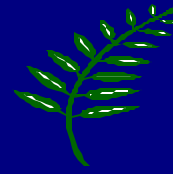


Engineers Forum on Sustainability



Forum Addresses Sustainability in Education and Practice

At the January 10, 2003 meeting of the Engineers Forum on Sustainability, participants heard and discussed a wide range of presentations on various aspects of sustainability. Topics included Science and Technology for Sustainability; Environment, Engineering and Human Health; The Business-Environment Learning and Leadership Network; Engineers Without Borders - USA; Air Quality Improvements in South Africa; and the RNR Conference on Non-point Source Water Pollution. Many of these presentations are summarized in this issue of the Newsletter.

Also featured in this

issue are articles on sustainability in engineering education and K-12 education, hydrogen as an alternative energy source, and efforts to include an engineering component in UNESCO programs.

The next meeting of the Engineers Forum on Sustainability is scheduled for Friday, May 9, 2003 in Room 250 of the National Academy of Engineering in Washington, D.C. The Forum will meet from 9 AM to Noon, and the Engineers International Roundtable will meet in the same room from 1 PM to 4 PM. Please mark your calendar for these two events. Detailed agendas will be e-mailed to you prior to the meetings.

Notice to First-Time Newsletter Recipients:

In order to "spread the word" about developments and issues in sustainability, the Forum is expanding its e-mail distribution list for the Newsletter to include individuals with leadership roles in engineering and related disciplines who may have responsibilities and/or interests in various aspects of sustainability. The Newsletter is published three times a year, and we hope that you will find it useful and informative in your professional activities. If you do not wish to receive future issues, please notify danap@aiche.org.

-- Al Grant – Forum Chair

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Sustainability in Engineering Education

(Ed. Note: This feature article was written by William E. Kelly, P.E., Fellow, ASCE; Professor of Civil Engineering, The Catholic University of America; and Immediate Past Chair, Engineering Accreditation Commission, Accreditation Board for Engineering and Technology [ABET])

Introduction

Sustainability is included in the new ABET Engineering Criteria as part of Criterion 4 which states in part *The curriculum must prepare students for engineering practice culminating in a*

major design experience based on the knowledge and skills acquired in earlier coursework and incorporating engineering standards and realistic constraints that include most of the following considerations: economic, environmental, sustainability, manufacturability, ethical, health, and safety, social, and political.

Comments on the new Criteria and on sustainable development by engineers and others underline the lack of agreement on the meaning sustainable development and sustainability in engineering. What sustainability means in

engineering practice continues to be debated but students will benefit by joining in the continuing discussion on the issues surrounding sustainable development. Sustainable development in any form will not succeed without well-informed input from the engineering community. Although some of the environmental problems that have turned our attention to sustainable development are undoubtedly technology induced, effectively dealing with these issues and indeed fully implementing sustainability in practice will depend on new technologies and new

Sustainability in Engineering Education continued

technological approaches. A recent report by the National Academy notes that relatively little of the input over the last 10 years or so had been from the science and technology community.

The Board of Direction of the American Society for Engineering Education (ASEE) approved the following statement on sustainable development education in June 1999:

Engineering students should learn about sustainable development and sustainability in the general education component of the curriculum as they are preparing for the major design experience. For example, studies of economics and ethics are necessary to understand the need to use sustainable engineering techniques, including improved clean technologies. In teaching sustainable design, faculty should ask their students to consider the impacts of design upon U.S. society, and upon other nations and cultures. Engineering faculty should use systems approaches, including interdisciplinary teams, to teach pollution prevention techniques, life cycle analysis, industrial ecology, and others sustainable engineering concepts.

Case studies, including studies of university-industry-government partnerships, can be used to illustrate the importance of the multidisciplinary aspects of designed systems, the impacts of those systems upon society and the environment, and the practical viability of the sustainability concept.

ASEE believes that engineering graduates must be prepared by their education to use sustainable engineering techniques in the practice of their profession and to take leadership roles in facilitating sustainable development in their communities.

Clearly there is a lot of support and encouragement to move ahead with sustainability in engineering education.

Sustainability in General Education

As noted in the ASEE Statement, much of what students learn about sus-

tainable development and sustainability must come from the general education component of the curriculum as they prepare for the major design experience. Studies of economics and ethics are necessary to develop an understanding of sustainable development and where technology, in particular clean technologies, could fit in.

A number of the ABET outcomes fit very well with building a knowledge of sustainability as a consideration in design. Overall, the ABET Criteria provide a framework for including sustainability in an undergraduate engineering program and suggest opportunities to educate the rest of the campus on sustainability issues as well.

For those interested in potential linkages between security and sustainable development, it has been suggested that the environment could be the national security issue of the twenty-first century. The reasoning is that some of the parts of the world where water is in short supply are also some of the most unstable.

Sustainability in Engineering Design

The only explicit requirement for sustainability in the ABET Criteria is in the general criteria. With the great strides being made in the application of sustainability concepts to manufacturing processes, it is important to begin to define the principles that apply to all fields of engineering and some basic principles that could be introduced to all engineering students early in their engineering program.

In discussing general engineering principles, it is important to define the design paradigm so as to include the considerations called for in ABET Criterion 4. It will also be necessary to define the systems context for design and define metrics that can be used to determine whether design goals are met and to compare alternatives.

Life cycle design is one of the ways

the engineering profession could contribute to sustainable development. Although life-cycle design is far from normal practice, consideration of life-cycle costs is common in many areas. Pollution prevention is an element in life-cycle design and many companies are finding that pollution prevention just makes good business sense.

In teaching design, sustainability is a broad enough concept to encourage students to consider design in its societal and global context. This should also encourage students to think in more interdisciplinary ways. In teaching pollution prevention for industry, it is necessary to know industrial processes in some detail. In discussing pollution prevention in manufacturing it becomes very clear to civil engineering students that they are dealing with an interdisciplinary problem that requires a team effort for solution.

Consideration of systems aspects of sustainability in engineering design education could encourage a reconsideration of the systems approach in engineering education in the United States.

In discussing sustainability as a consideration in design, students must consider the context of their projects. During construction of America's infrastructure, from the construction of the transcontinental railroad to the interstate highway system, relatively little consideration was given to the impacts that these systems would have on the environment and social-economic systems. Today, some even say that if we had had to consider sustainability when building these projects, they would never have been built!

By including sustainability in discussions of design, there is ample motivation to review some of the large existing infrastructure projects from the perspective of sustainability. It should be possible to learn a great deal from such an "enhanced" case history approach and at the same time learn about the history of their profession.

Sustainability in Engineering Education continued

After World War II, Europe and Japan had the opportunity to rebuild much of their infrastructure. To what extent did this rebuilding allow them to build a more efficient infrastructure? What can we learn from this experience and apply to developing countries is

sufficient capital can be found. Even with the best of intentions, sustainable development for developing countries is not going to be possible without capital. But efficient use of capital by well-educated engineers is going to be one of the keys to success in this development.

Finally, while ASCE includes some direction in its Code of Ethics, good examples of the application of the principles of sustainable development in civil engineering design, manufacturing, and construction are needed.

NCSE Conference Advances Education for a Sustainable and Secure Future

Roughly 700 people gathered in Washington, DC at the end of January to explore the linkages among science, environment, sustainability and security with the goal of sparking education reform to integrate these disciplines and create an agenda for a sustainable and secure future.

Sponsored by the National Council for Science and the Environment (NCSE), this conference brought together scientists, educators, policymakers, business people, environmentalists, government officials and community leaders to develop recommendations for a national education agenda to include sustainability and security, and to devise a plan and a constituency for making this agenda a national priority.

Jonathan Lash, President of the World Resources Institute, set the stage for conference participants to discuss the role of education in achieving a sus-

tainable and secure future, and made a case for a broader perspective of security that integrates sustainability and the environment.

Following the lecture a roundtable discussion involving leaders across the political spectrum from government, science, communication and education discussed the relationships between security, sustainability and the environment, and how education should be changed in order to increase the understanding of these relationships.

Conference attendees participated in 21 concurrent breakout sessions focused on K-12, community and higher education; public communication; and a variety of topics including diversity, geographic education, planetary health, business, and curricular development. The goal of these sessions was to develop 6 – 10 bulleted recommendations of what should be done to advance edu-

cation for a sustainable and secure future within the context of the breakout area.

At the end of the conference volunteers were given the task of producing a report of recommendations on how to improve environmental and sustainability education on various levels, in various communities and as a whole. Conference coordinators plan to distribute the report widely — through briefings and presentations to Congress, federal agencies, press, and K-12 and higher education professionals, as well as to UN officials working on the UN Decade of Education for Sustainability.

For more information please visit the NCSE conference web site at: <http://www.ncseonline.org/NCSEconference/>.

BELL Network Promotes Sustainability in Business Schools

Business schools all over the world have begun to recognize the important role they have to play in transforming the ways in which industry meets human needs. Protecting the environment was once considered only a cost of doing business; today, the environment is emerging as a fundamental issue for business. Companies all over the world are now winning and losing markets based on the environmental impact of their facilities, processes and products. Unfortunately, few managers emerge

from business school prepared to integrate environmental considerations into business strategy. WRI's BELL (Business-Environment Learning and Leadership) is helping to change that.

BELL faculty understand that the environment is an intrinsic part of all business activity, from design and production to marketing, use and disposal. To make management education "green", professors must address environmental issues across the entire spectrum of the curriculum's core courses. Furthermore,

students and faculty must form partnerships with business leaders and surrounding communities to share knowledge and gain practical experience in creatively addressing environmental challenges.

BELL Activities

Curriculum resources fill in the gaps that exist in the business and environment teaching literature. BELL publishes numerous teaching cases, developed by professors in all management

BELL Network continued

disciplines to help incorporate environmental issues into the management curriculum. BELL publishes a web-based, annotated guide to environment and business teaching cases from all publishers. With help from Second Nature, our partner for sustainability in higher education, BELL also offers a database of business school course syllabi demonstrating how numerous professors have integrated environment into their courses and what teaching materials they use.

Technical assistance provides the services of SEP staff and others to help each BELL school develop a unique, lasting approach to business and environment issues. The assistance may include - but is by no means limited to - site visits, faculty development workshops, guest speakers, student seminars, internships and career development. Environmental Enterprise Corps (EEC) provides an exciting opportunity for business students to gain first-hand experience assisting entrepreneurs who are

establishing or expanding environmental companies in Latin America. Through the EEC, student teams have the opportunity to help these companies with a range of services, including business plan development, marketing strategies, financial analyzes, and capital search. These services help the companies attract investment, while making aware of the business opportunities available in fast-growth environmental sectors.

BELL Conferences and workshops enable faculty to learn about leading-edge environment and business developments, network with their peers and learn about teaching innovations and resources. In addition to the annual BELL Conference, WRI also coordinates periodic regional or topical workshops or seminars.

Materials exchange occurs continuously through BELL. SEP regularly disseminates business and environment course material for faculty review and adoption. The quarterly BELL Newsletter keeps faculty and other BELL network members in touch with each other,

new development, new resources, etc.

Beyond Grey Pinstripes: Preparing MBAs for Social and Environmental Stewardship, is a biennial report published by WRI in partnership with the Aspen Institute's Initiative for Social Innovation through Business. The report evaluates leading business schools to identify innovators and to benchmark class work, research and student activities that foster social and environmental stewardship. Beyond Grey Pinstripes helps prospective students find the right MBA program for their needs, helps employers identify which schools offer training they want their employees to have, and helps innovative practices spread faster among business schools.

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World Economic Forum Creates Disaster Resource Network

The Disaster Resource Network (DRN) harnesses resources voluntarily donated by business to mitigate human suffering associated with disasters. DRN makes it easier for businesses to offer talent or in-kind donations for the emergency response phase of disaster relief and ensures that corporate donations are delivered in a coordinated and effective manner to existing humanitarian organizations. World Economic Forum members first conceived of DRN at the Annual Meeting 2001 in Davos, Switzerland, as they reflected on the Gujarat earthquake of January 2001.

The initial objectives of the Disaster Resource Network are to:

- Create a clearinghouse to efficiently couple the demand for goods and services following a disaster with

the supply of those goods and services from engineering and transportation companies.

- Develop a network of regional business leaders who are willing to take action and use influence to help out when disaster strikes in their region.
- Develop a training marketplace to train business employees who are prepared to volunteer their time and their knowledge to help out following a disaster.
- Develop a knowledge database to overcome the legal, contractual, and regulatory hurdles that can slow progress when time is critical.

By leveraging local resources through this network of regional business leaders, the DRN in bringing together companies to deepen collaboration between busi-

ness, governmental agencies, international organization and non governmental organizations to produce a much more effective contribution to existing disaster relief efforts. The DRN also provides companies with an opportunity to increase their engagement, and demonstrate their commitment and support in their local communities.

Further Steps

Planned activities include:

- Continuing collaboration with the International Federation of Red Cross and Red Crescent Societies (IFRC);
- Conducting training seminars in London, Mumbai and Mexico City to inform senior corporate executives of the private sector's role in

Disaster Resource Network continued

- supporting disaster relief agencies and to explain the processes for doing so;
- Continuing collaboration on the "INSARAG Critical OnSite Support" initiative in collaboration with the United Nations Disaster Assessment and Coordination (UNDAC), a department with OCHA;
- Liking the DRN Resource Database with the UN Central Registry of requests and resources for emergency use by UN agencies. The Disaster Resource Network would thus become the central point of contact for resource coordination between private corporations and the UN;
- Strengthening collaboration with the Corporate Network for Disaster Response in the Philippines, and expanding membership in all countries;
- Conducting the First Annual DRN Regional Leadership Seminar.

The DRN currently has over 15 corporate members in England, India, Mexico, the Philippines, Spain, Sweden, Switzerland and the United States.

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EWB-USA: A Program and Project Profile

Engineering curricula in modern universities are mostly designed toward solving the problems of the one billion rich but do not address the needs of the five billion poor. This is unfortunate as the demand of the developing world for engineering solutions is likely to increase in the forthcoming years due to population growth. There is a need for training a new generation of engineers who could better meet the challenges and needs of the developing world. The challenge is the education of engineers: (i) who have the skills and tools appropriate to address the issues that our planet is facing today and is likely to face within the next 20 years; (ii) who are aware of the needs of the developing world; and (iii) who can contribute to the relief of the endemic problems of poverty afflicting developing communities worldwide.

Engineers Without Borders in the US originated at the University of Colorado at Boulder as a follow-up to fieldwork in May 2001 when Bernard Amadei, Professor of Civil Engineering, took ten undergraduate students from the Department of Civil, Environmental and Architectural Engineering to help with the construction of a water distribution

system for a small Mayan village located in southern Belize.

The work in Belize led to the creation of a non-profit 501 (c)(3) tax-exempt corporation called Engineers Without Borders™ – USA (EWB-USA). The first chapter of EWB-USA (called EWB-CU) was formed at the University of Colorado at Boulder in late fall 2001. A national workshop was held near Boulder on October 5, 2002. About 50 participants attended the workshop with a representation from academia, industry, and national laboratories. As a follow-up to the workshop, about 20 new student chapters and several professional chapters are coming on-line across the U.S.

The mission of EWB-USA is to help developing areas worldwide with their engineering needs, while involving and training a new kind of internationally responsible engineering student. Most EWB-USA projects involve the design and construction of water, sanitation, and energy systems. These projects are initiated by, and completed with, contributions from the host community, which is trained to operate the systems without external assistance. All EWB-

USA projects are designed to be appropriate and self-sustaining. They are conducted by groups of engineering students under the supervision of professional engineers and university professors. The students select a project and go through all phases of conceptual design, analysis and construction during the school year with implementation and monitoring during breaks and the summer months. By involving students in all steps of the projects, the students become more aware of the social, economic, environmental, political, ethical, and cultural impacts of engineering projects. On-going EWB-USA projects are located in Belize, Peru, Mali, Nepal, Mauritania, Nicaragua, Haiti, Thailand, Armenia, and Senegal.

During 2001-2002, 35 engineering students at the University of Colorado at Boulder participated in the projects. Detailed description of these projects can be found on the web (www.ewb-usa.org). All EWB-CU projects have been financed by small grants from the University of Colorado (Outreach Committee; Engineering Excellence Fund; Undergraduate Research Opportunity Program) and private donations.

EWB-USA continued

Project Profile: San Pablo, Belize

EWB-USA began in San Pablo, a Mayan village of about 250 people. In April 2000, Angel Tzec, a representative of the Belize Ministry of Agriculture invited the author to visit San Pablo to examine the possibility of designing and installing a water delivery system to the village.

Since the village had no electricity, running water, or sanitation, and because most villagers worked at a nearby banana plantation, the responsibility for carrying drinking and irrigation water from a nearby river (the Swasey river) to the village fell to the village children. Confident that a water project would help improve the quality of life of the villagers, and strengthen their ability to maintain their community and their culture, the author returned to Boulder. There, he recruited eight University of Colorado students in civil and environmental engineering.

The team set to work considering the options for San Pablo and settled on a ram pump as the most efficient, sustainable design under the local conditions. A waterfall with 6-7 ft of head provided the energy necessary to drive the pump. The water distribution system consisted of a water intake structure, a ferro-cement drive tank and a storage tank connected by a network of about 3,000 ft of

PVC pipes. The pump was able to provide a steady flow of 1 gal/min to the village storage tank located about 120 ft above the river level.

The entire project was completed in May 2001 at a cost of about \$14,000. Nevertheless, more than that, it demonstrated the potential of professional and student engineers working together to help a local, underdeveloped community create a sustainable solution.



Three months after installation of the water distribution system, the Swasey river experienced a 10-year flood in August 2001. The water level rose about 70 ft over a short period and eroded severely the river embankments. The flood damaged a section of the water distribution system along the river including the ram pump. The rest of the water distribution between the river and the upper storage tank remained intact and could be salvaged. In September

2001, the ram pump was replaced by a more conventional 5.5 HP gasoline pump. The pump was connected to the existing 1.0 in PVC distribution line.

Following the September visit, the area of San Pablo was hit in November 2001 by a magnitude IV hurricane. Many of the banana plantations were leveled off and the men in the village found themselves out of work. The gasoline pump was damaged by the hurricane. The local villagers did not fix the pump due to a lack of financial resources. The author arranged to have the gasoline pump fixed at a Mennonite community in Belize. He then traveled to Belize in March 2002 to deliver the pump, reinstall it, and reconnect it to the existing 1.0 in PVC distribution line. A second 1.5 in PVC line was installed to provide more water to the storage tank.

Finally, in July 2002, three 140 ft deep water wells were drilled in the village. One of the three wells yielded a continuous flow of 7 gal/min of clean water. Plans are to return to San Pablo, drill more wells, provide electricity, and construct a medical clinic.

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CERF Assists South Africa in Phase-Out of Leaded Petrol

The Civil Engineering Research Foundation (CERF) is working with USEPA to assist the South African government in the phase out of leaded motor fuel. South Africa has major refining capacity with significant upcoming investment needs and is a major exporter of leaded gasoline to other countries on the continent. Influencing such a major supplier is likely to produce increased demand for deregulation and market-opening activities in other countries in

the continent, as well as substantial reduction in the health effects associated with lead in gasoline. This technical support is being carried out through a cooperative agreement with USEPA, using funding from the USAID Africa Trade and Investment Program.

This project provides an initial opportunity to achieve early successes in the "Clean Fuels and Energy Initiative" adopted by agreement at the World Summit on Sustainable Development

(WSSD). The project brings together many of the same players and issues that will be involved in further developments of the Initiative and offers a prototype for later activities.

South Africa accounts for about 53 percent of the lead produced on the continent and about 4 percent of the total global production. It is also responsible for about 28 percent of the annual lead emissions in the continent. The South African Government transportation air

CERF Assists South Africa continued

emission situation is characterized by the following conditions:

- The number of motor vehicles is increasing rapidly
- Auto emissions are not regulated
- Ambient air quality is deteriorating including higher lead levels
- Related health problems are increasing

Components of the Program

The existing situation provides an opportunity for beneficial change. A shift to unleaded gasoline can be used as the first step in a program of major energy efficiency and environmental improvements to the entire distribution chain and a program of pollution control for motor vehicles, with significant opportunities for international companies in vehicle emissions control, monitoring, and other areas.

The objectives of the project include the following:

- Promote and assist the phase out of leaded gasoline
- Build long-term linkages for environmental cooperation and trade, especially developing USA/South Africa business linkages
- Provide technical assistance to industry and the government
- Promote public awareness and education.

The components of a comprehensive program of implementation are being developed through new legislation and regulation by a variety of South African government agencies. The following efforts, and the relevant agencies are of particular importance:

- Air Quality Act—Dept. of Environmental Affairs and Tourism
- Fuel Quality—Dept. of Minerals and Energy
- Fuel Pricing—Dept. of Minerals and Energy
- Vehicle technical specifications—Dept. of Trade and Industry
- Emission inspection procedures—National Dept. of Transportation

- Vehicle/traffic control measures National Dept. of Transportation

USA Implementation Assistance

USEPA and CERF have been leading the USA effort to assist in the transition by developing partnerships with the South African government, industry, and NGOs. In particular, the assistance is occurring in the following areas:

- Potential business linkages—for example, many international markets and industrial linkages are possible in functions such as refinery conversion services and hardware, automobile parts, and gasoline distribution equipment.
- Technical assistance—we are providing research and support in the area of financial incentive mechanism, Fuel additive research and analysis and means to capture spin-off benefits.
- Capacity building—we are working with government environmental technical staff, small and medium sized businesses, and NGOs to provide training, resources, and information to improve their abilities to address the issues.
- Public awareness and education—we developed a broad-based information program ranging from designing cartoon characters to appeal to children, to designing information to be included with automobile registration packets.

The Path Forward

A major Implementation Collaboration Workshop, sponsored by USEPA and CERF took place in Johannesburg (January 2003). This workshop involved the full range of stakeholders in the program. The objective of the workshop was to assist in developing the relationship and involvement from all sectors that will be necessary to continue the successful implementation.

The lessons learned in South Africa will inform efforts elsewhere, whether linked to the Clean Fuels and Vehicles

Initiative, or other clean air or environmental enhancement programs. The interaction with the South African government, business, and NGOs will continue with a variety of activities including an assessment mission from South Africa to USA by environmental professionals, and continuing direct business and NGO linkages.

The South African strategy for implementation and activities to date include:

- Multi-stakeholder workshop held in May 2002
- Consensus on standards
- Agreement on approach
- Communicate benefits
- Develop timetable
- Communicate benefits including:
 - Increased health
 - Reduced cardiovascular disease
 - Reduced bronchial disorders
 - Reduced hospital admissions
 - Longer life expectancy
 - Reduced lost working hours
 - Economic benefits in auto production

South Africa will be adopting the Euro standards for motor vehicle emissions.

For further information, contact wkirksey@cerf.org

Shell Center for Sustainability

The new Shell Center for Sustainability at Rice University held its Inaugural Conference on March 12-13, 2003. The new Center is committed to developing and implementing sustainable solutions to the critical, interconnected environmental, economic, and social challenges facing our planet. A report on the Inaugural Conference will be given at the May 9, 2003 meeting of the Engineers Forum.

US Engineering Community Recommends UNESCO Engineering Program

With the return of the United States to UNESCO there is a significant opportunity to strengthen the capacity of developing countries to address poverty eradication and sustainable development and strengthen the capacity of UNESCO to assist in this process. The public should be aware of and understand the central role of engineering in promoting and creating the conditions for enduring peace and security.

Accordingly, the US engineering community has recommended that UNESCO create an *"Engineering and Technology Program for International Development"* with an estimated cost of \$5 million per biennium that would be based on UNESCO partnerships with non-governmental engineering organizations.

The proposed program would focus on strengthening engineering education, hands-on training, engineering ethics and codes of practice for sustainable development, promotion of engineering and technology in follow-up to the World Summit for Sustainable Development and enhanced application of engineering and technology for:

- Capacity Building in Engineering Sciences and Technology
- Poverty Eradication and Sustainable Development
- Dissemination of Information, Knowledge and Technology

Priority attention will be given to water supply and sanitation, cleaner production and recycling, energy efficiency and conservation, renewable energy, and emergencies and disaster preparedness.

Background

The United Nations Educational, Scientific, and Cultural Organization is an intergovernmental organization, founded in 1946, that has working relationships with other international organizations, and particularly with non-governmental organizations (NGOs)

such as the International Council for Science (ICSU), the International Council for Engineering and Technology (ICET), and the World Federation of Engineering Organizations (WFEO)/ Union of Technical Associations.

The United States withdrew from UNESCO in 1984, and is scheduled to rejoin in 2003. In the interim, U.S. engineers and scientists have worked through engineering NGOs in such areas as U.S. support of national hazards reduction programs and participation in the 1996 World Congress of Engineering Education and Business Leaders.

UNESCO has initiated a number of partnerships with NGOs since its establishment. Many are being given priority follow-up to the Johannesburg World Summit on Sustainable Development (WSSD). These partnerships (management of water resources, renewable energy resources, etc.) engage the engineering community as partners. For instance, the international engineering community is planning as a major initiative, the 2005 World Congress on Megacities of the Future, to be held at UNESCO.

The US engineering community is committed to supporting sustainable development through the Johannesburg Plan of Action and the UN Millennium Declaration. There is an opportunity to leverage these efforts and develop an engineering initiative, as part of the United States rejoining UNESCO, that would focus on engaging U.S. engineering capability to support US commitments to sustainable development. Priority areas common to UNESCO programs and the Johannesburg Plan of Action include "Water for the Poor Initiative" and the "Clean Energy Initiative."

Next Steps

The proposal signed by Hank Hatch representing the Engineers Coalition, Al Grant - Engineers Forum for

Sustainability and Bill Kelly - Engineers International Roundtable was sent to the State Department for inclusion in deliberation regarding US rejoining UNESCO.

In parallel, the proposal, endorsed by Paul Kostek Chair of AAES and Luther Graef US member of the WFEO Executive Council was forwarded to Jose Medem President of WFEO. Under President Jose Medem's signature, the WFEO Executive Committee, meeting in February, agreed to send its endorsement for the proposal directly to UNESCO Director General Matsuura.

To further support the proposal, several meetings, organized by State and the National Academies were held in February in DC with the UNESCO Delegation from Paris including: Walter Erdelin ADG for Natural Sciences, Maciej Nalecz Director - Division Basic and Engineering Sciences, Szollosi Nagy Secretary International Hydrological Programme and Howard Moore Director of UNESCO Venice Office. The proposal was well accepted by the delegation from UNESCO.

Much effort is now required to ensure that the proposal will be incorporated into the US UNESCO program and the needed financial resources are made available. Accordingly a small task group including Hank Hatch, Bill Kelly, Al Grant, Phil Hemily, Russ Jones, Tom Price, Jack Fritz and Michael Sanio is being assembled to develop the strategy and to seek the needed funding.

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Hydrogen is Focus of US Alternate Energy Plans in 108th Congress

President Bush recently announced in his state of the Union address \$720 million in new federal funding to develop the technology and infrastructure for moving toward a hydrogen based energy system in the U.S. This Freedom Fuel Initiative compliments the Freedom Car initiative announced last year, which would spur development of commercially viable fuel cell vehicles for use by 2020. A total of 1.7 billion will be spent on the integrated program for generation and transport of hydrogen to be used in fuel cell powered vehicles and electrical power generation over the next five years. While hydrogen is key focus for alternate energy this year, some additional support for fusion, biodiesel and solar energy usage is being developed.

The Hydrogen Program

A goal of the hydrogen program is to minimize the US dependence on foreign oil by developing technologies to produce, store and distribute hydrogen and to develop commercially viable hydrogen-powered fuel cells to power cars, trucks, homes and businesses.

Partnerships with the private sector are encouraged in the President's initiative. The president stated while fuel

cells are already a proven technology, citing that they have been in use by the US space program for over 30 years, research is needed to lower the cost of hydrogen and the fuel cells. According to the White House, hydrogen is currently is four times more expensive than gasoline when produced from its most affordable source, natural gas. Consequently, hydrogen sources from renewable resources, nuclear energy and coal will be emphasized. Also citing that fuel cell vehicles are currently 10 times more expensive than available technologies, the goal is to reduce the cost to more affordable levels.

Congressional Action on Alternate Energy

On the Senate Side, Senate Energy and Natural Resources Committee Chair, Senator Pete Domenici (R-NM) has scheduled a number of hearings during early 2003 to examine energy issues. Hearings on oil supplies, gas supplies, energy production on federal lands, and energy efficiency and conservation are scheduled to be completed by the end of March.

In the House of Representatives, Science Committee Chairman Sherwood Boehlert (R-NY) was supportive of the

President's hydrogen initiative. The Science Committee has jurisdiction over the FreedomCAR and Freedom Fuel initiatives which will be housed in the Department of Energy.

While the Administration has indicated their aim to keep total non-military domestic spending to below a 4% rise over FY2003, the new initiative on alternative energy may come from revenue generated from arctic drilling. Yet, drilling in The Arctic National Wildlife Refuge is not certain.

While the hydrogen economy will be the focus of alternative energy action in congress this year, some additional attention is being paid to other alternative energy sources. The US intends to join negotiations for the construction and operation of a major international magnetic fusion research project, known as the International Thermonuclear Energy Reactor (ITER).

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12 Principles of Green Engineering Available

(Ed. Note: At the January 10, 2003 Forum meeting, Paul T. Anastas, Assistant Director, White House Office of Science and Technology Policy, spoke on Science and Technology for Sustainability, and noted that a paper on green engineering principles was in preparation. The following is the introductory portion of the paper. The complete text of the paper is available at <http://pubs.acs.org/subscribe/journals/esthag-a/37/i05/pdf/303anastas.pdf>)

Through the 12 Principles of Green Engineering

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In recent years, numerous papers, books, and conferences have centered on the subject of lessening the negative human impacts on the planet and on its ability to sustain life. Often, from these

discussions, specific goals have emerged, such as minimizing waste, increasing recycling, or approaching sustainability. Goal statements can be very useful in providing a vision of what needs to be achieved, and many of these discussions contribute to important parts of that vision. Yet, goals are only effective when they become reality. Approaches are being developed to achieve these goals across disciplines, industries, and sectors. It is clear, however, that these approaches are currently neither systematic nor comprehensive.

Green Engineering Principles continued

Green engineering focuses on how to achieve sustainability through science and technology. The 12 Principles of Green Engineering provide a framework for scientists and engineers to engage in designing new materials, products, processes, and systems that are benign to human health and the environment. A design based on the 12 principles moves beyond baseline engineering quality and safety specifications to consider environmental, economic, and social factors.

The breadth of the principles' applicability are important. When dealing with design architecture - whether it is the molecular architecture required to construct chemical compounds, product architecture to create an automobile, or urban architecture to build a city - the same green engineering principles must be applicable, effective and appropriate. Otherwise, these would not be principles but simply a list of useful techniques that have been successfully demonstrated under specific conditions.

It is also useful to view the 12 principles as parameters in a complex and integrated system. Just as every parameter in a system cannot be optimized at any one time, especially when they are interdependent, the same is true of these principles. There are cases of synergy in which the successful application of one principle advances one or more of the others. In other cases, a balancing of

principles will be required to optimize the overall system solution. There are, however, two fundamental concepts that designers should strive to integrate at every opportunity: life cycle considerations and the first principle of green engineering, inherency.

The 12 Principles of Green Engineering

1. Designers need to strive to ensure that all material and energy inputs and outputs are as inherently nonhazardous as possible.
2. It is better to prevent waste than to treat or clean up waste after it is formed.
3. Separation and purification operations should be designed to minimize energy consumption and materials use.
4. Products, processes, and systems should be designed to maximize mass, energy, space, and time efficiency.
5. Products, processes, and systems should be "output pulled" rather than "input pushed" through the use of energy and materials.
6. Embedded entropy and complexity must be viewed as an investment when making design choices on recycle, reuse, or beneficial disposition.

7. Targeted durability, not immortality, should be a design goal.

8. Design for unnecessary capacity or capability (e.g. "one size fits all") solutions should be considered a design flaw.

9. Material diversity in multicomponent products should be minimized to promote disassembly and value retention.

10. Design of products, processes, and systems must include integration and interconnectivity with available energy and materials flow.

11. Products, processes, and systems should be designed for performance in a commercial "afterlife".

12. Material and energy inputs should be renewable rather than depleting.

The 12 Principles of Green Engineering provide a structure to create and assess the elements of design relevant to maximizing sustainability. Engineers can use these principles as guidelines to help insure that designs for products, processes, or systems have the fundamental components, conditions, and circumstances necessary to be more sustainable.

RNRF Holds Nonpoint Source Water Pollution Congress

The Renewable Natural Resources Foundation (RNRF) convened a congress on "Control of Nonpoint Source Water Pollution: Options and Opportunities" in September 2002, in Baltimore, Maryland. A case study and working group base approach was used to frame the issues and structure discussion among the delegates. This summary is based upon comments and discussion that took place during the plenary and working group sessions.

Current approaches to nonpoint

source pollution control, including Best Management Practices (BMPs), have made important contributions to improving water quality. However, as the sole approach they are insufficient. Efforts must be made to implement programs that concentrate on the characteristics of a particular region and take into account all sources of water quality impairment, such as Total Maximum Daily Loads (TMDLs). Using BMPs in conjunction with TMDLs can lead to significant improvement in water quality.

Local state and national governments have significant roles in controlling nonpoint source pollution. Government's responsibilities include ensuring funding for essential programs like education and research; providing necessary tools such as models and technical assistance; and developing financial incentive programs. Equally important is a robust monitoring program. Data are essential to gauge progress and to understand the effects of control strategies. Unfortunately, monitoring has been chronically

Nonpoint Source Water Pollution continued

under-funded. This must change.

Appropriately assigning these important responsibilities among the various levels of government is essential. This is particularly so given the inter-jurisdictional flow of water. Recognizing local variations in land and water characteristics---and community needs---the control of mitigation of nonpoint source pollution ultimately will be undertaken by local authorities. Regional management structures that have the ability to address inter-jurisdictional pollution issues, particularly at the watershed level, will need to be developed.

Developing and nurturing private and public partnerships is essential to accomplishing local and regional goals. Partnerships among governments also are necessary to improve cooperation and effectiveness. A mentoring or exchange program between and among state and federal agencies could help these partnerships develop as employees learn the challenges, goals, and constraints of other agencies. Partnerships with nongovernmental organization also can improve effectiveness of programs.

These partnerships ultimately should be responsible for developing and implementing control strategies. The Congress delegates recognized several key components of any control strategy. Education is an important tool to inform and motivate. Financial incentives can be used to encourage people to "do the right thing." Legislation, particularly in areas of zoning and planning, needs to be properly formulated to accomplish water quality goals. Existing laws also

must be linked and clarified to recognize the interconnectedness of resources, and to strengthen current programs.

While nonpoint source pollution has become a significant problem, most people are unaware of their contribution to it. Therefore, educating the public about how changed habits can contribute to cleaner water is necessary. Regional workshops involving local stakeholders including government, natural resource professionals, citizen groups, and schoolteachers, can create issue awareness and prompt participation among essential interests and regional leaders.

An especially important audience for educational efforts is our legislators, as they are a key component of any pollution control strategy. Legislators need to understand the gravity of the problem and strategies for controlling pollution. Pilot projects and success stories can provide information about what measures work and why they work.

Natural resource professionals and their societies play a key role in nonpoint source pollution control, as most natural resources decisions impact water quality. Professionals should be trained to anticipate and resolve potential impacts from nonpoint source water pollution; societies can improve awareness and practice through continuing education, certification, and publications.

Better use of the media and schools can contribute to a more informed public. A nonpoint source marketing campaign could include an easily recognized logo, mascot and slogan. Incorporating environmental education elements into

school curriculums prepare children to educate their parents.

Creating a sense of place in all sectors of society could help raise awareness and provide incentives to examine actions. The involvement of community groups such as Kiwanis and Rotary can bring community minded people into the mix. Targeting the consumers of pesticides, herbicides, and fertilizers should be accomplished through vendor licensing and instructional requirements.

There are many actions that can be taken to control nonpoint source water pollution:

- Governments need to work together, recognizing the variability in communities and resources.
- Monitoring programs need to be funded to determine where controls are necessary and to assure that they are working.
- Future legislation should be evaluated for its impact on water quality, and existing laws need to be clarified and used to take advantage of possible control opportunities
- Natural resources professionals have a responsibility to anticipate and resolve potential impacts from nonpoint source water pollution.
- An extensive education effort including all sectors of society---from legislators to elementary school students---is needed.

For further information, contact RNRF at www.rnrf.org

EWB Announces Forum on Sustainable Resources

Engineers Without Borders-USA (EWB) has announced an International Forum Connecting People of the Developing World with Skills, Capital, and Collaborative Resources. The Forum, called Sustainable Resources 2003, will be held at the University of Colorado at Boulder, October 1-4, 2003.

Sustainable Resources 2003 will provide a new platform of exchange where issues faced by the developing world can be addressed globally and solved locally. It will offer unique opportunities for non-profits, NGOs, donors, funding agencies, humanitarian organizations, educators, engineers, business people, volunteers, and representatives

of developing communities to meet, learn from each other, network, discuss new approaches for outreach, and create new partnerships. Such organizations have not traditionally interacted in the past. Sustainable Resources 2003 will provide a "meeting of the mind" and a platform for multidisciplinary exchange. It will also help develop recommenda-

Worldwatch Institute Releases *State of the World 2003*

The Worldwatch Institute, an independent, non-government environmental and social policy research organization based in Washington, D. C., has issued the twentieth edition in its series of annual reports on the world's progress toward a sustainable society. In its most recent report, **State of the World 2003**, the Institute's interdisciplinary research team argues that past successes – such as the elimination of smallpox and the encouraging drop in birth rates in many countries - prove that humanity is capable of redirecting itself in positive ways.

Most encouraging, the report argues that the world is sitting on the cusp of similar successes that could usher in a sustainable human civilization. The use of clean, renewable energy technologies, like wind turbines and photovoltaics, for example, is growing at over 25 percent per year, and these technologies are increasingly competitive with fossil fuels. Organic farming, the report also claims, is the fastest-growing sector of the world agricultural economy, with the potential to rejuvenate rural communities from the Philippines to Sweden.

The 175-page report is organized into a series of eight chapters: "A History of Our Future," an overview of the changes we face; "Watching Birds Disappear;" "Linking Population, Women, and Biodiversity;" "Combating Malaria;" "Charting a New Energy Future," "Scrapping Mining Dependence;" "Uniting Divided Cities;" and, finally, "Engaging Religion in the Quest for a Sustainable World." In this final chapter, the report asserts that a quickening of religious interest in humanity's place in the natural environment could awaken a powerful new constituency to the cause of sustainability: "By combining their considerable skills and complementary perspectives, environmentalists and religious people can help reunite our civilization's head and heart, re-engaging religion in the quest for a new cosmology, a new worldview for our time." Thus, while the challenges are still immense, as the report documents, its authors also conclude that the building blocks for a historic reinvention of human civilization are now within reach.

To order the Institute's latest report call 888-544-2303; send a fax to 570-322-2063; send an e-mail to wwpub@worldwatch.org or visit the Institute's web site at www.worldwatch.org.

EWB Forum on Sustainable Resources continued

tions toward a cooperative action plan in the areas of concern to the developing world.

Sustainable Resources 2003 will consist of a combination of keynote lectures, technical and non-technical presentations, case studies, workshops and short courses on the major issues facing developing communities: water, sanitation, infrastructure, energy, shelter, health and hygiene, eco-

nomics development, security, strategy, whole systems designs, food and nutrition, social and cultural concerns, communications, and environment.

Workshops and short courses will focus on generating cooperative partnerships that can more effectively accomplish each organization's goals. Exhibition space will be available for participant to showcase their projects, services, or projects. One of the

goals of the forum is to establish a collaborative marketplace where participants can match their skills and needs to work more effectively for sustainable development.

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Upcoming Meetings Focused on Sustainability

- March 30-April 3. *Process Intensification Workshop*; and *Towards a Sustainable Water Supply*. AIChE National Meeting, New Orleans, LA.
 - April 14-25. *US Environment 2003 Webcast*. AIChE and MICG.
 - May 8-10. *Design Matters*. American Institute of Architects, San Diego, CA.
 - May 11-16. *Sustainability Metrics and Process Intensification* workshops. Nato Meeting, Cetraro, Italy
 - May 18-22. *Green Engineering: Defining the Principles*. EPA-ORD, Destin, Florida.
 - May 19-22. *Electronics and the Environment*. IEEE, Boston, MA.
 - May 19-22. *2003 Going Green International Conference*, Boston, MA.
 - June 2-3. *Water & Sustainable Development*. Chemical Sciences Roundtable, Berkeley, CA.
 - June 23-26. *Green Chemistry and Engineering: Integrating Sustainability, Safety, and Security*. Green Chemistry Institute. *Sustainability & Federal Funding*. AIChE, Washington, DC.
 - June 29-July 2. International Society for Industrial Ecology, Ann Arbor, MI.
 - September 7-11. *Sustainability Implementation and Assessment*. ACS, New York, NY.
- For more information on these meetings please contact Dana Ponciroli, danap@aiche.org or visit the AIChE web site: <http://www.aiche.org/sustainability>.

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