LFEE
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INITIATIVES IN ENERGY and the ENVIRONMENT

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laboratory for energy and the environment

MIT inaugurates Program in Science, Technology and Environmental Policy

The Massachusetts Institute of Technology's leadership in engineering education is world-renowned and has led to a now-classic engineering science approach developed in the post-World-War II era that has influenced universities throughout the world. Continuing this tradition, MIT this year established a new Engineering Systems Division. It will reinvigorate engineering education with a broader perspective to address the intricate problems that characterize contemporary, large-scale issues related to the challenges of sustainable development and complex environmental systems.

With the implementation of this administrative division, a new program was established, the Program in Science, Technology and Environmental Policy (P-STEP). The program will be led by Professor Thomas Eagar (Head, MIT Department of Materials Science and Engineering) and Dr. Joanne Kauffman (Principal Research Scientist, MIT Laboratory for Energy and the Environment), as Co-Directors.

P-STEP's charter is to educate future decision-makers in government and industry who are committed to engineering leadership beyond technical and physical challenges to better serve the interests of society. The goal of P-STEP is to prepare students to become leaders through multi-disciplinary research and education that narrows the gap between engineering and the social and management sciences.

As a leading technical research institution, MIT has a particular responsibility to increase understanding of methods and tools that will contribute to solving complex environmental problems (which typically are science- and technology-intensive) and, at the same time, to prepare the next generation of leaders for government, industry and society who are competent to deal with those problems.

The concept of sustainable development expands definitions of risk — hence, the strategic importance of environmental management to corporations. Sustainability, which encompasses a broad range of ecological and societal impacts, challenges the

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CALENDAR

november 13-14

MIT Carbon Sequestration Forum II: "Developing Sinks to Sequester Carbon." Royal Sonesta Hotel,Cambridge, MA, November 13-14, 2001. For further information contact: Ms Mary Gallagher, Tel.: 617-258-0307 (Email: marygal@mit.edu).

november 14

"Designing a DNA for responsive architecture: A new built environment for social sustainability," Carlo Magnoli, Co-director of MIT Kinetic Design Group. Environment and Sustainability Seminar Series sponsored by LFEE, Wednesday November 21, 12 noon - 1:30 pm. Contact: Ms. Karen Gibson, Tel.: 617-258-6368 (Email: kgibson@mit.edu)

march 16-19

"Students of Today Creating Sustainable Futures." The Alliance for Global Sustainability World Student Community (WSC) Annual Meeting 2002, San José, Costa Rica; March 16-19. Information and call for papers: Mr. Steven R. L. Millman, Tel.: 617-258-5969 (Email: millman@mit.edu).

march 21-23

"Building the Future: Leadership, Technology, Global Citizenship." Alliance for Global Sustainability Annual Meeting 2002, San José, Costa Rica, March 21-23, 2002. For further information contact: Ms. Karen Gibson, 617-258-6368 (kgibson@mit.edu).

All events are held at MIT unless otherwise noted. For the most current listings, see the LFEE website: http://lfee.mit.edu/

Please send MIT sponsored event listings to Dr. Richard St. Clair, stclair@mit.edu, phone 617-253-9871.

notion of health risk as the principal justification for environmental regulation. Today, there is widespread agreement that holistic approaches to environmental performance are necessary, but there has been only limited success in efforts to 'reinvent' regulations that provide incentives. Progress toward sustainable development is hindered by inefficiencies in command-and-control policies, fragmented regulations that shift risks from one source or medium to another, and a failure to focus public resources on the highest priorities.

Technology must play an important role in mitigating environmental risks. Opportunities exist for government to improve environmental performance with incentives for technological innovation, and industry can seek competitive advantage through enhanced environmental performance.

The increase in environmental legislation since the early 1970s in the United States and other industrialized countries has produced significant benefits to quality of life in these countries. At the same time, and with the wisdom of hindsight and experience, the same body of legislation has given rise to frustration and inefficiencies that reveal a notable absence of technological depth or optimality in the regulations and standards put in place to achieve environmental goals. It is likely that this is due in part to a lack of input from the engineering sciences to decision-making in the public and private sectors and to the regulatory process.

Although many environmental regulations are by their nature science- and technology-intensive, many public officials and the public at large not only lack understanding of the role technology can and must play in solving environmental problems but also are suspicious of technology and are reluctant to to try to understand it. If these problems are to be overcome, it is crucial (1) that institutions like MIT have a voice in the policy arena, and (2) that MIT students be prepared to address them. For students, this will mean acquiring a better understanding of the gap between technology and policy that underscores much of environmental decision-making and standard-setting today.

Traditional engineers receive inadequate training and exposure to policy, government, and the social sciences. Because of this, they are under-weighted in the process of formulating and promulgating regulations. Too often, consequences for the envi-

ronment and the manufacturer — which may be obvious to or discoverable by engineers — are not even addressed in the decision-making process. Avoidable consequences are much more difficult and costly to redress after enactment of legislation.

Motivated by these concerns and by a desire to contribute to the preparation of new engineering leaders, the organizers of P-STEP have undertaken the task of putting together a research-based program that will bridge the gap between engineering and the social and management sciences and will focus on environmental policy.

The aims of P-STEP are: (1) to provide opportunities for masters and doctoral students to analyze specific regulatory standards through thesis work to determine the role of the engineering sciences in determining the feasibility of the regulations or standards, technical optimality in the decision at hand, and alternative technologies (if appropriate) for meeting the standard or realizing the goals; (2) to gain better understanding of the impact of environmental regulations on industrial development and its relationship to social progress; (3) to develop channels for educating government and business decision-makers on the role of technology in meeting environmental goals and how such knowledge can contribute to more effective policies and standards; and (4) in concert with industrial and governmental sponsors of the program, to develop or propose alternative regulatory approaches that offer beneficial incentives and provide flexibility in technological responses to specific environmental problems.

Technology and the engineering sciences have much to contribute to the improvement of environmental policy, and, to accomplish that, time is of the essence. Too often, policy failure is incorrectly attributed to scientific uncertainty. More often it is due to technological ignorance, which can be overcome by closing the gap between technology and public policy. P-STEP focuses on the engineering sciences and technology as the critical tools to address environmental policy and problem-solving.

A one day MIT/P-STEP workshop was held on November 1 to explore ways in which MIT can contribute to improving environmental regulation and performance through research, education, and outreach. Nearly 50 participants from industry, government and academia attended the workshop, which focused on issues related to environmental risk. The main goal of the presentations was to initiate a discussion about how MIT, and specifically P-STEP, can contribute to overcoming barriers to effective regulation and enhanced environmental performance. A white paper is planned to capture the insights, conclusions, and recommendations resulting from the workshop. More information about the workshop can be found on the web at: http://P-STEP.mit.edu/workshop.

The MIT P-STEP workshop on November 1 explored the following questions:

>How will changes in perceptions of risk affect regulation?

>What can government and industry do to improve risk management in an era focused on sustainable development and technological innovation?

>What can those in industry do about minimizing environmental risk and liability under new conditions?

>What are industries' associated competitive opportunities?

>How can MIT shape the engineering curriculum to prepare the next generation of environmental leaders for government, industry, and society?

>What are opportunities for better supply chain management and product development networks given new approaches to risk management?

P-STEP workshop participants
Photo: Ali Mostashari

Carbon sequestration on a large scale? The future of fossil fuels

Howard Herzog, MIT

Burning fossil fuels — primarily coal, oil and natural gas — has long been and still remains one of the cheapest sources of energy in the world. 85% of the world's commercial energy is obtained by burning fossil fuels, and it is expected that fossil fuels will remain the dominant energy source for this century. But there is a price — burning fossil fuels for energy generates large amounts of pollutant emissions, especially carbon dioxide (CO_2), a greenhouse gas (GHG) which is a major contributor to global warming and climate change.

The problem is compounded as developing countries of the world strive to attain the developed countries' higher standard of living, thus greatly increasing fossil fuel consumption worldwide. Added to this is the ongoing growth of industrialized countries and their appetite for energy, which comes largely through the consumption of fossil fuels. As a result, GHG emissions worldwide are at the highest level ever and continue to rise. With international pressure increasing to find ways to significantly reduce emissions into the atmosphere, a number of options are being considered.

Among the options being discussed is the suggestion to capture CO_2 from the smokestacks of power plants and factories and to sequester it in the oceans or underground. This might provide at least a partial solution to counter the process of climate change. In a pioneering effort starting in 1989, Howard Herzog, a Principal Research Engineer in MIT's Laboratory for Energy and the Environment (LFEE), has led a program to study technologies for capturing and sequestering CO_2 from large stationary sources.

Capture and sequestration of carbon dioxide refers specifically to capturing the CO_2 from sites such as coal-burning power and industrial plants and pumping it into places such as depleted oil and gas reservoirs, deep saline formations, unmineable coal beds, and the deep ocean, rather than allowing its continued release into the atmosphere. Such sequestration is already being done on a limited scale in a few locations, but it is still considered as in the trial stages.

Mr. Herzog and his associates have written or contributed to key documents on carbon sequestration in the last 10 years, including the US Department of Energy (DOE) Road Map, to try to define this field and cause it to be taken seriously by industry, government, and the public. Herzog says that US governmental interest in carbon management is reflected in the DOE's growing fossil energy budget, which funds carbon sequestration research. That budget has increased from about $6 million in FY 1999 to $9 million in FY 2000, $19 million in FY 2001, and $31 million for FY 2002.

Reducing CO_2 emissions through sequestration, Herzog suggests, would buy time to make the transition to non-carbon energy sources such as wind, hydropower, and nuclear. The goal is to develop ways of producing energy that are cost-effective and environmentally sound and which complement current efforts to improve the efficiency of fossil fuel combustion. There is no single solution to the problem of controlling and remedying CO_2 emissions, but the development of carbon capture and sequestration technologies could play a major role in addressing this issue, Herzog says.

Since the 1992 Framework Convention on Climate Change went into force in 1994, subsequent negotiations to reduce CO_2 emissions have failed to produce significant results. Nonetheless, a number of countries are moving ahead with unilateral efforts to reduce atmospheric emissions. Thus far, these initiatives have produced few concrete results. One promising experiment in Japan is the "Tokyo Half Project," which aims to reduce by 50%

the city's GHG emissions by the year 2020. Through the Alliance for Global Sustainability (AGS), researchers at the University of Tokyo are working with Herzog's team and others to determine what, if any, role sequestration techniques might play in meeting the project's goals. Meanwhile, in May, the First National Conference on Carbon Sequestration was held under the sponsorship of the US DOE's National Energy Technology Laboratory in an effort to move sequestration technology forward with industry participation.

The researchers stress that carbon capture and sequestration should not be seen as a green light to increase fossil fuel use.

Last year, Mr. Herzog and his MIT associates initiated an industrial consortium, the Carbon Sequestration Initiative (CSI), to work with the LFEE team investigating carbon management and sequestration technologies. There are currently 10 members in the CSI: American Electric Power, Electricité de France (EDF), EPRI, ExxonMobil, Ford Motor Company, General Motors, Norsk Hydro, Peabody Energy, ChevronTexaco, and TotalFinaElf. CSI will host the second MIT Carbon Sequestration Forum at MIT, November 13-14. The theme is "Developing Reservoirs to Sequester Carbon." More information on the CSI can be found on its website at http://sequestration.mit.edu/.

There are two major challenges for carbon sequestration from large stationary sources. One is reducing costs associated with CO_2 separation and capture. The other is developing sinks that are safe and effective for storing large quantities of CO_2. The researchers estimate that saline formations, oil and gas reservoirs, and abandoned coal seams together can hold hundreds to thousands of gigatons of carbon (GtC). The technology for CO_2 injection into geological formations for enhanced oil recovery (EOR) already exists: In 1998, 43 million metric tonnes of CO_2 were injected at 67 commercial EOR sites in the United States.

The main concerns with CO_2 storage are uncertainties in the amount of available storage, the long-term integrity of the storage, the costs associated with CO_2 transport to the sequestration site, and the safety of the storage operation itself. Before widespread utilization, carbon sequestration reservoirs must be demonstrated to be effective, safe, and environmentally sound. Better understanding of the long-term fate of CO_2 in storage reservoirs is needed. However, if it is found that the CO_2 reacts underground to form carbonate minerals, as is suspected, storage could prove to be even more effective, Herzog says.

In order to assess the viability of this approach, the LFEE project is analyzing techniques to ensure storage integrity, injection methods to reduce potential environmental impacts, and economic feasibility. Storage integrity is important not only to prevent the unintended return of CO_2 to the atmosphere but also for concerns about public safety, should there be a large-scale release from the storage location back into the atmosphere. CO_2 is not toxic or flammable, but it is heavier than air and can cause suffocation of living animals, including human beings, if present at high enough concentrations. Therefore, the mechanisms for potential leaks, both large and small, must be clearly understood, and dangerous situations must be avoided or safely handled to accomplish successful large-scale CO_2 sequestration.

The ocean, which is already a natural sink for CO_2, represents the largest potential sink for man-made CO_2. According to the Intergovernmental Panel on Climate Change (IPCC), the ocean contains an estimated 40,000 GtC of CO_2, compared with only 750 GtC in the atmosphere and 2,200 GtC in the terrestrial biosphere. It is thought that discharging captured CO_2 directly to the ocean would accelerate this ongoing but slow natural process and would reduce both peak atmospheric CO_2 concentrations and their rate of increase.

Though attractive as a potential solution, the direct injection of CO_2 into the ocean has a unique environmental impact near the injection point, where the pH (relative acidity/alkalinity) drops to a more acidic level because of the chemical reaction between CO_2 and seawater. This

Photo: Karen Polenske

adversely affects non-swimming marine organisms (*e.g.*, zooplankton, bacteria, and benthos) residing at depths of about 1000 meters or greater. The magnitude of the impact depends on the extent of pH change and the duration of exposure. The researchers argue that this impact can be controlled by the method of CO_2 injection. Data suggest that effects from pH change can be completely avoided if the injection technique disperses the CO_2 as it dissolves into seawater.

Better energy efficiency of fossil fuels and increased use of non-carbon energy sources and conservation must continue to be developed. Carbon sequestration should be seen as an important complement to these.

The economic feasibility of carbon capture and sequestration is a primary concern. Reducing costs depends on many factors: the source and ease of separation of the CO_2, the distance between source and sequestration point, and the type and characteristics of the sequestration reservoir. Capturing CO_2 is already a commercially viable process at over a dozen sites worldwide, where the CO_2 is being sold into commercial markets. However, these are just niche markets; the economics would change if much larger quantities of CO_2 were captured for sequestration purposes.

Even if assessments indicate carbon sequestration technologies can help reduce harmful CO_2 emissions, Herzog emphasizes that such techniques should not be interpreted as a green light to increase fossil fuel use. Better energy efficiency of fossil fuels and increased use of non-carbon energy sources and conservation must continue to be developed. Carbon sequestration should be seen as an important complement to these; however, the greater the number of technological options available the more likely will be society's ability to avoid the harmful consequences of climate change.

For further reading see *Scientific American* for February, 2000: "Capturing Greenhouse Gases," by H. Herzog, B. Eliasson and O. Kaarstad (pp. 72-79), and "What Future for Carbon Capture and Sequestration?" by H. Herzog, *Environmental Science and Technology*, 35:7, pp. 148A-153A (April 1, 2001). For additional information, see the project website at http://web.mit.edu/energylab/www/hjherzog/.

Is an energy crisis looming in the Northeastern US?

Dr. Marija Ilic, a senior research scientist in MIT's Department of Electrical Engineering and Computer Science and an expert in electric power systems, claims that the Northeastern United States may be headed toward energy chaos rivaling that seen recently in California. She and a colleague, Mr. Leonard Hyman from Salomon Smith Barney, reported their concerns and offer a solution in an invited paper in the September 1 issue of *Public Utilities Fortnightly*.

Dr. Marija Ilic, MIT

Dr. Ilic leads the Competitive Power Systems Group at MIT and is affiliated with both MIT's Laboratory for Energy and the Environment and Laboratory for Information and Decision Systems. With funding from a variety of industrial sources, the group is developing new concepts and models for competitive power systems operations and management and exploring the distributed power industry of the future.

Operators of the three big electric power grids in the Northeast have been asked by the Federal Energy Regulatory Commission (FERC) to submit a joint plan this month to ensure that anybody who wants to transfer electricity from one grid to another can do it. But, according to Ilic and Hyman, one of the plans being considered by the operators would unnecessarily increase electricity prices in the Northeast and leave the region more susceptible to blackouts in the future.

In the electricity industry, the marketers are individuals or organizations that buy electricity from generating companies and sell it to users. For the electricity industry to become

truly competitive, it needs to be able to offer customers the best deal possible. If the cheapest power plant is on the New York grid and the potential customer is on the New England grid, the marketer must buy transmission service to move the electricity from one grid to the other.

But buying that service is not simple: Transmission companies do not cross regional boundaries; thus, the marketer must patch together separate arrangements with transmission companies in each region. Worse still, if either regional grid runs into internal trouble, the marketer's transmission deal can get shut off unexpectedly. As a result, the cheapest electricity source is not always used.

To make the marketer's job easier, FERC has told the operators of the three Northeastern grids — New England, New York, and PJM (serving Pennsylvania, New Jersey, and Maryland) — that they have to coordinate transmission among the three regions. "The simplest solution would be to have one firm own and operate all the transmission wires in the three grids," said Dr. Ilic, "but that would be a shock to all participants. These are business people, and nobody wants to give up their turf."

The grid operators are likely to focus on another plan under discussion. In that plan, all three operators would adopt the same techniques and software for running their power grids and then exchange data and work together to make sure interregional transmission is available. However, this plan worries Ilic and Hyman, who do not think the plan will work. What concerns them is that the plan leaves no one overseeing the operation of the overall Northeastern transmission system, and thus they believe that serious problems are likely to occur.

The existing transmission grids were designed to serve regional needs. Power transfers from one grid to another were meant for emergencies only. Computer simulations performed by Dr. Ilic's team at MIT show that heavy use of grid interconnections to tap cheaper power sources can have unintended effects. Trades between two regional grids can adversely affect operations in a third regional grid, potentially leading to frequency and voltage disturbances. If no one is in charge of correcting such problems, a grid could enter an operating mode that it cannot fix itself — at least not easily or cheaply.

"Unless there's a clear understanding of who's ultimately responsible for reliability in the Northeast area, the lights may go out when we don't want them to go out — in a massive sort of way," said Ilic. In their article, Ilic and Hyman suggest something completely different. Their concept calls for establishing a market where transmission between grids is traded as a commodity. Any transmission company or grid operator who has extra transmission capacity could sell it, and any marketer who needs transmission capacity could buy it.

The market for interregional coordination would be run by a profit-making 'Interregional Transmission Organization' (IRTO). The IRTO would make sure that all trades are physically possible, and it would oversee the operation of the Northeastern transmission system. The better job it did, the more money it would earn — an attractive opportunity for entrepreneurs.

According to Dr. Ilic, "With this arrangement, no one would have to give up their turf. Market participants within each grid would still be able to make independent decisions about how to run their businesses." Regional transmission companies could still serve their customers, sell excess capacity on the IRTO market, and even build more transmission lines to make more money. Marketers would be able to do 'one-stop shopping' for the interregional transmission services they need.

Further, the operators of the regional grids would not be forced to adopt someone else's operating methods — a distinct advantage in Ilic and Hyman's view. They argue that PJM's current approach is not much different from that used in the old regulated industry. Most important, as trading increases, that approach will not be flexible enough to give industry participants the real-time information they need. For example, if customers know that the current electricity price is high, they can cut their use to save money and simultaneously help reduce peak demand.

The tricky part of implementing an IRTO market would be developing the protocols and software to run it. "You're selling transmission service between grids, so you would need more involved models than we currently have and intelligence to guarantee that the trades are physically possible," said Dr. Ilic. Developing the needed protocols and software would be a serious challenge that would require the collaboration of computer specialists, power engineers, and economists. Dr. Ilic's team at MIT is now developing approaches that demonstrate how an IRTO market might work. In their case studies, computer models examine bids to buy and sell transmission and select the most economically efficient trades that will not disrupt the interconnected regional grids. Case studies for the Northeast US show the hoped-for benefits of an IRTO market: inexpensive supply and increased reliability.

Ilic and Hyman hope they are in time to influence what is about to happen to electricity supply in the Northeastern US. They believe that their alternative approach would make the electricity industry more flexible and bring it into the 21st century.

McDonough lectures on "eco-effectiveness"

In a special lecture delivered to a packed MIT audience of more than 500 on October 1, William McDonough outlined in broad and detailed terms a vision of "the next industrial revolution," incorporating concern for economic intelligence, social equity, and environmental responsibility. McDonough is a founding partner of William McDonough + Partners (WM+P), Architecture and Community Design, a widely recognized firm practicing ecologically, socially, and economically intelligent architecture and community design in the US and abroad.

The lecture was sponsored by the Alliance for Global Sustainability at MIT (MIT/AGS) as well as MIT's Laboratory for Energy and the Environment (LFEE), Center for Real Estate, Department of Architecture, Department of Urban Studies and Planning, Sloan Energy and Environment Finance Club, and Technology and Policy Program.

Time Magazine recognized William McDonough as a "Hero for the Planet" in 1999, stating that "his utopianism is grounded in a unified philosophy that — in demonstrable and practical ways — is changing the design of the world." His ideas and efforts were also honored when, in 1996, he received the Presidential Award for Sustainable Development, the nation's highest environmental honor, presented by President Clinton in a White House ceremony.

A big part of Mr. McDonough's message is changing from negative thinking to positive thinking. Observing that mankind has overpowered the natural world, he put forward the idea of abandoning the current notion of eco-efficient sustainability (*i.e.*, being "less bad" to the environment, with a goal of zero damage) in favor of an eco-effective strategy of "being good" environmentally, of "increasing the human footprint" in ways that are beneficial to the environment. Such a strategy would be in accord with natural systems, which he terms "effective" rather than "efficient." He presented numerous slides showing photographs, architectural models and floor plans of projects he and his firm have designed over the past several years, all of which are uniquely integrated with nature. "We must move from the idea of [planetary] stewardship to being part of the natural world," he said: "When do we become indigenous people?"

Mr. McDonough and his partners' designs range in scale from molecules to regions, and his clients include companies such as Ford Motor Company and Nike; cities such as Williamsburg, Virginia and Chattanooga, Tennessee; and institutions including Oberlin College, the Environmental Defense Fund, and the Smithsonian Institution. Their designs range from simple solar-powered homes to environmentally revitalizing Henry Ford's River Rouge factory and surroundings in Dearborn, Michigan.

A leader in the sustainable development movement since 1977, Mr. McDonough helped launch the "green office" movement in the US with his design for the Environmental Defense Fund Headquarters, completed in 1985. Recent award-winning projects for Gap Inc., Nike, Herman Miller, and Oberlin College have set new standards for design quality, environmental sensitivity, and functional effectiveness. WM+P won *Business Week/Architectural Record's* "Good Design is Good Business" awards for large commercial projects in 1997 and 1998.

William McDonough has been termed a visionary, one who sees beyond the limitations of the present to a brighter future in which designers become leaders and leaders become designers. But McDonough also has a host of practical ideas and professional accomplishments to implement his vision for the future.

Mr. McDonough is cofounder and principal with German chemist Michael Braungart of McDonough Braungart Design Chemistry, a product and systems development firm. MBDC assists prominent client companies in the profitable implementation of the McDonough Braungart Design Protocol. Current MBDC projects include development of apparel and footwear products with Nike, personal care products with Unilever, furniture with

Herman Miller, fabrics with BASF, and transportation-related products with Ford Motor Company.

Mr. McDonough is former Dean of Architecture at the University of Virginia and currently holds professorships at the University of Virginia's Darden Graduate School of Business Administration and at Cornell University. He is also the Chairman of Second Nature and is US Chairman and member of the Board of Councilors of the China-US Center for Sustainable Development.

Mr. McDonough advises a number of key principles for eco-effective design: Recognize interdependence; recognize that all sustainability is local and can only be measured at the local level; respect relationships "between spirit and matter"; accept responsibility for the consequences of design ("design is the first signal of human intention"); create safe objects of long-term value; eliminate the very concept of waste (not simply "minimize" or "reduce" waste); understand the limitations of design; and seek constant improvement by constant sharing of knowledge. He calls for an end to environmental "intergenerational tyranny," in which we may "celebrate the abundance of the natural system." "In a world in which everything has value," he said, "there is the possibility of all people being treated as having value."

For further information, see the William McDonough + Partners homepage at http://www.mcdonough.com/.

Seminar Series:
Meeting sustainable development needs of the poor

The Laboratory for Energy and the Environment (LFEE) at the Massachusetts Institute of Technology presented an unique double seminar on October 10. First, Timothy Prestero, a Ph.D. candidate at MIT working in the MIT/Woods Hole Oceanographic Institution's Joint Program in Oceanographic Engineering, presented "ThinkCycle" — a method of teaching design students using real-world challenges posed by NGOs and stakeholders in developing and indigenous communities. Following his talk was a presentation by Mr. Rufino Zapeta, an environmental activist from Guatemala who is working on community participation in the resolution of environmental conflicts and raising popular awareness on environmental issues.

ThinkCycle: Creating a culture of design innovation for challenges in the environment and underserved communities

Noting that university design assignments in engineering, science, architecture and the social sciences typically represent solved problems, Mr. Prestero introduced a unique student-organized initiative that turns learning at elite technical schools into problem-solving for the poorest half of the world's 6 billion people. Because class assignments are usually structured to address problems that have already been solved, notes Mr. Prestero, students' efforts lack creativity and have little application in the real world. Why not work on *real* problems in need of solutions? And what better place to start than with the underserved world's poorest? Although non-governmental organizations (NGOs) working in developing countries can identify the needs of indigenous communities, they often lack the research and development resources necessary to address these problems.

Based on his work in the ThinkCycle initiative, Mr. Prestero proposed ways in which engineering, science, architecture, design, and the social sciences could replace traditional, already-solved homework and design problems with real-world technological and methodological design challenges posed by industry, NGOs and other stake-holders in developing and indigenous communities. For examples and ways to participate, see the project website at: http://www.thinkcycle.org.

Trópico Verde and its work

Mr. Rufino Zapeta works with Trópico Verde, a leading environmental organization in Guatemala, and has been involved in environmental issues for years. He is a Maya Quiché originally from the highland Totonicapán province in Guatemala. There, he works on community participation in the resolution of environmental conflicts and raising popular awareness on environmental issues. He was president of the Committee for the Conservation of the Communal Forest, founding member and president of the Ulew Che Ja Association in Totonicapán, and for 14 years was an instructor at the Universidad Rafael Landivar Extension.

Environmentalism in Guatemala only goes back 6 or 7 years, said Zapeta, who noted that prior to that time his nation had been ravaged by three decades of civil war. During the war, the army destroyed large expanses of rain

forest to gain control over those areas. In a poor country making the transition to democracy, decision-makers can easily lose sight of the ecological consequences of policies, said Zapeta — but these are the very effects that local people often feel first and most strongly. To address these issues, Trópico Verde was formed in 1999, though each of its members have many years of experience as environmentalists. It has focused on preserving the country's forests, wetlands, mangroves, and other wild areas, and making local people's voices heard on decisions that affect them.

Northern Guatemala is home to one of the largest rain forests in Latin America, approximately a third the area of Guatemala, and to about 100,000 people. Deforestation from decades of warfare and oil mining threatens this great forest and its inhabitants, but the situation also reflects a much broader global concern about protection of large forests, which convert carbon dioxide into oxygen through photosynthesis and make animal life on earth possible.

Rufino Zapeta

Though there are laws in Guatemala to protect the environment, institutions for enforcement are weak, Zapeta observed.

One issue that he has been focusing on, even since before he joined Trópico Verde, is the preservation of the endangered epinabete tree. Through community organizations and workshops like the ones Mr. Zapeta is involved with, environmentalists in his country are trying to raise awareness about the tree among residents and would-be loggers. Coupled with larger initiatives to educate people about deforestation and find viable alternatives, this strategy seems to be the best option for Guatemala's highland residents as well as its shrinking forests. But to achieve these and other environmental objectives, said Zapeta, "We need a constant exchange of new ideas to hope for a better future."

Youth Environmental Summit 2001

The Alliance for Global Sustainability (AGS) hosted two Youth Environmental Summit (YES) sessions in Braunwald, Switzerland, this summer, as a follow-up to the successful inaugural YES meeting a year earlier. YES 2001 doubled the size of last year's participation, dividing into two sessions, in July and in August.

An education component of the AGS, YES addresses the need to unite university students from around the world who share a common vision for sustainable development. The YES program brings together multi-national, multi-lingual, multi-cultural and multi-disciplinary college and graduate students from North America, Europe, Asia, Africa, Australasia and South America. YES 2001 focused on the implementation of Agenda 21 as part of Rio+10. The overall goal of YES is to prepare the participants for the challenges of justice, equity, and sustainability that the world now faces. This year over 200 students applied for the two sessions of YES, of whom a total of 78, representing 35 nationalities and schools from 28 countries, were finally chosen. The students were able to discuss issues related to sustainable development with experts from the AGS partner universities and other academic institutions, local politicians, and representatives from industry and the United Nations.

"The Youth Environmental Summit provides a fertile ground for a timely discussion on pressing sustainable development issues among young people," said Ronald Maliao, who studies Aquaculture and Resource Management at the Asian Institute of Technology, Philippines. "Sustainability is more than saving the earth's natural resources: the issue is to learn to feel empathy with others and understand their needs. YES is a perfect start for that," said participant Jenny Sahlin of Sweden, who is studying Energy Systems Technology at Chalmers University of Technology.

One of the first steps in encouraging discussion and friendship among the group is to provide the proper atmosphere. YES offers the comfortable, beautiful and secluded atmosphere of Braunwald, Switzerland as its backdrop. This mountain village is accessible only by funicular (or tram) from the valley below, which means there are no noisy streets to distract anyone.

The YES planning team has focused the course on Agenda

The goals of YES are
>to provide the participants with a broad understanding of sustainable development;
>to establish an international network of contacts with whom to work to achieve sustainability;
>to enable the participants to collaborate with people of diverse cultures and backgrounds; and
>to provide inspiration for participants to implement the aspects of sustainable development in their own lives.

21 and sustainable development using the topics of society and ethics, energy and climate, technology, and food and water. Through these topics, YES exposes the participants to the basics of sustainable development to bring out the knowledge the participants possess about these issues in their own countries and cultures. YES also hopes to inspire and open the door for further learning and research in the sustainable development areas that individual students are interested in by connecting them with other people around the world who share their interests.

AGS Technical Meeting at Chalmers

The Alliance for Global Sustainability (AGS) held its first technical level meeting at its new partner institute, Chalmers University of Technology, in Gothenburg, Sweden, October 18-19. The focus of the meeting was directions of AGS research and the implications for business and industry. 23 companies participated in the two-day meeting organized in three half-day sessions on mobility and AGS tools and techniques.

A panel moderated by David H. Marks, MIT Coordinator, on "Mobility in the 21st Century" presented results of a mobility study by the World Business Council on Sustainable Development (WBCSD). The mobility panel focused on future mobility fuels and power sources, information technologies and public transport, and the future of intercity transportation and freight mobility.

A panel chaired by Dr. Joanne Kauffman, MIT Coordinator, examined "Methods, Models, Tools and Techniques [M^2T^2] for Sustainable Development," an overview of decision-making tools developed in AGS projects to support better decision-making for sustainable development. The M^2T^2 panel looked at DOME (Distributed Object-based Modeling Environment), a modeling infrastructure being used in the AGS Tokyo Half Project to analyze the feasibility of cutting 1990 levels of CO_2 emissions in Tokyo in half by 2020. Electricity decision management is also benefiting from modeling tools, developed and refined in a number of AGS energy projects: SESAMS (Strategic Electric Sector Assessment Methodology under Sustainability Conditions), CETP — the China Energy Technology Project (with ABB partners), the Mexico City Project, and Alternatives for the Transition to Sustainable Electric Services in Northern Europe. AGS researchers are also examining ways to improve knowledge networking and communications between industry and academia to promote faster adoption of innovative tools for sustainable development.

The AGS has also developed innovative approaches to education and outreach. Roger Baud, AGS Coordinator at the Swiss Federal Institute of Technology, gave an overview of the Youth Environmental Summit (YES) (*see story, p. 10*). MIT Professor Jeffrey Steinfeld discussed the World Student Community initiated by the AGS and a number of other environmental education initiatives at MIT. YES alumnus and MIT graduate student, Timothy Prestero, presented a new student initiative at MIT, ThinkCycle (*see story, p. 9*).

Professor Anne-Marie Tillman, Environmental Systems Analysis, Chalmers University, moderated a panel on "Application of LCA — Where is it going?" Life Cycle Analysis creates learning opportunities and helps to identify research needs. LCA is well established and generally accepted because it is structured, scientifically based, and standardized. It is used widely in decision-making, learning, and exploration and communication.

For more information on the conference, see the AGS international website at www.globalsustainability.org.

Students at Youth Environmental Summit 2001 (Photo: Heather Seyfang)

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Alliance for Global Sustainability
Annual Meeting 2002

The AGS Annual Meeting 2002, on the theme "Building the Future: Leadership, Technology, Global Citizenship," will be held in San José, Costa Rica, March 21-23 in cooperation with the the Instituto Centroamericano de Administracion de Empreseas (INCAE). During the meetings the AGS community will examine its research and education portfolio against a backdrop of slow progress toward global sustainable development, and it will consider ways in which the academic community in partnership with industry, government, and civil society can help generate a clear and focused agenda for the future. Sobering realities in the world today increase this challenge. Given the present economic downturn, declining support for aid to developing countries, persistent poverty in the developing world, and increasing consumption in the developed world, the meeting will address the question, "What are the realistic prospects for sustainable development in the first decade of the new millennium, and how can the AGS contribute to improving them?" As the 10th anniversary of the 1992 Rio Conference on the Environment and Development nears, participants in the annual meeting will look forward to building the future through enhanced leadership, improved technologies, and global citizenship. For more information on the AGS, visit the website at www.globalsustainability.org.

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