, "The fact that it updates times automatically if a shuttle is arriving early or late is one of the best features possible." (http://www.northbynorthwestern.com/2009/10/50268/keeping-track-of-new-shuttle-technology/)

Carpooling programs have become increasingly attractive and prevalent, requiring practically no capital investment for the university while significantly reducing emissions. Costs go into awareness campaigns, networking programs to help carpools to form, and administrative costs for carpool parking permits, if the university chooses to use such tools. Several universities have implemented carpool programs and online matching services over recent years.

Cornell University
Cornell is a featured case study in Transportation & Sustainable Campus Communities by Will Toor and Spenser Havlick (2004). Faculty and staff commuters who form carpools are given discounts on their parking fees. Carpools that are large enough earn rebates and members of these carpools are actually paid for their avoided emissions. Individuals do not have to commit to carpooling long term; Cornell offers a thirty-day trial period. This option makes the carpooling commitment less daunting for people who are uncertain if it could work for them. Carpoolers can also count on a variety of supporting services to alleviate issues that can arise, including an emergency ride home program, occasional personal parking privileges, night-safety shuttles, and a campus-to-downtown express bus at lunchtimes.

Zimride
Zimride, a proprietary online ride-sharing program, leverages a valuable, pre-existing transportation asset of universities and corporations: a trustworthy network of linked individuals commuting to similar destinations on a regular basis. Since its launch in 2007, Zimride has become popular mainly through its links to Google Maps and online social networks like Facebook. A mobile phone interface that would facilitate real-time ride-sharing (think "e-hitchhiking") is also in the works.

Zimride is partnered with Zipcar car-sharing services and together they provide colleges and universities with an integrated transportation solution. At the time of writing, Zimride charges universities $9500 a year for carpool matching services within a private network and interface for members of the community. Over 25 public and private institutions have signed up, including Cornell University, Eastern Kentucky University, Moraine Valley Community College, Purchase College, State University of New York, Stanford University, UCLA, University of Michigan, and University of West Virginia. Zimride has demonstrated 20% carpool adoption and savings of over 500,000 lbs of CO_2 and $200,000 in vehicle operating costs.

Additional carpool program examples:
Emory University http://transportation.emory.edu/transportation/carpool/index.html

Sacramento State
http://www.csus.edu/aba/utaps/carpooling.html

San Jose State University
http://as.sjsu.edu/asts/index.jsp?val=carpool_overview

University of New Hampshire http://www.unh.edu/transportation/programs/carpool.htm

Bicycle sharing can be a useful alternative for getting around the local area.

University of New Hampshire
The University of New Hampshire's "Cat Cycle" program allows students, faculty, and staff to sign out a bike and accessories for exclusive short-term use (up to one week at a time). All bikes are single-speed "cruisers" equipped with a lock, fenders, a basket for cargo, and back-pedal brakes. The bikes can be used on or off campus, but only a limited number are available, so there is often a waiting list. The program is managed by the university's transportation services and is offered free of charge, as long as the bikes are returned on-time and in good shape.

Emory University
Bike Emory — a unique partnership between Emory University, national partner Fuji Bikes, and local partner Bicycle South —manages a bike share service for students, faculty, and staff to easily access bikes once they get to campus. Bikes are offered for daily use only and cannot be kept overnight; they can be checked out and returned at multiple locations around campus. There is no charge to check out a bike, and a helmet is required. The program supports alternative transportation to campus, especially for those whom cycling to campus is impractical.

Western Carolina University
The Yellow Bike Project, a student-led initiative modeled after the original Portland project, was recently launched at Western Carolina University. Student volunteers gathered donated bicycles, repaired them, painted them yellow, and distributed them across campus for all students, faculty, and staff to freely use. Yellow bikes are not checked out or locked up; they are available unlocked at designated racks on a first-come, first serve basis. Thus far, the program has not experienced bike abuse or theft, and Bibeka Shrestha of the Smoky Mountain News writes, "Ever since the launch of the Yellow Bike Project in late August, a new bike culture has quickly sprung up around campus at Western Carolina University." (http://www.smokymountainnews.com/issues/09_09/09_09_09/fr_borrowing_bikes.html)

Resources

The Bike Sharing Blog by MetroBike: http://bike-sharing.blogspot.com/

Carpooling software to build customized, online carpooling programs for universities:
Zimride:
http://www.nytimes.com/gwire/2009/07/29/29greenwire-startup-bets-that-social-networking-will-spur-36381.html
http://www.zimride.com/university_carpool_system
http://www.zimride.com/zipcar

Rideshark: http://www.rideshark.com/CampusEdition.aspx

4.9 There are no direct connections between transit routes and campus.

As major employers and local business drivers, colleges and universities often wield a significant amount of power and influence when it comes to local affairs. By emphasizing the benefits that could result from improved campus access to public transit, it is possible to drum up local support and funding for solutions. Societal benefits include:

- Reduced traffic and congestion, particularly in downtown areas and retail zones near campus
- Efficient land use and parking savings
- Increased business at off-campus eateries and stores
- Increased revenue for the local transit program
- Increased community livability through the expansion of alternative transportation and consumer choice for mobility, with reduced emissions as a positive societal co-benefit.
- Easier access for the community to attend campus events
- Enhanced social equity through increased accessibility to education for all citizens, especially for non-drivers

In exploring service contracts and route extensions with the local transit authorities, certain outstanding practices can strengthen partnerships between transit agency and university, for example:

- Aim for establishing multi-year contract terms, amenable to both sides.
- Each side should provide quantitative data upon which the amenable terms are based, not to create criteria for contract termination, but to foster an understanding between transit authority and university about the benefits, motivations, and constraints for each party.
    - The transit authority can project estimated ridership iincreases and cost increases over multiple years to clarify what level of utilization makes the contract financially attractive or detrimental. This data may be based upon preliminary feasibility studies funded jointly by the transit authority and the university.
    - The university should communicate whether there are time schedules and mandates that constrain how it handles student fee increases and general fund allocations.
- Both sides must formalize communication channels and agree to provide joint media statements in anticipation of interest and concern by the community, especially when transportation services become popular and essential. When there are negotiations, the university can be caught between financially strapped transit authorities and an anxious, vocal student population. Advance, private communications between transit authority and university spokespersons lets both sides properly prepare to handle inquiries and comments—as a functioning collaborative partnership would dictate.

If a partnership arrangement with a local transit agency is not viable, another option to consider would be a campus-sponsored shuttle to connect with local transit stops. This approach has been especially successful for community colleges near well-developed transit systems.

Shuttle services operate under various models. For example:

- Circulating shuttles carry passengers for short trips along busy corridors or between major activity centers. They can run only during certain hours, such as peak service hours, during special events, for holiday travel between campus and airport, or as late-night shuttles for colleges after regular transit service ends.
- Demand-response para-transit runs small buses, vans, or shared taxis on flexible routes and schedules. These services can be effective for off-peak hours and can be more cost-effective than fixed public transit routes in lower-density areas. Demand-response also works well for providing service to people with temporary or permanent disabilities.
- Jitneys can be small buses or vans that carry passengers on fixed or semi-fixed routes with flexible schedules. Riders typically pay a fixed fare. Jitney services are self-financed, privately operated transit services.

The costs of shuttle services are mainly the expenses of operation: labor, insurance, vehicle maintenance and fuel. Often shuttle services require subsidies to launch and operate. If the university decides to operate shuttle services privately, first costs include capital cost of vehicles.

In seeking how to fund costs, consider the broader community benefits mentioned earlier and how other organizations may be incentivized to invest, including:

- Regional business associations
- Real estate and community developers
- Municipalities
- Environmental organizations (Clean Cities Coalitions, Climate Action plans)
- Private transportation businesses or contractors
- Transit agencies as an operations partner, if not a financial supporter

In addition to shuttles, safe walking and biking routes to local transit stops improve carbon-neutral access to campus. Safe walking and biking routes throughout a campus also encourage students to walk or bike, rather than drive, further reducing a campus' climate impact. Many schools include pedestrian and cycling considerations in their campus master planning processes. In urban areas where there is significant pedestrian-vehicle conflict, universities should seek out and work with city planners on improving pathways near the school. Safe routes should be easy to navigate, well-signed, lit at night, and near emergency blue-light phones. Bicycle paths should include well-lit, easy-to-use bicycle storage racks at either end.

To make biking even more convenient, access to free bikes or inexpensive micro-rentals is a powerful enabler. For more about campus bike sharing, refer to section 4.8.

Examples:

Western Washington University, Bellingham, WA
Highly publicized negotiations between WWU and Whatcom Transit Authority (WTA) earlier this year illustrate the tensions that occur when collaborative working partnerships are broken. In 2007, over 80% of WWU's students voted to approve a $25-a-term transportation student fee which would pay for universal student bus passes and a late night shuttle service. Through a contract with WTA, WWU purchases prepaid WTA bus passes for all students with these funds.

In early 2009, WTA had approved a 25% rate increase across the system. A proportionate increase of funds from the university was expected, out of fairness to all riders. Discussions about these rate increases soured between WWU and WTA, with tensions peaking after WTA distributed key information through the media, both local and campus newspapers, before negotiations were finalized. This left WWU unprepared to handle questions and concerns from the student population about fee increases and potential services changes. Eventually negotiations concluded with WWU agreeing to lesser payment increases to WTA over a period of three years. These increases will not be passed along in any fee increase to students and the university has promised not to cutback the late-night shuttle service.

University of Maryland, College Park, MD
The transportation department at UMD has arranged a shuttle service to and from the Baltimore-Washington International airport over the Thanksgiving break. The service is free to the university community on a first-come, first-served basis. A university ID must be shown for boarding. http://www.transportation.umd.edu/alt_trans/shuttle_bwi.html

University of Iowa, Iowa City, IA
In 2006, the University of Iowa developed a new master plan and has now begun implementation to establish a unifying framework for the campus as a whole, support the university's educational mission, demonstrate stewardship of buildings and land, preserve and enhance the unique identity of the campus, promote a pedestrian-oriented campus, and enhance the quality of the visual environment. The all-encompassing master plan aims to create a long-term perspective to help define near-term project goals that advance these principles. The promotion of a pedestrian-oriented campus is of special interest and the university gives pedestrian movement the highest priority for campus travel by providing total separation from vehicle traffic, no greater than a ten-minute walking commute for undergraduates between classes, and frequent open and gathering spaces along the pedestrian pathways. For more information see http://masterplan.facilities.uiowa.edu/.

University of Arkansas at Little Rock , Little Rock, AR
UALR has been implementing its latest master plan since 2003. The guiding principles of the university's plan are to steer the physical development of the campus consistent with the university's strategic vision, create a vibrant, memorable, and safe student-life experience, and expand the university's presence and leadership role in the greater metropolitan Little Rock region. Located in an urban area, there is much pedestrian-vehicle conflict. As part of the student safety principle and alleviation of this conflict, UALR commissioned a pedestrian safety report in 2004 and has been working from that to upgrade its pedestrian ways. Specifically the university will use a distinct paving pattern to help with pedestrian guidance, provide effective signalization at extra-wide road crossings, improve lighting at crossing areas, prohibit right-hand turns at high-traffic intersections, and provide many other specific pedestrian best practices. Additionally, the university is striving to ensure that it is represented in all Little Rock municipal city planning that affects infrastructure near UALR. For additional specifics see http://ualr.edu/about/masterplan/index.php/home/planning-framework/.

Resources:

Shuttle Services: Spielberg and Pratt (2004) describe various factors affecting the travel impacts of demand response transit services, including feeder service to main transit routes, and special mobility services. It also discusses the costs of these services.

Pedestrian and Bicycle Information Center: An excellent compilation of university bicycle and pedestrian master plans can be found at http://www.bicyclinginfo.org/develop/sample-plans.cfm.

Socio-Cultural & Behavioral Barriers

4.10 Commuting faculty, staff and students perceive that there are no viable alternatives to driving single-occupancy vehicles to campus.

4.11 Although alternative transportation modes have been improved, many commuters don't use them due to earlier negative experiences with the alternatives.

Both of these socio-cultural and behavior barriers are influenced by how commuters and citizens experience alternative transportation services. Reliability, consistency, perceived safety, and both physical and psychological comfort affect the psychological response of commuters to various transportation modes.

Citizens and commuters also reference the way they perceive quality and convenience in other service sectors (e.g. internet providers, 24/7 retail stores) when evaluating transport performance. Students and employees expect mobility solutions that are quick, safe and secure, convenient, clean, affordable, and ultimately easily understood and easy-to-use.

All of these aspects relate to how the service is provided (efficiency of the networks, quality of the stations and vehicles, etc.), how well the information design provides accessible information, and the ease of exchange between modes.

Pleasant travel experiences will lead to changes in behavior and perception. This implies enhancing the travel experience and removing negative connotations. Well-understood needs, quality delivery, and innovation are the main drivers in providing mobility service successfully. This service-experience mindset is indispensable for turning public transport, or any other alternative to single-occupancy cars, into the preferred mobility option of citizens.

The International Sustainable Campus Network (ISCN - www.international-sustainable-campus-network.org) is a group of universities (including Stanford, Harvard, and Yale, as well as European universities in Göteborg, Bologna and Lausanne) sharing best practices on building design, transportation and teaching. Many of the network's challenges and solutions to campus sustainability are different among academic institutions due to their specific needs, but there are also clear similarities on the most important issues.

The following list of guidelines was compiled from the ISCN's case studies and from other transportation design resources. These guidelines address ways to efficiently implement alternative transport services, provide a better user experience, reduce the risk of negative experiences and eventually regain the trust of deluded riders:

- Become a true mobility provider: promote a full suite of complimentary services such as car pooling, bicycle access, and parking. Develop strategic intermodal partnerships with local transit authorities, bike and car sharing organization, parking facilities, para-transit services, and information providers to reach the campus and facilitate movement within and beyond it during the day.
- Respond to user's needs, expectations, and life style: monitor decision-making patterns related to mobility and develop a diverse portfolio of mobility products and services that suits both mobility needs and expectations related to identity and status.
- Provide clear user information on how to use the different services, using a broad range of different information channels such as the Internet, mobile phones and on-site signage. Feature a prominent weblink to transit information on the campus homepage or email system.
- Create channels for people to receive personalized advice and information about their transportation options.
- Provide a common badge or ID to facilitate seamless movement between services, and perhaps to track public transit usage for reward programs.
- Harness the power of social marketing by involving students and employees in the improvement of the campus transport system. Let them to rate the service in real-time (texting, Facebook, intra-campus networks, email, phone hotline), while at the same time informing administrators about service problems and possible solutions.
- Plan schedules to support peak demand periods and synchronize with public transit schedules to facilitate transfers. Enable data sharing amongst the service providers so that planning from a common website for all the different transport options is possible.
- Provide discounts on public transportation and other mobility services for students and employees, especially at the beginning of the academic year.
- Provide guaranteed ride-home programs to ensure public transport availability or to extend service hours (e.g. late-night ride programs), to eliminate anxiety about being "stranded" without a personal car.

Building on a strong foundation of integrated mobility options, a communication campaign helps create awareness, as well as supporting mass transit "advocates" who spread the word about their positive experiences. A recent research report sponsored by the Federal Transit Administration, "TCRP Synthesis 78: Transit Systems in College and University Communities," found that commuters are increasingly finding alternatives to driving alone to campus, especially when the campus makes a commitment to educating commuters and providing alternatives. http://www.nwf.org/campusEcology/climateedu/articleView.cfm?iArticleID=92

Targeted communication events to launch and promote integrated mobility services include:

- The president incorporating statements about transportation options in prominent speeches to the campus community
- Raffles where riders are automatically entered to win prizes when they ride public transit or use alternative transportation (see http://www.nuride.com)
- Rewards programs for driving less (gift certificates, campus cafeteria coupons, scholarship funds, annual celebrations for consistent participants, etc.)
- Competitions between departments or classes to reduce VMT

Section 4.6 includes a sampling of specific ideas that can be used to implement these guidelines.

Research:

<u>Indiana University, Bloomington, IN</u>
"Transportation Sustainability at Campus Level: Students' Residential Location Choice and Transportation Mode Shift" http://newsinfo.iu.edu/news/page/normal/10010.html will focus on the relationship between alternative transportation incentives and students' residential and behavioral choices and their impact on goals of transportation sustainability.

School of Public and Environmental Affairs (SPEA) associate professors Diane Henshel and David Good, master's students Yonghua Zou, Craig Harper, Max Jie Cui and Courtney Bonney, supported by adjunct advisers Kent McDaniel (IU Transporta tion Services), Rob Fischman (IU Maurer School of Law) and Nicole Schonemann (Office of Service Learning),

University of Maryland, Sate Park, MD
The university's self-funded Department of Transportation Services (DOTS) administers, supports and promotes a range of transportation services, including several regular and special event shuttles. *The Campus Connections Booklet* http://www.transportation.umd.edu/routes/schedules/Campus%20Connections/CampusConnections0910.pdf http://www.transportation.umd.edu/index.html
is available during the first week of classes to all students, faculty, staff, and visitors. It provides an overview of the services offered by DOTS and is also available online year-round.

DOTS resulted from a merger between a student-managed transit provider and the campus parking department in 2002. It operates under the supervision of the Vice President for Student Affairs.

Resources:

International Association of Public Transport
http://www.uitp.org/advocacy/public_transport.cfm

International Sustainable Campus Network: Best Practice — Future Challenges (Conference Summary); Network Kick-off Meeting; Novatlantis; Zurich, Switzerland; April 25-27 2007
http://www.international-sustainable-campus-network.org/

Case studies:

- Sustainable Mobility on the Ecole Polytechnique Federal de Lausanne campus
- Methodologies of Analysis and Actions for Sustainable Mobility, Universitá de Bologna
- Sustainable Communication, Travel and Transportation: Examples from Göteborg University

There are several strategies that can contribute to reducing air miles travelled. The following is by no means an exhaustive list:

Conferences/Meetings	Admissions	Athletics	International Study
Develop high-quality video-conference capability	Consolidate travel by using one round-trip flight to go to several cities in the same region	Add a surcharge to all athletic ticket sales to pay for carbon offsets for travel to away games	Book group travel on direct flights whenever possible and keep number of flight legs to a minimum
Establish campus policy to limit the number of trips per year	Rely on more alumni and parents to meet with prospective students and attend high school affairs	Rely on bus and rail travel whenever possible	Include carbon calculations and offsets in the study abroad experience, either through an additional fee or through service projects
Provide an additional travel stipend to employees who travel by bus or rail to conferenes and meetings	Host webinars with question and answer sessions for prospective students	Invest in comfortable, clean-fuel buses to support travel for the athletic program	
Provide awards and recognition to faculty who make an effort to and participate in and organize teleconferences	Ask students to speak at their high schools while visiting home	Give higher priority to companies that can provide clean fuel buses when contracting with transportation providers	

Long Distance Air Travel

Although emissions from air travel for campus business are less significant than emissions from commuting, there are compelling arguments for bolstering education and awareness of airline emissions. Each trip taken by plane is significantly more detrimental to the climate than each local trip taken on roads. Also, administrators may view campus-sponsored air travel as more of a direct result of campus business than commuting, and thus more of a liability or ethical responsibility.

Although the scale and complexity of the airline industry is beyond the control of each campus, there are organized efforts underway to improve energy-efficiency and clean fuel alternatives in the aviation industry.[50] It may be useful to educate the campus community about this topic in order to engage them in voluntarily reducing air miles travelled.

4.12 Air travel is essential to campus business and professional standing.

Examples

The university can demonstrate its commitment to sustainability in every service it provides, considering the following example as an alternative when your university conducts business meetings or hosts a conference.

Global Knowledge Training, LLC
North Carolina-based Global Knowledge Training, LLC is a provider of training and enterprise learning services for IT and management professionals. It uses iLinc web conferencing software for a number of cost and security reasons. iLinc also offers a "Green Meter" feature, which tracks the environmental impact of its distance learning programs.

"I hadn't thought about our direct effect on global warming before switching to iLinc," said Chris Gosk, VP of Distance Learning at Global Knowledge. "Now, however, we know precisely how our online programs help the environment, both for our organization and for our customers.

In offering distance learning to our students for the last six years we estimate that we've saved the environment approximately 316 million pounds of CO2 emissions – the equivalent of buying and burning 15.8 million gallons of gasoline."

The iLinc Green Meter™ http://www.ilinc.com/company/global-knowledge.php
http://www.businesswire.com/news/home/20070827005368/en

[50] Refer to the developing climate change plan of the International Civil Aviation Organization (IACO) at http://climate-l.org/2009/06/05/icao%E2%80%99s-giacc-develops-action-plan-to-tackle-international-aviation-emissions/ and to the website of GreenSkies for information on efforts by civil society at http://www.greenskies.org/

automatically calculates exactly how much CO2 emissions are saved for every individual that uses their web conferencing software. It detects the locations of those attending the web meeting and measures the distance between the meeting participants and the meeting leader, then calculates the exact amount of travel that is eliminated. Applying an algorithm that recognizes what means of travel would commonly be used for the distance (such as car, small aircraft, large aircraft, etc.), the Green Meter generates a CO2 emissions savings amount for both the web meeting leader and a composite number for the entire event.

James M. Powers, Jr., iLinc's President and Chief Executive Officer, states "By skipping just one traditional business meeting and having a Web conference instead a company can significantly reduce its CO2 emissions."

International study programs can embrace sustainable transportation practices, as well as providing exposure to sustainable lifestyles.

The Green Passport Program
http://greenpassport.ning.com/

The overarching goal of the program is to foster education, dialogue, advocacy, and action around the issues of environmental sustainability and social justice. The program provides study-abroad offices and education-abroad programs with resources to "green" their operations and provides students with a variety of tools to lessen their travel impacts and to learn about sustainability while abroad.

Resources

UNC's Green Passport Handbook:
http://studyabroad.unc.edu

Sustainable Travel International's Checklist
http://www.sustainabletravelinternational.org/documents/gi_travelchecklist.html

A list of questions to help travelers understand the environmental impacts of the travel providers they choose.

Sustainability Abroad Listserve
http://lists.livingroutes.org/mailman/listinfo/sustainabilityabroad

This listserve discusses sustainability in college level education abroad programs (e.g. program design and management, curriculum and student learning, staff training, promotion).

NAFSA's Recommendations on Environmental Sustainability in Education Abroad:
http://www.livingroutes.org/resources.htm

Living Routes:
http://www.insidehighered.com/news/2009/03/12/studyabroad

Middlebury
http://www.middlebury.edu/academics/ump/sap/sustainable/
As mentioned in section 4.7, carbon offsets are an excellent way to reduce an institution's overall carbon footprint. Chapter five gives a thorough overview of carbon offsets and the means to offset GHG emissions through these financial tools.

UCLA-CAP proposes additional offsets fee for all airline ticket purchases
http://www.sustain.ucla.edu/cap/article.asp?parentid=2162

Long Distance Ground Travel

Consolidation of emissions from long-distance ground travel is another piece of the campus climate puzzle. By discouraging the use of single-occupancy vehicles for long trips and providing clean-fuel buses, campus transportation planners can noticeably reduce emissions due to transportation. Transportation planners should concentrate on optimizing bus routes and ensuring that ridership rates remain high.

4.13 Long-distance ground travel is necessary for student activities and recruitment.

As a general rule, college students are on the lookout for inexpensive, fun alternatives to the status quo. Thus if there is a convenient way for them to save money on gas and improve the quality of the time they have to spend in a car or bus for break, they are likely to consider it. Here are a few initiatives that you could adapt for your campus:

- Ride-share boards that link with Facebook or other popular social-networking sites on campus
- Campus-sponsored buses with free or inexpensive fares that travel to the closest major cities at the start and end of school breaks
- Campus-sponsored buses to popular destinations for weekend trips, such as ski areas or nearby major cities
- Online registries for attending off-campus conferences and meetings with functions that facilitate and give incentives for ride-sharing
- WiFi-enabled buses or shuttles that enable productive travel times

Resources

Willamette Professor's idea of a choice for students: driving while on campus or studying abroad:
http://www.insidehighered.com/news/2009/03/12/studyabroad

CHAPTER FIVE: CARBON OFFSETS AND ASSOCIATED OPPORTUNITIES

Carbon offsets and renewable energy credits are most credible when purchased as a relatively small but deliberate piece of a comprehensive campus carbon management strategy. Once you have implemented as many efficiency and on-campus renewable-energy generation measures as your resources allow, your campus carbon footprint will be significantly smaller, but probably it will not be zero. For most schools, reaching carbon neutrality in the near term will require off-site carbon credits or offsets.

This chapter addresses perceived barriers to the use of carbon offsets in campus climate action plans that we heard from many campus leaders. They are listed and numbered, each followed by a discussion of solutions and, in many cases, examples and resources. For definitions of the often-confusing terms related to this topic, see Appendix J.

Perceived Barriers

5.1 Campus administrators are wary of carbon offsets.

Although wary, administrators also are unsure of how to deal with campus emissions that will remain after implementation of all feasible energy-efficiency and conservation measures and renewable energy sources.

This concern is understandable. After all, skepticism is part of administrators' jobs and, for many, this is an unfamiliar topic. Therefore, involve them in the process of considering alternative carbon-offsets. When people understand how particular offsets actually work, many accept the value of offsets in the overall effort to reduce greenhouse gas emissions. By exploring the relative value and applicability of a particular offset alongside your climate action committee, campus leaders may be persuaded that carbon offsets can be a genuine means to mitigate GHG emissions.

Two important factors can strongly influence your choices of offsets: location of prospective off-site projects and the type of impact on GHG emissions desired. Those making this decision may ask themselves, for instance, is our campus interested in assisting developing countries with sustainable development or supporting the local economy or both? Do we want to reduce emissions from electric generation, gasoline usage in vehicles, landfills, or deforestation?

The table below will help a group of campus leaders explore carbon credit options regarding location and societal impact.

In this first discovery phase in the exploration of offsets, participants explore possibilities without yet considering limitations. Once your group has established agreement on

The table below will help a group of campus leaders explore carbon credit options regarding location and societal impact.

		Impact				
		Renewable Generation	Building Efficiency	Transportation Efficiency	Methane Capture	Carbon Sequestration
Location	Local/In-state					
	National					
	International					

the types of offset projects you would ideally like to incorporate into your plan, it is time to move to the second phase.

In the design phase, your group will whittle down your options to those that align with your aspirations and also meet practical and environmental requirements. This is the point at which all participants in the offset planning discussion should read ACUPCC's Investing in Carbon Offsets, which offers a comprehensive and clear synopsis of offset investment options. Particularly, see pages 16-17 on evaluating risks and costs.

Understanding offsets can lead to adoption.

During this design phase, frankness from financial officers and administrators is especially important. The group must take a hard look at available funds, expertise and enthusiasm, and risk tolerance; then balance these considerations with their aspirations from the first phase.

If the group prefers to invest directly in projects or develop projects locally (or with partners elsewhere), this phase can include exploratory discussions with potential project developers and site owners. (See section 5.2, 5.3, and 5.5 for more specific information related to investment and development of different types of projects.)

In contrast, if the group prefers to purchase credits, resale or wholesale, this phase will include assessment of the quality and availability of credits that match aspirations identified in phase 1. (See section 5.4 for more information on assessing credits for purchase.)

A third and final phase could be called the multiplier phase in which the group returns to its aspirations and the campus's larger mission and searches for co-benefits that prospective offset projects may offer. Co-benefits are positive outcomes, in addition to GHG reductions, which will magnify the value of your offset project to your particular campus. Recall from section 2.1, the value of seeking multiple benefit from single solutions.

Co-benefits could include those that are:

- Environmental (e.g. reduced air pollution or improved biological diversity)
- Educational (e.g. course opportunities, service learning projects, student internships, or research opportunities)
- Social (e.g. improved quality of life for low-income citizens, revitalization of local farms)
- Economic (e.g. opportunities for revenue generation, new partnerships with potential funders), or other types of benefits

During the multiplier phase, participants can further examine each of the projects that were identified as potentially feasible and acceptable in phase two. The group might create a simple methodology to rank the options they have identified, by weighting possible co-benefits according to their institution's preferences. This could be similar to the decision matrix process described in the Appendix D.

This type of criteria weighting and evaluation has also been used widely by third-party organizations in the publication of consumer guides to quality offsets (see for example Clean Air-Cool Planet's *A Consumers Guide to Retail Carbon Offsets* from www.cleanair-coolplanet.org/ConsumersGuidetoCarbonOffsets.pdf, (page 8) and *Purchasing Carbon Offsets- A Guide for Canadian Consumers, Businesses, and Organizations* from www.davidsuzuki.org/Publications/offset_vendors.asp, (page 49 for evaluative criteria and weighting).

Yale-New Haven Community Carbon Fund

Yale is committed to a greenhouse-gas reduction target of 43% below 2005 levels by 2020. To help meet this commitment, Yale is creating the Yale-New Haven Community Carbon Fund. Developed jointly by students, staff and faculty, this initiative will invest in carbon-offset projects within the City of New Haven. By partnering with local organizations, the fund will provide home-energy-efficiency packages and neighborhood tree plantings that will genuinely reduce greenhouse gas emissions. These measures also will assist low-income families with the rising costs of energy and complement the city's greening initiatives.

Managed by the Yale Office of Sustainability and the Center for Business and Environment at Yale (CBEY), a major component of this project is the educational learning opportunity for both Yale students and community residents. Yale students will engage the local community and its residents by supporting local and innovative solutions to climate change. The project also will provide students with a practical opportunity to participate in the development of a rapidly evolving carbon market while contributing to national and international dialogue about the value of investing in local carbon-offset projects.

By Keri Enright-Kato,
Project Coordinator
Yale Office of Sustainability

While an institution could also undertake a more comprehensive assessment of offset quality criteria during the second phase, this can be extremely time consuming and has already been undertaken by several reputable environmental organizations noted below.

In some cases, a university may wish to comprehensively assess the quality and availability of regional offset-project investment options — in addition to assessing co-benefits. This is wise only if the institution has the time, expertise and resources available to complete such an ambitious policy project. *In many cases, it is more feasible to do a limited assessment for quality and availability, then assess new investment options on a case-by-case basis as they arise.*

Examples

Duke University, Durham, NC
Duke completed a comprehensive feasibility study to establish criteria for the development of an offset portfolio and assess the range of available offset options. For its climate action plan, Duke is most interested in incorporating "local offset measures that have educational, social and environmental co-benefits" (pg. 1). The report recommends how the university might use its expertise and research capacity to forge partnerships in North Carolina that catalyze the development of locally beneficial offset projects.

The study distinguishes between offsets for regulatory compliance and offsets for voluntary neutrality in order to highlight the need for different strategies, criteria and reporting. Duke's report is an offset decision-making model. *The Role of Offsets in Meeting Duke University's Commitment to 'Climate Neutrality': A Feasibility Study* is based largely on research conducted by students in an interdisciplinary graduate-level seminar with overall guidance and publishing support from the Nicholas Institute for Environmental Policy Solutions. http://www.nicholas.duke.edu/institute/offsets.html).

5.2 Campus leaders don't trust voluntary carbon credits.

On one of our campus visits, the college president compared carbon credits from afar to indulgences in 16th century Europe. Although he chuckled while offering this analogy, he was genuinely dubious about carbon credits. At the same time, he was clear that RECs purchased from a local farmer who was constructing a wind turbine would have great educational and community-relations value.

Among many campus leaders, we have heard distrust of carbon credits available on national markets and a growing desire for high-quality, local emission-reduction projects that benefit the community. We heard this particularly in regions of the country where there is a dearth of high quality, local carbon-offset projects that have been verified to show additional GHG reductions.

Because carbon offsets are a bi-product of societal changes that are widely needed for the transition to a low-carbon economy, lack of quality offsets in your region is a leadership opportunity for your institution. However, the process of creating high-quality, verifiable offsets at the local level is complicated and time-consuming. Developing local offset projects may not be wise for institutions with limited faculty and student interest.

In contrast, where faculty and students are enthusiastic, working with local partners to create high-quality offset projects can reap curriculum and research benefits in line with the institution's mission. Development and facilitation of local offset projects is especially appropriate and attractive for public land-grant institutions, where service and outreach are an essential part of the institution's mission.

The idea of partnering with developers to create, validate, verify, certify and monitor offset projects was on the radar of almost all the institutions we visited. But it seems to be little more than an idea as this stage. They were most interested in offset projects with local co-benefits and projects in less-industrialized countries where students study. Over the next five years colleges and universities will undertake a series of pilot projects that will yield important lessons for the nascent practice of offset project development in higher education.

Also, if the Waxman-Markey Bill passes Congress, it will establish a federally regulated carbon market, which may alleviate administrators' distrust of today's unregulated carbon funds.

Examples

The University of Colorado, Boulder , Boulder, CO
CU has supported a state-driven project to develop high-quality offsets in Colorado. "The Colorado Carbon Fund" is working with partners around the state to develop and validate energy efficiency and renewable energy projects and monitor, certify and market the associated offsets. The CU student government became the Fund's first customer in 2008 when they voted to allocate $90,000 over two years toward wind energy projects through Governor's Energy Office. More recently, CU's Intercollegiate Athletics Office announced that it would invest in local carbon offsets from the Fund to help offset energy use in the stadium and athletic-related travel. http://www.coloradocarbonfund.org/

Resources

Webcast by Dave Newport, Director of the CU Environmental Center, http://www.academicimpressions.com/on_demand/0609-offsets.php regarding evaluating, finding, and using local offsets.

5.3 Weatherizing local residential buildings is not a viable addition to a campus climate plan because there is no way to verify the emissions reductions.

Good news: new methodologies are on the way. A handful of committed colleges and universities have played a leadership role in the development of a methodology for verification of emission reductions from weatherization programs for low-income housing units, which will open the door to high-quality offset project investments in this area.

At Yale University, a group of students, faculty and staff are working to develop packages of efficiency measures that can be funded through the Office of Sustainability and implemented through student service projects in selected residential buildings in New Haven. The emissions reductions generated through this process will not be used for the university's overall climate commitment, but will be marketed to various schools and departments within the school to offset departmental events like ceremonies and conferences.

By designating a key staff member in the Yale Office of Sustainability to facilitate and help manage this project, the University has insured a high level of professionalism, quality, and attention to detail that will result in a pilot methodology that could be adopted by other schools.

At Unity College in Maine, Dr. Mick Womersley approached the Maine State Housing Authority to indicate his college's interest in purchasing offsets from the agency. As a result, the agency has undertaken a two-year long Carbon Quantification Project to measure, monitor, verify, aggregate and market carbon offsets from weatherization projects.

With financial support from the Ford Foundation and collaborative support from Oak Ridge National Laboratory, the project will develop a standardized methodology with which housing agencies can develop weatherization offset programs. Such programs should become viable sources of income for housing agencies. Expected in 2010, this methodology could be used by campus outreach, educational, and service-learning projects that promote local weatherization programs.

An interdisciplinary, graduate-level research seminar at Duke completed the ground work for the high-profile report cited in section 5.1. The publication and Duke's outreach has spurred discussions in North Carolina and beyond about opportunities for developing high-quality, local offsets.

These three cases demonstrate how higher education can transform climate solutions, in this case spurring projects to develop carbon offsets with local benefits. These solutions will be more widely implemented when such case studies are more widely shared and discussed among colleges and universities. Campus participants in Rocky Mountain Institute's June 2009 "Campus Climate Initiatives Workshop", coined the term "sustainability service" to describe this idea.

Resources

An early policy paper on MaineHousing's Carbon Market Project: http://mcspolicycenter.umaine.edu/?q=mcCormick_V17N2

An up-to-date overview of MaineHousing's Carbon Quantification Project: http://www.mainehousing.org/ABOUTGreen-Carbon.aspx

5.4 Campus leaders see renewable energy credits and carbon credits as illusory.

While some regulation of the carbon market in the U.S. may be on the horizon, caution is as wise in this market as in others. But for busy campus officials, thorough analysis of available options for purchasing carbon credits is often unrealistic.

Fortunately, a number of third-party organizations have published research and recommendations for sources of high-quality offsets, which are listed in "resources" at the end of this chapter. As demand for offsets grows, more research of this type is likely.

Also, analysis of options may be an excellent project for an interdisciplinary class such as the one that developed the Duke study mentioned in section 5.1.

Another approach: Consider purchasing credits generated by projects near your campus or from small offset companies in your region. For verification, organize an informal process whereby students, faculty and staff visit the project and survey project owners. Such informal verification can provide valuable educational benefits and serve as a second line of defense (after formal certification) in quality insurance.

Buying offsets from small local companies may be riskier, especially if they are just starting up. But this approach offers other benefits: It increases your campus's influence on verification. It may support local business, create jobs for graduates, and generate student internship opportunities. Also, as an important local client, you may receive special treatment.

5.5 Campus officials are not sure how to include carbon sequestration by campus-owned lands in their climate strategies

People who are new to climate-change mitigation are often perplexed by the carbon sequestration issue. They might look across a large swath of campus forest and say, "Those trees are soaking up a lot of carbon, let's just count them and we'll be ahead of the game." Sounds reasonable.

Unfortunately, it's not nearly that simple. Although preservation of greenfields and promotion of biological carbon sequestration on campus is compatible with campus climate action plan, and a wonderful campus asset for a host of reasons, reliable measurement of sequestration by various ecosystems remains uncertain. Experienced scientists who set out to quantify carbon sequestration consistently develop widely differing results. But that's just the first problem.

Number two: Sequestration by campus green space is even more problematic as a campus climate solution because it's seldom "additional." Recall from the definitions in Appendix J that carbon credits can be issued only to those GHG-mitigation projects that are "additional," that is, those that would not have happened anyway. If land has already been conserved, or would have been conserved for goals other than carbon reduction, then it is not "additional," that is, it cannot be counted as an offset. For example, according to ACUPCC protocol and generally accepted practice, if a campus owns forest land and has no plans to develop it, carbon sequestration cannot be considered as an offset, even if one could accurately measure the carbon that was being sequestered. Similarly, if there is conservation easement on a certain piece of campus land, it cannot be regarded as additional.

If you like a challenge and you're thinking about taking on the issues of measurability and additionality, consider first that, even if these issues could be somehow reversed, the total carbon sequestered by campus lands is probably small in relation to the campus's total carbon footprint.

For a more complete description of this issue, read *Investing in Carbon Offsets: Guidelines for ACUPCC Institutions*, November 2008 v1.0 (http://www.presidentsclimatecommitment.org/resources/guidance-documents/offset-protocol). For a detailed discussion of how to decide whether to count, how to measure and how to report carbon sequestered in campus-owned lands, refer to *A Recommendation of How to Account for Carbon Sinks in Campus Forests and Lands* by Jennifer Andrews, Campus Program Manager, Clean Air-Cool Planet (http://www.aashe.org/blog/recommendation-how-account-carbon-sinks-campus-forests-or-lands). Clean Air-Cool Planet also hosts a series of webinars on this topic.

Research

The Department of Energy recently awarded 19 research grants for the study of geological carbon sequestration. Recipients included:
New Mexico Tech (http://acupcc.aashe.org/cap-report.php?id=113),
University of South Carolina (http://www.americaspower.org/News/CARBON-CAPTURE-University-will-study-sequestration-in-S.C),
University of Miami (http://www.americaspower.org/News/CARBON-CAPTURE-University-will-study-sequestration-in-S.C)

5.6 The benefit of RECs and carbon offsets to students and campus mission is unclear.

Since carbon credits are generally considered subordinate to other more direct means to avoid, reduce and replace on-campus emissions, it also makes sense that they take a backseat to the central goals of higher education. Therefore, strengthen your case for the purchase of offsets by describing first the benefits that an offset program offers education, service, and research projects. For example, purchasing offsets from a particular project may open up opportunities for student field trips and faculty research on that project.

One way to position yourself to accurately describe co-benefits is to fund future courses, service-learning, and research projects that meet objectives related to both content and carbon mitigation. With guidance, students can take on such projects.

Examples

<u>Allegheny College, Meadville, Pennsylvania</u>
As her senior project, student Tara Fortier helped Temple Anshe Hesed become carbon neutral — possibly the first such synagogue in the nation — by purchasing solar-electric panels for the Arava Institute for Environmental Studies in Israel. The institute prepares future Arab and Jewish leaders to cooperatively solve the Middle East's environmental challenges. Fortier calculated the cost for the synagogue to offset its emissions and developed a series of recommendations for them to fund solar panels at the institute.

"Through its efforts to become the first carbon-neutral synagogue in the United States, Temple Anshe Hesed demonstrates a deep and abiding commitment to the Jewish value of tikkun olam -- repair of our world," said Rabbi Eric H. Yoffie, president of the Union for Reform Judaism in New York City. See a press release http://www.reuters.com/article/pressRelease/idUS261104+04-Feb-2009+PRN20090204 on the effort.

<u>Oberlin College, Oberlin, Ohio</u>
The "Light Bulb Brigade" empowered Oberlin students to educate the community and generated a 6,500-ton carbon reduction in one year. The anonymous donor who funded this student-led project required benefits for students, benefits for the local community, and the ability to replicate the project at other schools. Although the project fulfilled the first two requirements, it is too early to tell if the third will be satisfied. Student leaders involved in the project gained invaluable skills organizing the community to exchange 10,000 compact fluorescent lamps for inefficient incandescent bulbs.
Oberlin senior, Kristin Braziunas played a central role in organizing the exchanges and described her experience. http://stories.oberlin.edu/3/environment-sustainability/kristin-braziunas-08.shtml.
A synopsis http://www.scienceprogress.org/2008/11/light-bulb-brigade-offsets-to-a-different-beat/of the project is on the Center for American Progress blog.

5.7 The distinction between renewable energy certificates and carbon offsets is unclear.

It is easy to confuse renewable energy certificates (RECs) with carbon offsets, in part, because some RECs can be converted to offsets by using the appropriate emissions factor for the grid in the region where the renewable energy is being generated. But because this distinction is unclear, it is difficult to discuss how these climate-mitigation options might fit into a campus climate strategy.

However, even if a few people involved in climate-strategy decisions are not clear on the distinction, progress can be made if the person setting up contracts for offsets understands that RECs may not be additional and cannot credibly count as offsets.

As long as climate-strategy decision makers are willing to participate in a guided discussion, this barrier is relatively easy to overcome. A round-robin style of introducing all the pieces under consideration for the institution's climate action plan can be an effective way to get participants up to speed on terminology.

Examples

<u>Furman University, Greenville, SC</u>
Furman University found that using a round-robin approach, where students presented background information to trustees, was effective in engaging trustees in the climate-action process. (They used this approach in a workshophttp://www.furman.edu/sustain/capworkshop.htm they hosted for several schools (Using a similar approach that focused on offsets could include such discussion topics as renewable energy projects, building efficiency projects, methane-capture projects, biological sequestration projects, curriculum, co-curriculum, and role of offsets in the overall CAP.

<u>Cornell University's Climate Action Plan</u>
(CAP) http://www.sustainablecampus.cornell.edu/climate/co2.cfm includes a policy statement about offsetting. It specifies a very limited role for offsets, in which either enhancement of the university's land-grant outreach mission, or cost-effective compliance with emissions regulations is the sole reason for incorporating offsets. For more information see

Resources

A solid background document that will support a better understand of this topic is Investing in Carbon Offsets: Guidelines for ACUPCC Institutions, November 2008 v1.0 (http://www.presidentsclimatecommitment.org/resources/guidance-documents/offset-protocol). Alternatively, if they have less time, a brief overview of this issue can be found in *Investing in Carbon Offsets: Guidelines for ACUPCC Institutions* on pages 52-54.

"Choosing an Offset" by the Environmental Protection Agency of Victoria, Canada
http://www.epa.vic.gov.au/climate-change/carbon-offsets/choosing-an-offset.asp
This is a concise and clear list of questions to consider in selection of offset providers.

Research and Evaluation on Voluntary Carbon Offset Providers

Environmental Defense Fund's Carbon Offset List (2009)
http://innovation.edf.org/page.cfm?tagID=23994

Purchasing Carbon Offsets- A Guide for Canadian Consumers, Businesses, and Organizations (2009) from www.davidsuzuki.org/Publications/offset_vendors.asp

Carbon Offset Provider Evaluation Matrix (2008) (Carbon Concierge plans to update annually) - http://www.carbonconcierge.com/

Clean Air-Cool Planet's *A Consumers Guide to Retail Carbon Offsets*(2006) from www.cleanair-coolplanet.org/ConsumersGuidetoCarbonOffsets.pdf

Appendix A

Rocky Mountain Institute's Campus Climate Project

Developed in collaboration with the Association for the Advancement of Sustainability in Higher Education (AASHE), the project was designed to understand the barriers to campus climate initiatives and their solutions

The topical scope of the project was climate — climate action plans, climate-related emissions, energy use and systems, buildings, and transportation. Its institutional scope was primarily campus operations, and secondarily curricula and campus issues where they integrate with a given campus's climate issues.

AASHE's deep experience and history with campus leadership complements RMI's solutions orientation, whole-system analysis, and experience with campuses, major corporations, and communities. The project included:

Research — Summer 2008
Building on existing literature, WE researched successes and challenges of university and college climate-change-mitigation programs, with heavy emphasis on operations, and including resource needs. It served as the basis for campus visits and later workshop.

Campus Visits — October 2008 through February 2009
A team of three RMI staff visited twelve campuses for two days each to directly and more fully understand specific campus climate initiatives and challenges, set the stage for the later workshop, and offer campus officials informal feedback. In August 2008, an RFP was issued through AASHE for campuses that wish to be included in the research and to participate in the RMI visits and workshop.

Innovation Workshop — June 2-4 2009
A team of eight RMI staff and colleagues convened three representatives each from the twelve campuses, plus AASHE, Second Nature, and National Wildlife Federation. To help refine participants' challenges and solutions and to develop greater clarity on how to overcome barriers to campus carbon-reduction efforts, workshop topics included building renovations, new construction, recommissioning of existing buildings, building operations, finance & accounting for building projects, wind and solar projects, biomass energy, public transportation supply and demand, renewable-energy finance, buildings and utilities that teach, and climate-action plans.

Book — Late 2009
Using information developed in its research, campus visits, and workshop, RMI in collaboration with AASHE developed this web-based book for campus leaders (and foundations) describing how to accelerate campus climate initiatives.

Whole-System Thinking and Integrative Design

Integrative design is one of the most important tools for tackling the world's greatest energy- and resource-related challenges. It accomplishes large resource savings at lower cost than modest, incremental savings achieved by conventional means.

Integrative design is a process employing whole-system thinking through which the interconnections among and within systems are actively considered and solutions are designed to address multiple problems. Because this approach optimizes the entire system rather than individual parts, it naturally is more challenging than conventional (reductionist) problem solving, which tends to reduce a problem into separate components and then focus on those components individually. (Read more on integrative design in section 2.2.)

> ***"It ain't what you don't know that gets you into trouble. It's what you know for sure, but just ain't so."***
> ***–Mark Twain***

Thinking in terms of whole systems requires ingenuity, intuition, and teamwork — especially teamwork. Don't expect to fully understand a whole system by yourself, at least at first. Instead, gather colleagues to help.

Whole-system design is not new. Old expressions such as "you can't see the forest for the trees" and "the whole is greater than the sum of its parts" affirm that being able to understand the big picture has long been understood as important. But our industrial past pushed society away from thinking in terms of entire systems. Highly skilled, designers, facilities operators, and decision-makers often define problems too narrowly, without identifying their causes or connections, which merely shifts or amplifies problems. This kind of "silo" thinking is often found in large organizations, whose various departments each handle their own set of problems and issues in isolation—limiting opportunities, innovation, and creativity. In contrast, integrative design cuts across departments, occupations, and disciplines—often revealing lasting, elegantly frugal solutions with multiple benefits, which often enable us to transcend ideological and turf battles and unite all parties around shared goals.

For many businesses, understanding the dynamics of systems is essential to maintaining long-term profitability. Not only does the integrative design process point the way to solutions to particular resource problems, but it also reveals interconnections between problems, which often permits one solution to be applied to numerous challenges. Investing in single "system solutions" can often generate multiple benefits, providing several sources of revenues and a higher return on investment.

Take cars, for example. Driven by complexity, automotive engineers and designers tend to specialize. One person's job is to make a given component or subsystem the best it can be. As a result, the modern automobile has evolved, through an incremental process of small improvements to individual components, without much change to the overall concept. The current market position of U.S. automakers painfully demonstrates how reductionist thinking, specialization, and incrementalization has stifled sweeping innovation and has limited market share.

The problem with blind specialization is that optimizing isolated parts often "pessimizes" the greater system or other parts of the greater system—integration and synergy are lost, and complexity, over-sizing, and inefficiency abound. What's lacking is a sense of the big picture, the whole system.

The balance of this section of the appendix describes various aspects of whole-system thinking. Because many of these aspects are different ways of thinking about the same concept, some overlap and some refer to others. Think of each aspect as another facet of a single jewel.

System Definition

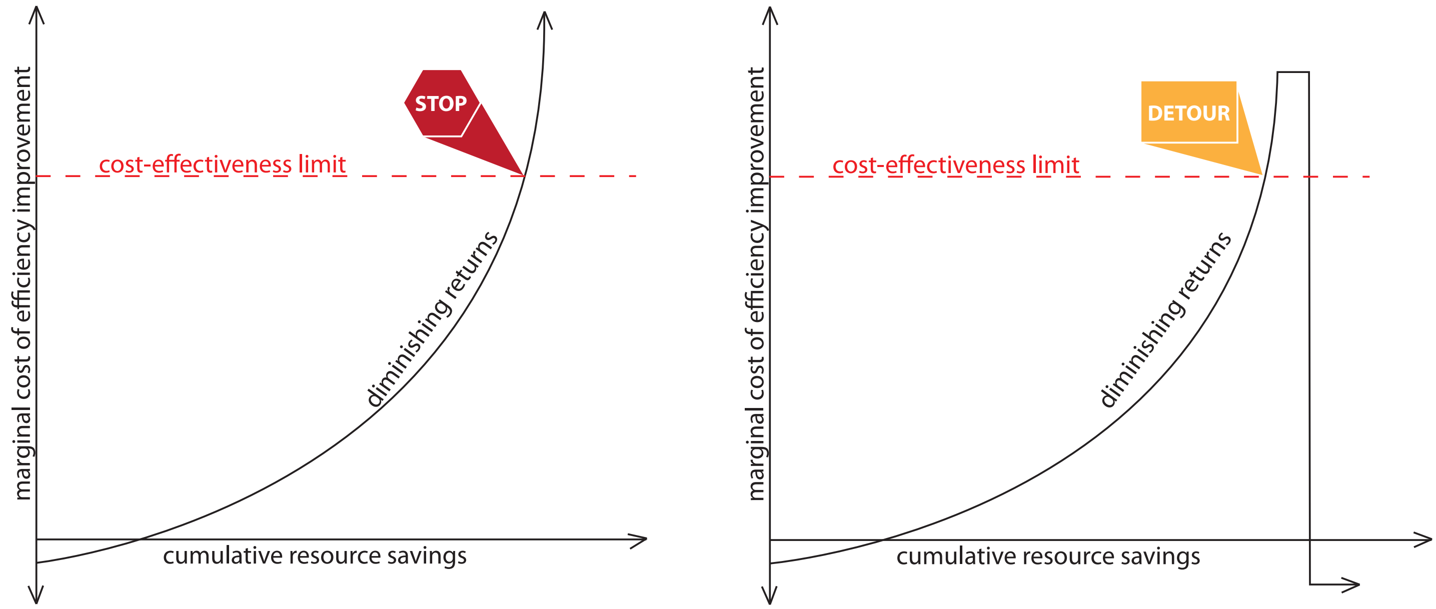
A system is a set of inter-related elements that behave in a specific way. Our lives are embedded in systems: families, communities, industries, economies, and ecosystems. Even the machines we rely on are systems. All these systems have increasingly profound effects on the human and biotic systems around them. Examples:

- A building: its plumbing, users, types of uses, plug loads, climate, electricity, window coverings, lighting, controls, etc.
- A campus: its mission, people, buildings, parking lots, utilities, vehicles, vegetation, climate, etc.
- A fishery: its fish, boats, fisher-people, catch/year, type of technology, weather, price of fish, etc.
- A business: its people, shared purpose, salary, rewards, stress, commitment, amount of work, facilities, costs, revenues, etc.

Mental Models

"Mental models are deeply ingrained assumptions, generalizations, or even pictures or images that influence how we understand the world and how we take action." (Peter Senge, *The Fifth Discipline*. 1990, p. 8)

Though mental models are comforting when we are faced with a problem or issue, they are often incomplete, outdated,



Old design mentality stops investing in efficiency when the next incremental gain is no longer cost-effective. Conversely, integrative design mentality continues on the curve of diminishing returns but then captures even larger capital savings by downsizing or eliminating system components that are no longer necessary—resulting in negative net cost and leading to even *bigger* and *cheaper* resource savings.

or just plain erroneous. They are filters that affect what we pay attention to and how we interpret information. Though we all carry them, they are fundamental barriers to accurate understanding of problems and issues, and to critical thinking and effective solutions.

We noticed one mental model on several campuses: When campus stakeholders noticed a problem with an unfamiliar technology, for example, the size of some electric cars, many assume that the technology itself is fundamentally flawed and, therefore, inappropriate for their campus.

Detecting mental models requires accepting that everyone does, in fact, have them, noticing when they come up, and accepting help from trusted allies in indentifying one's own mental models. Detecting them opens the opportunity that one will hear and at least consider ideas that runs counter to those mental models. Detecting them will make one a more effective leader and problem-solver.

Tunneling Through The Cost Barrier

Why Big Savings Often Cost Less than Small Ones

There is an ordinary-looking tract house in Davis, California that defies conventional wisdom. It has no furnace. Despite temperatures of up to 113°F, it has no air conditioning system. It uses 67 percent less energy than comparable houses in the area, saving $490 annually.

It cost more to build because it was a one-off demonstration, but if it were built in the same quantity as other tract houses it would cost $1,800 less than they do. The house, part of an experimental program sponsored by Pacific Gas & Electric, illustrates an important principle: big savings can be easier and cheaper to achieve than small ones if you combine the right ingredients in the right way.

The usual way to redesign a product is to analyze its components or subsystems separately and optimize the cost-effectiveness of each in isolation. But components interact in ways that aren't obvious when you're looking at them separately, and optimizing one part may "pessimize" the whole. Often you can reduce the total cost of a technical system by spending extra on certain components.

That's what happened, many times over, with the Davis house. To give just one example: having reduced the building's cooling requirements by two-thirds with various cost-effective measures, the designers found that other measures, previously screened out because they didn't save enough energy to pay for themselves, were now worth doing because they could together eliminate the remaining cooling requirement. That saved $1,500 on the capital cost of air conditioning and ductwork.

The Davis house may be the shape of things to come. It points toward a future in which engineering designs become simpler rather than more complex, cheaper rather than costlier, uniquely optimized rather than formulaic, and radically more efficient rather than incrementally so.

Undiminishing Returns

Most of us view efficiency as a process of diminishing returns. Let's say you're trying to make an office building more efficient. You prioritize all the things you could do, from the highest return on investment down to the lowest. You work your way down the list until either your budget for improve-

ments is used up, or the return on your investment is so small that you'd be better off spending the money on something else. You've reached what we call the cost barrier.
This is a fine way to identify simple, cost-effective improvements, but it's limited in what it can do. This approach would have eliminated two-thirds of the Davis house's cooling load, for instance, but it would have left the remaining third, which would have necessitated retaining the cooling system, leaving the whole house costing more, not less. And if this approach comes unstuck with something as simple as a house, imagine how inadequate it is for redesigning a skyscraper or a car.
The fact is that our major technologies are getting so complex that they're outstripping our traditional methods for designing them. Even with CAD workstations, designers tend to simplify the process by optimizing just one or two variables at a time. Moreover, designers are now so specialized that they rarely understand all the workings of an entire system, and tend to confine themselves to optimizing their particular component or subsystem.

For decades, industry has preferred to keep design processes relatively simple while allowing products to become devilishly complex. It will take a revolution in design sophistication to make products simple and efficient again.

Electronics and personal computers may be both harbingers and enablers of the coming changes. Other enabling technologies such as photovoltaics, advanced polymer composites, and fuel cells have the potential, as they reach critical price points, to cause dramatic technological shifts.

Inspired Design

Back to that cost barrier. Conventional wisdom says you've got to stop when you get to your cost-effectiveness limit. But as the Davis house demonstrated, there are times when, by allowing yourself to exceed that threshold temporarily, you can tunnel through the cost barrier and drop back down the other side for even greater savings at lower total cost.

Such breakthroughs happen all the time, usually thanks to new technologies. But what we're finding is that inspired design and whole-system engineering can often accomplish the same thing, even with old technologies.

Here's another example. An industrial process in the manufacture of carpet involves melting bitumen by means of a hot-oil pumping loop. The engineers who design these loops typically optimize the pipe size in isolation by comparing the extra cost of fatter pipe with the pumping energy it can save.

Designing a system for a new Shanghai carpet plant, Dutch engineer Jan Schilham decided to optimize for total lifecycle cost, which includes capital as well as operational costs.
Since pipe friction falls as the fifth power of diameter, he used bigger pipes to reduce friction. The pipes cost more, but the smaller pumps and motors to circulate the oil cost much less to buy and to run. Schilham's other innovation was to lay out the pipes first, then the equipment they connect, not vice versa. That resulted in straight pipe runs, further reducing friction, saving even more construction costs, and making it cost-effective to insulate the pipes more heavily, saving 72 kilowatts of heat.

Schilham's loop is expected to reduce pumping energy by an amazing 92 percent, compared to a standard system designed earlier for the same plant by a top engineering firm. Capital cost and construction time went down; reliability, controllability, and maintainability went up.

"Siloed" Thinking versus Whole-System Thinking

Conventional "siloed" (reductionist) thinking	Whole-system thinking (integrative design)
Big problems require big solutions	Big problems can be solved by many small solutions
Problems are a burden	Many problems are opportunities
Centralized solutions	Distributed solutions
Optimize my portion of the system, the part I understand, and from which I benefit	Optimize the whole system
Processes are linear	Processes are cyclical, with closed loops
One problem requires one solution	Problems are interconnected, so are solutions
Nature supplies raw materials	Nature supplies raw materials and services
Waste = problem to "throw away"	Waste = food. There is no "away"
Prosperity requires perpetual expansion	Prosperity requires increased diversity, resource efficiency, and waste minimization
Prosperity requires increasing throughput	Prosperity is increased net benefit and economic multiplier
Supply-side solutions only	Demand-side solutions first
Economics of scale	Economics of systems
Economy is independent of nature	Economy is a subset of nature
Short term	Long term
Solutions generate single benefits	Solutions generate multiple benefits
Smart, powerful individuals are the best sources of solutions	Collaboration among people with diverse knowledge and interests derives effective solutions
Leaders have the right answers	Leaders have the right questions
Leaders talk	Leaders listen
Hard infrastructure	Green infrastructure

Tunneling through cost barriers is as much an art as a science. There's no formula for doing it, but here are four helpful principles:

Capture multiple benefits from single expenditures. This might seem obvious, but the trick is properly counting all the benefits. It's easy to get fixated on optimizing for energy savings, say, and fail to take into account reduced capital costs, maintenance, risk, or other attributes (such as mass, which in the case of a car, for instance, may make it possible for other components to be smaller, cheaper, lighter, and so on). Another way to capture multiple benefits is to coordinate a retrofit with renovations that need to be done for other reasons anyway. Being alert to these possibilities requires lateral thinking and an awareness of how the whole system works.

Start downstream to turn compounding losses into savings. Think pipes again. An engineer looks at an industrial pipe system and sees a series of compounding energy losses: the motor that drives the pump wastes a certain amount of electricity converting it to torque, the pump and coupling have their own inefficiencies, and the pipe, valves, and fittings all have inherent frictions. So the engineer sizes the motor and pump to overcome all these losses and deliver the required flow.

But starting downstream—at the pipe instead of the pump—turns these losses into compounding savings. Make the pipe more efficient, as Jan Schilham did, and you reduce the cumulative energy requirements of every step upstream. You can then work back upstream, making each part smaller, simpler, and cheaper, saving not only energy but also capital costs. And every unit of friction saved in the pipe saves about nine units of fuel and pollution at the power station.

Get the sequence right. Achieving big energy savings is a process of multiplying little savings. That means breaking the task down into many steps and tackling them in the right sequence.

RMI's Amory Lovins created a list of six guidelines for doing this, which he's reduced to sound-bite brevity: people before hardware; shell before contents; application before equipment; quality before quantity; passive before active; and load reduction before supply.

We don't have enough space here to explain each of these best-buys-first principles, but here's an example that illustrates some of them. Suppose you're considering making your office lighting more efficient. First you should improve seating and surface configurations (people before hardware), reduce glare (quality before quantity), harness natural light (passive before active) through better window and building design (shell before contents), and only then improve the technical efficiency of your lights and how thoughtfully they're used and maintained.

Optimize the whole system, not parts. Optimizing an entire system takes ingenuity, intuition, and close attention to the way technical systems really work. It requires a sense of what's on the other side of the cost barrier and how to get to it by selectively relaxing your constraints, as the designers of the Davis house did when they decided to pay extra for better windows.

Whole-system engineering is back-to-the drawing-board engineering. It doesn't rely on rules of thumb, which are typically based on single components, operating costs only, old prices, and very high discount rates. Nor does it rest on theoretical assumptions (for instance, that efficient components must cost more—they often don't). And, importantly, it incorporates "feedback" to make the design process intelligent, cyclical, and capable of continuous improvement based on measured performance.

Think Big. One of the great myths of our time is that technology has reached such an exalted plateau that only modest, incremental improvements remain to be made. The builders of steam locomotives and linotype machines probably felt the same way about their handiwork.

The fact is, the more complex the technology, the richer the opportunities for improvement. There are huge systematic inefficiencies in our technologies; minimize them and you can reap huge dividends, for your pocketbook and for the earth.

Why settle for small savings when you can tunnel through to big ones? Tunneling through the cost barrier demonstrates huge opportunities for re-engineering, not only buildings, but also cars, lights, motor systems, electric utilities, industrial processes, and almost anything that uses energy.

Solve the Right Problem

When the solution to the problem being addressed creates significant additional problems or "unintended consequences," it may be the wrong problem. It's important to correctly identify the problem in the first place in order to ensure that a solution to the selected problem actually achieves underlying goals. Often, preconceived notions about problems—so-called "mental models"—are misguided.

For example, when building new projects, affordable-housing agencies tend to define their challenge as minimizing first cost. The buildings that result are often drafty and inefficient with exceedingly high, often unaffordable, utility bills. In sharp contrast, Isles, a nonprofit housing group in Trenton, reframed its challenge. They now focus on minimizing monthly housing costs of tenants. Where other housing advocates might have said, "Energy is not my problem, not my job," Isles included minimizing energy costs as part of its challenge. The result was that Isles began building higher-quality, more efficient apartments whose utility-bill savings exceeded additional capital costs when folded into mortgages. While others are content in the darkness of their organization's silos, Isles' integrative approach is solving tenants' problems.

Related concepts: Ask the right question; choose the right goals and objectives. Ensure that they address the real issue. Problems need to be explored at deeper and deeper levels of causality until the root cause is reached. For example, a pool of oil on the floor of a manufacturing plant might have been caused by a leaking piece of machinery, which was in turn was caused by defective gaskets. A purchasing department may have bought the defective gaskets motivated by a policy of buying all equipment at the lowest price.[51] If we attempt to solve the problem by changing gaskets, it will soon recur. In contrast, whole-system thinking involves the aggressive pursuit of root causes in order to identify what is really going wrong. This avoids a common trap when trying to identify and fix problems: symptom treatment, which is both inefficient and self-defeating.

Similarly, carefully defining end goals can help a company serve clients and gain a competitive advantage far more effectively than constantly pushing to sell more of a product, regardless of consumer need. People don't really want electricity; they want hot showers and cold beer. A smart company seeks ways to provide heating and cooling at competitive prices, instead of forever selling only electricity. This approach is called end-use/least-cost thinking.

Resilience

An essential characteristic of a sustainable system is resilience. A stiff and brittle tree will not withstand a storm, while a supple tree can bend and survive a hurricane. Similarly, a business is not sustainable if its energy source is "brittle"—that is, if its operations depend entirely on a high-risk, price-volatile, polluting energy source whose future supply is uncertain. Such a business should seek alternative means to drive its throughput before the next economic storm.

Another aspect of resilience is diversity. A prairie comprised of a wide range of plant and animal species is far better prepared to survive a drought or insect infestation that the same area planted with one species. Similarly, a business with a diverse portfolio is stronger and better able to withstand economic changes. Also, when it is considering changes that will affect its campus, a business will be more resilient and experience fewer delays if it collaborates with a diverse range of campus stakeholders.

Mangrove forests protected the Indonesian coastline during the 2004 tsunami, while land cleared of mangroves for development or shrimp farming was devastated. Similarly, planting native vegetation to replace turf lawns in a business park saves maintenance costs and water. And lastly, hiring for ethnic diversity that reflects the surrounding campus will make a business more compatible with that campus, and it may make it a more interesting place to work.

Perverse Incentives

In many large organizations, both private and public, siloed thinking often creates perverse incentives. For example, one department, say, Capital Projects, might be responsible for capital expenditures, while another, say, General Services, might tackle the operations and maintenance budgets for the organization's buildings. In many organizations, the Capital Projects department has no incentive to spend its budget on energy-efficiency retrofits of buildings when the savings resulting from the retrofits will improve the General Services budget. The result: stifled innovation and higher costs. From a whole-system perspective, Capital Projects is optimizing its budget, while "pessimizing" the organization's budget. Properly informed, the organization's leadership will prefer to optimize the whole system. Properly incentivized, Capital Projects will do the same.

[51] Senge *et al.* 1996 (pp. 108–109). For a more engineering-focused use of this tool, see also Romm 1994 (p. 28).

Checklist for Integrated Review Process

Because integrated design includes more variables and "what-if's" than conventional project development processes, design decisions can become very complex. Decisions are based on a variety of factors ranging from benefits (e.g., energy reduction, cost reduction, LEED points, aesthetics, comfort), to upstream and downstream impacts on other systems and infrastructure, to the degree to which certain measures achieve overall project goals.

To determine the viability of various design options, several levels of inquiry can be explored. Answers to questions such as those below can supplant value engineering and help the your team understand how well a particular design measure meets the ultimate needs of the project across a range of topics and metrics. (In typical value engineering, design decisions are based primarily on capital-cost reductions viewed against operational cost savings for individual measures, rather than accounting for the synergies in an integrated system.)

The checklist below can help ensure the right process is implemented for your project. Though developed for buildings, it can be adapted to other applications.

Step 1. Service/Need Definition

- What is the service needed for the space and who or what is prescribing this need?
- Are these appropriate needs and/or demands for the space?
- What are the specifications that have been assigned to this need? What are the variables that could be changed?
- What could be done to increase the flexibility of these specifications?
- Would the needs for the space be different if it were located elsewhere in the building?

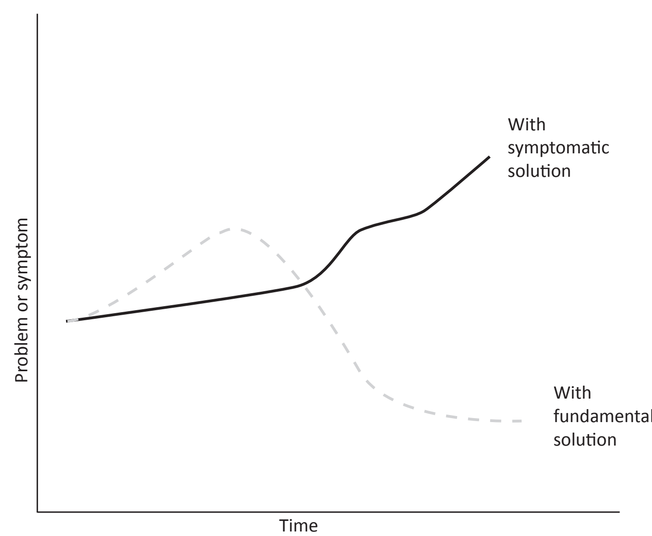
Step 2. Reduce Needs through Passive/Whole-Systems Measures

- It is possible for a passive system to replace an active system?
- What would it take to eliminate an active system?
- What passive measures would reduce the size/use of an active system?
- What other systems are directly impacted by this system? How can negative impacts be further reduced?
- What other systems directly impact this system? What opportunities exist to reduce those impacts? Or to benefit from them?

Step 3. System Design: Multiple Benefits from Single Expenditures

- What is the best layout, placement, or location for this system?
- Have rules of thumb about the design of this system been questioned?
- If multiple people designed the system components, has one person thought about the whole picture?
- What are the boundaries/limits of this system? Would the design change if the boundaries changed? What are the optimal boundaries for this system?
- Is each individual component optimized and is the system as a whole optimized? Can you make one component "worse" or "better" to make multiple other components and thus the whole system better?
- How many functions does this system/component serve? Could it be adapted to serve more than one purpose (and eliminate the need for another system)?
- Is the system flexible? Can it change as building needs change?

Effect of symptomatic solution versus effect of fundamental solution



Step 4. Efficient Technology

- Is this the most efficient technology available? What would the system look like if a more or less efficient product were used? What is the cost/benefit of doing so?
- Will a more efficient technology be available in the next 1, 2 or 5 years?
- Can the system be adapted or modified when new technologies become available?
- Does this technology use an appropriate energy supply source?
- Could this technology use a renewable technology supply?

Step 5. Controls and Demand Response

- Does this system/equipment need to be on all the time?
- Can this system be shut off or turned down for some of the time in response to varying operating parameters or factors it may be dependent on?
- Can this system be shut off or turned down to reduce operating costs by way of demand charges or peak utility charges?

Step 5. Use of Waste Streams

- What waste is created by this system?
- Can this waste be used in the building as a feedstock for another process?
- Is there a local service that can recycle or reuse this waste?
- Would a different system/design approach reduce waste?
- What is the lifespan of this product? How can this product/system be replaced in 5, 10, or 20 years?

Step 6. Appropriate Metrics

- What metrics are being used to analyze this system?
- Do these metrics include all value and costs? Are all the life-cycle costs and benefits captured?
- What is the purpose of this system? Is there a reason to spend more or less on this system? Are there exceptions for this system?
- Is this application replicable within the building? In other buildings?
- What are the risks of implementing this system?
- What would be the absolute best and worst application of this system?

October 1, 2008 by RMI's Aalok Deshmukh; Stephen Doig; Greg Franta, and Caroline Fluhrer

Energy Decision Matrix

This tool that has been used successfully by federal agencies making decisions about energy projects. We have adapted it for campuses designing their own pathways to climate neutrality. A sustainability director, a member of the facilities staff, a CFO, a student team, or any member of climate action planning committee could compile a similar matrix with input from the larger committee. Once completed, the matrix will be useful for understanding the implications of choosing any particular project and for subsequently communicating to campus constituents why particular projects were chosen. We adapted this from "Greening Federal Facilities- An Energy, Environmental, and Economic Resource Guide for Federal Facility Managers," DOE/EE-0123.

1. List the available options under consideration for investment. All possible options under consideration should be listed to ensure a complete comparison. For example:
- New windows for three office buildings
- Retrofitted windows for one office building, New windows for the other two
- Demonstration-size solar PV installation
- Residential-size wind turbine
- High-efficiency boiler installation for library
- Geothermal heating system for two office/classroom buildings
2. List criteria you wish to consider in evaluating the options. We suggest that you always include life-cycle cost and net present value per ton of carbon dioxide equivalent avoided as two of your criteria. For example:
- Life-cycle cost
- Up-front capital cost
- Annual operations and maintenance costs
- Greenhouse gas emissions avoided annually
- Net Present Value per ton of carbon dioxide equivalent avoided
- Savings to Investment Ratio
- Educational opportunities created for students/faculty
- Informal educational opportunities for local campus
- Visibility to campus constituents
- Availability of local labor to complete this job
- Donor interest
3. Place the criteria (A-K) across upper edge of a criteria matrix (as pictured below in figure A).
4. Place the options (1-6…) down the left side of a decision analysis matrix and the criteria (A-K…) across the upper edge (as pictured below in figure B).
5. Determine the relative weights you wish to assign to each of the criteria. This can be done through a pair-wise comparison between each criterion and each of the other criteria to decide which ones your institution wishes to weight the most heavily. For example:
- Below is an example Criteria Matrix used to determine weights for a sample decision on funding one of the emissions-mitigation project options listed above (1-6). The first step in developing criteria weights is to compare "Life-cycle cost" (Criterion A) to "Up-front capital cost" (Criterion B). The more important of these two criteria will be recorded along with the preference weight for the more important. In this example, life-cycle cost is slightly more important to decision makers and there is a minor difference between the importance of these two which has a weight of 1. As a result "A1" is entered in the box at the intersection of these two criteria.
- Continue this process to complete a pair-wise comparison of all the criteria (as shown in the example below). Use the following scale to indicate preference weights:
- 1. minor difference; 3. intermediate difference; 5. major difference; 2. between minor and intermediate difference; 4. between intermediate and major difference
- Once all boxes at the intersections of criteria have been filled in, add the weight factors for each criterion both horizontally and vertically and write the totals on the right. In this example life-cycle cost (A) has a total weight of 9 and availability of local labor (J) has a total weight of 16.
- Write the rank in the far right column of the criteria matrix. The criterion with the highest weight will receive the rank of 1 and so on.
6. Prepare to apply the criteria weights you developed in step five by filling them in underneath the corresponding option in the analysis matrix (see example below in figure B).
7. For each option in the analysis matrix, give a score from 1-5 (5 being the best score) for each criterion across the top of the matrix. Enter each score in the upper left hand corner of the box where the option and given criterion intersect.
8. Multiply the criterion weight that corresponds to each box by the score you entered and record the result in the bottom left hand corner of the given box.
9. By row, total the weighted scores for each option. This is done by adding up the numbers you recorded in all the bottom left hand corner of the boxes in a given row.
10. Once you have calculated "Totals" for each option, rank them from highest total (and hence number one priority for investment) to lowest total (and thus lowest priority for investment).

Resources

http://whitepapers.techrepublic.com.com/abstract.aspx?docid=395595

Example Criteria Matrix

A-LCC	B-Capital Cost	C-O&M	D-GHG	E-NPV/MTCE	F-SIR	G-Edu	H-Community	I-Visibility	J-Labor	K-Donor	Sum of Scores	Rank
A >	A1	A2	D3	E4	F2	A1	A2	A3	J2	K2	A^{9}	7
	B >	B2	D1	E2	F2	B1	B2	B2	J1	K3	B^{7}	8
		C >	D4	E3	F4	G3	H2	I1	J4	C1	C^{1}	11
			D >	E3	D1	G1	D2	D1	D1	D2	D^{11}	5
				E >	E2	G1	E2	E1	E1	E1	E^{19}	2
					F >	G1	F2	F2	J1	K1	F^{12}	4
						G >	G4	G5	G3	G4	G^{22}	1
							H >	I2	J3	K2	H^{2}	9
								I >	J4	K3	I^{2}	9
									J >	J1	J^{16}	3
											K^{11}	5

Example analysis matrix for campus emission mitigation projects

Basic function: Reduce greenhouse gas emissions in a cost-efficient manner													
						Desired criteria							
	A-LCC	B-Capital Cost	C-O&M	D-GHG	E-NPV/MTCE	F-SIR	G-Edu	H-Community	I-Visibility	J-Labor	K-Donor	Sum of Scores	Rank
Weight	9	7	1	11	19	12	22	2	2	16	11		
New Windows	5/45	5/35	5/5	4/44	4/76	4/48	1/22	1/2	2/4	5/80	1/11	372	
Window Retrofit	5/45	3/21	5/5	4/44	3/57	3/36	2/44	2/4	2/4	4/64	2/22	346	
Solar Demo				2/22			5/110	5/10	5/10	3/48	5/55		
Wind Turbine Demo				2/22			4/88	5/10	5/10	1/16	5/55		
New Boiler				4/44			1/22	1/2	1/2	3/48	1/11		
Geothermal Systems				5/55			4/88	3/6	4/8	1/16	5/55		

Decision-Making Tool

Any discussion of payback calculation methods and time frames is a discussion of economic analysis, which is "a systematic approach to the problem of choosing how to employ scarce resources to achieve a given objective(s) in an effective and efficient manner." * This definition pertains to a major portion of a campus sustainability department's job. The business of choosing how to employ scarce resources in collaboration with your facilities department and administration, will dictate whether you achieve your campus climate goals.[52]

The following framework is based on a set of simplified best practices designed to provide you with a methodology to quantify and qualify your decision-making. Its methodology will still require your sound management and operational judgment while systematically investigating and relating life-cycle costs and benefit implications to achieve your objectives and produce optimal results. Federal facility managers use it to analyze and evaluate alternatives for allocating scarce resources to achieve their objectives.

The evaluation of "Qualitative Values" is best done through such a decision matrix as the one in Appendix E. Each alternative will have its unique combination of uncertainties, benefits, and life-cycle costs, and its associated political, social and economic considerations. The systematic application of these methodologies will provide the data to make an informed, calculated decision and the associated documentation to justify that decision to both your facilities department and your administration.

Six Step Process

1. **Define the Objective —** This is the most important step in the process. State your objective succinctly and ensure that you include an easily measurable standard of accomplishment. The wording should be totally unbiased and can explicitly or implicitly identify your standard of measure.
   (e.g. provide a new cooling system for 500ft^2 of admin spaces – implicit)
   (e.g. provide a new cooling system to maintain a temp range of 65^o – 75^o in 500ft^2 of admin spaces – explicit)

2. **Generate Alternatives —** Identify all feasible alternative methods of accomplishing your objective. Generating alternatives is more "art" than "science." Identify constraints, but challenge existing paradigms. What seems impossible may become a significant opportunity. In generating alternatives for comparison, apply life cycle cost analysis (LCCA) using your own preferred tool or one referenced in this document.

The basic categories of alternatives are as follows:
- Status quo
- Modification of existing asset – conversion, upgrade, renovation, expansion, etc.
- Leasing
- Acquisition

A. Determine the economic life
- *Mission life* – the length of time you need the asset(s) to function. (e.g., 25 years)
- *Physical life* – length of time the asset(s) is projected to last. (e.g., 50 years with salvage value X)
- *Technological life* – length of time before the asset(s) is so obsolete that you must replace it. (This will be a judgment call based on the best available data and historic precedent.)

Note: Use the shortest period from the above analysis as your economic life.

The following are sample economic-life values used by the US government facilities managers:
- Computer equipment – 2 years
- Buildings
  1. Permanent – 25-100 years
  2. Semi-permanent, non-wood– 25 years
  3. Semi-permanent, wood – 20 years
  4. Temporary or rehabilitated – 15 years
- Operating equipment – 10 years
- Utilities, plants, and utility
- Distribution systems – 15-25 years
- Energy conserving assets
  1. Insulation, solar screens, heat recovery systems, and solar energy installations – 25 years
  2. Energy monitoring and control systems – 15 years
  3. Controls (e.g., thermostats, limit switches, auto matic ignition devices. clocks, photocells, flow controls, temperature sensors, etc.) – 15 years
  4. Refrigeration compressors – 15 years

B. Due to inflation, the productivity of money has a dollar-for-dollar decline over time. In economic analysis this is seen in the "time value of money." In order to compare alternatives that "produce" over time, calculate a constant "value" for the money. Traditionally, net present value (NPV) of money is used for comparing alternatives. There are many good publications with in-depth explanations of NPV. The formula is:

NPV= (Future Value at n)[1/(1+i)^n]

where i= the interest rate and n = the period usually in years. [1/(1+i)^n] can also be found in tables of pre-calculated values where it is referred to as the "discount rate."

This brings us to one of the most useful calculations in evaluating your alternatives against the status quo: *Savings to investment ratio* (SIR).

SIR= NPV(savings)/NPV(investment)

[52] U.S. Navy's Economic Analysis Handbook (NAVFAC P- 442 Economic Analysis Handbook), http://www.wbdg.org/design/use_analysis.php

This equation represents, the present value of the reduced expenditures (O&M etc) over the present value of the investment(s) minus any salvage value. The ratio should be greater than one for the alternative to be considered and the amount greater than one is a major differentiator among alternatives.

There are also many methods to calculate payback periods. One is to use an SIR to payback conversion table, which converts the SIR into the number of years it would take for the SIR to equal one.

For alternatives with different economic lives, use the *uniform annual cost* (UAC) method instead of the SIR.

$UAC = NPV/b_n$

where b_n is the nth year factor taken from a table where n is the economic life and NPV is of the investment.

3. **Formulate Assumptions** — To the greatest extent possible, your decision should be based on the facts that drive a future-oriented benefit/cost analysis. However, this complete factual picture may be impossible under certain circumstances. In these instances, you must explicitly state your "-assumptions and how you derived them. Assumptions are not intended to simplify your analysis; they are intended to reduce highly complex situations to manageable systems that evaluated.

Basic Rule for making assumptions:

1. Do not confuse assumptions with facts. Use assumptions only to bridge gaps in essential information that you were unable to obtain after diligent effort.
2. Assumptions must be realistic.
3. Use positive "will" statements in your assumptions.
4. Ask yourself if your conclusions would still be valid if your assumption did not hold. If yes, then eliminate this assumption; it is unnecessary.

Sample Assumptions:

- The period that you are using for your analysis. (e.g. ten years)
- This is key. If you are evaluating a project based on its life cycle and how long you will own and occupy the facility, you should use a period that reflects that circumstance. However, this gets challenging when evaluating things like adding solar electric panels because of their continuous evolution in the market place. This is where assumption on "replacement set-points" can be made and factored into the analysis. Since you are already making assumptions for the future cost of electricity in your analysis, you may want to make an assumption on when the efficiency of today's panels and their installation costs will be eclipsed to a point that makes it advisable to change the panels out, instead of continuing with them. This is a special case and will require a more detailed set of assumptions based on the market conditions at the time of the decision.
- Functional life of the asset.
- The discount rate you are using.
- Any salvage value.

Another consideration is any constraints on your system that will affect the analysis. Constraints are factors that limit your alternatives or act as limits within your alternatives. (i.e.
physical – fixed amount of space, time – deadlines, financial – any resource limitations, institutional – policy/regulations)

4. **Determine Costs and Benefits** – The principal benefit of most facilities and other capital improvement projects is the completion of the stated objective. Thus, you will probably focus on the differences in the costs of the various alternatives. If there is a cost that is common to all the alternatives and which will not vary, it should be omitted. It should still be noted in the assumptions, but it will not affect your analysis.

Evaluate all the costs and benefits over the entire life cycle of the project. There are several good references to aid you in determining what your current and future costs may be for your project. Costs are usually much easier to quantify using dollars spent. Benefits are usually more difficult to quantify because the most important of them may be qualitative in nature. Endeavor to quantify these benefits as best you can; it is often useful to evaluate them on a "cost offset" basis. Completely non-tangible benefits should be identified and used in a narrative format. A good way to quantify the qualitative is shown in Appendix D. There are also numerous publications that provide advice on this process.

Ensure that you create an audit trail to record your cost sources and derivations, as well as your associated benefits. This will allow you to track and defend your analysis as necessary.

5. **Compare Cost and Benefits, and Rank Alternatives:**

Use three criteria to choose between alternatives:

- Least cost for a given effectiveness.
- Most effectiveness for a given constraint.
- Largest ratio of effectiveness to cost.

Alternatives usually fall into the following configurations:

- Equal costs/equal benefits – If this case occurs you have done something wrong.
- Equal costs/unequal benefits – Costs cancel each other out. Use the alternative that provides the most benefits.
- Unequal costs/equal benefits – Exactly equal benefits are very rare. However, if the differences in benefits are negligible, this makes using the least-cost alternative an easy decision.
- Unequal costs/unequal benefits – This is most frequently the case and you must address both sides of the benefit/cost equation.

Identify relevant inputs and outputs and their associated costs and benefits and ensure they have the same unit of measure. Determining costs is a fairly straightforward exercise compared to benefits. Deriving dollar values for your overall returns (your outputs, products, yields, etc), from which you 'benefit' is one of the most challenging that you will face – monetizing the intangibles. However, your level of success depends on it and you should dedicate significant time and

effort to the process. When you are comfortable that you have dollar values for all of your 'benefits' and 'costs' use the equation for benefit cost ratio (BCR): **BCR = benefits/costs**
This ratio should be at a minimum equal to or greater than '1', but the higher the better.

This exercise is the key to your economic analysis. Evaluation of costs (use LCCA) is fairly straightforward. However, quantifying benefits often presents a significant challenge.

Four categories of benefits:
1. Direct cost savings: Many methods of calculation exist and require more discussion and examples that will be shown here. There are several publications dedicated to these methods. (e.g., SIR, self-amortizing, partially self-amortizing etc)
2. Efficiency/Productivity increases: Calculate the efficiency/productivity investment ratio (EPIR), which equals the NPV of the E/P benefits generated/ NPV of the investment required. In some cases the EPIR should be added to the SIR to calculate the BCR.

An example from page 5-5 of NAVFAC P-442

The proposed project is expected to completely solve the current power problem, and thus provide an additional 2.1 person-years of industrial capacity with no increase in personnel. The value of this benefit is the cost the Navy would incur if it had to hire enough additional workers to provide 2.1 person-years of labor per year. Thus, the figure must be accelerated to account for both leave and fringe benefits:

Annual Benefits = (2.1 man-years) x ($14,820/yr) x (1.51) = $47,000

This does not represent a direct savings, but a benefit whose value is $47,000 per year. Using this information, the Navy calculated an efficiency-production/investment ratio (EPIR) according to the following formula: (P.V. = Present Value) and (Efficiency/Productivity is a term not an equation)

$$EPIR = \frac{P.V.\ of\ Efficiency/Productivity\ Benefits\ Generated}{P.V.\ of\ Investment\ Required} \qquad (5.2)$$

The computation follows:
- Total Recurring Annual Benefits $ 47,000
- 25 Year (Table B) 10% Discount Factor 9.524
- P.V. of Total Discounted Benefits 47,000 X 9.524 = $447,600
- P.V. of Investment Required $500,000 therefore
- Efficiency-Productivity/investment Ratio (EPIR) = $447,600/$500,000 = 0.90

3. Other quantifiable output measures: (i.e. annual benefit/output measure:
BCR = (annual benefit/output measure)/uniform annual cost
Other examples: Integrate-ability, maintainability, controllability, manageability, operating efficiency, production or productivity, quality, reliability, safety, security, etc.

4. Difficult to quantify benefits: Morale, safety, security, etc. Every effort should be made to find a creative and accurate measure for these benefits.

6. **Perform a sensitivity analysis:** This analysis should be performed on your alternatives to test changes with respect to the system's original parameters and assumptions. If a change in a parameter or assumption significantly impacts the results of your analysis, it should be noted and presented to your reviewers. Also, if the system does prove particularly sensitive to certain parameters or assumptions, they should be given further study. Often, those parameters or assumptions will become key factors in reaching your objective.

Resources
Guidance on eco analysis and a downloadable copy of the U.S. Navy's Economic Analysis Handbook (NAVFAC P442) can be found at http://www.wbdg.org/design/use_analysis.php

Tools for Energy Efficiency in Campus Buildings

This document describes tools for strengthening energy efficiency in existing buildings and new construction. It includes no tools for energy conservation, though such efforts are important and complement efficiency measures.

Note that the term energy "efficiency" refers primarily to technical fixes, that is, products and services that reduce demand on energy systems, often with little or no change in behavior. In sharp contrast, energy "conservation" refers to changes in user behavior, which influences demand for such energy services as heat, cooling, illumination, and transport. Skills necessary for conservation are quite different from those needed for efficiency. The latter requires expertise in building sciences, which often involves a combination of skills that address the interactions of various building systems such as thermal properties of the envelope and mechanical conditioning systems. In contrast, conservation is achieved through education and information, which connects particular energy use to specific behavior.

Both efficiency and conservation are necessary to reduce long-term energy consumption . Even the most efficient building can require inordinate amounts of electricity if its plug loads are high. Plugs loads are driven by behavior, occupants plugging devices into the wall.

Measuring Efficiency in Existing Buildings

The largest potential for short-term, cost-effective energy-use reduction is in existing buildings. Performance can be measured three ways:

1. *Utility bill tracking* monitors how much your institution is spending on energy for the entire campus and, if they are metered, individual buildings. Tracking methods range in complexity and sophistication from manual spreadsheet to automated commercial software with a web-enabled interface.

No matter what tools you use, certain features are necessary: For proper analysis of utility billing data, you should be able to adjust for variations in weather and facility use, which will allow you to compare use among years in order to determine if a certain facility is having a certain energy-system problems, regardless of weather events or atypical periods of use such as sporting events.

More sophisticated tools will simplify the data entry. Some may even provide automated input of billing information. This may be a matter of convenience for smaller campuses but it can be a way to reduce program costs for larger campuses where a significant number of man-hours would be required each month for data entry.

2. *Benchmarking* compares your buildings' energy use to a standard or to another building of similar use type. The most common tool for this purpose is the EnergyStar Portfolio manager. It automates the process of comparing a large number of buildings to their respective standard for a particular building type according to the Commercial Building Energy Consumption Survey (CBECS), which is a database of average building consumption.

3. *Trend logging* is a powerful tool the tracks the effects of energy-efficiency measures and identifies specific problems in particular buildings. Often overlooked, it involves physical measurements and software tools. Trend logging is often used to determine opportunities for saving energy by end-use category such as lighting, heating or cooling. It is often required to calibrate a whole-building energy model. Trend logging can also be helpful in determining the long-term effectiveness of energy measures after they have been implemented.

Trend logging may require new skills among facility staff, but it is quite accessible and does not necessarily require hiring an outside expert. It requires installation of sensors that measure energy consumption as specific points such as a lamp ballast or fan motor. Some systems report the information back to a computer in a central location.

Energy Analysis Tools for Existing Buildings

EnergyCAP is a commercial software package that requires a substantial investment of both time and money. In return, it will automate the process of energy bill tracking and uploading energy use information. It may be most useful for campuses with a large number of buildings of various types because they would otherwise require a significant amount of time to update each month.

EnergyStar Portfolio Manager is a free online tool for benchmarking buildings. It will allow you to store your utility billing information and compare the consumption of each building to the typical energy use for its type in the U.S., though not all building types are available. It also has the ability to incorporate trend logging..

Energy Analysis Tools for New Construction

Though many energy-design software tools require expertise both in building science and the specific tool being used. Some simplified tools will allow facility managers and building owners to gain insight into the general strategies that will be effective for a given building type and location.

eQUEST is a comprehensive whole-building analysis tool suitable for both early design and final LEED documentation (as well as title 24 compliance). It can be used in a limited form or 'wizard mode' for simplified modeling during early design phases. An experienced professional should do more detailed analysis.

Energy10 is a simplified design tool for whole building analysis during the early design phases of a new construction project. It may not be suitable for detailed analysis or documentation.

Energy Analysis within the Phases of Design

The design process for new construction typically goes through the phases listed below from design to construction documents. Energy analysis takes a different form in each phase of the design process.

1. *Conceptual design* requires the simplest methods since major characteristics of the building, such as overall shape, orientation and general envelope characteristics (mass walls, metal or wood framing, etc.) are still being decided. Because little building information is available, some decision makers see no reason to include as energy analyst at this stage. This is a very expensive assumption. Quite the contrary, such early decisions as orientation and shape dramatically influence lifetime energy use of resulting building. Therefore, this phase requires the advice of an experienced energy analyst as much as the others.

2. *Schematic design* often considers several plausible scenarios that can be evaluated for climactic suitability and relative energy use.

3. *Design development* requires a good representation of the large-scale characteristics of the building and focuses on comparisons of more detailed building components such as HVAC, lighting, insulation and glazing.

4. *Construction documents* represent a fully formed design. While some changes may still occur, changes to the major characteristics are difficult. This phase is where the energy model is finalized for LEED documentation.

References

http://www.buildinggreen.com/features/mr/sim_lit_101.cfm
http://www.betterbricks.com/DetailPage.aspx?ID=491#TrendLogging

Active Listening

Active listening is the basis for all effective communication. When people understand that you're listening to them, they will be far more likely to listen to you; they'll be more willing to work with you. Active listening is based on three skills: acknowledging, empathizing, and clarifying. These skills are easy enough to understand; in fact, you probably already know them. But to use them, you probably will need to remind yourself.

Clarify: When speaking with a person with whom you have issues or who seems unwilling to hear your point of view, a powerful way to ensure that you fully understand their message is to respectfully ask questions of clarification. Also, when people talk about issues that are important to them, their statements may become a bit jumbled. One excellent way to help find a way through the tangle is to clarify, that is, say what you think you heard them say. Carefully reframe, rather than interpret, their statements. That is, don't color the clarification with your values, needs, perceptions, and assumptions (even if you think you're right). And when you reframe, offer it as a question, not a statement. For example, "Are you saying that..."

Another way to clarify is to summarize. For instance, when they make several points over the course of a long statement, you can help by summarizing the points and checking with the speaker that your summary is correct. Clarifying and summarizing not only ensure that you understand what they are saying, these skills help make clear to the other person that you've heard them—a critical ingredient of an effective conversation. Once they understand that you are genuinely listening, they may be prepared to hear your ideas or suggestions to which they otherwise may be deaf.

Acknowledge: As the conversation proceeds, look for anything positive in what the other person says. Then acknowledge them for their positive comments or actions, which be something like going out on a limb or showing a willingness to volunteer information or to work with an adversary—whatever positive you find in what they've said. Be careful not to patronize and there's no need to dwell on it; just ensure they are clearly acknowledged for what they've said or done.

Empathize: None of this is to suggest that you gloss over difficulties. Rather, in charged conversations, when participants seem to be having a problem or displaying a strong emotion, empathize by letting them know that you understand what they're going through. You might even note similar difficulties that you've had. Empathy isn't sympathy. For instance, "I get the feeling that you're angry" is an empathetic statement. It acknowledges important feelings, it confirms that what is being said is being heard. In contrast, "He shouldn't have done that to you" is sympathetic. It supports negative feelings and judges who is wrong or right. Note that, if the conversation does not seem emotional, there may be no need for you to empathize.

These active listening techniques are vital to any important communication. They may seem obvious, but they're easier said than done. Most of us tend to talk and not listen.

Collaborating for a Sustainable Campus

The path to a sustainable campus is not paved with charismatic leadership, increasing revenues, or technical expertise — though each of those can be helpful; it's not a series of big, quick fixes. Rather, it's a twisted and rocky path, found one step at a time by creative, open-minded staff, faculty and students who have a vision of a sustainable future and a willingness to listen to those with whom they disagree.

When campus issues are challenging, tensions often heighten as decision-making pits one faction against another and both against the administration. Each pushes its position instead of helping solve problems; neither takes responsible for a workable outcome.

Often, the results are anger, resentment, disrespect, distrust, delay, expense, and litigation. One side wins, the other loses, and adversaries become enemies. Campus leaders can hardly focus on the merits of a question before them; many just want to make the issue vanish. Their primary motivation become minimizing their own discomfort—not a recipe for a just and durable outcome.

In sharp contrast, more collaborative forms of decision-making build respect and trust. They involve all relevant parties and shift the responsibility to them. Results are neither easy nor quick, but ultimately faster and more sustainable than the alternative.

There's a far better chance that no one will lose and that everyone will be able to live with the results.

Though the appropriate mix of solutions for a given campus must be carefully and systematically chosen, the primary challenge for a campus is not technical (though technical aspects can be difficult). Rather, it's attitudinal; it's developing the capacity of advocates — however passionate, committed, and outspoken — to work together.

Social, economic, and environmental factors are the three legs that keep a sustainable campus's stool from toppling. The challenge is not to "balance" social concerns against business issues, against environmental issues—taking a piece from one to benefit another—but rather to integrate the three — to regard all three as overlapping, inter-related factors that, when considered together, offer solutions that are otherwise obscured when one factor is regarded as paramount and the others subordinate. This is often called whole-system thinking or integrative design.

No single individual, however intelligent and well meaning, can integrate all necessary factors. Rather, sustainable solutions require many people with different skills and points of view to bring sufficient wisdom to the conversation. Their wisdom is best exercised, not by imparting it on others, but by using it to inquire deeply and to listen to those with different experiences.

Principles of Collaboration

- Collaboration begins at the intersection of interests, where people find common interests upon which their different points of view are founded.
- Collaboration occurs early, during the development of an idea or solution, rather than later, when the solution is chosen or implemented.
- Collaboration does not necessarily require compromise. Working together intelligently, leaving dogma behind, people consistently find solutions beneficial to all parties.
- Collaborators take responsibility for the outcome, even when they don't have the authority to make the decision.

How to Collaborate

- Employ active listening: empathize, validate, clarify, summarize
- Hear their concerns and ideas before telling them yours
- Understand their interests before describing yours
- Describe your interests instead of defending your position
- Set aside differences and disagreements to solve mutual problems
- Pursue easiest issues first.
- Identify common problems, needs, and interests before seeking solutions.
- Join them in achieving their goals before asking them to join you

Practical Collaboration in the Face of Conflict

Say your campus is confronted by a difficult and divisive issue that has deeply divided several factions.

- Find a neutral convener and a neutral location for a discussion. Identify groups that are interested in the problem, ensuring that economic, environmental and social concerns will be represented.
- Find one person within each group who is well informed, least contentious, and most willing to listen—the diplomats, not the warriors.
- Convene these diplomats and ask them to identify the primary issues and facts regarding the subject problem.
- Where there are disagreements on the facts, agree on objective sources of information for determining the facts.
- Once the facts are determined, reconvene the diplomats. Seek agreement on overarching social, environmental, and economic goals.
- Based on common goals and facts, begin an extended discussion of possible outcomes.

This approach often, not always, reveals solutions previously unknown. Also, it often results in a solution that all parties can live with. This may sound impossible in your particular, seemingly intractable circumstance, but it's more effective and practical than the alternative.

Appendix I

Revolving Loan Funds

Following three tables taken from the "Student Green Fee proposal for the sustainable revolving loan fund"

Portland State University (March, 2008)

Harvard
Previously funded revolving loan fund projects

The final amount assumes:
1. Energy prices don't increase, which they will. In Oregon, Northwest Natural announced a utility hike of 40% for its natural gas. Half of PSU's natural gas is supplied from them (via Sempra). As reported by the Vanguard in April of 08', student housing prices will be increasing by an average of 8%, and in some cases as much as 15%. According to John Eckman, this is primarily due to an increase in natural gas prices.
2. The 2007 annual savings is a constant, which it isn't. As the RLF enables more projects, the actual net annual savings will increase.

Portland State University

School	RLF amount
Harvard	12 million
Iowa State University	3 million
University of Michigan, ECM	2 million
Yale	1 million
University of Colorado	500,000
University of Maine	300,000
Tufts	hundreds of thousands?
Whitman	100,000
Duke	50,000
Macalester	67,000
Other non-RLF	
Penn. State	10 million/year

Harvard's Projected RLF Savings

Year	Annual Savings	Accumulative Savings
2010	$ 3,847,587	$ 3,847,587
2011	$ 3,847,587	$ 7,695,174
2012	$ 3,847,587	$ 11,542,761
2013	$ 3,847,587	$ 15,390,348
2014	$ 3,847,587	$ 19,237,935
2015	$ 3,847,587	$ 23,085,522
2016	$ 3,847,587	$ 26,933,109
2017	$ 3,847,587	$ 30,780,696
2018	$ 3,847,587	$ 34,628,283
2019	$ 3,847,587	$ 38,475,870
2020	**$ 3,847,587**	$ **42,327,304**

Previously funded revolving loan fund projects

Project category	# of Projects	Amount of fund allocation	% Total fund allocation
Lighting	72	$ 5,231,027	49%
Heating, ventilation, air conditioning (HVAC)	32	$ 2,650,004	22%
Ground source heat pump	2	$ 1,000,000	1%
Behavior	8	$ 955,435	6%
Kitchen renovation	10	$ 563,257	7%
Co-generation	2	$ 464,222	1%
Photovoltaic power generation (PV)	3	$ 334,591	2%
Controls	4	$ 286,517	3%
Irrigation	2	$ 252,150	2%
Insulation	3	$ 92,336	2%
Construction soft costs	1	$ 69,724	1%
Metering	2	$ 67,432	1%
Process load	1	$ 53,460	1%
Recycling enhancement	1	$ 38,000	1%
Transportation	2	$ 9,868	1%
Feasibility	1	$ 29,000	1%
Renovation	1	$ 115,122	1%
Total	**147**	**$ 12,212,146**	**100%**

Carbon-Offset Terminology

Carbon Credit: A tradable financial instrument that represents the reduction of one metric ton of carbon dioxide from the atmosphere, or its equivalent in other greenhouse gases.

Carbon Offset: A reduction or removal of carbon-dioxide-equivalent greenhouse gas (GHG) emissions, which is used to counterbalance or compensate for emissions from other activities. Offset projects generate carbon credits that can be purchased from outside an institution's boundary to meet that institution's own targets for reducing GHG emissions within its boundary.

Renewable Energy Certificates (RECs) represent proof that one megawatt-hour (MWh) of electricity was generated from an eligible renewable energy resource. By purchasing a REC, a customer purchases the green qualities that are associated with renewable energy, such as reduced greenhouse-gas emissions, but does not purchase the electricity associated with the generation

RECs can incentivize carbon-neutral renewable energy by providing a production subsidy to electricity generated from renewable sources. RECs are often treated as carbon offsets, even though the concept is distinct. Some RECs can be converted to carbon credits by translating the clean energy (in MWh) into carbon reductions (based on the appropriate conversion factor for the grid in that region). RECs are also know as green tags, renewable energy credits, or tradable renewable certificates.

Environmental Integrity: In the context of carbon offsets, this general term refers to the degree to which offset claims provide genuine climate benefits, that is, the degree to which they are real, additional, and counted only once. The term should not be confused with "secondary environmental benefits," which refers to other benefits from an offset project (e.g. air pollution reduction or protection of biodiversity.)

Additionality: the principle that carbon credits should be issued only to those GHG-mitigation projects that would not have happened for other reasons (e.g. easements, regulations requiring conservation, wildlife habitat preservation, etc.).

Certification: written verification by a disinterested third party that a project activity achieved certain reductions in anthropogenic GHG emissions during a specified time period.

Double Counting: occurs when a certain increment of GHG reduction is counted toward multiple offsetting goals or targets (voluntary or regulated). For example, credits from an energy-efficiency project could be counted as part of a national emissions-reduction target, but not if they had already been sold to business owners. A REC certifying agency gives each REC a unique identification number to make sure it doesn't get double-counted.

Verification provides an independent third party assessment of the expected or actual emission reductions of a particular GHG abatement project. Verification is necessary to achieve certification.

These definitions are adapted, in part, from ACUPCC's Investing in Carbon Offsets: Guidelines for Institutions. http://www.presidentsclimatecommitment.org/resources/guidance-documents/offset-protocol

Campus Climate Publications

RMI's research on campus climate initiatives built on excellent work offered in recent publications by practicing sustainability coordinators and non-profit support organizations. Below is information and excerpts, and notes regarding particularly useful sections of these publications.

Campus Climate Toolkit by Clean Air-Cool Planet
www.cleanair-coolplanet.org/toolkit/
Though not excerpted here, this is an excellent tool

Strategies for Carbon Neutrality by Davis Bookhart (2008) http://www.liebertonline.com/doi/abs/10.1089/SUS.2008.9991

Sustainability as a guiding focus
"There are, and will continue to be, trade-offs that place one set of sustainability priorities over another."..."A strategic plan should have mechanisms for evaluating these trade-offs and ensuring that a broader focus on sustainability remains a centering guide" (page 35).

Identify finance opportunities
"Finding and allocating funds for carbon reduction goals will be a key element in strategic planning." ... "Often overlooked are opportunities for the institution to raise revenue through its operations" (page 38).

Refocus bragging rights
Instead of hyping successes, schools need to dig deeper to do the hard work of evaluating shortcomings and crafting solutions to overcome them:

> "A carbon strategy... may force a different approach to some of the marketing and publicizing efforts of schools and their sustainability offices. It is painful to look at the opposite side of progress—what is left to do" (page 38).

Focus on vision, not just numbers (though numbers are an important detail)
Too much focus on numbers can obscure development of a cohesive vision for transformation through climate-change mitigation: "The results that will make the most impact are those that are transformative; students, faculty, staff, alumni, neighboring communities, and the neighboring region all need to be impacted positively by the efforts of the strategic plan" (page 39).

Guide for Climate Action Planning by National Wildlife Federation http://www.nwf.org/campusEcology/resources/HTML/climateactionplanning.cfm

Random-Project Portfolio
Avoid the random-project-portfolio approach to reducing GHG emissions because it leads to uncertain emissions-reduction outcomes. (see page 9) "The experiences of the first wave of schools that implemented carbon-cutting initiatives have shown that good planning is the best way to ensure good results" (page 8).

People, Process and Products

Developing the Plan

Working with Stakeholders

Project Identification and Evaluation

Cost-benefit and feasibility analyses
For campuses that are far along in the process, "Ranking the Projects:" Using such cost-benefit data as dollars per MTCDE eliminated and risk associated with techno logical uncertainty, plus other indicators to account for social benefits.

Opportunities and Lessons Learned
Involving students in the planning; Integration with other campus planning efforts; Achieving net emissions reduction requires new ways of thinking about growth; Encouraging productive collaboration between campuses.

Degrees That Matter: Climate Change and the University by Ann Rappaport & Sarah Hammond Creighton (2007) MIT Press in Cambridge, MA.

"The challenge for most climate change action efforts is to dovetail effectively the climate change issue with the day-to-day decisions and the long-term goals and issues facing university decision makers" (52).

"Considering buildings as an integrated system rather than a collection of unrelated parts is a critical shift. In many design and renovation projects the largest savings may be realized by finding opportunities for optimizing systems, often by identifying their interrelated components"(175).

Life-cycle thinking

Long-term thinking

Cash catalyst model

The Green Campus: Meeting the Challenge of Environmental Sustainability by Walter Simpson (2008) by APPA (Association of Higher Education Facilities Officers) in Alexandria, VA.
http://www.campuserc.org/resources/reports/Pages/TheGreenCampusMeetingtheChallengeofEnvironmentalSustainability.aspx
Organizing an Effective Campus Energy Program: Lessons from the University at Buffalo (Chapter 7)

Energy Demand Side
- Operate campus buildings and equipment in an energy

efficient manner
- Employ conservation measures wherever possible
- Conservation can reduce total campus energy consumption by 30 percent or more (page 67).
- UB has been able to save $180,000 annually for each degree of corrected overcooling and $290,000 annually for each degree of corrected overheating (page 70).

Energy Supply Side
- Shift away from the most carbon-intensive fossil fuels in energy sources

Top-Level Support for Administration
- Speak the language of administrators
- Give campus administrators "a piece of the action"

Leadership in Facilities Management
- In-house energy management committee
- Energy officer and team participation
- Holding the line on energy conservation policies

Campus-wide Awareness
- Environmental contacts network
- Social marketing campaigns
- Educate about climate change
- Incorporate energy program into larger campus environmental program
- Audience-specific outreach
- Encourage complaints about energy waste

Institutionalizing Campus Energy Policies
"Go for the Gold but Pick Low Hanging Fruit with Caution"
Don't let low hanging fruit blind you to larger opportunities; mix them together. "While exclusively targeting quick payback measures is tempting, campuses should avoid this fast payback trap. Project planners would be well advised to do short and long payback measures together so that their combined paybacks are attractive, and, in the end, more measures are installed. If all "low hanging fruit" is done first, much of the higher hanging fruit (projects with longer paybacks) may be unreachable."

Coping with Computer Explosion
- Green Computing Policy with required switch off at night and over breaks
- Purchase of most energy-efficient computers

Financial Disincentives and Incentives
- Consider energy operating costs and who will have to pay them.
- Minimize disconnects between planning and operations so that cost savings in operations motivate and provide incentives for greener planning.

The Two Faces of Deregulation
1. Finding Cheap Electricity
- Make connection between efficiency and attracting utility bids with lower rates by pointing out how efficiency flattens campus load profile and peak demand.
- Don't get side-tracked or distracted by forgetting that efficiency and conservation are the means to an end of cheapness by looking only for cheapness and forgetting about dirtiness factor.

2. Switching to Renewable Energy
- "The real challenge is figuring out how to make these purchases as economical as possible while genuinely bolstering renewable energy development."
- The decision about what to buy --RECs, commodity green power, on-campus renewable systems, or do some combination of these--is a complex one.

Designing Right (and Green) in the First Place
"While it is tempting to pursue a LEED rating by identifying the easiest and cheapest points achievable by your project, this 'checklist approach' violates the spirit of green design, which is holistic and integrative in pursuing design solutions that genuinely seek to minimize environmental impact" (Simpson 2008: 84). See the *UB High Performance Building Guidelines* developed by the UB facilities unit with input from the State University Construction Fund and the Dormitory Authority of the State of New York—these aim to "ensure that UB's green building design efforts are genuinely integrative, holistic and committed to reducing the environmental impact of new construction" (page 84). http://www.ubgreen.buffalo.edu

Assessing Greenhouse Gas Emissions and Developing a Climate Action Plan:
"We are all too aware that signing a climate neutrality pledge and achieving its goal are two different matters" (page 86). Campus growth and expansion often seems at odds with the goal of carbon neutrality.

Documenting Benefits and Celebrating Successes:
Metrics for tracking progress and effectiveness

<u>STARS Assessment Tool for Campus Sustainability</u>
http://www.aashe.org/stars/index.php

I. I.C Diversity of Challenges to Climate Action Planning Regional Differences:
   a. NWF's observations and input about general barrier patterns in different areas of the country
   b. Urban and Rural Differences
II. Institutional Type: Public and Private Divisions (and size, wealth etc.)
   a. Capital planning budget limitations at public institu tions
   b. Lack of state and federal policy drivers for private institutions
III. Institutional Culture and Leadership Style:
   a. Balance between respect for organic creativity and societal need for robust, measureable process
   b. PCC, the Climate Registry and regulatory require ments provide standardized reporting structure and accountability to an external public "watchdog"
   c. The Leap of Faith Issue: Carbon neutrality statement readiness levels (ex: momentum could be slowed without careful consideration of timing)

IV. Collaboration between Growing Communities of Knowledge (include a generalized stakeholder map). The changing national landscape and the path to solutions.
    a. NWF's work on Climate Action Planning (with SCUP)
    b. AASHE's work on supporting the ACUPCC
    c. Clean Air-Cool Planet's work on GHG inventorying
    d. Student Organizations and Events (FtN, EAC)
    e. All of the above organizations working together (e.g., ACUPCC recommends CA-CP's GHG calculator.)
    f. Sustainability Coordinators (don't id individuals here for the visual-- inc: Bookhart, Simpson, Rappaport & Creighton, Toor & Havlick) – Books and Networks (also include a list in appendix here)
    g. HESA and other Federal Policies
    h. State Policies (leads well into Regional Differences section)

II. The RESEARCH: Climate-change mitigation issues in Campus Operations
    a. Finance & Accounting

Unrealistic limitations on acceptable payback periods for energy-efficiency investments:
Although colleges and universities generally plan to own and operate their buildings in perpetuity, their financial-governance bodies are often uncomfortable with waiting more than seven years for investments in energy-saving technologies to pay back. This mentality limits options and can prevent consideration of technologies that have the highest potential to reduce energy consumption and reduce greenhouse gas emissions. For example, installing a synergistic combination of several energy-saving technologies when a building is retrofitted usually has a higher upfront cost and results in a larger annual energy savings than installing just one technology; however, the higher-impact, synergistic installation may take several years longer to pay back due to its high upfront cost. When faced with a decision between these two types of options, the single installation with a higher annual ROI and shorter payback often wins out even though the energy savings, cost savings and greenhouse reductions over the full life of the building will be significantly lower than if the synergistic installation had been chosen.
<u>Suggested solutions:</u> Incorporate Life-Cycle Cost Analysis (LCCA) into financial decision-making about energy-saving investments in campus buildings. Done carefully, this type of analysis will highlight the potential for higher cost savings over the full operating life of buildings with the most impactful energy-efficient technologies.

Inadequate attention to annual building maintenance needs:
It is common practice for college and university budgets allocate too little to annual maintenance and upkeep of campus facilities. This practice too often results in a daunting backlog of deferred maintenance needs that can cut into an institution's bottom line and dampen opportunities to improve the energy-efficiency of its buildings and power equipment. Once the backlog begins to collapse such that annual emergency maintenance eats away at spare capital every year, it becomes close to impossible to conveniently incorporate energy-saving technologies into planned maintenance projects because capital has to be allocated to "just-getting-by."
<u>Suggested solutions:</u> Increase annual maintenance budgets by adopting a policy of incorporating the most energy-efficient available technologies into all planned maintenance upgrades and investing resulting energy-cost savings back into the maintenance budget for the following year. If followed with discipline, this approach will result in lower heating and cooling loads so that HVAC equipment replacement costs will decrease in the long run because boiler and chiller systems can be safely downsized.

Disaggregation of energy and facility-related planning processes:
Campus planning is a fairly ambiguous term that encompasses a spectrum of management areas, all of which are theoretically driven by over-arching campus strategic priorities. Coordination and integration of different areas of campus planning are sometimes loose. When departments responsible for sustainability planning, capital planning and facilities planning do not collaborate and communicate regularly, opportunities to glean the highest possible levels of energy-efficiency tend to be missed.
<u>Suggested solutions:</u> Develop a clear communication strategy and schedule collaborative meetings between various campus planning departments to keep abreast of opportunities for creative energy-management and renewable energy-generation solutions.

Inflexible separation between capital and operating budgets:
When there is no mechanism for financial savings that will accrue from reduced energy and water use to directly increase the first-cost capital budget for improving the resource-use performance of a building, it is difficult to justify capital investments in energy-efficiency. Careful, nuanced attention to design of the structures for funneling energy savings to debt service, building operating budgets, and budgets for future renewable energy or energy-saving projects is critical for sustainable financing of campus climate-change initiatives, but in the rush to "get going" the design of these structures may be overlooked.
<u>Suggested solutions:</u> Refer to Campus InPower's Raise the Funds Campus Action Toolkit for an overview of ways to structure energy-efficiency and renewable energy funding by creating revolving loan funds, administrative funds, and leveraging energy-efficiency paybacks to grow the endowment or an internal campus bank. Combinations and hybrids of these various structures can result in powerful finance models that make good business sense. http://www.CampusInPower.org

Strict arms-length endowment investment policies:
The duty of fiscal responsibility in managing an institution's endowment should be taken seriously by trustees and regents of colleges and universities but sometimes this duty is reinforced by inflexible policies that prevent thinking about "outside of the box" investment strategies that are low-risk and can provide a high return on investment. Investment opportunities related to energy-savings generated by building retrofits are not well understood by financial decision-makers

and the idea of investing endowment funds "close to home" by funding retrofits on campus is uncomfortable for trustees. Suggested solutions: Form institutional energy-savings investment networks whereby trustees at one school can choose to invest a small portion of their endowment in energy-efficiency retrofits at another school and receive the associated return on investment for an agreed-upon number of years. This type of arrangement would allow trustees and their investment managers to maintain arms-length control over their investments while reaping high returns from low-risk investments and supporting climate-change mitigation on college and university campuses. It would also open up another avenue for funding energy-efficiency retrofits on campus, by allowing each school to attract investors from other institutions.

b. Capital, Human, Social and Knowledge Resources

Lack of information about the financial value of energy-efficiency: When financial analyses emphasize one-off projects instead of an integrated approach to retrofitting existing buildings, the full financial value and potential of energy efficiency remains hidden. The practice of value engineering to save on first cost investments can undermine potential energy-savings by removing essential pieces of a systematic energy-saving package. In addition, the uncertainty of energy prices in the future makes it difficult for financial decision makers to quantify the potential returns from energy-saving investments in campus facilities.
Suggested solutions: *Getting over the peer support and connection hump:* Assessing options for greenhouse gas reductions can be a daunting, lonely and frustrating process without support and collaboration. Carving out time and space for meaningful shared learning and problem-solving with peer institutions is a challenge for busy administrators, faculty, staff and students. Nonetheless, collaboration and support from peers facing the same research and planning challenges is critical for making confident progress.

Limited access to capital for energy-saving investments: Access to lines of credit and capital to support the up-front costs of energy-efficiency retrofits is one of the most commonly cited barriers to reducing campus greenhouse gas emissions.
Suggested solutions: There is a growing body of literature and a widening circle of firms and non-profit organizations that can help campuses navigate the financing for energy-efficient technologies. The Clinton Climate Initiative provides free facilitation, mediation and advising to support campuses in constructing their energy and carbon management portfolios. The U.S. Department of Energy (DOE) and the E.P.A. Energy Star program offer tailored resources for colleges and universities to demonstrate the business case of energy efficiency. The DOE Rebuild America online Solutions Center (www.rebuildamerica.gov) offers tools for targeting cost-efficient energy-upgrade projects and Energy Star (www.energystar.gov) offers free, downloadable calculators for energy performance assessment and cash flow planning.
Limited access to capital for renewable energy projects: On-site renewable energy projects usually require a sizeable, up-front capital investment and since colleges and universities are non-profit, tax-exempt organizations the federal tax credit benefits that are available for this type of investment do not apply to them. Raising the initial investment money and/or negotiating with third-party organizations to make the initial investment are complicated challenges.
Suggested solutions: There are a number of ownership models and financing models that can be used to creatively develop, customize and construct an on-site solar, wind or biomass generator. Each installation could be owned by the college or university, a third-party private vendor, a private equity partnership, the local utility company, the local campus or some hybrid of these options; the financing package will be different depending on the ownership model. For a detailed overview of options, consult chapters 4 and 6 of The Business Case for Renewable Energy: A Guide for Colleges and Universities (2006) by Andrea Putnam and Michael Philips. In addition, the Harvard University Office of Sustainability maintains a useful webpage on financing models for campus renewable energy initiatives (see http://www.greencampus.harvard.edu/cre/financing.php).

Limited staff time for researching energy-related projects: On most campuses, the departmental support staff for both facilities and operations and finance and administration have many balls to juggle and adding the responsibility of energy-project research to their already full plates is not always the best way to generate reliable information on which to base energy-related investment decisions. Staff will likely feel over-extended and resentful unless they are already pre-disposed to be passionate about clean energy solutions. In addition, without structured support and guidance about how to wade through the multiplying array of information available about energy-efficiency and clean energy, staff members are hard-pressed to come up with a confident and thorough analysis of the best options for investment.
Suggested solutions: Students, CCI

Incomplete and unverified greenhouse gas inventory data: A common barrier to progress in implementing additional greenhouse gas reduction measures is the perception that a thorough and complete greenhouse gas inventory of the college or university's emissions is necessary in order to begin decision-making for the implementation process. Quantifiable measures of emissions are important and fiscally conservative decision makers desire detailed, quantitative analysis in order to make responsible decisions.
Suggested solutions: Inventory calculations need not delay implementation planning altogether. Reliable analyses are already available at the general campus scale (see (1) AASHE's online directory of existing Climate Action Plans at http://aashe.org/resources/climate_action_plans.php,(2) National Wildlife Federation Campus Ecology's Guide to Climate Action Planning at http://www.nwf.org/campusecology/resources/HTML/climateactionplanning.cfm, and (3) EH& E's white paper- Striving for Climate Neutrality on Campus: 7 Steps for Writing a Climate Action Plan at http://www.eheinc.com/7stepscap.htm). Instead of allocating resources linearly, first to the inventory and then to the implementation planning, consider whether some limited resources of time, hu-

man capital and financial capital might be better invested in implementation decisions based on broad GHG source trends that have emerged in higher education. Once a customized GHG inventory is completed, it can be used to add to and adjust implementation choices.

c. Physical Space and Planning

History of investment in centralized, fossil-fuel-powered heating and cooling:
Centralized heating and cooling equipment requires a significant up-front investment. In cases where fossil-fuel-powered equipment has not yet achieved full payback, campuses are not likely to consider investing in different supply-side equipment in the near term. Thus these campuses will continue to burn fossil fuels and emit greenhouse gases at least until their initial HVAC equipment investments have been recovered. Suggested solutions: Improving end-use efficiency in buildings served by centralized heating and cooling equipment will facilitate faster paybacks by generating energy-cost-savings that can be used to recover the investment. The green attributes of efficiency retrofits to campus buildings may be able to generate some additional revenue of their own through the sale of Energy Savings Certificates (ESCs, which are also called Energy efficiency certificates/EECs, Tradeable white certificates/TWCs and White TagsTM). There are advantages and disadvantages associated with selling energy savings generated through building efficiency-retrofits: Savings sold as certificates during a given year cannot be counted toward institutional greenhouse gas reductions but they can generate revenue streams and energy-cost savings that an institution can use to pay for other energy-management costs like paying off expensive equipment, funding new green buildings, and investing in renewable energy generation on campus.

Historic buildings with inefficient, expensive preservation requirements:
- Lack of access to energy-consumption data at the level of units of users
- Lack of space for on-campus renewable energy generators

d. Socio-cultural and Contextual Factors
- Lack of coordination between green efforts on campus
- Invisibility of energy-efficiency
- Pressure to expand campus facilities
- Increasing plug-loads
- Lack on incentives for energy conservation
- The culture and privilege of academia
- Research laboratory energy needs
- Psychological attachment to an inefficient campus fleet
- Concern about campus aesthetics

e. External Barriers and Solutions
- Policy Factors
- Tax incentives for investments in on-site renewable energy generators are not effective for motivating non-profit institutions to make these kinds of investments.
- Supply of small-scale wind turbines is very limited given growing demand for large-scale projects.