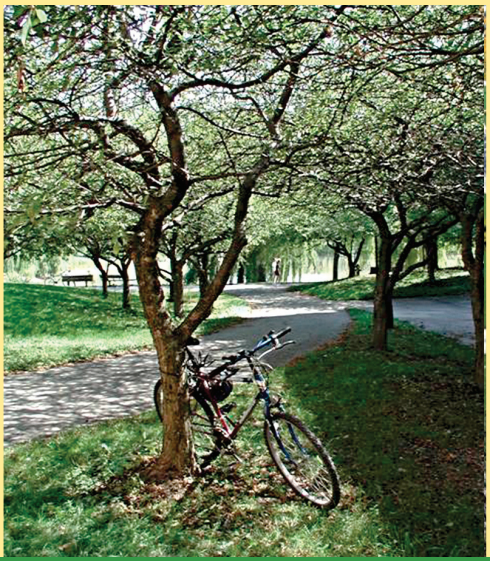
THE GREEN CAMPUS



MEETING THE CHALLENGE OF ENVIRONMENTAL SUSTAINABILITY


WALTER SIMPSON, EDITOR

The Green Campus: Meeting the Challenge of Environmental Sustainability

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Acknowledgments and Thanks

IT'S BEEN an honor to serve as editor for this anthology. I would like to express my heartfelt gratitude to many people especially to all the authors who generously contributed their articles to this anthology. Writing a new article or updating an existing one is time-consuming work which all the authors—all very busy people—did cheerfully and with a sense of contribution to an important social and environmental cause—the green campus movement. Their work, dedication, and well crafted words are inspiring to me, and I trust readers will respond the same way.

I would not have had this opportunity if not for Steve Glazner, APPA's director of Knowledge Management and editor of *Facilities Manager* magazine, who offered me this project, which grew considerably from its initial conception. I can't thank him enough or Betsy Colgan for all her painstaking work as copy editor and in laying out the book. I would also like to thank my friend and supervisor, Mike Dupre, the University at Buffalo's associate vice president for Facilities, who saw the potential of this book and allowed me the time to work on it.

I would like to especially thank Judy Walton, director of Strategic Initiatives for the Association for the Advancement of Sustainability in Higher Education (AASHE), for her help and guidance from the beginning of this project. In addition to authoring two articles and assisting with the resources section and other parts of the book, she was always there for advice and counsel which I very much appreciated and relied on often.

This book means a lot to me because of the latitude I have had in creating it and because it represents so much of what I have thought is important and worth working and fighting for over the twenty-five years of my career as an energy conservation and green campus professional at the University at Buffalo (UB). Pulling this book together has given me an opportunity to reflect on my experiences in the green campus fields and trenches. Whatever knack I had for assembling it comes from this experience.

At UB, I have had the honor of working closely with my friends and co-workers in the UB Green Office, Erin Cala and Jim Simon, and the terrific student assistants we have had over the years (many of whom are off now doing great green things in the "real

world"). I also greatly appreciate my other facilities colleagues who have enthusiastically supported and significantly contributed to our energy and environmental program, and the students, faculty, and staff who have been part of our campus environmental task force and environmental advocacy over the years.

I remember with gratitude UB Vice President Ed Doty who in 1982 gave me my start as university energy officer (he challenged me to at least reduce energy costs equal to my salary—a task which proved easy to do because there was so much opportunity to conserve energy), and my early mentors Professors Les Milbrath and Fred Snell and Facilities Plant Superintendent Herb Lewis, who took me under his wing from the first day I walked in the door. When I would get discouraged at times when campus administrative support for our energy conservation program was at a low ebb, Lewis would use a pendulum metaphor to ease my pain and encourage patience (never my strong point). He would say, "Walter, don't worry, the pendulum will eventually swing back, and what we do will once again be viewed by campus leaders with the importance it deserves." There is a lesson there for all of us to hang in and not quit. We need to be at this for the long haul. Moreover, as we contemplate the war in Iraq, growing concern about peak oil, and what appears to be a full-blown climate change emergency, it is clear that the energy pendulum has swung back with a vengeance.

Most of all I want to thank my wife Nan who is at the heart of everything I do—including this book. She has helped me sustain and survive, with lots of love and humor, my sometimes obsessive commitment to this green campus work. Our children Jay and Skye are now almost ready to leave the nest and enter the big wide world. Everyday they remind me why this work is so important. We need to acknowledge our debt to all children and to the world which sustains us. We have a fundamental obligation to leave this beautiful planet intact and full of possibility for future generations.

Introduction

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I LOVE Tom Toles's cartoons, including the ironic one which graces this page. Yes, we love the environment even as we are damaging it! This book is about getting beyond all the lip service and horn honking to demo-nstrate our love for the environment and actually doing something to protect this beautiful planet which is our home. For those of us on campus—as students, faculty, staff and admin-istrators – what could better reflect the principle, "think globally, act locally," than getting our own campus on a greener, more sustainable path? This anthology is intended to help its readers do just that. It's about the growing movement for "green" campuses—colleges and universities exercising intellectual and moral leadership by striving for environmental responsibility, stewardship, and sustainability.

There are many dimensions of campus environmental sustainability and all are important. There is the greening of academic programs and courses and a commitment to graduate eco-literate and eco-motivated students—what David Orr eloquently refers to as graduates "suited for a responsible life on a planet with a biosphere." There is also the greening of faculty and student research activities—emphasizing the discovery and implementation of ideas, strategies, policies, and technologies that promote environmental protection and restoration so that we and future generations can live less harmfully and more constructively on our increasingly small and stressed planet.

Another important dimension of campus greening is public service.. Green campuses lead society by example and by directing their intellectual and organizational resources

to enhance the environment in local, regional, and global communities. This may take the form of setting an example that others follow, conducting public environmental education, or implementing community programs run by students, faculty, and staff that provide direct environmental services.

Making all of the above possible is campus operations – the business and physical functioning of the campus itself. This is the main subject of this book. It seeks to answer the question: how can we operate our colleges and universities in support of higher education's academic, research and public service missions while reducing the environmental footprint of campus operations? Or, more simply, how can we run our campuses causing the least amount of environmental harm?

The term "sustainability" is used in many ways and deserves clarification here. I am using it in the sense of "environmental sustainability," recognizing that the concept is often regarded to be broader and include economic and social dimensions as well. Nonetheless, environmental sustainability is a readily used and understood concept—though, like sustainability generally, it tends to be misused and watered down. I would argue that environmental sustainability is a strict standard and very little of what we do meets that standard. Sadly, to date, most human activity—at least in modern industrialized economies—degrades the environment and is ultimately not environmentally sustainable. Thus, if we are to use the term properly, environmental sustainability becomes more of a goal or direction than an achievement. In evaluating green campuses, we should be humble and recognize that even the best green campus programs probably have a very long way to go before achieving anything approaching genuine environmental sustainability.

The discussion in this book follows a natural progression, beginning with introductory articles to provide basic principles and the lay of the green campus land, followed by articles that focus on specific green campus issues and opportunities. Most of these articles highlight green campus programs which exemplify achievement in a specific area. Discussion then turns to profiles of a few schools whose efforts are comprehensive and exemplary – with apologies to those other excellent programs not described here. As the green campus movement grows, we have an embarrassment of riches. Many campuses are stepping up to the plate and launching or improving their environmental programs.

While I would have liked to cover all areas of green campus operations, space and time did not permit that. The book covers most of the basics but some omissions stand out, such as green campus master planning and food and dining service issues. Doing justice to these opportunities in a sentence or two is not possible but let me mention the critical need to consider green space and transportation impacts in campus master

plans, particularly when planning new campuses or siting new facilities on existing campuses. Campuses built on greenfields or in suburban locations may have lifetime environmental impacts much greater than those built in urban locations where "in-fill" development is possible and public transit an easy option. The environmental impacts of food production and consumption, whether or not on campus, are generally lower if food is local and organic. We also need to recognize the well documented fact that eating lower on the food chain—thus minimizing meat consumption and livestock production—can also significantly reduce environmental impact.

I make no apology for the emphasis I place on energy issues and climate change. In my opinion, the problem of global warming and climate change is the greatest issue our species has ever faced, with the possible exception of the risk of nuclear war—the latter still with us but having abated somewhat since the end of the Cold War. I am pleased to be able to include an article by leading climatologist Jim Hansen, director of NASA's Goddard Institute for Space Studies, whose efforts as a scientist as well as a public citizen have forced us to contemplate this looming crisis and finally begin taking action. Hansen's article provides an intellectual anchor for all the attention given to climate change in this volume. A number of other contributors to this book—including Anthony Cortese and David Orr—have been among the strongest voices making a clear and persuasive case for campus leadership to address climate change. An important outcome of their efforts and those of many others is the American College & University Presidents Climate Commitment, which I strongly support.

The clock is ticking on climate change. As Nobel Peace Prize winner Al Gore has said, the debate is over and the time for action is now. Decisive campus action can help lead the way and catalyze much-needed action throughout our society.

—Walter Simpson
December 1, 2007

Chapter 1

A Reflection on Green Campuses

Walter Simpson

THE MODERN environmental movement is often said to have begun with the first Earth Day on April 22, 1970. Earth Day galvanized concern about environmental problems and gave the movement the spark it needed to take off. An estimated twenty million people participated in that first Earth Day—really a series of grassroots teach-ins across the country. While environmental enthusiasm for Earth Day has ebbed and flowed over the years, the event has now become part of our cultural landscape and is celebrated internationally by many millions of people annually in a majority of countries. Early on, the slogan "Every Day Is Earth Day" was adopted to make clear that respect for the Earth and activism on behalf of environmental protection should not be a one-day-a-year event.

In the spring of 2007, environmental leader Denis Hayes spoke at the University at Buffalo (UB) in a wide-ranging address highlighting renewable energy solutions to climate change. In response to a question about biofuels, Hayes, who was the national coordinator of the first Earth Day and director of the federal renewable energy laboratories during the Carter Administration, lamented the fact that over twenty-five years ago we knew that corn-based ethanol was problematic and that making ethanol from plants with high cellulose content made more sense. This seemingly narrow technical comment is emblematic of a broader concern that was expressed by Hayes. We have known that we have an energy problem since at least the 1970s and we've known about potential solutions for nearly that long—yet so little has been done. Now we find ourselves bogged down in a war in the oil-rich but highly volatile Middle East, while confronting the greatest environmental challenge we have ever faced—the climate crisis—fueled by our carefree, exuberant consumption of fossil fuels.

The news about climate change has not been good. Al Gore called it both an "inconvenient truth" and a "planetary emergency," and the science backs him up. Leading climatologist Jim Hansen, director of NASA's Goddard Institute for Space Studies, warned in 2006, that we had just ten years to adopt a new energy path and begin

reducing greenhouse gas emissions—principally carbon dioxide from burning fossil fuels—or climate change may reach a "tipping point" and accelerate out of control, leaving our children and grandchildren an "unrecognizable world."

The good news is that thanks to the efforts of Al Gore, Jim Hansen, Denis Hayes, and many others, public awareness of the danger of climate change is also reaching a tipping point, and long overdue constructive action appears to be around the corner. Many hundreds of U.S. mayors have pledged to significantly reduce greenhouse gas emissions in their cities. Governors and state legislatures are beginning to act following the lead of Gov. Arnold Schwarzenegger and California legislators. And the U.S. Congress appears poised to begin addressing this huge problem. While it remains to be seen if our response to climate destabilization will be too little to late, the debate is over. The alarm has been sounded and heard, and meaningful action is now at least under consideration.

The Green Campus Movement

As the environmental movement has advanced since the first Earth Day, albeit in fits and starts, college and university campuses have been focal points of concern and action. This observation should surprise no one who has ever spent time on a college campus. Of course, the reflective, intellectual nature of the academy can be both a benefit and a hindrance. We need to apply our best thinking to environmental issues, but care must be taken to avoid the pitfall of being merely "academic." Luckily, on most campuses, action-oriented students and others have reminded the rest of us that we need to affect the "real world" or we are just spinning our wheels.

While some campuses have been hotbeds of activism, others have been cooler and calmer—with smaller groups of students, faculty, and staff keeping a spark of concern alive. Concerns about the wider world have always been the natural focus of environmentalism, but it did not take long before students, faculty, and staff looked inward and asked if the curriculum was rich enough in environmental studies and if campuses were operating in an environmentally friendly way. In our consumer society, it was only natural that operational concerns initially focused on waste—the volume of solid waste and the waste of energy. In recycling and energy conservation, we see the roots of the modern green campus movement.

While recycling may not be the most important environmental action, it is essential and it has an undeniable special appeal. After Earth Day raised our consciousness, people on many campuses created their own recycling programs if campus authorities did not. While students, faculty, and staff also played a role on many campuses in getting early energy conservation programs going, campus leaders and facilities managers got the jump on this issue simply because of the rising cost of energy after the energy crises of 1974 and 1979.

Recycling and energy conservation are still the basic building blocks of green campus programs, though hopefully we now see these programs more fully institutionalized and expanded as part of a larger fabric of mutually reinforcing green campus program elements. These elements include waste reduction campaigns, green purchasing (including green power and recycled paper purchasing), green building design and campus planning, and sustainable campus grounds keeping, all coupled with a stronger environmental and social responsibility emphasis in academics and research. The march toward green campuses has been steady in recent years. More and more colleges and universities have meaningful programs, many with sustainability coordinators, staff, and offices—with more and more attention being focused on global warming and climate change.

The term sustainability needs clarification here. To date, the main priority of campus sustainability programs, offices, and staff has been environmental. Sustainability, however, has a much broader meaning, involving social and economic dimensions as well as an environmental dimension. All of these elements are important, though the green campus discussion in this book is focused primarily on sustainability narrowly defined as environmental sustainability.

There have been a number of events, organizations, and leaders who have helped build the growing national green campus movement we now see. At the risk of leaving some out, here is a short list:

- The Talloires Declaration on campus sustainability, since 1990 signed by over 350 colleges and universities worldwide.
- 1994: The Yale University Campus Earth Summit supported by the Heinz Foundation—an international gathering of 450 faculty, staff, and student environmental leaders from 160 institutions, which produced a "Blueprint for a Green Campus."
- Julian Keniry's book, *Ecodemia: Campus Environmental Stewardship at the Turn of the 21st Century* (1995), along with other important works by David Orr (author of *Earth in Mind, The Nature of Design, and Design on the Edge*), Sarah Hammond Creighton (*Greening of the Ivory Tower*, and *Degrees that Matter*, co-authored with Anne Rappaport), April Smith (*Campus Ecology*), and other authors.
- 1995–2000: Design and construction of the Adams Joseph Lewis Environmental Center at Oberlin College, pioneering climate neutral campus green building design.
- 1996: The first Ball State University's "Greening of the Campus" national conferences; the Seventh Ball State Greening of the Campus conference was held September 2007.
- 1999: Founding of the Tufts Climate Initiative, a pioneer in climate change mitigation in higher education.

- Formation during the 1990s of organizations with a national or regional green campus agenda such as the Campus Ecology Program of the National Wildlife Federation, University Leaders for a Sustainable Future (supported by the Humane Society of the United States), and Second Nature.
- 2005: Higher Education Associations Sustainability Consortium, a coalition of twelve of the most important mainstream higher education professional associations.
- 2006: Association for the Advancement of Sustainability in Higher Education (AASHE), with over 360 campus members by December 2007 (AASHE's potential was demonstrated by its first national conference in 2006, which was the largest green campus conference yet, attracting 700 campus representatives).
- 2007: The American College & University Presidents Climate Commitment, a pledge to achieve climate neutrality – with over 450 signatories as of December 2007.
- 2007: Focus the Nation, a national group that is coordinating teams of faculty and students at over a thousand colleges, universities, and K-12 schools in the United States, to collaboratively engage in a nationwide, interdisciplinary discussion about "Global Warming Solutions for America."

A special debt is owed to Second Nature's President Anthony Cortese, who is responsible for founding, inspiring, or supporting so many of the efforts above. AASHE and the American College & University Presidents Climate Commitment (coordinated by AASHE, Second Nature, and ecoAmerica) have been particularly important in leveraging change on campus since 2006. AASHE has a huge potential to further energize the green campus movement and provide it with the leadership and resources it needs for growth (see sidebar below). The Presidents Climate Commitment has come along at just the right moment to provide colleges and universities with a landmark opportunity to demonstrate leadership in helping to solve the climate crisis (see Chapter 6 on page 49.

Association for the Advancement of Sustainability in Higher Education

The Association for the Advancement of Sustainability in Higher Education (AASHE) is a new and rapidly growing association of colleges and universities working to advance sustainability in higher education in the United States and Canada. Its mission extends to all sectors of the campus—from governance and operations to curriculum and outreach. Since its founding in early 2006, it has expanded from 35 campus members to nearly 360 in December 2007, paralleling the explosive growth of the campus sustainability movement.

The association facilitates member efforts to integrate sustainability into teaching, research, and operations. It connects members to resources, discussion groups, and professional development opportunities and serves as a home for campus sustainability professionals (a rapidly growing career field). One of AASHE's most popular resources is the weekly *AASHE Bulletin*, an e-newsletter with briefings on the leading campus sustainability happenings as well as new resources, job opportunities, and events. *Bulletin* items are compiled by category each year into an online *AASHE Digest*, providing an excellent database for research. AASHE is also known for its extensive online Resource Center.

Among AASHE's major initiatives is the American College & University Presidents Climate Commitment. This is a collective effort of presidents and chancellors to demonstrate higher education's leadership on global warming by committing their own campuses to eventual climate neutrality and providing the education and research to equip society to solve this complex problem. The effort is being coordinated and supported by AASHE, Second Nature, and ecoAmerica.

AASHE is also leading another major initiative—a collaborative effort to develop a formal assessment and rating system for sustainability in higher education, with guidelines by which institutions may attain progressive levels of accomplishment and recognition. The project responds to the need expressed by many stakeholders for a standard rating system that compares higher education institutions on progress toward sustainability.

AASHE grew out of a regional organization, Education for Sustainability (EFS) Western Network, founded in 2001, and serving campuses in the western United States and Canada. Anthony Cortese, president of Second Nature, was instrumental in both EFS West's and AASHE's founding. Judy Walton, another EFS West co-founder, served as the first executive director of EFS West and then of AASHE, both based in Portland, Oregon. AASHE's inaugural conference in 2006, at Arizona State University, was the largest campus sustainability event to date, with over 700 attendees.

Membership in AASHE is by institution and covers every individual on campus, including students. Businesses, nongovernmental organizations (NGOs), and government agencies also participate in AASHE as partner members. A list of members and other information about membership can be found at: http://www.aashe.org/membership/members.php.

Sustainability is defined by AASHE in an inclusive way, encompassing human and ecological health, social justice, secure livelihoods, and a better world for all generations. The organization strives to model sustainable practices in its own operations and activities, from conferences and travel to procurement and communications. AASHE continues to build on its accomplishments in making sustainable practices mainstream within higher education.

To learn more about AASHE, visit www.aashe.org or call its office at 859-402-9272. Questions can be sent to: info@aashe.org.

Green Campus Models and Rationales

Green campus programs evolve differently at different schools. At the University at Buffalo, our program has always had the facilities unit as its main strength. When I began my work there as energy officer in 1982, there was already an active energy conservation program run by Herb Lewis, the plant superintendent at the time. This committee met regularly and Lewis kept the drum beat for energy conservation going.

UB is an example of a school that started energy conservation in the 1970s and just kept doing it, with the commitment of our facilities unit. While we always hoped that students, faculty, and campus administrators would rise up and insist that the campus do more, it very rarely has happened. From the facilities commitment grew our commitments to green campus operations and eventually led to the formation of our UB Green Office and its campus-wide environmental advocacy. This model has worked for us, but it is clear that UB would be greener if the push was coming from all directions.

On other campuses the impetus for green campus activities and programs has come from students and faculty, sometimes with facilities dragging its feet and playing hard to get. There are a handful of campuses where environmental concern has been championed by top level campus leadership—a fortunate circumstance, though to be most effective, top-down change needs to be matched with grassroots enthusiasm and involvement. The best green campuses have both.

While all members of the campus community have a part to play in greening their campuses, facilities managers and their staff are in a unique position to make a difference because they are ultimately running the physical plant of the campus. They have their hands on the levers, switches, and controls of the largest pieces of equipment on campus that use the most energy. They can run this equipment efficiently or wastefully; they can choose to retrofit it so that it is more efficient. They manage the solid waste stream and can implement or improve campus-wide recycling efforts. Facilities managers and their staff manage the campus grounds and can do so sustainably or not. They manage the design and construction of new campus buildings, which if not done right will be environmental liabilities for 50 or 100 years to come. They are responsible for water and sewer and so much more that defines the campus environmental footprint. None of this is to say that facilities units can do it all without the support and active involvement of students, faculty, administrators, and staff, but it is clear that facilities units are well positioned to provide critical green campus leadership.

In the end, green campus program success will be a function of how clearly campus leaders, movers, shakers, and followers perceive the program's benefits. These benefits are manifold and include:

- Reducing environmental impact
- Saving money by reducing waste and conserving energy, freeing up funds for other programs
- Contributing to academic excellence through environmental education
- Instilling campus pride and building morale
- Improving campus image and creating public relations benefits
- Improving student and faculty recruitment and retention
- Creating a healthier learning environment on campus
- Setting an example for the wider community
- Catalyzing social change
- Being relevant
- Creating hope

The last two points deserves special mention. Members of the campus community are acutely aware of environmental problems and are becoming increasingly concerned about the climate crisis. Students may be especially concerned about the future as they contemplate their own future. They wonder (silently or out loud) about the kind of planet they are inheriting from their parents and grandparents. Colleges and universities run the risk of being irrelevant if they ignore this—asking their students, in effect, to keep these worries under wraps in their anxiety closets. By addressing concerns about the future directly, colleges and universities can demonstrate relevance and instill hope.

The Long Road to Environmental Sustainability

The green campus movement has also been called a movement for campus environmental sustainability. We know we need to become environmentally sustainable, so pointing ourselves in that direction is a good idea. It is also important that we realize how far most of us are from achieving it.

Sustainability is a great concept. In its simplest meaning, it refers to the ability of an activity to be sustained, namely, to continue indefinitely. This is a deceptively tough standard. The United Nations has defined international development in terms of sustainability, which led to a widely accepted definition of "sustainable development." The 1987 Brundtland Commission Report titled "Our Common Future," states this definition succinctly as "meeting the needs of the present generation without compromising the ability of future generations to meet their own needs." Ensuing definitions of sustainable development and sustainability generally include social, economic and environmental components. Sustainable development occurs when economic prosperity is pursued in the context of social equity, human rights, peaceful relations among peoples, and ecological balance.

Native Americans approximate this definition with their law of "seven generations," which requires that decisions be made based on consideration of the consequences of actions over seven generations.

World-renowned architect William McDonough has translated the sustainability challenge into a provocative question he poses when he speaks about the fundamental goals of design: "In our lives and in our work, how do we love all the children of all species for all time?" Clearly, McDonough believes that sustainability and sustainable development involve a shift in attitudes and values and an expansion of our sphere of moral concern that crosses species as well as generational boundaries. Talk about an ambitious concept!

How does the environmental component of sustainability get translated into green campus programs, aspirations, and nomenclature? For starters, it is important to realize that campus environmental sustainability should involve much more than just reducing campus environmental impacts. An environmentally sustainable campus would not damage or deplete the environment beyond the environment's ability to repair and restore itself naturally. As such, an environmentally sustainable campus would have these characteristics:

- Significantly reduced consumption of all resources, especially nonrenewable resources
- Reliance on products made of 100 percent recycled materials or sustainably produced renewable resources
- Reuse or recycling of all waste, using a cradle-to-cradle concept wherein products are used, recycled, and made into products again without losing any material quality
- No polluting or emitting of wastes beyond what ecosystems can breakdown and harmlessly recycle naturally
- Total reliance on clean, renewable energy technologies to achieve climate neutrality.

Higher Education Associations Sustainability Consortium

The Higher Education Associations Sustainability Consortium (HEASC) is an informal network of higher education associations (HEAs) with a commitment to advancing sustainability within their constituencies and within the system of higher education itself.

HEASC was formed in December 2005, by leaders of several HEAs to support and enhance the capacity of higher education to fulfill its critical role in producing an educated and engaged citizenry and the knowledge needed to create a thriving and civil society while preserving the life support system on which we all depend. This task becomes more daunting as the world's population and our need to increase economic output grows.

The HEAs that have formed HEASC see the need for developing in-depth capability to address sustainability issues through their associations and have decided to work together in this effort. HEASC provides a forum in which member associations can learn from each other, work together on joint projects, get access to the best expertise and information on sustainability, and to keep a collective, ongoing focus on advancing education for a sustainable future over time. HEASC's goal is to involve all higher education associations to get the broadest perspectives and produce the greatest effectiveness and synergy in their efforts.

As of December 2007, HEASC includes these twelve members:

- American Association of Community Colleges (AACC)
- ACPA-College Student Educators International (ACPA)
- American Association of State Colleges & Universities (AASCU)
- APPA, providing leadership in educational facilities
- Association for the Advancement of Sustainability in Higher Education (AASHE)
- Association of College & University Housing Officers International (ACUHO-I)
- Association of Governing Boards of Universities & Colleges (AGB)
- National Association for Campus Activities (NACA)
- National Association of College & University Business Officers (NACUBO)
- National Association of Educational Procurement (NAEP)
- National Intramural-Recreational Sports Association (NIRSA)
- Society for College & University Planning (SCUP)

HEASC member associations are involved in various aspects of higher education including planning, purchasing, housing, facilities, business, governing boards, campus activities, and recreation, as well as associations for institutional types—state colleges and universities and community colleges. Each member of HEASC works to instill the principles of sustainability into their own operations as well as into their programs, publications, and conferences for their members and constituents.

The coordinating agent for HEASC is Second Nature, headed by Anthony Cortese who was also instrumental in the founding of the Association for the Advancement of Sustainability in Higher Education (AASHE). Dr. Cortese acts as the co-coordinator of HEASC, along with Debra Rowe, president of the U.S. Partnership for Education for Sustainable Development. Stephen Muzzy serves as program manager for HEASC.

HEASC membership entitles staff of each member association to resources, activities, training, newsletters, etc. In addition, members' constituents are entitled to the same resources.

HEASC continues to evolve as the need for sustainability initiatives in higher education increases. Members will be instrumental in assisting colleges and universities that have signed the American College & University Presidents Climate Commitment to achieve the goal of climate neutrality.

For more information: http://www.aashe.org/heasc.

Try to imagine a campus that consumes little, wastes nothing, and runs on solar energy. That doesn't sound like any campus I know. We see that even schools with highly successful green campus programs do not come close to achieving environmental sustainability when defined properly.

In providing this commentary on environmental sustainability and stressing a strict definition with high hurdles, I don't mean to discourage the use of the term but rather to make its meaning clear. It is the right goal, as is sustainability more broadly defined. Let's just be clear how far we still have to go and keep the pressure up for steady and rapid improvement.

The bottom line is that the movement for green campuses has come a long way and many schools now have excellent programs. A great many people and organizations have done wonderful work and deserve our thanks and appreciation. But none of us can afford to rest on our laurels.

About the Author

Walter Simpson, CEM, LEEP AP, is university energy officer and director of the UB Green Office of the University at Buffalo (SUNY Buffalo).

Chapter 2

Rating Colleges

David W. Orr

ONE OF the more consistent idiosyncrasies of Americans is their penchant for ranking things. It is, on the whole, a harmless pastime, giving indoor pleasure to many, and bestowing high status upon those called on to create and maintain various rankings. It has also been known to boost sales of publications of one sort or another and, like *Sports Illustrated*'s annual swimsuit issue, it provides either agreeable diversion or a source for moral indignation during an otherwise dull part of the year. One should not presume, however, that the relationship between such lists and reality is great. Nor is it necessary that it be so. Their function, rather, is to gratify, amuse, employ, sell, or fuel disagreement, hence the development of subsequent lists and rankings.

Until recently, colleges and universities, for the most part, ranked themselves. After due consideration, the great majority solemnly proclaimed themselves to be "excellent." But hundreds, if not thousands, of institutions laying claim to an attribute scarce by definition gives scant basis for ranking. The subsequent loss of pleasurable contention has been considerable. We have been rescued from this plight by various guides' to colleges, including those by the *New York Times* and *U.S. News and World Report*. These and others like them rank colleges on such things as peer reputation, Scholastic Aptitude Test scores of incoming freshmen, size of endowments, number of books in the library, percentage of Ph.D.s on the faculty, publications by faculty, tuition, faculty-student ratios, and so forth. These purport to describe, in one way or another, the capacity of educational institutions to educate.

Educational institutions, however, are not like football teams, so judging the capacity of a college to cultivate the higher qualities of life and mind is considerably more subtle and complex than appraising the ability of eleven men to do mayhem for 60 minutes. Good education, in fact, may be inversely proportional to many of the quali-

This chapter was previously published in *Earth in Mind: On Education, Environment, and the Human Prospect* (revised edition 2004), David W. Orr.

ties now used to rank educational institutions. Peer reputation may be an index only of snobbery and pomposity. Faculty publications may be an indicator of student dissatisfaction and the decline of forests. Large endowments might be a reasonable index of institutional torpor. Research grants may, on occasion, reflect ties to corporate and U.S. Department of Defense activities that Boards of Trustees might rather conceal.

Ranking works best when things are simple and can be easily counted. But good educational institutions are complex, creative, and difficult to describe in numbers. This is why I think that the editors of *U.S. News and World Report's* college issue would have ranked Plato's Academy rather far down on its list of "regional" institutions. Its library by all accounts was small, it had no laboratories, its student body consisted mostly of locals, and the major professor and founder, whose work has descended to us by hearsay, was highly discredited through a lifetime of rabble rousing and carousing among the city's young.

There is yet a second problem. Most ranking systems face backwards, using measures that no longer describe present realities or the role of the institution to those realities. For example, whatever their stated purposes, colleges and universities have played a major role in the industrialization of the world in the belief that the domination of nature, on balance, was a good thing. The reality, however, has changed. We have several centuries of hard work ahead of us to clean up the mess: sequestering toxic and radioactive wastes; restoring depleted and mined land; cleaning up lakes, seas, and rivers; stabilizing climate; replanting forests; protecting whatever biological diversity we can; rebuilding decayed urban areas; and bringing all of the other vital signs of earth back to health.

Accordingly, I propose a different rating system for colleges based on whether or not the institution and its graduates move the world in more sustainable directions. Do four years at a particular institution instill knowledge, love, and competence toward the natural world or indifference and ignorance? Are the graduates of this or that college suited for a responsible life on a planet with a biosphere? This is an admittedly difficult, but not impossible, task. I propose that colleges and universities be ranked on the basis of five criteria.

The first of these has to do with how much of various things the institution consumes or discards per student. Arguably, the best indicator of institutional impacts on the sustainability of the earth is how much carbon dioxide it releases per student per year from electrical generation, heating, and direct fuel purchases.[1] Other ratios of interest would include amounts of paper, water, materials, and electricity consumed per student. These can only be determined by careful audits of how much of what enters and leaves the campus.[1] On this basis colleges might compete to become increasingly efficient in lowering resource use per student.

A second basis for ranking has to do with the institutions management policies for materials, waste, recycling, purchasing, landscaping, energy use, and building. What priority does the institution give to the use of recycled materials? What percentage of its material flows are recycled? Does it limit the use of toxic chemicals on the grounds and in buildings? Does it emphasize energy efficiency and solar energy in renovations and new buildings? Does it use nontoxic materials?

Third, does the curriculum provide the essential tools for ecological literacy? What percentage of its graduates know the rudiments of ecology? Do they understand that no good economy can be built on the ruins of natural systems? Do they have experience in the out-of-doors? Is there opportunity and encouragement to restore some part of the nearby rivers, prairies, worn-out farmland, or strip-mined land? Do they understand the rudiments of environmental ethics? Do they understand the difference between optimum and maximum, stocks and flows, design and planning, renewable and nonrenewable, dwelling and residing, sufficiency and efficiency, can do and should do, health and disease, development and growth, and intelligence and cleverness? This presumes, of course, that the faculty itself is ecologically literate and relates environmental themes to course material.

My fourth criterion has to do with institutional finances. Does the institution use its buying power to help build sustainable regional economies? What percentage of its food purchases come from nearby farmers?

In studies of food buying at Hendrix College, Oberlin College, Saint Olaf College, and Carleton College, for example, students discovered significant opportunities to increase food quality, decrease costs, and help the local economy. The same approach could be applied throughout all institutional purchases, giving priority to local craftspeople, merchants, and suppliers. Use of institutional buying power to help rebuild local and regional economies is also a prudent hedge against future price shocks associated with higher energy costs coming from supply interruptions, future scarcity, and the eventual imposition of carbon taxes to reduce emission of greenhouse gases.

Colleges and universities also have investment power. To what extent are their funds invested in enterprises that move the world toward sustainability? All institutions should set long-term goals to harmonize their investments with the goal of sustainability, seeking out companies and investment opportunities, doing things that need to be done to move the world in sustainable directions.

Fifth, institutions might be ranked on the basis of what their graduates do in the world. On average, what price will future generations pay for the manner in which graduates of particular institutions now live?

How much do they consume over a lifetime? How much carbon dioxide do they contribute to the atmosphere? How many trees do they plant? How do they earn their keep? How many work through business, law, social work, education, agriculture, communications, research, and so forth to create the basis for a sustainable society? Are they part of the larger ecological enlightenment that must occur as the basis for any kind of sustainable society, or are they part of the rear guard of a vandal economy? Most colleges make serious efforts to discover who among their alumni have attained wealth. I know of no college that has surveyed its graduates to determine their cumulative environmental impacts.

This leads me finally to an observation and a modest suggestion. All educational institutions honor alumni in various ways, including the granting of honorary degrees mostly in direct proportion to wealth, power, fame, and gifts not yet received. None to my knowledge has ever revoked a degree for any cause whatsoever. Perhaps they should. If, for example, it were discovered that a graduate could not read, the embarrassment would be great and the institution's reputation would be greatly and deservedly damaged.

No such shame as yet is attached to graduates who are merely ecologically illiterate and ignorant of how the planet works. There is, I think, only one reasonable course of action, the precedent for which is the practice of recalling defective automobiles at the manufacturer's expense. Likewise, defective minds should be "recalled" and offered an opportunity to return to the institution's tutelage to undergo remedial instruction. Alternatively, the institution that awarded the degree may wish to refund the tuition plus interest charges with its apology. It would, of course, remain liable for the damage done to the earth by the degree holder as a result of an ecologically defective education. In either case the nation, the institution, and the offender would be well served, and all would be greatly edified.

Reference

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About the Author

David W. Orr, Ph.D., is the Paul Sears Distinguished Professor of Environmental Studies and Politics at Oberlin College and author/editor of eight books including *Design on the Edge: the Making of a High Performance Building* (MIT: 2006), *The Last Refuge: Patriotism, Politics, and the Environment* (Island Press: 2004), *The Nature of Design* (Oxford, 2002), and *Earth in Mind* (Island Press: 1994/2004). Orr is best known for his pioneering work on environmental literacy in higher education and his recent work in ecological design.

Chapter 3

Higher Education's Critical Role in Creating a Healthy, Just, and Sustainable Society

Anthony D. Cortese

WHAT IS sustainability and why should we care? The literal definition of sustainability refers to the ability to maintain a positive status or set of conditions over time. In the past two decades, the concept of sustainability has emerged as an aspiration for the direction of society that evolved from the conclusions of the World Commission on Environment and Development (WCED) in its 1987 landmark report titled, *Our Common Future.*[1] Established by the United Nations, WCED examined the worldwide problems of environmental pollution, degradation and destruction and their relationship to hunger, poverty, public health, and social and political structure. Contrary to conventional wisdom, traditional economic development was making all of these problems worse. In contrast, *Our Common Future* called for a new kind of development—sustainable development—defined as development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

The WCED report led to the United Nations Conference on Environment and Development, popularly known as the Earth Summit, in Brazil, in 1992, at which 162 heads of state developed a 21-point action plan—Agenda 21—for human progress in the twenty-first century. Agenda 21 set the international framework for sustainable development and international environmental treaties. It led to the above definition of sustainable development becoming the most commonly accepted meaning of what is now called "sustainability."

The purpose of the international commitment to Agenda 21 was to improve health for current and future humans; build strong, secure, and thriving communities; and provide economic opportunity for all by restoring and preserving the integrity of the life support system—the biosphere. Sustainability is not just about protecting the environment; it is also about finding ways to meet the basic needs of all current and future generations of humans. This can only be done by finding a better way for humans to live within the cradle of life.

The earth and its ecosystems provide all the resources and services that make life possible, including the conversion of our waste products into useful substances. Humans can live about three minutes without breathing, three days without water, and three weeks without food. Food, shelter, fuel, pharmaceuticals, water, and all economic activity derive from the earth's biosphere. For these reasons, sustainability advocates have focused mostly on the environmental dimensions of sustainability. Unless we also simultaneously focus on the health, social, and economic aspects, it is unlikely that we will achieve the desired result—a better life for all current and future generations on a healthy planet that can sustain them.

The Twenty-First Century Challenge

Despite the international agreements that emerged from Earth Summit in 1992, humanity is at a crossroads. For the first time in human history, the size and scale of the human population and its technological and economic prowess have made humanity the pervasive and dominant force in the health and well-being of the earth and all its inhabitants. No part of the earth is unaffected by humans, and the scale of our impact is growing exponentially. For example, the Inuit in Alaska have the highest level of the toxic chemicals polychlorinated biphenyls (PCBs) and DDT in their bodies in the world, despite being 1,000 miles from any industrial activity. Despite all the work we have done on environmental protection, all living systems are in long-term decline and are declining at an increasing rate according to all international scientific, health, and policy organizations. And the challenge that will accelerate all of the negative trends is global warming, which is leading to unprecedented destabilization of the earth's climate.

Human progress has accelerated in the last 10,000 years during a time of a relatively stable climate. Global warming is now destabilizing the earth's climate in ways that threaten to reverse this progress and undermine the survival of millions of people now and in the future. The resulting climate disruption is real and is already affecting us; it is worse and happening faster than predicted by the most conservative scientists. This is happening with 20 percent of the world's population consuming 80 percent of the world's resources. How will we cope in a world that soon will have nine billion people and that will increase its gross world product by 500 percent by 2050? This is an awesome ethical responsibility for us, especially those of us in higher education. We can meet this challenge if we act rapidly and decisively to provide the necessary education and research and make higher education a model for sustainable living.

We need an unprecedented shift in the way we think and act. We currently view health, social, economic, political, security, population, environmental, and other major societal issues as separate, competing, and hierarchical, when they are really systemic and interdependent. For example, we do not have environmental problems, per se. We have negative environmental consequences of the way we have designed our social,

economic, and political systems. We have a *de facto* systems design failure. The twenty-first-century challenges must be addressed in a systemic, integrated, and holistic fashion.

Higher education can play a unique and critical role, one often overlooked, in making this vision a reality. Higher education has been granted tax-free status, the ability to receive public and private funds, and academic freedom in exchange for educating students and producing the knowledge that will result in a thriving and civil society. It prepares most of the professionals who develop, lead, manage, teach, work in, and influence society's institutions, including the most basic foundation of K-12 education. Besides training future teachers, higher education strongly influences the learning framework of K-12 education, which is largely geared toward subsequent higher education. For the first time in U.S. history, 70 percent of children in the K-12 system intend to go to college. Moreover, given the need for a much more highly skilled workforce for this century, lifelong education has become another critical role for higher education.

However, the current educational system is reinforcing the current unhealthy, inequitable, and unsustainable path that society is pursuing. The people who are leading most of society's institutions down this path are graduates of the best colleges, universities, and professional schools in the world. As David Orr has said, the crisis humanity is facing is a "crisis of mind, perception and heart. It is not a problem IN education; it is a problem OF education." This is not intentional; it is a function of a worldview that is no longer suitable to create a world that works for everyone. Higher education, following and enabling this worldview, is generally organized into highly specialized areas of knowledge and traditional disciplines. Designing a sustainable human future requires a paradigm shift toward a systemic perspective emphasizing interdisciplinary understanding, collaboration, and cooperation that must be led by those in higher education.

Leading the Transition to a Sustainable Society

What if higher education were to take a leadership role, as it did in the space race and the war on cancer, in preparing students and providing the information and knowledge to achieve a just and sustainable society? The education of all graduates and professionals would reflect a new approach to learning and practice. A college or university would operate as a fully integrated community that models social and biological sustainability within itself and in its interdependence with the local, regional, and global communities.

In many cases, we think of teaching, research, operations, and relations with local communities as separate activities; they are not. All parts of the university are critical in helping to create transformative change in the individual and collective mind set. Everything that happens at a university and every impact, positive and negative, of university activities shapes the knowledge, skills, and values of the students. Future education must connect head, heart, and hands. The educational experience must reflect an intimate connection between 1) curriculum; 2) research; 3) understanding and reduc-

ing any negative ecological and social footprint of the institution; and (4) working to improve local and regional communities so that they are healthier, more socially vibrant and stable, economically secure, and environmentally sustainable.

Imagine that in the twenty-first century, the educational experience of all students were aligned with the principles of sustainability:

- The content of learning would reflect interdisciplinary systems thinking, dynamics, and analysis for all majors, disciplines, and professional degrees. Education would have the same rigor across disciplines as it has within disciplines.
- The context of learning would change to make human–environment interdependence, values, and ethics a seamless and central part of the teaching of all the disciplines, rather than isolated as a special course or module in programs for specialists. All students would understand that we are an integral part of nature. They would understand that the ecological services that are provided by the natural world are critical for human existence. They would also know how to make largely invisible health, social, economic, and environmental impacts visible. For example, most people do not know where products we use originate or are made or the impacts that occur in their production and use. For instance, it takes several thousand pounds of fossil fuels, metallic ore, and chemicals to produce a laptop computer. The energy, resource use, pollution, and waste of the manufacturing process are invisible to the final consumer, especially since most of the impacts occur hundreds or thousands of miles away. Students would then learn how to eliminate negative impacts of societal activities and make the outcome of these activities largely positive.
- The process of education would emphasize active, experiential, inquiry-based learning, and real-world problem solving on the campus and in the larger community.
- Higher education would practice sustainability. Institutions of higher learning would practice what they preach and make sustainability an integral part of operations, planning, facility design, purchasing, and investments, and tie these efforts to the formal curriculum. The university is a microcosm of the larger community. Therefore, the way it carries out its daily activities is an important demonstration of ways to achieve environmentally responsible living and to reinforce desired values and behaviors in the whole community. These activities provide unparalleled opportunities for teaching, research, and learning.
- Higher education would form partnerships with local and regional communities to help make them healthy, socially vibrant, economically secure, and environmentally sustainable as an integral part of higher education's mission and the student experience. Higher education institutions are anchor institutions for economic development in most of their communities, especially now that the private sector moves facilities, capital, and jobs frequently as mergers, acquisitions, and globalization become the norm for corporations. The 4,000 higher education institutions in

the United States are, themselves, large economic engines with annual operational budgets that totaled $320 billion in 2005. This is about 2.8 percent of the gross domestic product (GNP) and greater than the GNP of all but twenty-five countries in the world.

Can Higher Education Meet This Challenge?

At issue is not the ability of higher education to take on the sustainability challenge, but rather the will and the time frame for doing so. Most of the world's major governmental, scientific, and nongovernmental institutions, as well as many business organizations, agree that the changes needed in individual and collective values and action must occur within the next decade. If higher education does not lead the sustainability effort in society, who will?

There has been exponential growth in distinct programs related to the environmental dimension of sustainability in higher education in the last decade. Exciting environmental studies and graduate programs in every major scientific, engineering, business, law, public health, ethics, and religious discipline are abundant and growing. Progress on modeling sustainability has grown at an even faster rate, especially in the last five years. Higher education has embraced programs for energy and water conservation, renewable energy, waste minimization and recycling, green buildings and purchasing, alternative transportation, local and organic food growing, and purchasing at a rate of increase unmatched by any other sector.

As one example, higher education is the largest user of wind power for electricity in the United States. The student environmental movement is the most well organized, largest and most sophisticated student movement since the antiwar movement of the 1960s. These efforts have largely been distinct programs that are helping to begin the cultural shift to making deep and comprehensive sustainability the goal of higher education. Despite these efforts, the overwhelming majority of graduates know little about the importance of sustainability or how to lead their personal and professional lives aligned with sustainability principles. As institutions, most colleges and universities still view sustainability as an option that they will pursue if they can afford it.

Recently, there have been some large and encouraging shifts in higher education that have led my colleagues and me to believe that we may be approaching a tipping point in the near future.

The American College & University Presidents Climate Commitment

In just the last year, more than 450 college and university presidents from institutions in forty-five states and representing 2.4 million students have committed to comprehensively addressing global warming in a unique way—the American College & University Presidents Climate Commitment (ACUPCC). These presidents are individu-

ally and jointly committing to reducing and eventually neutralizing greenhouse gas emissions, as well as providing the education and research for all of society to do the same. They are also committing to publicly report on their progress. Visit www.presidentsclimatecommitment.org for more information about this commitment. This is the first major U.S sector commitment to climate neutrality. It also represents the elevation of sustainability to a strategic rather than just a programmatic issue for higher education.

The Association for the Advancement of Sustainability in Higher Education

In January 2006, a number of higher education and sustainability leaders launched the Association for the Advancement of Sustainability in Higher Education (AASHE), a professional association committed to rapidly advance sustainability through collaboration, information sharing, and professional development. It has grown from thirty-five dues-paying colleges and universities to over 360 and has become the go-to organization for faculty, students, administrators, and staff on all aspects of sustainability in higher education. The October 2006 conference at Arizona State University attracted 700 participants from nearly 200 colleges and universities. The results are stunningly good. On the AASHE website site (www.aashe.org), the most content-rich website on sustainability in higher education, you can see many examples of progress by higher education in the area of sustainability.

Higher Education Associations Sustainability Consortium

Another development in the movement toward systemic embracing of sustainability in higher education occurred in May 2006, with the launch of the Higher Education Associations Sustainability Consortium (HEASC)—visit www.heasc.net. HEASC is a consortium of twelve of the most important mainstream higher education professional associations (members are presidents, business officers, purchasing agents, facilities, planning, student life, and other operations personnel) that are building a learning community among themselves to advance sustainability within their constituencies and the system of higher education itself. This effort will help mainstream sustainability by making it a central focus of the professional development, conferences, communications, publications, and operations of these associations.

Making the Commitment

Broad transformative change and leadership in higher education has large implications for all college and university leaders. Taking the educational experience from a theoretical to a practical level will have an impact on the way institutions interact with external communities. This shift will certainly affect the leaders who are necessarily the most interdisciplinary and long-range thinkers and connected to the decision-making structure of higher education.

Making sustainability the lens through which colleges and universities view all of their actions will have major lasting benefits:

- Improve learning for all—inside and outside higher education
- Prepare students for citizenship and careers
- Meet increasing student desires for sustainable living
- Increase external respect from alumni, businesses, and communities
- Attract students, faculty, and funding
- Reduce economic, social, and environmental costs
- Promote cooperation and satisfaction across the university
- Fulfill moral and social responsibilities

Finding a way for nine billion people to live in harmony with each other and the natural world of which we are a part is the defining challenge of this century, and higher education must lead the effort to address this challenge. It is impossible to be a leader in higher education without thinking a great deal about the future—and not just when its time to deliver commencement addresses. Today's students and their children will experience the worst effects of climate disruption if we continue business as usual. We are faced with the greatest intergenerational equity challenge in human history. It is now clear that thinking about tomorrow means taking action now on climate change as well as on other critical global issues to create a healthy, just, and sustainable world.

What will future generations say about higher education if there is runaway climate change and those with the expertise and the mandate to create a thriving society did not do everything they could to help society recognize the risks and find solutions to the challenge? Higher education could lose its lofty perch in society, which would be a tragedy for humanity. As a society we have risen to huge challenges—Nazism, fascism, the space race, and attempts to eradicate cancer. I believe we are up to this even larger challenge and that higher education can and will lead it, because it is in our own collective interest.

Reference

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About the Author

Anthony Cortese, Ph.D., is the principal founder and president of Second Nature, a nonprofit organization with a mission to develop the national capacity to make healthy, just, and sustainable action a foundation of all learning and practice in higher education. He is co-founder and co-coordinator of the Higher

Education Associations Sustainability Consortium, a co-founder of the Association for the Advancement of Sustainability in Higher Education, and a co-organizer of the American College & University Presidents Climate Commitment. Prior to his work with Second Nature, Cortese was the commissioner of the Massachusetts Department of Environmental Protection and the first dean of environmental programs at Tufts University and spearheaded the internationally acclaimed Talloires Declaration of University Leaders for a Sustainable Future.

Chapter 4

Will Sustainability Take Root?

Karla Hignite

DO YOU know sustainability when you see it? The results of an institution's commitment to environmental, social, and economic health are often subtle. They aren't always evident, and they can be measured by what you don't find.

While every isolated action is important—from paving bike lanes to perking fair trade coffee to paying workers a living wage—the core value of sustainability transcends individual efforts. Campus advocates and practitioners who have been planting sustainability ideals for years declare that absent a strong network of support nurtured across disciplines, departments, and stakeholder groups, the probability that any initiative will reach full height is hampered. A holistic focus is needed to capitalize on curriculum changes and operational investments tilted toward a sustainable future. And that is what appears to be happening: more institutions are embracing systemic sustainability, pairing theory and practice and involving students in key problem-solving and decision-making roles.

Why Now?

College and university sustainability projects have been around for years. The more recent push to connect academic and operational initiatives and reposition sustainability at the campus core is gaining ground in part because related issues have entered mainstream public debate. "There is growing awareness concerning how various social, economic, and ecological issues interrelate," says Judy Walton, of the Association for the Advancement of Sustainability in Higher Education (AASHE).

In one example, serious concerns about energy supplies and costs in the midst of unstable economies, devastating natural disasters, and burgeoning development of population giants such as China and India have heightened discourse about a shared future on this planet. Combined, the 4,100 higher education institutions in the United

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States also represent a vast economic engine with a definite capability to leverage spending and consumption patterns in positive ways, says Anthony Cortese, president of Second Nature and AASHE cofounder. The question is: does higher education have the will to be a key player in teaching and modeling sustainability? In the face of escalating operational costs alone, can it choose *not* to?

For Cortese, the problem drills much deeper. He argues that, at a macro level, higher education has made far more progress in modeling sustainability than it has in teaching about sustainability. "A sustainability focus requires that we as a society focus simultaneously on systemic solutions for building healthy, economically strong, and secure thriving communities." And yet, we still tend to view health, economic, political, security, environmental, population, and other major social issues as separate, competing, and hierarchical, says Cortese. Likewise, higher education itself is generally organized into specialized areas of knowledge and traditional disciplines, emphasizing individual learning and competition and producing graduates ill prepared for cooperative efforts.

"Because they prepare most of the professionals who develop, lead, manage, teach, and work in, and otherwise influence society's institutions, higher education institutions bear a profound moral responsibility to increase the awareness, knowledge, skills, and values needed to create a just and sustainable future," argues Cortese. Understanding how to create a just and sustainable society must become a fundamental principle taught throughout all education levels and disciplines. "Sustainability is not one more issue that higher education must deal with—like computer literacy. It really is central to an institution's mission and function."

The number of alliances and coalitions that have formed in recent years to support sustainability show that it is gaining attention if not acceptance as an organizing value for setting mission. At the least, says AASHE's Julian Dautremont-Smith, "society in general and local communities in particular are increasing expectations for higher education to respond to global challenges in sustainable ways." While early campus efforts represented more of a scattershot approach, Dautremont-Smith is excited about a recent convergence of four key areas in which he believes institutions can make a substantial impact: energy, facilities, food, and curriculum.

Hold the Carbon

Skyrocketing campus energy costs are encouraging more institutions to revisit long-term heating, cooling, and lighting options. More attractive than ever: conservation and alternative energy strategies.

Berea College, located in a southern Appalachian Kentucky community of 12,000, serves 1,500 undergraduates. Through its campus-wide energy master plan, Berea is in

the early stages of a multiyear project to redesign its energy system and slash consumption by 45 percent by 2015, says Diane Kerby, vice president for business and administration and past APPA President. In addition to building retrofits, Berea is transitioning from a 65-year-old coal-fired heat plant to natural gas. The roughly five miles of buried insulated pipe will bear only a 3 or 4 percent loss of energy compared to a 30 percent loss from the current central coal plant and will require about half the space, says President Larry Shinn. Geothermal technology represents another piece of Berea's new energy plan. Entertaining this option meant the college had to slow its renovation process and hire an engineering firm to learn about geothermal requirements and benefits.

Today five of Berea's seventy buildings are heated this way. "The entire process has entailed stepping back to figure out how to take a late nineteenth-century campus with $140 million in deferred maintenance in 1995 and turn it into something with a smaller environmental and financial footprint," says Shinn. "It's been a somewhat slow, building-by-building approach, but the outcome will be measured not only in cumulative energy savings but in knowledge gained. Along the way we are educating architects, contractors, our staff, and community members, whom we've invited to be part of our process."

Shinn argues that the greatest cost of ecological design is when you do little. "Cutting energy use of a single building by 15 percent is a good start, but if you can make bold steps to cut campus-wide energy use by 40 or 50 percent, that will certainly cost more upfront but will save much more and more quickly." Leaders must base investments on fact, including costs of not implementing energy efficiency and renewable energy. Institutions that don't begin to pay attention to the need to conserve energy and water will pay mightily in the not-too-distant future when greater percentages of operating budgets are required for utilities, says Shinn. "We all need to calculate what we will spend in ten years if we don't do anything now."

Walter Simpson couldn't agree more. As energy officer for the State University of New York at Buffalo (UB), he believes that a key thrust of any campus greening effort must be energy conservation. "Simply put, energy reflects the single largest environmental impact of a campus—and the biggest potential payback," says Simpson. "You can do many things, but if you aren't serious about conservation, you are simply missing the boat."

In the world of energy conservation, Simpson is marathoner. He has been catalyzing UB's energy efficiency efforts since 1982 when he pitched the idea for his job to university administration by promising to pay his own salary from reduced energy costs. Since then, the combination of conservation efforts employed by Simpson and UB's facilities staff has paid off handsomely, resulting in an estimated annual savings of over $10 million. Even so, says Simpson, "UB's energy team is still scratching the surface."

"On a campus as big as UB—with 27,000 students and 10 million square feet of buildings—severe energy price fluctuations can spell the difference between a $20 million and a $30 million energy bill during a single year," states Simpson. The big culprit: continued reliance on fossil fuels. "In addition to implementing dramatic conservation measures, making any real dent in energy cost savings requires a radical departure from current consumption practices. From an energy perspective, you aren't really talking about sustainability until you can cut fossil fuel use by 60 or 70 percent or more." So far, UB has achieved about a 30 percent reduction—nowhere near where it needs to be, Simpson notes.

Until recently, the university was New York's largest purchaser of wind-generated electricity. "We've taken small steps in the right direction for renewable energy, but when you look at total consumption, renewable still represents less than 6 percent of our electricity requirements," he points out. In recent semesters, Simpson has rallied the involvement of senior engineering students to analyze renewable energy options on campus.

"I could take you building by building and give you two tours of this campus. On the one hand I could point out some impressive conservation measures we've taken, but in the same breath note dramatic inefficiencies that still exist. In reality, this campus is still a giant waste machine. There is so much more we could be doing."

Simpson says that what he most needs is a big boost from the top. "To really start making the transition to energy sustainability, we need active involvement by campus leaders. This should be a campus priority."

Certified Sustainability

"A second component pushing campus sustainability forward is the establishment of accepted criteria," says AASHE's Dautremont-Smith.

While many institutions are developing critical internal benchmarks for measuring progress toward specific goals, national standards offered by external industry groups have done much to raise awareness about available and proven technologies and applications. Probably no other group is more recognized in campus sustainability circles than the U.S. Green Building Council for its levels of Leadership in Energy and Environmental Design (LEED) certification for both new construction and existing facilities. "Not only do national criteria help shape the debate around credible assessment tools, they also provide the basis for healthy peer pressure and public recognition," says Dautremont-Smith.

Look no further than the University of Florida (UF) for well-earned kudos. UF is sending a strong sustainability message with its certification achievements. Rinker Hall, a learning laboratory for architecture and building construction students, models the

design and efficiency standards that students are being taught. (For detailed information on Ricker Hall, visit www.bcn.ufl.edu/rinkerhall/rinker.htm.)

The new LEED gold facility is the second LEED-certified building on the Gainesville campus, where another fourteen buildings are registered as LEED projects, says Kim Tanzer, UF School of Architecture professor and faculty senate chair.

Beyond its built environment, UF has received a prestigious certification from the Audubon Cooperative Sanctuary Program.

"When the suggestion was made to seek sanctuary status for the university's golf course, UF's associate vice president of finance and administration spearheaded a proposal to apply the standards across the entire campus," says Tanzer. The designation recognizes a high level of environmental stewardship in wildlife habitat management, resource conservation, and outreach associated with the 2,000 contiguous acres of the Gainesville campus, which includes twenty-three conservation areas, some off limits to human traffic.

What's for Dinner?

A third area of increased campus sustainability focus is within food services. Specifically, local food initiatives are carving a place at more institutions.

Middlebury College has been setting its table with local produce and dairy for decades. One-third of its dining budget is shared among thirty-five suppliers in Vermont, says Nan Jenks-Jay, director of environmental affairs and planning. In an age of mass transport and wide food distribution networks, she says, that takes more effort than many may think.

One tangible benefit for students is fresher food, but the bigger payoff extends beyond campus boundaries. "Support of local and regional production and labor sources strengthens local economies and bolsters community relations," says Berea's Kerby. Berea recently formed a steering committee of students, faculty, and staff to develop a local food initiative through which the college will become a patron and a producer, growing some of its food on existing farms located on campus. The proposal will also formalize the college's commitment to buy locally produced food and make evident the institution's economic link to its community, says Kerby. "Establishing guidelines for purchasing targets will entail working closely with local producers to determine their capability and may require helping local farmers get organized, perhaps by forming cooperatives, so they can meet Berea's increased needs."

According to Cortese, sustainability blossoms in such instances when colleges and universities start to understand their mutual interdependence with their local and re-

gional communities. And understanding occurs to the extent that institutions view themselves as part of their communities and not merely in them.

Changing Coursework

No discussion of what campuses are doing to promote sustainability would be complete without considering what they teach. While decades-long environmental studies programs have produced wonderfully trained specialists, the harder part—and arguably the greater need—is to infuse the full curriculum with a sustainability focus, says Cortese. Among the institutions to comprehensively tackle this challenge is the Georgia Institute of Technology, where the process has proven intensive and long term.

Berea has been sustainability-minded since its founding, with a long-standing commitment to educating students of limited economic means and a strong focus on interracial education and service-learning opportunities. More recently, concerted efforts toward ecological proficiency are being centralized, with a multidisciplinary sustainability and environmental studies program. And students aren't only learning about sustainability in the classroom. Ecovillage is the college's newest residential component for married and single parent students who, along with their children, experiment with environmentally responsible living through everyday practice. Vegetable gardens, fruit trees, a greenhouse, and a wetland are accompanied by technologies that help residents dramatically reduce energy and water use by up to 75 percent.

That kind of modeling and experimentation are vital for sustainability as a core value to take root, believes Cortese. "Ultimately the entire educational experience of students is a function of not only what they are taught, but how they are taught and the way in which an institution conducts research, manages operations, designs facilities, purchases materials, invests resources, and interacts with local communities," he says. "In many cases, we think of these as separate activities. They are not. All parts of the university are critical in creating transformative change in the individual and collective mindsets."

If sustainability makes such good sense, why aren't more institutions heading down this path? Why aren't some further along? One major impediment to a full-scale sustainability focus is denial of the real-world challenges we all face, says Shinn. "College campuses are good at this. Not all scientists agree, therefore we don't think we should move forward. The very diversity of opinions on campus can create a certain skepticism about taking any action."

Half Full

Despite its unrealized potential, sustainability is gaining ground to an extent that should dissuade glass half-empty thinking. The promise that a sustainability focus can permeate a campus-wide agenda certainly seems feasible. But most veterans caution that cultivating a sustainability mindset still requires getting down in the weeds.

For Simpson, putting a commitment in ink can encourage desired actions and attitudes. "More institutions are developing socially and environmentally responsible purchasing policies and spelling out specific benchmarks for everything from tons of waste recycled and kilowatt hours saved to zero sweatshop-produced products sold in the bookstore. Not having written policies and standards can be a real impediment," says Simpson.

One achievable goal in his mind would be shifting the entire UB campus to 100 percent postconsumer content-recycled copying paper. "Currently about 40 percent of the campus has converted. Getting the remaining 60 percent on board would be much easier with a campus policy," he says. "We can do only so much by knocking on doors to make a plea for voluntary transition. We need campus leaders to step up and require this environmentally superior paper."

Good policies are one thing. Implementing those policies is another matter. UB has energy-conserving temperature polices, but compliance is a challenge, Simpson admits. "We do our best, knowing that each degree of overheating is costing us more than $300,000 a year." Deep cuts in energy use and kicking the fossil fuel habit will be possible only when everyone sees the urgency of addressing problems such as climate change and is ready to make sacrifices for the sake of achieving genuine sustainability, says Simpson.

The invisible nature of daily consumption is another impediment, notes Cortese. "We simply don't see the waste stream associated with the manufacture of goods and products or their disposal. Making that waste expressly visible should be a key strategy for institutions in teaching sustainability," he says.

Likewise, cost-cutting decisions should be considered in light of potential impacts to other program areas, says Simpson. His goal of moving UB from 35 percent recycling of solid waste to 50 percent or better should get a boost with improvements in construction debris recycling. His bigger concern now is what appears to be a setback in office paper recycling. UB's incremental transition from fully benefited state cleaners to contract cleaning crews who were paid low wages and no benefits resulted in high worker turnover and a sloppy job of keeping recyclables out of the waste stream, he notes. "Understandably, when university employees start to believe that their efforts to separate materials are a waste of their time, they lose interest in recycling, and the program begins to unravel." As Simpson asserts, this is also a living wage issue that shows how sustainability has a justice component. Fortunately, UB is transitioning back to fully benefited, better paid state cleaners. Simpson expects to see recycling program improvements as a result.

Externally, the ways in which institutions are evaluated present a significant obstacle, Tanzer believes. "In addition to assessing institutions on student-teacher ratios and

their volumes of library holdings, what if institutions were also accountable for their energy consumption?" On the positive side, commitments to diversity and access do give sustainability a foothold in the larger debate, she notes. "If institutions would begin measuring the criteria by which students choose the institution—including decisions based on an institution's sustainability focus and programming—perhaps national rankings would some day include these aspects in their priority mix."

As Cortese suggests, one way to expedite that kind of influence on accreditation standards would be to seek a strong voice among employers in business and industry asking for graduates with the kind of knowledge, skills, and values needed to move society toward a sustainable future.

"Influencing a significant shift in the priorities of external funding sources is another key challenge," says Debra Rowe, professor of renewable energies and energy management at Oakland Community College, Bloomfield Hills, Michigan, and senior fellow of University Leaders for a Sustainable Future. "Many foundations that fund sustainable production in nonindustrialized countries—such as fair trade coffee or sustainably harvested wood—don't yet recognize that sustainability initiatives within higher education in the United States are necessary to create healthy demand for these sustainable products."

You Are What You Fund

Internally, how to pay for sustainability initiatives requires creativity. Rowe believes bonds offer one great way to fund a package of sustainability projects. "While an individual project may not have a return on investment that would meet that of a bond, the combination of projects that focus on both the social and environmental components of sustainability can meet that return on investment and allow a much greater number of projects to be implemented."

Budget incentives also don't hurt. The promise of payback can set significant savings in motion that pay for other initiatives and programs, says Tanzer. With approximately 75,000 people on its Gainesville campus each day, UF is a city unto itself. "Specific steps we take to reduce energy consumption can have a big impact on institutional savings." The university has the ability to measure energy use within each building and is working on an incentive program to reward departments and units that reduce consumption by giving half the savings back for them to use as they wish.

Jenks-Jay believes institutional funding should be used to encourage further innovation. "Funding to explore and experiment with campus sustainability can not only result in savings back to the institution but can also reinforce the very purpose of higher education." In 1999, Middlebury initiated an environmental grants program with a mere $1,000. "After seeing the results of first-year projects, the president was so

impressed that he offered $10,000 from his discretionary fund to support the next grant cycle," says Jenks-Jay. Since its inception, the program has awarded $69,000 to fund fifty-six projects, and the college is now working to permanently endow the program.

"Grants are available to anyone on campus, but to reinforce the collaborative spirit of sustainability, proposals that include involvement by more than one group—such as students and faculty or students and staff—are more highly ranked," says Jenks-Jay. "Many of the grants have served as the catalyst to lead to permanent systemic changes on campus." For instance, one grant made it possible to offset the initial higher costs of using a 100 percent recycled, no-bleach paper stock for the college magazine. In making the switch, the college is planning to partner with other institutions in a bulk purchase agreement to bring down overall expenses on a permanent basis. Beyond inspiring innovation and creating collaborations among staff, faculty, and students, she believes the grants program models the foundation required for larger societal sustainability by breaking down barriers, encouraging trust in partner relationships, and building an ethic of joint problem solving.

That kind of close-knit collaboration presents a bigger challenge for an institution the size of UF, but the university's sustainability committee is striving to bring together the hundreds of faculty members working in some aspect of sustainability. For starters, the committee is developing a dedicated Web section for faculty research to capture their projects and to encourage at least virtual interactivity, says Tanzer.

"In building interactions, it's important to cast a wide net when identifying campus sustainability," says Cortese. "Those who work to improve public health may not think that what they do relates to sustainability. But the health of individuals is an essential component of a sustainable society."

Germination

Ultimately, the benefits of sustainability are lost if not communicated—externally, internally, and at all levels, says Cortese. He believes one indicator of whether an institution is moving toward a sustainable future is what it is doing to promote its initiatives in every manner possible.

Ironically, while colleges and universities are a hotbed of learning and innovation, they often miss key opportunities to educate, says Cortese. "I have toured six new LEED silver buildings on campuses in the past six months and only one had information about its sustainable design and what that means for the community." Finding ways to celebrate and communicate everything being done by anyone—administrators, business and operations staff, faculty, and students—is critical for shifting a campus community in favor of sustainability.

According to Cortese, the following questions identify other essential opportunities for the germination of sustainable thinking and practice on campus:

- Is sustainability recognized as a core goal of education and practice by the president, trustees, and senior academic and administration officers?
- Is it incorporated into the mission and vision of the institution?
- Are academic and operational policies in place and relations established with the local community to help move in this direction?
- Are specific rewards and incentives in place for faculty and staff that make sustainability an obvious goal?
- Have indicators been established and measurement processes put in place to benchmark progress?
- Does the institution have a comprehensive communication plan that not only celebrates what it is doing but also connects those activities with the social and economic health of its larger community?

Even after an institution has embraced and internalized the concepts of sustainability, it still must commit to ongoing internal education, says Shinn. "We will always have an influx of new faculty, staff, and students each semester. In trying to make sustainability part of the air we breathe, we must continue to entertain the broad philosophical question about humans in relationship to their natural and fabricated environment."

From a practical standpoint, engaging that philosophical debate is more easily accomplished if sustainability efforts are centralized. A Berea graduate, Tammy Clemons serves as sustainability coordinator for her alma mater. "Part of my job is simply making sure that the campus community has access to information about green purchasing practices and recycling," says Clemons. Currently she is compiling best practices so that others are aware of what they can do without reinventing the wheel. Assessment efforts include monitoring performance metrics for a range of activities and twenty-four progress indicators established by Berea's campus environmental policy committee. The college also tracks students' awareness of and their commitment to environmental issues from the time they enter as freshmen to when they graduate.

Education, another component of Clemons's role, may be as straightforward as explaining how a product is offered on campus. Recent energy efficiency measures such as turning off display lights on vending machines required signage to let people know that the machines were operable. "Part of teaching sustainability is modeling behavior," says Clemons. "It's important to show that you don't have to suffer to be sustainable but can still operate in ways that contribute to personal comfort and convenience without harming other people, cultures, or the environment." To the extent that insti-

tutions model these behaviors, Clemons believes municipalities will take note of the possibilities and potential for sustainable living.

Other venues for bringing campus-wide sustainability front and center include formal governance structures. Middlebury College's environmental council is a standing committee of appointed faculty, staff, and students that recommends policy, educates the campus community, and advises the president about projects and their progress. Jenks-Jay believes that the prominence given to serving on the council and to her own role speaks volumes about the institution's commitment to placing sustainability at its core. She was recently involved in the search for a new vice president for facilities and is serving on the committee to name a new architectural firm responsible for campus design under a new master plan. A newly revised college mission statement clearly identifies a commitment to environmental stewardship in both curriculum and campus practices, says Jenks-Jay. "Sustainability isn't an add-on here, but is central to the decision-making infrastructure of the institution."

Beneath the Surface

As higher education co-chair for the U.S. Partnership for the Decade of Education for Sustainable Development, Rowe has seen a national trend toward sustainability in both the higher education and the corporate sectors. And for those that haven't yet found their sustainability footing? "My experience is that many colleges and universities can already find a sustainability focus somewhere within their mission," says Rowe. "At its core, sustainability is about educating students and the larger community about the challenges our society faces and providing them with the skills and knowledge to engage in solutions."

Seeds worth planting.

About the Author

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Chapter 5

The 800-Pound Gorilla: The Threat and Taming of Global Climate Change

Jim Hansen

ANIMALS ARE on the run. Plants are migrating too. The Earth's creatures, save for one species, do not have thermostats in their living rooms that they can adjust for an optimum environment. Animals and plants are adapted to specific climate zones, and they can survive only when they are in those zones. Indeed, scientists often define climate zones by the vegetation and animal life that they support. Gardeners and bird watchers are well aware of this, and their handbooks contain maps of the zones in which a tree or flower can survive and the range of each bird species.

Those maps will have to be redrawn. Most people, mainly aware of larger day-to-day fluctuations in the weather, barely notice that climate, the average weather, is changing. In the 1980s, I started to use colored dice that I hoped would help people understand global warming at an early stage. Of the six sides of the dice only two sides were red, or hot, representing the probability of having an unusually warm season during the years between 1951 and 1980. By the first decade of the twenty-first century, four sides were red. Just such an increase in the frequency of unusually warm seasons, in fact, has occurred. But most people—who have other things on their minds and can use thermostats—have taken little notice.

Animals have no choice, since their survival is at stake. Recently after appearing on television to discuss climate change, I received an e-mail from a man in northeast Arkansas: "I enjoyed your report on *Sixty Minutes* and commend your strength. I would like to tell you of an observation I have made. It is the armadillo. I had not seen one of these animals my entire life, until the last ten years. I drive the same forty-mile trip on the same road every day and have slowly watched these critters advance further north every year and they are not stopping. Every year they move several miles."

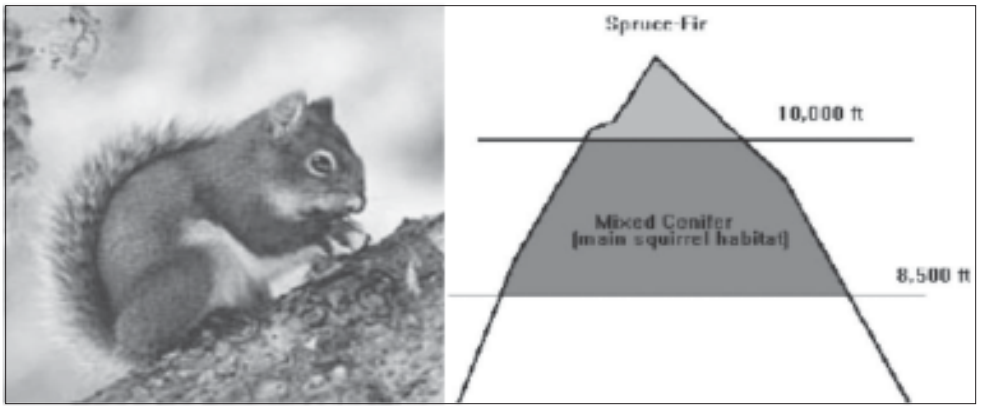
This chapter is adapted from Jim Hansen's *Threat to the Planet*, which originally appeared in the July 13, 2006, *New York Review of Books*.

Armadillos appear to be pretty tough. Their mobility suggests that they have a good chance to keep up with the movement of their climate zone and to be one of the surviving species. Of course, as they reach the city limits of St. Louis and Chicago, they may not be welcome. And their ingenuity may be taxed as they seek ways to ford rivers and multiple-lane highways.

Problems are greater for other species. Ecosystems are based on interdependencies—between, for example, flower and pollinator, hunter and hunted, grazers and plant life—so the less mobile species have an impact on the survival of others. Of course climate fluctuated in the past, yet species adapted and flourished. But now the rate of climate change driven by human activity is reaching a level that dwarfs natural rates of change. And barriers created by human beings, such as urban sprawl and homogeneous agricultural fields, block many migration routes. If climate change is too great, natural barriers, such as coastlines, spell doom for some species.

Studies of more than 1,000 species of plants, animals, and insects, including butterfly ranges charted by members of the public, found an average migration rate toward the North and South Poles of about four miles per decade in the second half of the twentieth century. That is not fast enough. During the past thirty years the lines marking the regions in which a given average temperature prevails ("isotherms") have been moving poleward at a rate of about thirty-five miles per decade. That is the size of a county in Iowa. Each decade the range of a given species is moving one row of counties northward.

As long as the total movement of isotherms toward the poles is much smaller than the size of the habitat or the ranges in which the animals live, the effect on species is limited. But now the movement is inexorably toward the poles and totals more than



Mountain Graham Red Squirrel survives on a single mountain in Arizona, one of dozens of 'islands in the sky', green regions surrounded by desert. Green islands and squirrels are pushed higher as temperature rises and will be pushed off the planet if global warming continues. Source: PHOTOSMITH, 2004, Claire Zugmeyer and Bruce Walsh, University of Arizona.

An Unrecognizable World? Likely Consequences of Climate Change

- Higher temperatures, more frequent heat waves
- Greater warming at high northern latitudes
- Loss of Arctic summer ice cover and melting of permafrost, possibly releasing methane and accelerating warming
- Melting of ice sheets, ice shelves, and glaciers, raising sea levels and inundating coastal areas worldwide
- Intensification of the hydrologic cycle, that is, stronger heat waves, droughts and fires, but also heavier downpours and flooding
- Decreased fresh water supplies, especially in subtropical regions and large areas dependent on runoff from mountain glaciers
- More powerful storms driven by latent heat, including hurricanes and thunderstorms, and thus increased storm damage
- Migration of tropical diseases and pests toward the poles
- Shifting of ecological niches poleward, threatening massive species extinction
- Disruption of agriculture and increased risk of famine
- Exacerbation of eco-refugee problem as millions abandons their homes in search of survival
- Increasing political strife and risk of war

a hundred miles over the past several decades. If emissions of greenhouse gases continue to increase at the current rate—"business as usual"—then the rate of isotherm movement will double in this century to at least seventy miles per decade. If we continue on this path, a large fraction of the species on Earth, as many as 50 percent or more, may become extinct.

The species most at risk are those in polar climates and the biologically diverse slopes of alpine regions. Polar animals, in effect, will be pushed off the planet. Alpine species will be pushed toward higher altitudes and toward smaller, rockier areas with thinner air; thus, in effect, they will also be pushed off the planet. A few such species, such as polar bears, no doubt will be "rescued" by human beings, but survival in zoos or managed animal reserves will be small consolation to bears or nature lovers.

In the Earth's history, during periods when average global temperatures increased by as much as ten degrees Fahrenheit, there have been several "mass extinctions," when between 50 and 90 percent of the species on Earth disappeared forever. In each case, life survived and new species developed over hundreds of thousands of years. The most recent of these mass extinctions defines the boundary, fifty-five million years ago, between the Paleocene and Eocene epochs. The evolutionary turmoil associated with that climate change gave rise to a host of modern mammals, from rodents to primates, which appear in fossil records for the first time in the early Eocene.

If human beings follow a business-as-usual course, continuing to exploit fossil fuel resources without reducing carbon emissions or capturing and sequestering them before they warm the atmosphere, the eventual effects on climate and life may be comparable to those at the time of mass extinctions. Life will survive, but it will do so on a transformed planet. For all foreseeable human generations, it will be a far more desolate world than the one in which civilization developed and flourished during the past several thousand years.

Melting Ice and Higher Sea Levels

The greatest threat of climate change for human beings lies in the potential destabilization of the massive ice sheets in Greenland and Antarctica. As with the extinction of species, the disintegration of ice sheets is irreversible for practical purposes. Our children, grandchildren, and many more generations will bear the consequences of choices that we make in the next few years.

The level of the sea throughout the globe is a reflection primarily of changes in the volume of ice sheets and thus of changes of global temperature. When the planet cools, ice sheets grow on continents and the sea level falls. Conversely, when the Earth warms, ice melts and the sea level rises.

Ice sheets waxed and waned as the Earth cooled and warmed over the past 500,000 years. During the coldest ice ages, the Earth's average temperature was about ten degrees Fahrenheit colder than today. So much water was locked in the largest ice sheet, more than a mile thick and covering most of Canada and the northern parts of the United States, that the sea level was 400 feet lower than today. The warmest interglacial periods were about two degrees Fahrenheit warmer than today, and the sea level was as much as 16 feet higher.

Future rise in the sea level will depend, dramatically, on the increase in greenhouse gases, which will largely determine the amount of global warming. Sunlight enters the atmosphere and warms the Earth, and then is sent back into space as heat radiation. Greenhouse gases trap this heat in the atmosphere and thereby warm the Earth's surface as we are warmed when blankets are piled on our bed. Carbon dioxide (CO_2), produced mainly by burning fossil fuels (coal, oil, and gas), is the most important greenhouse gas made by human beings. Methane (CH_4), which is "natural gas" that escapes to the atmosphere from coal mines, oil wells, rice paddies, landfills, and animal feedlots, is also an important greenhouse gas. Other significant warming agents are ground-level ozone and black soot, which arise mainly from incomplete combustion of fossil fuels and biofuels.

In order to arrive at an effective policy we can project two different scenarios concerning climate change. In the business-as-usual scenario, annual emissions of CO_2 con-

Jakobshaven Ice Stream in Greenland. Discharge from major Greenland ice streams is accelerating markedly. Source: Professor Konrad Steffen, University of Colorado.

tinue to increase at the current rate for at least fifty years, as do non-CO_2 warming agents including methane, ozone, and black soot. In the alternative scenario, CO_2 emissions level off this decade, slowly decline for a few decades, and by mid-century decrease rapidly, aided by new technologies.

The business-as-usual scenario yields an increase of about five degrees Fahrenheit of global warming during this century, while the alternative scenario yields an increase of less than two degrees Fahrenheit during the same period. Warming can be predicted accurately based on knowledge of how Earth responded to similar levels of greenhouse gases in the past. (By drilling into glaciers to analyze air bubbles trapped under layers of snow, scientists can measure the levels of each gas in the atmosphere hundreds of thousands of years ago. By comparing the concentrations of different isotopes of oxygen in these air bubbles, they can measure the average temperature of past centuries.) Climate models by themselves yield similar answers. However, the evidence from the Earth's history provides a more precise and sensitive measure, and we know that the real world accurately included the effects of all feedback processes, such as changes of clouds and water vapor, that have an effect on temperature.

How much will sea level rise with five degrees of global warming? Here too, our best information comes from the Earth's history. The last time that the Earth was five degrees warmer was three million years ago, when sea level was about 80 feet higher.

Eighty feet! In that case, the United States would lose most East Coast cities: Boston, New York, Philadelphia, Washington, and Miami; indeed, practically the entire state of Florida would be under water. Fifty million people in the United States live below that sea level. Other places would fare worse. China would have 250 million displaced persons. Bangladesh would produce 120 million refugees, practically the entire nation. India would lose the land of 150 million people.

A rise in sea level, necessarily, begins slowly. Massive ice sheets must be softened and weakened before rapid disintegration and melting occurs and the sea level rises. It may require as much as a few centuries to produce most of the long-term response. But the inertia of ice sheets is not our ally against the effects of global warming. The Earth's

history reveals cases in which sea level, once ice sheets began to collapse, rose one meter (1.1 yards) every twenty years for centuries. That would be a calamity for hundreds of cities around the world, most of them far larger than New Orleans. Devastation from a rising sea occurs as the result of local storms, which can be expected to cause repeated retreats from transitory shorelines and rebuilding away from them.

Satellite images and other data have revealed the initial response of ice sheets to global warming. The area on Greenland in which summer melting of ice took place increased more than 50 percent during the last twenty-five years. Meltwater descends through crevasses to the ice sheet base, where it provides lubrication that increases the movement of the ice sheet and the discharge of giant icebergs into the ocean. The volume of icebergs from Greenland has doubled in the last ten years. Seismic stations reveal a shocking increase in "icequakes" on Greenland, caused by a portion of an ice sheet lurching forward and grinding to a halt. The annual number of these icequakes registering 4.6 or greater on the Richter scale doubled from 7 in 1993 to 14 in the late 1990s; it doubled again by 2005. A satellite that measures minute changes in Earth's gravitational field found the mass of Greenland to have decreased by 50 cubic miles of ice in 2005. West Antarctica's mass decreased by a similar amount.

The effect of this loss of ice on the global sea level is small, so far, but it is accelerating. The likelihood of the sudden collapse of ice sheets increases as global warming continues. For example, wet ice is darker, absorbing more sunlight, which increases the melting rate of the ice. Also, the warming ocean melts the offshore accumulations of ice—"ice shelves"—that form a barrier between the ice sheets and the ocean. As the ice shelves melt, more icebergs are discharged from the ice sheets into the ocean. And as the ice sheet discharges more icebergs into the ocean and loses mass, its surface sinks to a lower level where the temperature is warmer, causing it to melt faster.

The business-as-usual scenario, with five degrees Fahrenheit global warming and ten degrees Fahrenheit at the ice sheets, certainly would cause the disintegration of ice sheets. The only question is when the collapse of these sheets would begin. The business-as-usual scenario, which could lead to an eventual sea level rise of 80 feet, with 20 feet or more per century, could produce global chaos, leaving fewer resources with which to mitigate the change in climate. The alternative scenario, with global warming under two degrees Fahrenheit, still produces a significant rise in the sea level, but its slower rate, probably less than a few feet per century, would allow time to develop strategies that would adapt to, and mitigate, the rise in the sea level.

Energy Scenarios and Tipping Points

Both the U.S. Department of Energy and some fossil fuel companies insist that continued growth of fossil fuel use and of CO_2 emissions are facts that cannot be altered to any great extent. Their prophecies become self-fulfilling, with the help of govern-

ment subsidies and intensive efforts by special interest groups to prevent the public from becoming well-informed.

In reality, an alternative scenario is possible and makes sense for other reasons, especially in the United States, which has become an importer of energy, hemorrhaging wealth to foreign nations in order to pay for it. In response to oil shortages and price rises in the 1970s, the United States slowed its growth in energy use mainly by requiring an increase from thirteen to twenty-four miles per gallon in the standard of auto efficiency. Economic growth was decoupled from growth in the use of fossil fuels and the gains in efficiency were felt worldwide. Global growth of CO_2 emissions slowed from more than 4 percent each year to between 1 and 2 percent growth each year.

This slower growth rate in fossil fuel use was maintained despite lower energy prices. The United States is still only half as efficient in its use of energy as Western Europe, i.e., the United States emits twice as much CO_2 to produce a unit of GNP, partly because Europe encourages efficiency by fossil fuel taxes. China and India, using older technologies, are less energy efficient than the United States and have a higher rate of CO_2 emissions.

Available technologies would allow great improvement of energy efficiency, even in Europe. Economists agree that the potential could be achieved most effectively by a tax on carbon emissions, although strong political leadership would be needed to persuasively explain the case for such a tax to the public. The tax could be revenue-neutral, i.e., it could also provide for tax credits or tax decreases for the public generally, leaving government revenue unchanged; and it should be introduced gradually. The consumer who makes a special effort to save energy could gain, benefiting from the tax credit or decrease while buying less fuel; the well-to-do consumer who insisted on having three Hummers would pay for his own excesses.

Achieving a decline in CO_2 emissions faces two major obstacles: the huge number of vehicles that are inefficient in their use of fuel and the continuing CO_2 emissions from power plants. Automakers oppose efficiency standards and prominently advertise their heaviest and most powerful vehicles, which yield the greatest short-term profits. Coal companies want new coal-fired power plants to be built soon, thus assuring long-term profits.

The California legislature has passed a regulation requiring a 30 percent reduction in automobile greenhouse gas emissions by 2016. If adopted nationwide, this regulation would save more than $150 billion annually in oil imports. In thirty-five years, it would save seven times the amount of oil estimated by the U.S. Geological Services to exist in the Arctic National Wildlife Refuge. By fighting it in court, automakers and the Bush administration have stymied the California law, which many other states

stand ready to adopt. Further reductions of emissions would be possible by means of technologies now being developed. For example, new hybrid cars with larger batteries and the ability to plug into wall outlets will soon be available, along with cars whose bodies are made of a lightweight carbon composite to get better mileage.

If power plants are to achieve the goals of the alternative scenario, construction of new coal-fired power plants should be delayed until the technology needed to capture and sequester their CO_2 emissions is available. In the interim, new electricity requirements should be met by the use of renewable energies such as wind power as well as by nuclear power and other sources that do not produce CO_2. Much could be done to limit emissions by improving the standards of fuel efficiency in buildings, lighting, and appliances. Such improvements are entirely possible, but strong leadership would be required to bring them about. The most effective action, as I have indicated, would be a slowly increasing carbon tax, which could be revenue-neutral or would cover a portion of the costs of mitigating climate change.

The alternative scenario I have been referring to has been designed to be consistent with the Kyoto Protocol, i.e., with a world in which emissions from developed countries would decrease slowly early in this century and the developing countries would get help to adopt "clean" energy technologies that would limit the growth of their emissions. Delays in that approach—especially United States refusal both to participate in Kyoto and to improve vehicle and power plant efficiencies—and the rapid growth in the use of dirty technologies have resulted in an increase of 2 percent per year in global CO_2 emissions during the past ten years. If such growth continues for another decade, emissions in 2015 will be 35 percent greater than they were in 2000, making it impractical to achieve results close to the alternative scenario.

The situation is critical because of the clear difference between the two scenarios I have projected. Further global warming can be kept within limits (under two degrees Fahrenheit) only by means of simultaneous slowdown of CO_2 emissions and absolute reduction of the principal non-CO_2 agents of global warming, particularly emissions of methane gas. Such methane emissions are not only the second-largest human contribution to climate change, but also the main cause of an increase in ozone—the third-largest human-produced greenhouse gas—in the troposphere, the lowest part of the Earth's atmosphere. Practical methods can be used to reduce human sources of methane emission, for example, at coal mines, landfills, and waste management facilities. However, the question is whether these reductions will be overwhelmed by the release of frozen methane hydrates—the ice-like crystals in which large deposits of methane are trapped—if permafrost melts.

If both the slowdown in CO_2 emissions and reductions in non-CO_2 emissions called for by the alternative scenario are achieved, release of "frozen methane" should be

moderate, judging from prior interglacial periods that were warmer than today by one or two degrees Fahrenheit. But if CO_2 emissions are not limited and further warming reaches three or four degrees Fahrenheit, all bets are off. Indeed, there is evidence that greater warming could release substantial amounts of methane in the Arctic. Much of the ten-degree Fahrenheit global warming that caused mass extinctions, such as the one at the Paleocene-Eocene boundary, appears to have been caused by release of "frozen methane." Those releases of methane may have taken place over centuries or millennia, but release of even a significant fraction of the methane during this century could accelerate global warming, preventing achievement of the alternative scenario and possibly causing ice sheet disintegration and further long-term methane release that are out of our control.

Any responsible assessment of environmental impact must conclude that further global warming exceeding two degrees Fahrenheit will be dangerous. Yet, because of the global warming already bound to take place as a result of the continuing long-term effects of greenhouse gases and the energy systems now in use, the two-degree Fahrenheit limit will be exceeded unless a change in direction can begin during the current decade. Unless this fact is widely communicated, and decision makers are responsive, it will soon be impossible to avoid climate change with far-ranging undesirable consequences. We have reached a critical tipping point.

Our Responsibility

The public can act as our planet's keeper, as has been shown in the past. The first human-made atmospheric crisis emerged in 1974, when the chemists Sherry Rowland and Mario Molina reported that chlorofluorocarbons (CFCs) might destroy the stratospheric ozone layer that protects animal and plant life from the sun's harmful ultraviolet rays. How narrowly we escaped disaster was not realized until years later.

CFC appeared to be a marvelous inert chemical, one so useful as an aerosol propellant, fire suppressor, and refrigerant fluid that CFC production increased 10 percent per year for decades. If this business-as-usual growth of CFCs had continued just one more decade, the stratospheric ozone layer would have been severely depleted over the entire planet, and CFCs themselves would have caused a larger greenhouse effect than CO_2.

Instead, the press and television reported Rowland and Molina's warning widely. The public, responding to the warnings of environmental groups, boycotted frivolous use of CFCs as propellants for hair spray and deodorant, choosing non-CFC products instead. The annual growth of CFC usage plummeted immediately from 10 percent to zero. Thus no new facilities to produce CFCs were built. The principal CFC manufacturer, after first questioning the scientific evidence, developed alternative chemicals. When the use of CFCs for refrigeration began to increase and a voluntary phaseout of CFCs for that purpose proved ineffective, the United States and European govern-

ments took the lead in negotiating the Montreal Protocol to control the production of CFCs. Developing countries were allowed to increase the use of CFCs for a decade, and they were given financial assistance to construct alternative chemical plants. The result is that the use of CFCs is now decreasing, the ozone layer was damaged but not destroyed, and it will soon be recovering.

Why are the same scientists and political forces that succeeded in controlling the threat to the ozone layer now failing miserably to deal with the global warming crisis? Though we depend on fossil fuels far more than we ever did on CFCs, there is plenty of blame to go around. Scientists present the facts about climate change clinically, failing to stress that business-as-usual will transform the planet. The press and television, despite an overwhelming scientific consensus concerning global warming, give equal time to fringe "contrarians" supported by the fossil fuel industry. Special interest groups mount effective disinformation campaigns to sow doubt about the reality of global warming. The government appears to be strongly influenced by special interests, or otherwise confused and distracted, and it has failed to provide leadership. The public is understandably confused or uninterested.

I used to spread the blame uniformly until, when I was about to appear on public television, the producer informed me that the program "must" also include a "contrarian," who would take issue with claims of global warming. Presenting such a view, he told me, was a common practice in commercial television as well as radio and newspapers. Supporters of public TV or advertisers, with their own special interests, require "balance" as a price for their continued financial support. Al Gore's book, *An Inconvenient Truth,* reveals that while more than half of the recent newspaper articles on climate change have given equal weight to such contrarian views, virtually none of the scientific articles in peer-reviewed journals have questioned the consensus that emissions from human activities cause global warming. As a result, even when the scientific evidence is clear, technical nit-picking by contrarians leaves the public with the false impression that there is still great scientific uncertainty about the reality and causes of climate change.

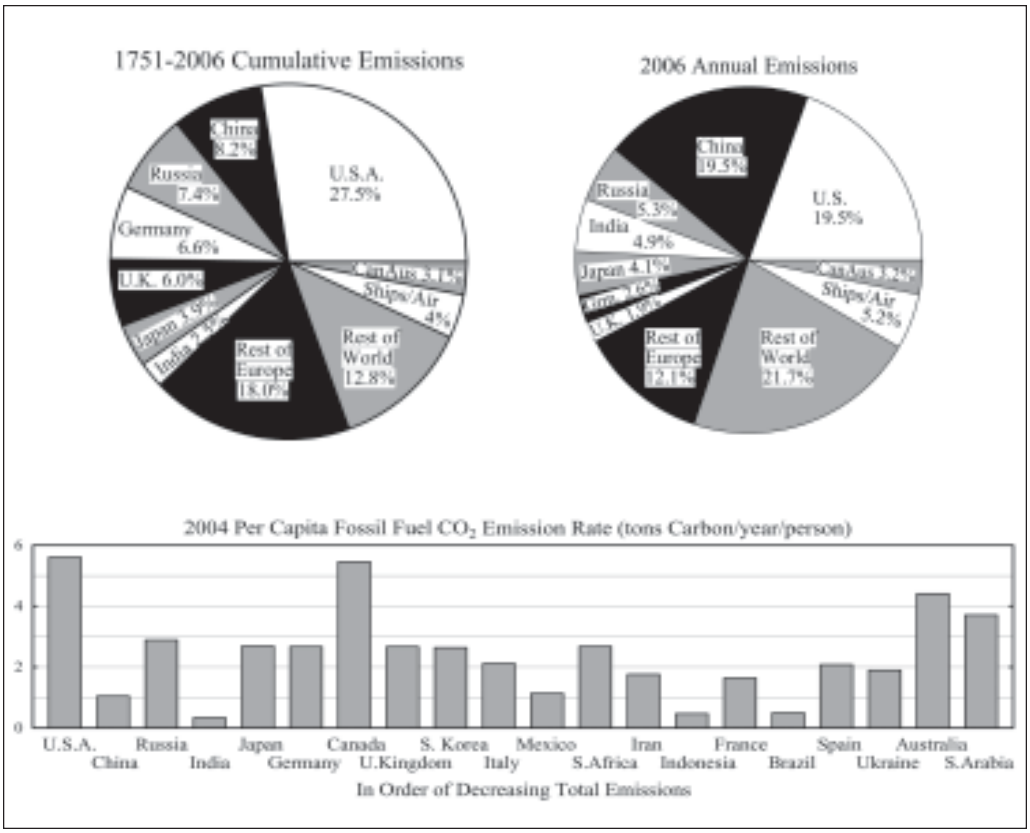
Policies favoring the short-term profits of energy companies and other special interests are cast by many politicians as being in the best economic interests of the country. They take no account of the mounting costs of environmental damage and of the future costs of maintaining the supply of fossil fuels. Leaders with a long-term vision would place greater value on developing more efficient energy technology and sources of clean energy. Rather than subsidizing fossil fuels, the government should provide incentives for fossil-fuel companies to develop other kinds of energy.

Who will pay for the tragic effects of a warming climate? Not the political leaders and business executives I have mentioned. If we pass the crucial point and tragedies caused

by climate change begin to unfold, history will judge harshly the scientists, reporters, special interests, and politicians who failed to protect the planet. But our children will pay the consequences.

The United States has heavy legal and moral responsibilities for what is now happening. Of all the CO_2 emissions produced from fossil fuels so far, we are responsible for almost 30 percent, an amount much larger than that of the next-closest countries, China and Russia, each less than 8 percent. Yet, our responsibility and liability may run higher than those numbers suggest. The United States cannot validly claim to be ignorant of the consequences. When nations must abandon large parts of their land because of rising seas, what will our liability be? And will our children, as adults in the world, carry a burden of guilt, as Germans carried after World War II, however unfair inherited blame may be?

The responsibility of the United States goes beyond its disproportionate share of the world's emissions. By refusing to participate in the Kyoto Protocol, we delayed its implementation and weakened its effectiveness, thus undermining the attempt of the international community to slow down the emissions of developed countries in a way consistent with the alternative scenario. If the United States had accepted the Kyoto



Protocol, it would have been possible to reduce the growing emissions of China and India through the Protocol's Clean Development Mechanism, by which the developed countries could offset their own continuing emissions by investing in projects to reduce emissions in the developing countries. This would have eased the way to later full participation by China and India, as occurred with the Montreal Protocol. The United States was right to object to quotas in the Kyoto Protocol that were unfair to the US; but an appropriate response would have been to negotiate revised quotas, since U.S. political and technology leadership are essential for dealing with climate change.

It is not too late. The United States hesitated to enter other conflicts in which the future was at stake. But enter we did, earning gratitude in the end, not condemnation. Such an outcome is still feasible in the case of global warming, but just barely.

As explained above, we have at most ten years—not ten years to decide upon action, but ten years to alter fundamentally the trajectory of global greenhouse emissions. Our previous decade of inaction has made the task more difficult, since emissions in the developing world are accelerating. To achieve the alternative scenario will require prompt gains in energy efficiencies so that the supply of oil and natural gas can be sustained until advanced technologies can be developed. If instead we follow an energy-intensive path of squeezing liquid fuels from tar sands, shale oil, and heavy oil, and do so without capturing and sequestering CO_2 emissions, climate disasters will become unavoidable.

Policy Solutions

When I recently met Larry King, he said, "Nobody cares about fifty years from now." Maybe so. But if we stay on the business-as-usual course, disastrous effects are no further from us than we are from the Elvis era. And significant climate change is already evident.

What are we to do? While appropriate, calling on individuals to reduce energy use and greenhouse gas emissions oversimplifies and diverts attention from the essential requirement: government leadership. Without such leadership and comprehensive economic policies, conservation of energy by individuals merely reduces demands for fuel, thus lowering prices and ultimately promoting the wasteful use of energy.

A good energy policy, economists agree, is not difficult to define. A carbon tax, involving a combination of a fuel tax and a cap-and-trade on carbon emissions, should encourage conservation, but with rebates to taxpayers so that the government tax revenue does not increase. The taxpayer can use his rebate to fill his gas-guzzler if he likes, but most people will eventually reduce their use of fuel in order to save money and will spend the rebate on something else. With slow and continual increases of fuel cost, energy consumption will decline. The economy will not be harmed. Indeed, it

will be improved since the trade deficit will be reduced; so will the need to protect U.S. access to energy abroad by means of diplomatic and military action. U.S. manufacturers would be forced to emphasize energy efficiency in order to make their products competitive internationally. Our automakers need not go bankrupt.

Would this approach result in fewer ultra-heavy SUVs on the road? Probably. Would it slow the trend toward bigger houses with higher ceilings? Possibly. But experts say that because technology has sufficient potential to become more efficient, our quality of life need not decline. In order for this to happen, the price of energy should reflect its true cost to society.

Of course, the carbon tax should be complemented by other ways to encourage energy conservation and efficiency. Government policy should reflect a variety of strategies that include an appropriate mix of building codes, efficiency standards, incentives, and public education—all intended to significantly and quickly reduce the amount of fossil fuel we burn and consume. The carbon tax need not be large. The certainty that it will grow will be sufficient to drive innovations and technology development, assuring that consumers have options to minimize their costs.

An increasing carbon tax will promote a switch to renewable energies such as solar, wind, biomass, and other sources that do not produce CO_2. Nuclear power should be included among these options—but we must recognize that several serious issues have yet to be adequately addressed, including procedures for disposal of nuclear waste and assurance that weapons-grade nuclear material can and will be kept out of the hands of terrorists. Governments should address these issues with greater urgency than they have to date. The pace at which the carbon tax grows should be adjusted by a carbon tax "tsar," analogous to the chairman of the Federal Reserve, who adjusts the carbon price to optimize the combination of economic development and emissions reduction.

One other major action, in addition to a gradually increasing carbon tax, is needed to solve the global warming problem. The need for this second action, a moratorium on the building of any more coal-fired power plants until we have the technology to capture and store the CO_2, stems from the magnitude of the fossil fuel reservoirs. It has become clear, to scientists, that consumption of oil and gas alone will take global warming close to the dangerous level. And oil and gas are such convenient fuels (and located in countries where we can't tell people not to mine them) that they surely will be used. Thus the only way to keep CO_2 from going well above the dangerous level will be to phase-out coal use except at places where the CO_2 can be captured and stored. Old, dirty-coal power-plants will need to be 'bulldozed' over the next few decades. So why build old-technology power plants if you are not going to be able to operate them over their lifetime, which is fifty or seventy-five years? It doesn't make sense. Besides, there is so much potential in efficiency, we don't need new power plants

in the near-term, if we take advantage of efficiency and renewable energies. There will be other benefits in phasing out dirty coal use: it is the greatest source of global air pollution and is poisoning even the world's ocean with contaminants such as mercury, which accumulates in fish.

Even with these two strong actions, a carbon tax and phase-out of dirty-coal, it is likely that CO_2 will reach and at least marginally pass the dangerous level. This is no cause for despair, as there are two other actions that can counter moderately excessive CO_2. One of these is to reduce human-made climate forcings other than CO_2, such as methane and black soot. Needed actions have other benefits, such as improved public health and increased agricultural productivity. A second way to combat an overshoot of the safe level of CO_2 is "negative CO_2 power plants" that generate electricity by burning biomass and then capture and store the carbon dioxide emissions. These power plants would take carbon dioxide recently removed from the atmosphere by growing biomass and sequestered it deep beneath ocean sediments—thus producing a net reduction of atmospheric carbon dioxide. Such power plants could be a modest help in our efforts to stabilize climate, but their impact is insufficient to relieve us of the burden and challenge of meeting our energy needs through strategies enumerated above.

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

College and universities have a critical role to play. By demonstrating their campuses can operate effectively while significantly curtailing greenhouse gas emissions, institutions of higher learning can show what is possible and point the way for others to follow. The American College & University Presidents' Climate Commitment is a particularly hopeful development. By committing to achieve climate neutrality at the earliest possible date, signatories to the pledge are recognizing the urgency of the problem and not waiting for government to take the required action. These important efforts will inspire similar actions in other sectors of our economy and create the momentum needed to get our political leaders and government on all levels to act before it is too late.

About the Author

Jim Hansen is director of the NASA Goddard Institute for Space Studies and adjunct professor of Earth and Environmental Sciences at Columbia University's Earth Institute. Hansen was trained in physics at the University of Iowa under James Van Allen. He was elected to the National Academy of Sciences in 1995 and has received honors including the John Heinz Environment Award and the Duke of Edinburgh Conservation Medal. His opinions are expressed here, he writes, "as personal views under the protection of the First Amendment of the United States Constitution."