

Green Destiny: Universities Leading the Way to a Sustainable Future

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Even as universities teach their students that the vital signs of the Earth are in decline, graduates leave college to begin lives that generally contribute to, rather than mitigate, a growing array of environmental and social problems. Unless a great change occurs, by the time today's university graduates are middle-aged, the Earth's human population will have expanded by one-third and resource use as well as waste production may well have doubled—all this on a planet that is already groaning under the weight of the human enterprise.

Humans face a challenge in learning to live in a manner that does not endanger the Earth. We contend that universities are in a unique position to address this challenge. Because their mission is education and not social action, some may seek to excuse colleges and universities from the call to embrace policies grounded in solutions to the ecological and social challenges of our times. But what is education for, if not to play a fundamental role in how our society moves forward in meeting its many challenges? David Orr (1994) put it this way: "The crisis we face is first and foremost one of the mind, perception, and values; hence, it is a challenge to those institutions presuming to shape minds, perceptions, and values. It is an educational challenge" (p. 27).

Not only do universities educate our citizenry with interdisciplinary knowledge, but they are large, prestigious, and influential institutions in their own right, capable of having large impacts on the environment as well as some influence on local and global communities.

The challenge faced by humankind will require rethinking of our values and reeducation of our citizenry in many aspects of our society's way of life. We therefore contend that the time has come for the concept of sustainability—that is, meeting present needs without compromising the ability of future generations to meet their needs—to become a new central organizing focus for higher education.

Sustainability may be understood by referring to a set of five core principles:

- Respecting life and natural processes. Sustainability commits us to explicit consideration of the effects of our decisions and actions on the health and well-being of the entire community of life.
- Living within limits. Sustainability involves an awareness that natural resources are finite endowments to be used with care and prudence at a rate consonant with their capacity for regeneration.
- Valuing the local. Sustainability commits us to show respect for the natural components of our neighborhoods and bioregions; to preservation, restoration, and use of local knowledge; and to creation of strong, self-reliant local economies.
- Accounting for full costs. Sustainability requires that we become aware of the costs generated by our products—from "source to sink"—to the environment and society. Product prices must reflect this awareness.
- Sharing power. Sustainability demands we recognize that we are all interconnected—people, biota, and physical elements. Problems are solved by each individual assuming a share of the responsibility.

Though the concept of sustainability may seem relatively new, the substance of its principles is already embedded in our national character. What is respect for life but our appreciation for the integrity, stability, and beauty of the biotic community upon which we all depend? Living within limits embodies the traditional values of frugality and thrift. Full-cost accounting reminds us of the value of honesty and complete disclosure. Respect for what is local honors our

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history and traditions, and sharing power is the definition of democracy. In an age when many argue that morality is being left by the wayside, the practice of sustainability has the potential to bring what some might consider moral values back to the forefront of our lives.

Case study

Recently a group of students and faculty at the Pennsylvania State University (see www.bio.psu.edu/greendestiny) examined their university through the lens of sustainability to make its ecological and societal impacts more visible. The team conducted botanical surveys on the campus grounds, traced the sources of the ingredients of food served in the university's dining halls, looked into dumpsters to see what Penn State was throwing away, studied land transactions at the County Deeds Office, and administered student questionnaires, among other tasks. Overall, the study depicted an institution whose performance, when measured by sustainability indicators, was merely mediocre. For category after category—energy, water, food, materials, buildings—Penn State's practices departed little from the nation's status quo of growth and consumption. Consequently, Penn State's graduates, like those of most other universities, complete their education with little sense of their ecological identity; hence they are more likely to contribute to than to solve the growing planetary crisis.

Integrating sustainability into higher education

What if, instead of reinforcing nonsustainable practices, universities began to apply their interdisciplinary know-how toward a new purpose: the research, design, and showcasing of such revolutionary things as highly efficient, state-of-the-art energy generation based on renewable sources; cyclical water systems based on "living machines"; local or regional food production using sustainable farming methods; ecologically sound buildings based on "green" design principles; alternatives to car transportation that are clean and efficient; and community education aimed at promoting ecological literacy.

The following are nine proposals suggesting how universities can help set American society on a sustainable course, with examples of how some of them are developing sustainable milieus.

Seek fossil fuel independence. At present, most US universities rely exclusively on fossil fuels to meet their energy needs. The aforementioned Penn State study determined that each Penn Stater (i.e., full-time students, faculty, and staff) consumed about 7,000 pounds of coal per year, resulting in the emission of, among other things, about 10 tons of carbon dioxide per person. To set a wise example, universities must move beyond excessive and exclusive fossil-fuel energy dependence to an energy system that is nonpolluting and generated from renewable resources (e.g., hydropower, wind, solar, geothermal).

The first step is to reduce overall energy consumption. Using existing technologies, there is little doubt that factor-four increases (many would argue factor-ten increases) in energy use efficiency are readily attainable (Hawken et al. 1999). For example, the State University of New York (SUNY) at Buffalo was able to reduce energy consumption by 20 million kilowatts on its north campus between 1982 and 1999 while adding eight new buildings. These savings were achieved by retrofitting lights, building shell insulation and window improvements, and upgrading heating and cooling systems (see <http://wings.buffalo.edu/ubgreen>).

In addition to using energy more efficiently, universities must also shift to nonpolluting and renewable energy sources. Carleton University in Ottawa, Canada, has launched a \$20 million energy conservation program that includes installation of a cogeneration facility and use of geothermal systems to heat buildings in winter. In addition to reducing greenhouse gas emissions, Carleton expects to save \$2 million a year, allowing the program to pay for itself within 10 years. Describing Carleton University's program, M. A. Pierce (1992) wrote, "Whatever fields students choose after graduation, an intensive exposure to the realities of energy and environmental issues will make them not only better educated but also better citizens of the global community" (p. 43).

Of course, universities cannot achieve fossil-fuel independence in one bold stroke. They could, however, do it over the next half century in a relentless sequence of "green" steps. However long it takes, it is time for universities to start replacing the subtle message of environmental irresponsibility conveyed through prodigious fossil energy consumption with the more powerful lesson taught by the use of clean, renewable, sustainable energy. Indeed, by making a bold commitment to gradually phase out the use of fossil fuels in favor of clean, renewable energy sources, our universities could provide important leadership on one of the most pressing environmental challenges of our times.

Conserve water resources. Universities place great demands on the watersheds of their communities. During 1999, for example, water consumption at Penn State University was roughly 1 billion gallons. Students living in dorms consumed almost 60 gallons of water each day through showers (40 gallons per student), toilets (10 gallons per student), clothes washing (5 gallons per student), and sink usage (2 gallons per student).

We have the knowledge and technology to greatly reduce water consumption and wastewater production without undue inconvenience. California State University at Northridge has reduced water consumption by 15% by retrofitting showers, installing flush valves and faucets with water-saving devices, posting water-conservation information, and using reclaimed water for landscaping (Smith 1993).

A complementary step would be to close the water loop by relying on local water sources and by cycling water back to its place of origin. Scientists and engineers at Penn State developed an innovative way to discharge the university's wastewater in an approximation of this natural cycle. After wastewater is filtered and broken down, the effluent is sprayed onto fields and woods just north of campus. In this living filter system, the fields and crops in the sprayed area are fertilized with the effluent while the groundwater supply from which the university extracts its water is replenished.

An even more innovative approach to wastewater treatment—living machines—is now under study at Penn State. Wastewater in the prototype living machine first goes to a tank teeming with bacteria and then on to a tank with algae and protozoa; the water is then shunted to a marshlike community with sedges, and eventually on to a pond analogue with snails and fish. By using the waste as food, the organisms rid the water of harmful bacteria and pathogens and render it clean (Todd and Todd 1993).

Penn State's living filter and living machine projects serve as important sites for student research. At the end of their undergraduate or graduate studies, students recognize that water does not simply come from a tap.

End materials waste. The worldwide rate of consumption of the Earth's raw materials is increasing at a faster rate than that of population growth, with a concomitant rise in waste (Korten 1995). Paper is a good example.

To remind students and faculty alike of their ecological dependency on paper, we calculated the forest area necessary to supply the annual paper needs of a typical student at Penn State. The result: 3,100 square feet of forest per student. At the other end of the materials stream is waste. Penn State produces almost 10,000 tons of solid waste annually.

It is possible to reduce—even to eliminate—linear waste streams, and universities can lead society toward zero-waste production systems. SUNY Buffalo's procurement policy states that the university "will seek to utilize to the fullest extent possible environmentally friendly products" (Simpson 1999). Following SUNY's lead, a consortium of major universities might commit to purchasing products from companies that endorse, for example, the Valdez principles (i.e., suppliers that publicly commit to waste reduction, wise use of energy, sustainable use of natural resources; Thorpe 1999); the impact of such an action would be immense. Imagine the even greater potential effect if this same consortium were to endorse the concept of extended producer responsibility by giving special preference to companies that accept responsibility for taking back their product at the end of its useful life. Thus, as concerned businesspeople and engineers work to create these "intelligent product systems" (Hawken 1993), universities could demonstrate their own wisdom and commitment by using their buying power to

leverage their suppliers toward adoption of more responsible production technologies.

Eat food produced sustainably. US farms produce twice as much food per acre as they did a half-century ago. Meanwhile, American supermarkets offer food from all over the planet. Amazing as it is, this food system is not sustainable. The US General Accounting Office reports that 84% of US farms have soil losses greater than 5 tons per acre, a rate that is far more rapid than the rate of new soil formation. In addition, the food system is running an energy deficit: Considerably more energy (fossil fuel) is used to produce and transport the food we eat than is contained within the food itself (Pimentel and Pimentel 1979). Moreover, US agriculture's excessive use of fertilizers and pesticides contaminates our country's aquifers, wells, and waterways.

The purchase of food at American universities is typically based on least-cost and convenience criteria, not on intelligent responses to ecological problems. Few significant measures are taken to address distances involved in food transport, unsustainable farming practices, excessive food packaging, unethical treatment of farm animals, and unjust labor practices, all of which must be considered in the promotion of a sustainable food system. The Penn State research team estimated that the average isolated ingredient in the university's dining hall food traveled approximately 900 miles from its last distribution point, and in most cases little was known about the environmental and social conditions governing its production.

Instead of perpetuating a national food system that is increasingly centered on genetically engineered crops, industrial farming, and excessively processed food, universities could use their agricultural research and extension expertise to guide the nation toward a food system that respects family farms and engenders healthy soil, strong regional farm economies, and wholesome food. Indeed, the considerable food budgets of universities could be applied to direct support of regional farm economies.

Hendrix College in Arkansas provides a model for how an institution of higher learning can fortify the local farm economy while promoting sustainable agriculture and a healthy diet. Hendrix requires that food served in its cafeterias be locally produced (if possible) using sustainable agricultural methods, and that animals consumed in the dining halls be treated humanely during their lives. Hendrix strives to make sure at least half of its food comes from Arkansas (Valen 1992). Even at more northerly latitudes, a large percentage of university food purchases could come from local sources (Bakko and Woodwell 1992).

Following the leadership of our universities, other institutions—hospitals, corporations, and government agencies, for example—might also become markets for regional food producers who employ healthy and environmentally sensitive production methods. Such an outcome would not

only conserve energy and protect the environment but also spur the economic vitality of the local region.

Create and abide by a land ethic. As owners and caretakers of large landholdings in their communities, universities are in a position to demonstrate responsible land stewardship to their students and community members. Cultivation of land's natural beauty derives from pride in and respect for our home places. In turn, when land is not altered or suppressed by unnatural means, it can foster pride and respect in those who experience it, connecting them to the Earth. Many universities own considerable amounts of land, but rarely do they have a clearly articulated land ethic. The Penn State sustainability study found, for example, that Penn State (University Park), a land-grant university, owns approximately 18,000 acres of land. About half of the woody plants in the central campus area are nonnatives (plants imported from other regions). Preventing the landscape from reverting to its natural state, pesticides and herbicides—hundreds of gallons of them—are applied to the campus grounds each year, a situation probably typical of most universities.

To develop a land ethic at universities, Aldo Leopold's (1953) often-quoted remark might serve as a starting point: "A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise." A strong land ethic could, for example, provide a framework for considering how universities might change their campus landscape from one dependent on exotic annual plantings, chemical pesticides and fertilizers, and frequent watering to one that is chemical free, dominated by hardy native species, and punctuated with bursts of wildness. For example, Connecticut College has committed one-third of its property to serve as an arboretum devoted to developing a regional identity. The arboretum's collection contains 288 taxa of trees, shrubs and woody vines—all indigenous to eastern North America.

Finally, a land ethic might also lead universities to think in much more creative ways about how campuses can be used to teach important lessons. For example, there might be a global warming classroom—i.e., a plot of young forest that annually sequesters an amount of carbon dioxide equivalent to that produced by a typical student or faculty member. Or there might be a constructed wetland that processes a portion of the university's wastewater. Similarly, land surrounding dining halls could be landscaped with certain native edibles to remind students of where their food ultimately comes from. In this same vein, academic departments might be challenged to use the land at their doorsteps to illustrate the links between their discipline and the Earth. For example, the Geography Department might tend a living map of the vegetation types of the local bioregion; Agronomy, using biointensive methods, might farm a "circle of plenty"—i.e., a one-third-acre plot capable of providing all the food needed by a family of four for a year.

In essence, when land is used wisely and sustainably, and when its natural integrity is preserved without undue human intervention, university land can teach important lessons about our home places to students and the community, lessons that cannot be taught entirely in the classroom.

Create sustainable alternatives to car-based transit. It has taken the United States more than half a century to begin to question the wisdom of a strongly car-dependent transportation system (Olinger 1992). Most university transportation systems are fully embedded in this system and thus are ever more car dependent. As enrollments increase, car travel rises, as does the demand for more roads and more parking facilities. At Penn State approximately 90% of the employees drive to work. In aggregate, these employees commute more than 100,000 miles each workday. Fifteen acres of land have been paved for parking in just the last 12 years.

Instead of relying on sprawling, inefficient, car-dependent transportation systems, universities could play a catalytic role in creating tight, compact patterns of land settlement and attractive alternatives to car transit. Such measures might include the following:

- Move vehicle parking to the perimeter of the campus, using public transit to shuttle individuals to and from their destinations.
- Create efficient and safe networks of bike paths throughout the campus.
- Promote "traffic calming" measures (e.g., narrow existing roads, lower and enforce speed limits, and grant right-of-way to pedestrians and bicyclists).
- Create incentive packages aimed at reducing the number of vehicles operated by university students and staff.
- Conduct (in collaboration with state transportation institutes) cost-benefit studies on public transportation alternatives, and appeal to state governments for support of sustainable public transportation systems.

Some universities are already pursuing sustainable solutions to transportation problems. For example, Cornell University, when faced with a shortfall of 2,500 parking spaces in the early 1990s, devised other ways to get faculty and staff to and from work. Cornell created a package of alternatives to single-occupant commuter vehicles and is now not only saving about \$3 million a year but also reaping the beneficial environmental effects of 10 million fewer car miles traveled to and from the school each year (National Wildlife Federation 1998).

In sum, it is time for universities to use their expertise and vision to create communities with fewer rather than more roads, develop better public transportation, enforce urban growth boundaries, protect open space, and build vibrant,

people-friendly town centers that encourage walking and biking.

Create “green” buildings. America’s buildings use immense amounts of energy for heating and cooling, and the materials used in their construction are among the most energy intensive in existence (steel, concrete, glass, plastic, aluminum, asphalt; Barnett and Browning 1996). However, with the use of “green design” techniques and green materials, buildings can be much more energy and resource efficient than those of the past (Hawken et al. 1999). Universities have an opportunity to act as pioneers in the creation of environmentally friendly buildings by tapping into the expertise—already present on many campuses—in the burgeoning fields of green engineering and green architecture.

Some schools—Oberlin and Northland Colleges, for example—are already rising to the challenge. Oberlin College in Ohio has just completed a green environmental science building that will be a net energy producer by virtue of its efficient design and state-of-the-art photovoltaic system (Orr 1997). In addition, the Oberlin building has been equipped with a living machine to ensure that the wastewater discharged from the building is at least as clean as the water that enters it. Northland College in Wisconsin has completed a new residence hall that houses 110 students and features community and classroom space, passive solar design, supplemental photovoltaic and wind generators for electricity, two greenhouses, composting toilets, low-volume showers, and energy-efficient appliances and lighting. The construction cost per bed is comparable to that for recently constructed buildings at other colleges, but the operational costs are expected to be much lower than average.

In the final analysis, it is important for universities to consider what they want their buildings to teach. For example, how might they design university buildings to foster civic competence and citizenship? Given the range and depth of knowledge and creativity they comprise, universities surely have the means to build the most sustainable and life-affirming buildings in the history of North America.

Guarantee ecological literacy. A quality education should help students develop a comprehensive understanding of and respect for their ecological dependencies. Such ecological literacy is at least as fundamental to living fully and wisely as the capacity to read and write.

Unfortunately, today’s universities often seem to cultivate ecological indifference rather than ecological literacy. The Penn State study showed that 40% of graduating seniors did not know the size of the world’s population to the nearest billion, and 72% had no idea that they were living within the Susquehanna Basin. Moreover, university operations often set an example at odds with what the new generation of students needs to learn. For example, the prolific consumption of materials on our college campuses teaches (indirectly) that the Earth can supply our needs, however grand they may be; dining hall food grown or produced thousands of miles

away signals that students need not be concerned about their food’s origins or the loss of farmland close to home; and campus dumpsters overflowing with refuse suggest that resources are unlimited and need not be recycled (Orr 1994). In other words, US college students are not learning nearly enough about how to live day by day in a sustainable fashion.

It is time for our universities, through well-designed courses, labs, internships, and, most important, by example, to ensure that their graduates are

- aware of ecological dependencies: College graduates should become aware of the sources of their food, water, and energy, as well as the destination of their wastes.
- grounded in the natural world: Graduates should be able to visit the ecosystems of their local watershed and recognize the commonly occurring organisms (biodiversity) and fundamental ecological processes (e.g., energy flow, nutrient cycling, species interactions).
- skilled at making ecological connections: Graduates should be able to take any ordinary manmade object (e.g., a sheet of paper, aluminum can, plastic binder) and elucidate the principal “upstream” and “downstream” ecological connections associated with the manufacture, use, and disposal of the product.
- mindful of ecological footprints: Graduates should be able to calculate the size of their ecological footprint (Wackernagel and Rees 1996) and know how they can minimize the size of that “footprint.”

Florida Gulf Coast University has instituted a course called “The Colloquium: A Sustainable Future,” which is a graduation requirement for all undergraduates, and Tufts has made ecological literacy a goal for all graduates by creating an Environmental Literacy Institute. George Washington University has gone further by making a high-profile commitment to imbuing its entire culture with ecological responsibility. George Washington’s president, Stephen J. Trachtenberg, described the university’s Green Strategic Plan thus: “Through this initiative, GW will bring to all its operations, academic offerings, services, and research a principled environmental ethic and a resolve to create a sustainable future. Moreover, the University will produce a new generation of graduates who will inherently embody and advance such values and ethics in their own lives, and in those of coming generations” (Trachtenberg 2000).

Some universities have already begun to institutionalize sustainable practices right on campus. The University of Kansas, for example, has appointed an ombudsman for the environment. The ombudsman reports directly to the executive vice chancellor and works with faculty, staff, and students to identify and initiate research projects that seek to ameliorate the stress that humans impose on the environment. Projects are wide ranging (e.g., formulation of an ozone depletion policy, solvent recycling, improvement of energy efficiency in lighting). The cost of running the ombudsman office at Kansas is more than covered by the

Table 1. Leading the way toward sustainability: An ecological mission for American universities

| System | Goal | Reduce | Increase |
|------------|--|-------------------------------------|--|
| Energy | Seek fossil fuel independence | Fossil fuels | Renewable energy |
| Water | Conserve water resources | Water waste | Water conservation |
| Materials | End materials waste | Materials waste | Green procurement policies |
| Food | Eat food produced sustainably | Industrial, far-flung food system | Sustainable, more regional food system |
| Land | Create and abide by a land ethic | Treatment of land as a commodity | Wise stewardship of land |
| Transport | Create sustainable alternatives to car-based transit | Car dependence/sprawl | Public transit/compact settlement |
| Buildings | Create “green” buildings | Conventional buildings | Ecological design |
| Curriculum | Guarantee ecological literacy | Alienation from natural world | Connection to natural world |
| Research | Prioritize research for a sustainable world | Research undermining sustainability | Research promoting sustainability |

savings attributable to the environmental projects (Hamburg and Ask 1992).

Prioritize research for a sustainable world. American universities are recognized globally for the quantity and quality of their research, but most of them have little knowledge of how their myriad research initiatives affect sustainability. Of course, research that seeks ways to harness renewable sources of energy, increase the health of our soils, or improve the cleanliness of our environment contributes directly to sustainability; the impact of many other types of research on sustainability, however, is difficult to discern. A study on this topic might well reveal that much university research does not contribute directly to sustainability and that many university research programs even undermine sustainability.

If our civilization is to reverse the negative environmental trends all around us, leading centers of research need to focus research attention explicitly on sustainable practices. It is time for universities to augment their existing efforts with a new research emphasis centered on the five sustainability precepts:

- Promote respect for the biota and natural processes instead of regarding all of life as raw material for human manipulation. We must challenge natural scientists and educators to seek a fuller understanding of global biodiversity and earth processes, so that they may lead humankind to revitalize and restore the health of the planet.
- Live within limits instead of promoting continual expansion. We must employ engineering, scientific, and social science expertise to achieve a transition to a “factor-ten economy”—a 10-fold decrease in material use as we dramatically increase efficiency and, to the extent possible, eliminate waste.

- Manifest mindfulness of place instead of mindlessly promoting economic globalization and homogenization of culture. We must call on historians, geographers, agronomists, architects, natural scientists, and artists to help us celebrate the uniqueness and richness of the places where we live and to promote the development of healthy local economies.
- Create full-cost analyses of policy options instead of narrow economic critiques. It is time for business planners, economists, political scientists, and ecologists to take an even greater leadership role in examining commerce in holistic ways, so that product pricing is in accord with the true ecological and social costs of production.
- Promote civic responsibility instead of cultivating dependency with its inevitable disempowerment. We must gather all the intelligence, creativity, and good will in our university communities to pioneer in the development of more democratic forms of planning, decisionmaking, and conflict resolution.

Research advances are determined largely by funding priorities. Provide money for “Star Wars” and the work gets done; prioritize research on the human genome and the work steams ahead. By the same token, if funding is provided for innovative technical and social solutions to the sustainability crisis now facing civilization, great things might be accomplished. University leaders should make this point with those in the federal government and the private sector who have money; they should educate, urge, and cajole until support is forthcoming for research that promotes sustainability in concrete ways (e.g., sustainable food production systems, ecological building design, efficient energy systems, sustainable forestry).

The emphasis on research should be strongly linked to graduate training. Fortunately, some universities are already forging the way. The Georgia Institute of Technology has

made sustainable technology a core mission permeating research, teaching, and operations (Cortese 1999); the Center of Energy and Environmental Studies at Boston University offers graduate training and research opportunities in ecological economics, energy analysis, and environmental modeling; and the University of Virginia School of Architecture places a strong emphasis on ecological principles and green design.

Summary

It is time to embrace a new way of living and a new way of thinking. Universities, individually and collectively, can be the catalyst by assembling their various environmental efforts into a comprehensive ecological mission aimed at achieving sustainability in all facets of university life (Table 1).

It is certainly true that there will be up-front costs for reducing waste of energy, water, and materials, and there will be expenses for constructing green buildings and promoting alternatives to the automobile. But businesses and universities are discovering that waste is also expensive and that up-front investments in sustainable practices often pay off handsomely over the long term, especially when environmental and social costs are calculated and educational benefits are tallied.

A golden opportunity to create a new generation of socially and ecologically responsible citizens is before us. By pursuing this ninefold ecological mission, American universities could create a new model for living—one that is highly energy efficient, produces little or no waste, supports regional economies, engenders an abiding respect for life, and fosters bonds among all members of the community of life. At a time when we desperately need our universities to offer vision and serve as models of integrity and wisdom, may they seize the opportunity to light the way.

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