

Education for a Sustainable Future: The Next Industrial Revolution

Convocation Ceremony
Clarkson University

Anthony D. Cortese, ScD, President
Second Nature

August 31, 2001

Mr. President, members of the distinguished administration and faculty, other members of the university community, matriculating and current students, and Prof. Vitek, thank you for the invitation to participate in the 2001 Convocation of Clarkson University. I am proud of my engineering background and honored to be speaking at one of the finest technologically based universities in the North America.

Need for a New Human Perspective

In the last century, engineers have developed unprecedented technologies which have allowed many to have clean water, adequate and safe food, be cured of many diseases, fly all over the world and into space, communicate instantaneously around the world by wireless telephones, TV and through the Internet from personal computers that are now small enough to fit in one hand. This first industrial revolution has reduced the death rate so dramatically that population has increased **six fold** in the last 150 years. Improvements in transportation alone have enabled rapid migration of large numbers of people all over the world and increased the volume of raw materials and finished products in international trade 800 times in the last century. Economic output has increased over 20 times, fossil fuel use 30 times and industrial production 100 times in the last century.

Along with this growth has come some undesirable, unsustainable, inequitable (and mostly unintentional) environmental, health and social impacts, particularly in the last half century. These impacts urgently require a different model of living in the 21st century - a new industrial revolution. Why?

First, we are living off our life support systems in an unhealthy, degrading, inequitable and unsustainable manner.

Secondly, for the first time in history:

Humans are pervasive and dominant forces in the health and well being of the earth and its inhabitants. **You** are the first generation capable of determining the habitability of the planet for humans and other species.

The limiting factors for future economic growth are not labor or technology:

- a. Natural capital (e.g., fish not boats; and forests, not chain saws)
- b. Social capital (e.g., market corrections, health, equity and stability)

Thirdly, global ecosystems do 3 things humans cannot do without:

- a. **Provide resources**
food, fiber, fuel, shelter, water
- b. **Ecological services**
air, photosynthesis, soil formation & fertility, climate regulation, pollination, pest control, cycling of nutrients, maintenance of biodiversity, mitigation of droughts, floods and coastal erosion, mental well-being (\$33 trillion/year)
ex: pharmaceuticals: vincristine and leukemia; Lovejoy:
Biologically diverse ecosystems are the library of the biological sciences
ex: trees: not just for wood and fiber: water storage, habitat, water, purification, soil retention and climate regulation
ex: freshwater: prerequisite for life; no substitutes for most of its uses; finite (per capita availability half of 1970); balancing human needs with protection of aquatic ecosystems:
ex: NY water supply system.
- c. **Absorb and convert wastes to substances useful for all life**

Most of these functions are **complementary** and not substitutable with each or by human technology: air for water, water for food, food for warmth, energy for air, technology for photosynthesis.

Finally, we must understand that **Ecological Health = Human Health**

- Assuming UN projected growth in population and the desire of most of the world to live like people in industrialized countries, **we will require an 80–90 percent reduction in pollution generated per unit of economic output just to maintain the current unhealthy and unsustainable pollution and waste loadings.** According to IPCC, a 60-80% reduction in greenhouse gases is necessary to prevent the doubling of greenhouse gas concentrations in the atmosphere.
- As far back as 1992, a group composed of scientists from around the globe, including 102 Nobel Laureates, drafted the World Scientists' Warning to Humanity, which read in part: "We, the undersigned, senior members of the world's scientific community, hereby warn all humanity of what lies ahead. **A great change** in our stewardship of the earth and the life on it is required, if vast human misery is to be avoided and our global home on this planet is not to be irretrievably mutilated."

This "**great change**" cannot be achieved by building more waste treatment plants or air pollution control devices. A fundamental change in thinking, values and action is critical to human health and survival and must be a part of the education, research, operations and community interaction of all professionals, especially health professionals.

The environment is not a competing interest: it is the playing field on which all other interests intersect.

Envisioning a Sustainable Future: The Next Industrial Revolution

Let us imagine... a society in which all present and future humans are healthy and have their basic needs met. What if everyone had fair and equitable access to the Earth's resources, a decent quality of life, and celebrated cultural diversity. Imagine all people realizing their highest aspirations and restoring and preserving the biologically diverse ecosystems on which we all depend. Imagine future scientists, engineers and business people designing technology and economic activities that sustain rather than degrade the natural environment, that enhance human health and well-being, and that mimic and live within the limits of natural systems. Imagine a future where we design our technology inspired by biological models by operating on renewable energy; where the concept of "waste" is eliminated because every waste product is a raw material or nutrient for another species or activity, or is returned into the cycles of nature. Imagine that we are managing human activities in a way that **increases** biological diversity and complexity.

Imagine all professionals understand their connections to the natural world and to other humans, knowing where products and services come from, knowing where wastes go, and knowing what they do to humans and other living species and how to minimize this *ecological footprint*. Our ecological footprint (our impact on the Earth) is invisible to most of us. We must make the invisible visible. The average person does not know that for every 100 lbs. of product produced in the United States, we actually move 3,200 lbs. of material and energy, most of which go to waste before we ever see the product or the service.

Imagine that we have stabilized the population at a level that is within the carrying capacity of Earth's ecosystems because we have increased the education as well as the social and economic status of women. Imagine that we have timely and accurate economic and ecological signals: micro-economic signals for price that reflect the true social and environmental cost to society; macro-economic indicators that reflect the true well-being of society and the Earth; and ecological signals that we receive in time to prevent or remedy damage to humans or the

environment. (Current signals are either incomplete, inaccurate, lead us to a false sense of security or are too late to prevent or reverse damage.

Now imagine that all current and future generations are able to pursue meaningful work and have the opportunity to realize their full human potential both personally and socially. Imagine that through our "dreaming" and "doing", we have dramatically reduced resource consumption, pollution and waste in the developed world so that there is opportunity in the developing world to be healthy and have a decent quality of life. Imagine that communities are strong and vibrant because they celebrate cultural diversity, are designed to encourage collaboration and participation in governance and emphasize the quality of life over the consumption of stuff. Think what it could be like if globalization is humanized to support democracy, human rights and economic opportunity for everyone.

How do we create this future? This will require a huge shift in thinking, values and action. To paraphrase Einstein, "The significant problems we face cannot be solved by the same level of thinking we used when we created them." We must reinvent the world socially, economically and environmentally. In effect, we must de-couple social and economic progress from environmental deterioration — or, as Bill McDonough, a world-renown green architect, says, "We must take the filters out of the pipes and put the filters in our minds."

Does this describe an unattainable utopia? No. It is possible because of the thousands of things that are being done, by progressive groups in civil society, philanthropy, universities, major industries, governments and communities around the world today.

Higher Education's Role

The change in mindset necessary to achieve this vision is a sustained, long-term effort to transform education at all levels. Despite the efforts of many individuals and organizations, education for a just and sustainable world is not a priority in formal education. Only one engineering school, Georgia Institute of Technology, has made sustainable technology and design a core mission of the university. Indeed, through an emphasis on the separation of humans from the rest of nature, through compartmentalized learning, individual specialization and success, and the absence of explicit ethics and values in learning, the predominant educational model is reinforcing the current inequitable and unsustainable worldview. As David Orr has said, "The crisis we face is one of mind, perception and heart... It is not a problem in education; it is a problem of education."

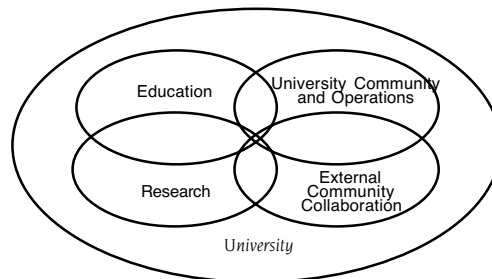
Higher education plays a profound and pivotal, but often overlooked, role in making this vision a reality. It prepares most of the professionals who develop, lead, manage, teach, work in and influence society's institutions, including K-12 education. Besides training future teachers, higher education strongly influences the learning framework of K-12 education. Higher education plays a critical role in creating and disseminating the knowledge, skills and values for society. Moreover, higher education has unique academic freedom and the critical mass and diversity of skill to develop new ideas; to comment on society and its challenges; and to engage in bold experimentation in sustainable living.

In addition, higher education is a large economic engine. There are 4,100 higher education institutions in the United States—community colleges, universities, colleges and professional schools—with a total of 14.6 million students. The annual operational budgets of those institutions is \$200 billion—greater than the GDP of all but twenty countries in the world. Their endowment is over \$200 billion.

Imagine the economic leverage if the universities were modeling sustainability by purchasing environmentally friendly products and services. And imagine the leverage if universities were utilizing the faculty and students to conduct the research to help them make those decisions. Graduating students would have the knowledge and values to demand environmentally- friendly products and services and know how to help business create them.

Education for the Twenty-first Century

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? What would higher education look like? The education of all professionals would reflect a new approach to learning and practice. The university would operate as a fully integrated community that models social and biological sustainability itself and in its interdependence with the local, regional and global community. In many cases, we think of teaching, research, operations and relations with local communities as separate activities; they are not. Because you, as students, learn from everything around you, everyone with whom you interact and everything you do, these activities form a linked and interdependent web of your learning experience.



Society & Biosphere

Universities Modeling Sustainability as a Fully Integrated System

Universities are fully integrated systems that are part of and interdependent with local and regional communities and local, regional and global ecosystems. All parts of the university system are critical to achieving a transformative change in thinking, values and action which can only occur by connecting head, heart and hand.

Imagine if, in the twenty-first century, the educational experience of all students is aligned with the principles of sustainability. The content of learning would embrace interdisciplinary systems thinking to address environmentally sustainable action on local, regional and global scales over short-, medium- and inter-generational time periods. Education would have the same "lateral rigor" across the disciplines as the "vertical rigor" within the disciplines. Compartmentalized knowledge without connection to larger system interactions results in viewing many interdependent challenges—such as population, consumption, economic, health and the environment—as separate and often competing. The net results are often narrow, ineffective solutions, or worse, more harmful to people and the environment in another place or another time. [E.g., Prius and transportation] Systemic thinking is essential to developing a shared framework for understanding and dealing with complex nonlinear systems that are characteristic of society and the natural world. Understanding how the natural world works and learning how to have human technology and activity mimic and live within the limits of natural systems is crucial to education for citizenship in the 21st century.

The context of learning would change to make the human/environment interdependence and values and ethics a central part of teaching in 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 the ecological services that are critical for human existence and how to assess and minimize the ecological and social footprint of human activity - making explicitly visible what is now invisible. For example, in order to reflect human/environment interdependence, the teaching of all chemistry courses would include attendant dangers to human health and the environment of chemical processes and development of safe and sustainable processes that are also profitable. In short imagine as engineering students you first learned how the natural world worked

The process of education would emphasize active, experiential learning and real-world problem solving on the campus and in the larger community. For example, as part of the curriculum, the learning experience for students should include working on actual, real-world problems facing communities, government and industry. It would also increase group work and learning so students will be able to effectively collaborate as future managers and leaders on complex problems.

To take us **one step closer**, higher education must "**practice what it preaches**" and make sustainability an integral part of **operations, purchasing and investments**, and tie these efforts to the formal curriculum. The university is a microcosm of the larger community. Therefore, the manner in which 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. By focusing on itself, the university can engage students in understanding the "institutional metabolism" and ecological footprint of materials and activities. Students can be made aware of their "ecological address and footprint" and they can and should be actively engaged in the practice of environmentally sustainable living.

To take us to the **next step**, think of the impact of higher education forming partnerships with local and regional communities to help make them socially vibrant, economically secure and environmentally sustainable. When they graduate, the students would bring their knowledge, skills and values of sustainability to their future employment, consumption decisions, lifestyle choices, and to the improvement of communities in which they live. All university activities should benefit local communities.

WHAT ROAD WILL WE TAKE?

We Can Make a Conscious Choice

Business as Usual ?

- ◆ Full steam (speed) ahead
- ◆ Let nature set limits through
 - environmental collapse
 - poverty
 - malnutrition
 - social instability
 - war

Chinese Proverb:

If you don't know where you're going you'll end up getting there

Deliberate Individual and Collective Action?

- ◆ Civilized and cooperative ways to live in harmony with each other and nature

I am optimistic we will choose the latter and excited by growing numbers of people like you! Not easy and the results are uncertain. Can't predict the future, but we can shape it!

Chinese symbol for crisis:

2 characters – danger + opportunity

There are Encouraging Signs:

- US energy conservation 1973-86
- Solar energy increasing 43%/yr since 1990
- Organic food is increasing at 20%/yr for past 7 yrs
- Wind energy increased 25% over the decade
- China largest mfr of compact fluorescents; India wind turbines
- China's coal use has dropped 25% since peak of 1996
- December 2000 POP treaty by 122 countries
- Forestry Certification Council
 - 1 million ha certified in 1995 sustainably harvested
 - 17 million in 1999; 200 million projected by 2005
 - Home Depot and Loews announcements to buy only sustainably harvested wood by 2002
- SR Investing
 - 1 out of every \$7 professionally managed
 - DJSI: 200 companies outperformed Dow 2000 by 50% over last 3 yrs
- U.S. policy on protection of children in health & env. qual. stds
- HP & IBM: computer take back & recycling programs
- University presidents' mtg in November 2000 at Oberlin
- University presidents' open letter to bush on energy policy
- SN Sustainable Design Program for schools of architecture and CEEM.
- Graduate Pledge Alliance
- NJ College and University Greenhouse Action Plan

The Special Role for Engineers

Because Clarkson has such a strong engineering school which is a large part of the university's programs, I want to say a few special words about engineers. Engineers are the designers that make modern life possible. We have a special responsibility to develop technology that is life enhancing and preserves and enhances the life support system – the ecosphere.

The engineers of the future must be much more interdisciplinary—the lines between the traditional engineering disciplines must be much more fluid or removed completely. Engineers will have to **join forces with health professionals, biologists, chemists, meteorologists, economists, political scientists, ethicists, environmental scientists and ecologists; urban, land use and transportation planners; architects; materials scientists; environmentalists and community leaders in unprecedented ways** to lead society on a sustainable path. For example, we will **double the amount of housing and building construction in the next 50 years!** Because of the severe limitations of conventional design and the huge ecological impact of this amount of building, engineers must be leaders in life enhancing and environmentally sustainable design.

Engineers must play a much **stronger role in the public policy process** to provide the **right incentives** for industry and others to design sustainable technology. We must become better informed of the **interdependence** of environmental, economic, health and social issues, inform others and become leaders. **Otherwise the agenda will be set by others** who neither know the benefits nor the limits of technology in a sustainable modern society.

Conclusion

We are now in the process of breaking away from an old paradigm which, like the gravitational pull, will require a great deal of energy, commitment and perseverance. When we move our understanding to ways of creating an environmentally sustainable future we will quickly accelerate the changes necessary for a better world that works for everyone.

We must do it quickly. We have only one Planet Earth. Space travel has made us realize just how small and interconnected our planet really is. We are coming to realize that in the only galaxy we know, we may be the only human experiment - with only one chance for survival. Rene Dubos has said, "Think globally, act locally." I offer a friendly addition, "Think future, act now." We can do it if we set our minds to it. I'm reminded that President John F. Kennedy in the early 1960s set a goal for man to reach the moon. At the time we had no way of knowing if it could be done. But because it was a goal we shared and to which we put our minds, hearts and our backs, we achieved the goal.

We must take the actions now which will prevent long-term problems and have a deep regard for the world we will leave to future generations. It has been said that we inherited the earth from our ancestors. A more appropriate view is that we are borrowing it from future generations.

Thomas Jefferson clearly understood the idea of intergenerational equity. In 1789, he wrote a letter to James Madison, which I will paraphrase here:

“The earth belongs to the living. No man may by natural right oblige the lands he owns or occupies to debts greater than those that may be paid during his own lifetime. Because if he could, then the world **would belong to the dead and not to the living.**”

APPENDIX

Examples

Design

◆ *University of Wisconsin-Green Bay*

An academic building at UW-Green Bay is about to become one of the most energy-efficient buildings ever constructed. The focus of the new 120,000 square foot facility will be its advanced Building Integrated Photovoltaic (BIPV) energy system. Early estimates include an annual savings of 42,000 lbs. coal, 74,000 lbs. CO₂, 340 lbs. SO₂, and 400 lbs. NO_x.

Oberlin

Under the direction of David Orr, with administration and student help, Oberlin College has designed one of the most environmentally sustainable buildings at any university. For example, no toxic building materials were used in its construction; it is completely solar-powered and produces excess energy for the campus; it causes no air pollution and the effluent water meets EPA standards for drinking water quality.⁵

Energy

◆ *State University of New York-Buffalo*

A cumulative \$65 million has been saved; energy costs constant on one campus since 1993 while constructing 6 new buildings and expanding the campus by 20%.

◆ *University of Colorado-Boulder*

By a 6 to 1 margin, the referendum passed, resulting in a \$1 per student/per semester student fee increase that would generate \$60,000 a year to purchase output from one turbine at the Excel Wind Farm. The University began purchasing the wind power in September 2000, and it now provides 35-40% of the energy used by those buildings.

Transportation

◆ *Cornell University*

Purchasing

◆ *Purchasing at Rutgers University*

Beginning in 1988, Kevin Lyons, Head of Purchasing at Rutgers University, Camden, has led a university-wide commitment to sustainability through his purchasing department. Over 10 years, Rutgers Camden saved \$7.5 million and dramatically reduced its environmental impact. Become Rutgers' institutional practice.

Greenhouse/Climate

◆ *Sustainability Greenhouse Gas Action Plan for New Jersey*

In Feb. 2001, 56 college presidents signed commitment to a plan, a 3.5% reduction in New Jersey greenhouse gas emissions below 1990 levels by the year 2005."

Medical and Research Facilities

◆ *584 medical facilities nationwide have pledged to virtually eliminate mercury waste by 2005; All 39 hospitals in the state of Maine.*

◆ *The California Medical Association and the Massachusetts Medical Society resolved in 2000 to call for policies that will lead toward the eventual elimination of mercury from incinerator waste streams.*

Research and Curriculum

◆ *Green Chemistry at UMASS*

- a new UMASS "green chemistry" doctoral program led by Dr. John Warner.
- promotes "green chemistry" in labs from the beginning of students' careers.
- promotes chemical and biotech methods that use fewer toxic chemicals and result in less waste.

Investing

◆ *Columbia University*

In 1999 the group Students for Socially Responsible Investing (SSRI) was formed: a permanent channel for conveying to the University Trustees concerns of the Columbia community regarding socially responsible investing issues and the endowment.

Integrated Approaches

◆ *Emory University*

A new campus-wide mission statement's fundamental principles are to:

- Incorporate environmental concerns as a significant priority in university decision making.
- Conserve natural resources and restore environmental quality.
- No net loss of forests

Stuff that wasn't used...

1. Reduce ecological & social footprint as a responsible institution, being a good corporate citizen

2. Microcosm of society and a mirror to it

- Practice what it preaches in operations, purchasing & investments
- Manifests and reinforces values & practices & desired behavior
- Improved learning
 - Experiential, cooperative and collaborative
 - applied, systemic, complex research & problem solving
 - sense of place & connection to community; ecological address

3. Demonstration/Experiments in sustainable living for students and surrounding communities.

Second Nature believes that the sustainable design and management of facilities and physical plants presents a valuable opportunity for institutional transformation on campus and in nearby communities. The planning, design and implementation process can bring stakeholders from across the campus community into a common conversation, striving towards common goals and tangible results. Colleges and universities construct buildings, maintain sanitation systems and facilities, provide heat and power, employ, house and feed people, and contract with government and private institutions. These activities provide unparalleled opportunities for collaboration, teaching, research and learning. Facilities and financial managers, environmental health and safety managers, purchasing managers, transportation managers, dining facilities managers, university hospital administrators, maintenance services staff, custodial staff, department heads, and faculty and students.

Imagine a sustainable design or facilities management project as the opportunity to create:

- buildings that are ecologically sound and showcase very visibly an institution's commitment to a just and sustainable future;
- working and living spaces that promote positive social interaction and thereby contribute to community-building and community engagement;
- environments that help students, faculty, staff and visitors live and work comfortably and productively and reduce the physical problems associated with less environmentally sound materials;
- facilities that, over the long run, contribute to financial savings and resource efficiency;
- surroundings that provide rich opportunity for community-wide collaboration and experiential learning.

-“ No person, institution, or nation has the right to participate in activities that contribute to large-scale, irreversible changes of the Earth’s biogeochemical cycles or undermine the integrity, stability, and beauty of the Earth’s ecologies – the consequences of which would fall on succeeding generations as an irrevocable form of remote tyranny.”

We have an obligation to leave the planet in better shape than it was when we arrived. The native American Chief Seattle, in an account that we know as fictional, but accurately reflects Native American beliefs and captures the concept of the interconnectedness of the natural and physical world, said to President Franklin Pierce in 1844, about the sale of land which is now the state of Washington, "The earth does not belong to us; we belong to the earth. All things are connected, like the blood that unites one family. Mankind did not weave the web of life. We are but one strand within it. Whatever we do to the web, we do to ourselves.

-It is also critical to overcoming the effect of 3000 advertising messages a day, emphasizing individual satisfaction through consumption that has no limits save our ability to pay.

KEYS TO SUCCESS

- ❖ Passion (vision and change)
- ❖ Patience (be flexible & adaptable – change won't occur overnight); offer solutions
- ❖ Persistence (buy-in; hard on principles, soft on strategies)
- ❖ Practice what we preach
 - Shared Responsibility
 - Increased Internal +External credibility
- ❖ Partnerships
 - Communities, industry, academia, professionals
 - Health Care Professionals and others - list
- ❖ Praise + Share Credit
- ❖ Precautionary principle – public health model of medicine