



INITIATIVES IN ENVIRONMENT and SUSTAINABILITY

*a quarterly publication of MIT's
Center for Environmental Initiatives*

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welcome

Hello and welcome to the new newsletter for MIT's Center for Environmental Initiatives. Through this newsletter we hope to give you some insight into the environmental research and education activities of CEI and the greater MIT community. CEI is a new center, established in 1997 to facilitate and coordinate Institute activities on emerging environmental and sustainability issues that affect worldwide development and welfare. MIT has a strong environmental research focus. About 10 percent of on-campus research involves the environment and there are a number of strong environmental education programs. With this newsletter, we will provide you a window on that activity.

CEI provides research knowledge and fosters collaboration between industry, government, academia, non-government organizations and the public. Its aim is to help develop scientifically and economically sound strategies to respond to global environmental challenges. The Center also provides outreach to share the knowledge developed. CEI is committed to educating emerging environmental and sustainability leaders world-wide via joint projects, distance education and special educational programs.

To develop effective environmental policy, a number of factors must be brought together, including multi-disciplinary inquiry and the integration of multiple stakeholders' perspectives into the research and policy development process. CEI brings these factors together.

Programs under the Center's umbrella include the Consortium on Environmental Challenges, the Alliance for Global Sustainability (AGS), the Program on Environmental Education and Research (PEER), the MIT Venture Fund for Energy Choices and the MIT Program on Chemicals in Society. The Center's steering committee is comprised of members of the MIT Council on the Environment's Executive Committee. The Center's programs operate independently, with faculty, students, and stakeholders benefiting from the inevitable synergies born of proximity.

I hope you find the information in our newsletter interesting and helpful.

Sincerely,

David Hunter Marks
Director, MIT's Center for Environmental Initiatives
James Mason Crafts Professor of Civil and Environmental
Engineering

CALENDAR

June **11-12**

Chemicals in Society: A New Look
at Persistent Concerns Conference
Contact: Jennifer Nash 617-253-3586,
jnash@mit.edu

June **22-26**

Risk-Informed Decision Making for
Contaminated Site Clean-up
MIT Professional Institute course
Contact: 617-253-2101, summer-
professional-programs@mit.edu
<http://web.mit.edu/professional/summer/>

Fundamentals of Internal Combustion Engines:
Performance, Efficiency and Emissions
MIT Professional Institute course
Contact: 617-253-2101, summer-
professional-programs@mit.edu
<http://web.mit.edu/professional/summer/>

July **13-17**

Nuclear Power Reactor Safety I
MIT Professional Institute course
Contact: 617-253-2101, summer-
professional-programs@mit.edu
<http://web.mit.edu/professional/summer/>

July **20-24**

Nuclear Power Reactor Safety I
MIT Professional Institute course
Contact: 617-253-2101, summer-
professional-programs@mit.edu
<http://web.mit.edu/professional/summer/>

consortium RESEARCH TO *focus* ON *environmental* *decision-making*

Created in October 1997, the Consortium on Environmental Challenges (CEC) recently completed its startup phase and is developing the agenda for its first full program year. Efforts are currently underway to form the Consortium Advisory Committee of sponsors and participants, including other university partners in the United States and abroad.

During the startup phase, the Consortium management team organized research modules, established the Strategic Faculty Workshop with faculty and research associate participants from across the Institute, and sponsored the Center for International Studies' research on the use of science in environmental decision-making. The Consortium is managed by faculty leaders Larry Bacow, David Marks, Mario Molina and Dr. Joanne Kauffman.

CEC was created to improve the environmental decision-making process through the better use of scientific, technical, and socioeconomic understanding. In order to achieve this aim, the Consortium defined the following goals:

- Assess global environmental challenges and their impact on ecosystems, economic development and health
- Identify and contribute to the knowledge needed to meet those challenges
- Improve policy making through use of unbiased knowledge — scientific, technological and socioeconomic.

CEC scholars from across the Institute are assessing the state of knowledge needed to effectively meet global environmental challenges by focusing on specific issue areas. Current linkages focus on energy choices for the future; chemicals and society; mobility, with an emphasis on options for congested mega-cities; water for a sustainable future; and global climate change.

All events are held at MIT unless otherwise noted. For the most current listings, see the CEI website:
<http://environment.mit.edu>

Please send MIT sponsored event listings to Karen Gibson, kgibson@mit.edu, fax 617-258-6099, phone 617-258-6368.

Working papers on the “state of the knowledge” and inventories and analysis of case studies on the use of science in environmental decision-making will identify constraints on the use of scientific and technical knowledge in environmental decision-making.

In addition to assessments of the state of knowledge in specific areas, the Center for International Studies is spearheading a Consortium project on the use of scientific and technical knowledge in environmental decision-making. Through this project, researchers are looking to understand how to increase the role scientific evidence and technological knowledge play in meeting the challenges posed by environmental risks to economic development and social welfare.

The Faculty Workshop is the Institute’s vehicle to identify cross-cutting themes and research questions that can lead to responses to complex global environmental challenges now and in the future. In the first six months, MIT scholars identified several themes they believe can be addressed through multi-disciplinary, integrated research.

Among the themes identified are:

How can science influence the framing of important policy questions?

What determines the willingness of different decision makers to act in the face of uncertainty?

What characterizes decision-making processes that are adaptive and responsive to knowledge?

How can we develop the institutional capacity to put current knowledge to better use?

What would a theory of clean paths to economic development look like?

How do we organize and manage a truly integrated environmental assessment?



The multi-disciplinary faculty workshops allow individuals from across MIT to share research and exchange ideas — facilitating the development of cross-cutting themes and research questions which can be incorporated into the research agenda. Models and methods for integrated assessments are also being developed.

To begin to address the cross-cutting questions identified in the workshop, the research plan includes an integrated assessment of local, regional, and global environmental problems in Mexico City and a proposal to analyze the implications of sustainability for a world-wide industry, such as the automobile industry.

Interactions with environmental stakeholders and increased Institute-wide communication across disciplines help to identify gaps in knowledge and ways in which the gaps can be filled. The Consortium is developing communication vehicles for dissemination of knowledge, including the creation of an advisory committee, and workshops and forums for stakeholders such as the Energy Choices meeting last November and the joint meeting on risk assessment with Carnegie-Mellon University and Resources for the Future held May 4-5. A workshop on Chemicals and the Environment will be held in June 1998. In addition to stakeholder meetings, CEC anticipates sharing knowledge through published books, papers, presentations, and electronic media.

The MIT Consortium on Environmental Challenges was created in October 1997, when MIT and Ford Motor Company announced a collaboration focusing on education and research. As a component of this partnership, Ford has pledged \$5 million over five years to initiate and support the Consortium.

Alex Trotman, Chairman and Chief Executive Officer of Ford said, regarding protecting the worldwide environment, “It’s a challenge we must meet and one that can threaten the global economy if we choose the wrong path.” The agreement with Ford results from a recognition that globalization and the impact of information technologies require new models of collaboration by universities and industries.

The Consortium on Environmental Challenges provides the infrastructure needed to enable different stakeholders to work collectively towards a credible, informed, and knowledge-driven process for understanding and assessing the nature and scope of our major environmental problems. Through this multi-party collaboration, the Consortium promotes the development of effective policy options. 🌍

AGS focused on developing countries at annual meeting

"Institutional reforms are...critical

if 'sustainability' is to become

an aspect of urban development

in these countries.

Professor Akin L. Mabogunje,
Development Policy Centre,
Ibadan, Nigeria

Cooperation with developing countries was the focus of the Alliance for Global Sustainability's (AGS) annual meeting, January 21-24 in Zürich. MIT President Charles M. Vest led an MIT delegation of 47 faculty and visiting scholars and 31 students to this international meeting. The AGS is a partnership of three universities, MIT, the Swiss Federal Institutes of Technology and the University of Tokyo, created in 1994 as a strategic approach to the problems of global sustainability. In his opening remarks, Vest noted that the AGS "is still a young organization, but its growing influence and value are amply illustrated at this year's meeting by the participation of so many distinguished scholars and business leaders from around the globe."

In looking at building relationships with developing countries, the AGS focused on the rapidly developing "megacities" of the southern hemisphere. In his talk, Rajendra Pachauri, Director of the Tata Energy Research Institute, New Dehli, warned that the transfer of knowledge, not simply the formulation of models based on the North's ideals for the South, will be the key to successful interaction. "The critical input that would need to be provided in this context is knowledge, which means that knowledge management should be the essential ingredient of international partnerships between the North and South in the Future," said Dr. Pachauri.

Professor Akin L. Mabogunje, Executive Chairman of the Development Policy Centre, Ibadan, Nigeria opened discussions on Africa. "Institutional reforms are...critical if 'sustainability' is to become an aspect of urban development in these countries. The empowerment of urban authorities and all that this entails in institutional capacity-building are a critical prerequisite for promoting sustainable development of municipalities in developing countries." His comments on urbanization explained that over-



*MIT President
Charles Vest discusses
issues with AGS
International Advisory
Board Chairman
Stephan Schmidheiny.*

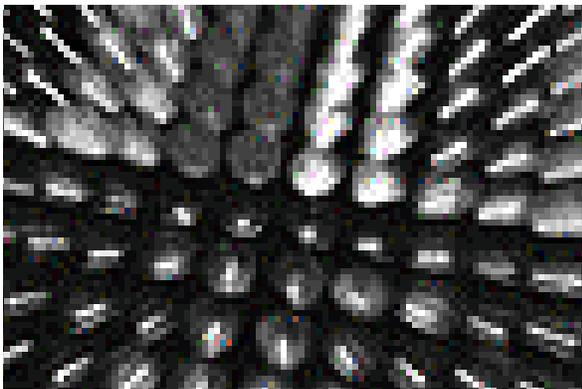
centralization has bred alienation and indifference on the part of the majority of city residents to environmental conditions in cities.

International Advisory Board Chairman, and Swiss industrialist, Stephan Schmidheiny, believes the AGS can play an important role in building relationships with developing countries. "The global market offers the developing world opportunities through the pursuit of sustainable development," he said. In order for companies in developing countries to export to the industrial world, Schmidheiny said, they must "not only be eco-efficient but must be seen to be eco-efficient and environmentally benign."

In addition to hearing progress reports on its first set of major AGS projects launched in 1997, the International Advisory Board (IAB) approved funding for an additional 16 projects, bringing the total number of AGS projects to 37.

In a panel discussion on the "Relevance of research and educational partnership between industrialized and developing countries: Different Perspectives," the group addressed the question of what amount of scientific research ever reaches practical relevance? In developing countries there is a fear of growing disparity in globalization. To allay this fear, developing countries must be included in discussions and decisions regarding their own sustainable development. Partnerships must be global, expanded to specifically include partners from the South. Because there are inherently different needs and curiosities, there must be a multi-directional exchange of information.

The AGS must work with the developing world to find a balance in values, traditions, and culture, said Gran Lindahl, President and CEO of Asea Brown Boveri Ltd. and IAB member. With regard to the relevance of scientific research, Paul Egger, DEZA of Switzerland, emphasized that key stakeholders should be involved in research planning, claiming "scientific excellence must be linked to social awareness."



In a special Students' Challenge session, six students from each of the three universities presented their view of AGS today, their vision for the future, and recommended paths for achieving those goals. The format for this portion of the conference built upon a meeting between Schmidheiny and students at the AGS annual meeting at MIT in January 1997. The students showed a keen interest in expanding the role of the AGS and the AGS goal of translating knowledge into action. Among the suggestions expected to be implemented, the students recommended that AGS funds be allocated for development of educational materials, that project leaders be encouraged to work with stakeholders and local populations when defining their research, and that the AGS expand its outreach activities in developing countries.

In another session, representatives from three nations, MIT Professors Mario Molina and Ron Prinn; Professor Atsumo Ohmura, ETH; and Professor Kenji Yamachi, UT, each shared their impressions of the Kyoto negotiations on global climate change and the need for further action to more fully address the climate issue. Ron Prinn noted in his remarks that the need for further action included:

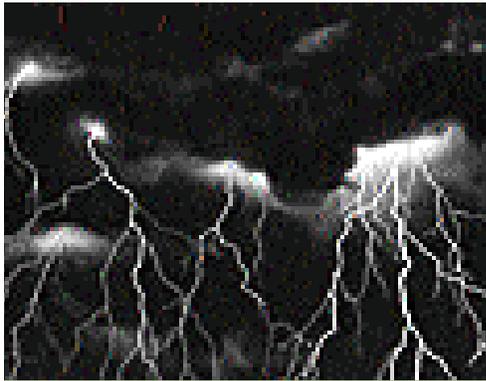
- an enhanced research program;
- an international climate agreement which includes trust, to enable investment in developing countries;
- enhanced technical options; and
- societal infrastructure that is less vulnerable and more easily adaptable to climate change.

Nearly 300 people attended the meeting, exceeding the previous year's attendance by over 100 people. Professor David H. Marks, MIT AGS Coordinator and Director of the Center for Environmental Initiatives, said the enthusiastic response of the faculty and students at the three partner universities is a clear indication of progress the group has made and the intellectual importance of the challenge of sustainability.

The 1999 annual meeting will be hosted by the University of Tokyo. 🌍



John Ehrenfeld, MIT Senior Research Associate, chats with Professor Mamadou Diawara, Point Sud Muscler le Savoir Local, Mali and Professor Visaria Pravin, University of Dehli, India.



'SUSTAINABILITY'

is analogous to 'peace':
Moving from concept to
practice is a difficult task.

— Stephen Connors,
*former Peace Corps volunteer and
director of the MIT Energy Lab's
Electric Utility Program*

energy choices launches new projects

Following its initial planning workshop in November and subsequent Advisory Board meetings, a new MIT collaborative research initiative, the MIT Energy Choices Program, has launched three new projects: Energy-Efficient Buildings in Developing Countries; China Nuclear Power Reliability and Safety; and Future Transportation Fuels. The program's initial research agenda is aimed at building a credible, knowledge-based framework for assessing promising energy technology options.

In the Energy-Efficient Buildings project, MIT faculty in the Department of Architecture, in conjunction with faculty in the Department of Thermal Engineering at Tsinghua University in Beijing, plan to identify the most promising technologies for a generic residential building in a developing country. Focusing on a single climatic zone and urban area within China, the researchers will develop several prototype designs of energy efficient systems and buildings. The emphasis of the work will be to develop simple generic solutions that are appropriate to the local area, are cost effective, and will be accepted by the local people.

The China Nuclear Power Reliability and Safety project addresses the evolution of safety guidelines for nuclear power plants based on lessons learned from countries with long experience in nuclear technology. It is interesting to note that safety standards are still evolving in many parts of the world, including the US. MIT will work closely with Tsinghua University to develop a better understanding of appropriate ways to formulate safety standards and to ensure a high level of reliability in the plants.

The oil industry initiative, Future Transportation Fuels, has two objectives. The first is a comprehensive assessment of the role of technology in emission reduction in the future supply of transportation energy. This assessment would be used to advise ongoing international assessments, to provide a basis for the petroleum industry to make positive changes to address climate change concerns, and to inform the policy process. The second objective is development of a research program to identify and assess the feasibility of "leap-frog" technologies for transportation that might improve the longer term response to emission reduction goals for oil refineries.

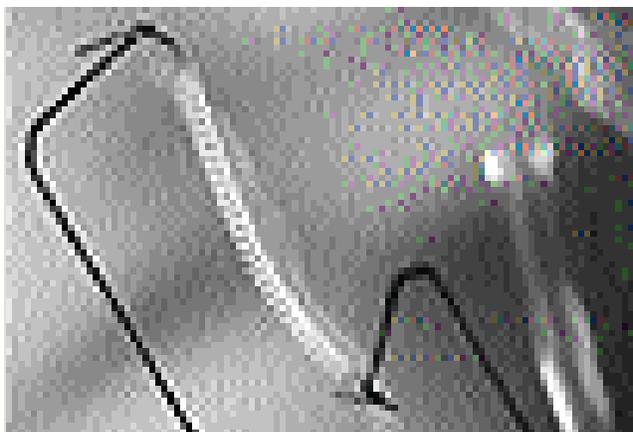
The MIT Energy Choices Program was launched in September 1997 with three objectives: fundamental research; technology forecasting; and intense, interactive, multi-disciplinary communi-

cation including workshops and publications. The Program's five-year goals include 1) integrating more robust technology models into the climate change models of MIT's Joint Program on the Science and Policy of Global Change (these models already incorporate science and economic information); 2) completing case studies that show new and innovative options for meeting global energy needs in more environmentally sound ways; 3) continuing to build a visible and broad basis for making environmental concerns a central priority; and 4) sponsoring outreach activities that begin to influence government policies, research budgets and attitudes within the academic community, the broader scientific community, and publics worldwide.

Initial funding for Energy Choices Program research came from the Venture Fund for Energy Choices, established through the generosity of the V. Kann Rasmussen Foundation. In fall 1997, the foundation committed \$1,350,000 over two years to allow MIT to launch broad research initiatives focusing on innovative energy solutions. These funds will be used in conjunction with funds raised from corporate and other sponsors to pursue important research in strategic areas of opportunity.

The Energy Choices Program's initial planning meeting was attended by 66 people, including 21 industrial experts from 15 major companies, two senior representatives from the U.S. Department of Energy, three representatives from foundations supporting environmental activities at MIT, the project director from the International Energy Agency's Greenhouse Gas R&D Programme, an expert from Central Research Institute of Electric Power Industry (Japan), and a representative from the Global Environmental Facility (under the United Nations Development Programme). The November workshop fostered partnerships among industry, academic, and policy-making colleagues to begin a focused collaborative research and outreach program. The Future Transportation Fuels project is a result of that workshop with initial support for this project provided by Mobil Oil Corporation.

For further information on the MIT Energy Choices Program, contact Liz Drake, 617-253-5325, edrake@mit.edu. 



MIT to hold forum on chemicals *and society*

Persistent public concerns about chemical risk in day-to-day living will be the topic for the June 11-12 conference "Chemicals and Society: A New Look at Persistent Concerns" sponsored by the MIT Center for Environmental Initiatives.

Conference attendees will explore questions about managing chemicals in a socially and environmentally acceptable way. Topics will deal with the trend toward a diminished role for science in decision-making, and moderators will pose questions about the appropriate role for science, government and advocacy groups. A diverse audience from the chemical industry, government, environmental advocacy groups, and academia has been invited.

In the United States and Europe, large sectors of the public are continuing to demand that the chemical risks present in day-to-day living be reduced, despite significant environmental improvements on the part of the chemical industry: reduction of toxic releases, improvement of regulatory compliance, and a new openness to community concerns. The forum will look at the relationship between scientifically-based risk assessment and the growing societal concerns regarding sustainability, quality of life, and corporate responsibility.

The June conference will address the following questions:

- Why does the public continue to hold a negative view of the chemical industry, despite the tremendous allocation of financial and human resources to the chemical industry's Responsible Care Initiative? Arguably, the industry's environmental performance is improving. Why are industry decisions to introduce and maintain chemicals in commerce not being accepted by the public?

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- Do the EPA's regulatory programs adequately respond to society's deepening, generalized concerns for the future?
- How can environmental advocacy groups best serve the public interest when the credibility of nearly every institution is being questioned?
- Do current educational curricula and research programs reflect the societal concerns that complicate scientific decision-making? How can academics contribute to better decisions about chemicals?

Three critical papers will be presented to open up discussions. The first paper, to be given by Sheila Jasanoff, Professor of Science Policy and Law, Cornell University, will address the relationship between the scientific assessment of chemical risks and growing societal concerns about sustainability and corporate responsibility. A second paper, by John Ehrenfeld, Director of MIT's Technology, Business, and Environment Program, will consider the effectiveness of the Responsible Care Initiative, the chemical industry's strategic response to public concerns. A final paper, by Dr. Ellen Silbergeld, Director, Program in Human Health & the Environment, University of Maryland, will explore the public interest in informed consent regarding products decisions. Each paper will be followed by responses from representatives of selected stakeholder groups.

The conference will be interactive, and participants will be encouraged to speak from their own experience. Attendance will be limited to 100.

The Forum on Chemicals in Society was created to engage MIT in a larger societal debate— to clarify and articulate the questions that are driving public concerns, motivate research to answer these questions, share and discuss research, and publish the findings.

For more information on Chemicals in Society, contact Jennifer Nash, at 617-253-3586 or by e-mail jnash@mit.edu. 🌱

kyoto: an ambiguous first step

David M. Reiner, graduate student in political science

This past December, I had the opportunity to attend the Third Conference of the Parties to the UN Framework Convention on Climate Change (or COP-3) in Kyoto. The 10,000 delegates included representatives from almost every nation, environmental group, firm, industry association, international organization and media outlet with an interest in the negotiations and their outcome. I attended the conference on behalf of MIT's Joint Program on the Science and Policy of Global Change and the Center for International Studies, but found myself to be among a tiny minority from academia. Almost all of the 10,000 delegates had a short-term agenda, whether it was to influence delegates to support a particular position, negotiate an agreement, or to file a story under deadline. As an observer with interests in both political science and climate policy, attending the conference provided a wonderful opportunity to witness how international environmental policy is made.

As COP-3 began, major differences existed between the key players. The United States came to the table constrained by a unanimous Senate resolution demanding meaningful participation of key developing countries. The United States supported returning emissions of greenhouse gases in industrialized nations to 1990 levels by 2012. The European Union (EU) arrived in Kyoto with a call for a 15 percent reduction below 1990 levels. Key developing countries including China and India were vehement in their opposition to assuming any limitations, arguing that developing countries had not reached a stage where they could or should take actions.

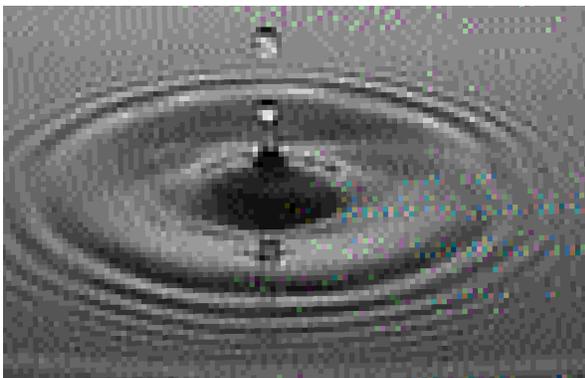
Many other issues remained unresolved as well: how to trade off emissions reductions among the major greenhouse gases, carbon dioxide, methane, and nitrous oxide, that have differential effects on climate; whether to add three greenhouse gases

used in industrial applications (many of which are used as replacements for the ozone-depleting CFCs); how to treat forests and other natural sinks that absorb greenhouse gases; whether there should be enforcement mechanisms or sanctions for non-compliance; whether to mandate the use of certain policy instruments or specific technologies; whether credit should be awarded for projects in developing countries; and how to carry out reductions in the industrialized world most efficiently.

During the negotiations, nations agreed to differentiate burdens according to national circumstance and willingness to assume burdens. Some nations agreed to make substantial cuts in emissions by 2008-2012 relative to 1990 emissions. The United States agreed to cut by 7% and the European Union by 8%. Others, such as Australia (+8%), agreed to limit their increase in emissions to a certain percentage over 1990 levels.

Reaching agreement on overall reduction targets is only one part of differentiating burdens. Countries did not want to appear too different in the overall reductions they pledged, but domestic circumstances dictated that each had a different willingness to assume burdens. The US and a fairly unified non-EU bloc of Japan, Canada, Australia, New Zealand, and others were only willing to assume tougher targets because of flexibility provisions.

The flexibility measures introduce a significant element of ambiguity. For example, although no consensus exists on how to properly trade lower emissions of one greenhouse gas for higher emissions of another, a decision was reached at Kyoto to use a 100-year Global Warming Potential (GWP) conversion factor to compare greenhouse gas emissions. In addition, while countries will seek credits for planting trees, they will not necessarily be penalized for deforestation. Also included as flexible provisions: credits for developing countries and the ability to form a bloc and engage in emissions trading, especially with Russia and other economies in transition.



The details of many key issues have been deferred until the next Conference of the Parties, in Buenos Aires in November, 1998. Emissions trading was sought by the United States and was included in the final agreement but is still subject to further elaboration. Divisions within the developing world were highlighted by the debate over trading which was by far the most acrimonious. Some nations supported trading because it was viewed as effective in reducing emissions at lowest-possible cost, but many supported the provision only because they recognized that to come to agreement, emissions trading would need to be included in some form.

The other notably controversial provision that was struck from the final Kyoto text would have allowed developing countries to voluntarily limit their emissions. Instead, the Clean Development Mechanism (CDM), that emerged and was accepted in the last days of the conference, is the only way to award credit for carrying out emission reduction projects in developing countries. The CDM's lack of detail may have helped secure agreement between parties with different conceptions of the CDM's goal. However, American officials have made clear that this will not be considered sufficient participation. Once details of trading and the CDM are clarified at Buenos Aires, many of the parties may end up being strongly opposed.

Several other major practical difficulties remain. The first is United States ratification. The protocol will go into effect when at least 55 countries which represent 55 percent of industrialized world 1990 emissions ratify it, making it difficult to imagine the protocol taking effect without United States ratification. The second is the absence of an effective non-compliance regime. The final agreement spoke only of the need to draw up "an indicative list of consequences."

Reaching agreement was in many ways a remarkable achievement, but given the many key areas still to be defined, and the compromises needed to reach consensus, the agreement reached in Kyoto may not translate into an effective, or even a desirable, outcome. The Kyoto Protocol is indeed a first step, but it is an extremely ambiguous one. 🌍

AGS board funds new research

Sustainability issues are most dramatically evident in the burgeoning global demands for energy, transportation and social mobility — especially in the rapidly expanding “mega-cities” of the southern hemisphere. Development decisions of the next decade will have lasting impact on societies’ ability to meet these growing demands to ensure future growth and prosperity.



At the annual meeting of the Alliance for Global Sustainability (AGS) International Advisory Board in Zurich in January, the AGS Governing Board awarded \$1.8 million in funding for 14 new projects over the next two years. This new funding brings the total AGS environmental research commitment to over \$4 million for 29 projects. These projects fall within the five thematic areas, or pathways to sustainability, previously established by the AGS to provide a coherent framework for research and outreach: global environmental change, natural resource depletion, future cities, energy and mobility, cleaner technologies and industrial processes, and policy choices. AGS-supported research brings together scholars from the three founding partner universities (MIT, the Swiss Federal Institutes of Technology, and the University of Tokyo) to address complex environmental problems that transcend geographical and disciplinary boundaries. AGS project leaders have raised more than \$18 million in present and future commitments to supplement these projects and related sustainability research at the partner universities.

Future Cities, Energy, and Mobility

1998 funding was awarded for four projects in this category. The Strategic Electric Sector Assessment Methodology under Sustainability conditions (SESAMS) project seeks to develop fundamental strategic analytic capabilities to identify the sustainable production and use of electricity. SESAMS will involve stakeholders in the process. The second project examines biomass and waste as a resource for developing renewable fuels using gasification technology - the conversion of solid fuels into synthesis gas.

The third project will examine the technological, institutional and design choices which can substantially improve buildings of the 21st century. The last new project in this area addresses systems and technologies for urban transportation in the developed and developing world, including conditions imposed by economy, financial practice, political management, and especially, institutional structure of each venue.

“AGS research activities on the emerging mega-cities, meeting energy needs in the 21st Century, and ensuring mobility, exemplify the AGS commitment to go beyond “business as usual,” said Dr. Joanne Kauffman, AGS Associate Coordinator. Current initiatives include a project to improve energy efficiency to help sustain Chinese rapid economic development while simultaneously mitigating local and regional pollution problems and therefore risks of global climate change. One project aimed at the clean and efficient utilization of coal in China focuses on modifications to existing technologies in small and medium sized industries. The

other examines the pollution and health effects caused by the use of coal in the household sector in China. Another project in this category uses a systems approach to problem-solving to look at why urban transportation systems work in some areas and not in others.

Depletion of Natural Resources

Because the sources of environmental deregulation are complex and often inter-related, integrated knowledge is crucial to protecting regional ecosystems and the populations that depend on them. One newly funded project will study how a combination of improved agricultural practices can improve the sustainability of wheat production. The research will develop techniques to accurately diagnose plants' nutrient and pesticide requirements, based on an understanding of root development and soil characteristics. This project complements efforts already underway that address issues of water management and quality; agriculture; and hazardous waste disposal.

Another new research project is aimed at better understanding how sustainable agriculture techniques may be used in regions where water resources are scarce and highly vulnerable to over-exploitation. Other projects, built upon research begun several years ago on indicators of sustainability at the watershed scale, will develop criteria for the long-term environmentally sound use of natural resources and protection of human health. Researchers are also currently investigating the sustainable cultivation of cereals and the potential for organic waste management.

Global Environmental Change

"The profound uncertainty in our current ability to predict potential impacts of climate change retards appropriate societal response," said Kauffman. "The newly funded AGS global environmental change projects seek to remedy this uncertainty by addressing monitoring, climate modeling, natural hazards and earthquake prediction." One project's focus will be development of measurement tools and databases for managing trace gases in the atmosphere. Other efforts will focus on global climate change—investigating its influence on the rise of sea levels and researching potential regional effects on incidence of droughts and floods. A fourth climate change project will establish a network of experts in seismology, economics, and urban planning to investigate how earthquake risk affects global sustainability and to propose practical solutions.

These new projects build upon the AGS' existing focus in climate change research. Two projects already underway seek to increase our understanding of global environmental change. These projects use stronger models to understand and predict environmental effects and increase knowledge about long-term effects of local and regional pollution on the global atmosphere. Results from these efforts have important implications for ongoing policy discussions and international negotiations.

Cleaner Technologies/Industrial Process

An important and distinguishing component of the AGS research initiative is the centrality of technology to understanding sustainability opportunities and constraints. One of the projects on cleaner technologies and industrial processes that is receiving new funds is focused on the energy used, and pollution generated, by households in China. Another project will develop a methodology and decision tools for planning environmentally friendly industrial product systems. The third project investigates the environmental effects of synthetic fuel additives used to tailor fuel properties to meet the need of modern combustion engines or legislative constraints.

AGS projects are aimed at providing industries and policy-makers with a new set of tools for approaching the development of new products and processes. These design, technologic, economic, and policy tools will help move society toward more sustainable forms of progress. One project already underway is contributing to the development of design and decision tools for the chemical industry in the future. Another is addressing "industrial ecology" by striving to meet industry's need to operate in an environmentally constrained world.

Policy Choices

While all AGS researchers are encouraged to look at policy components in their research, AGS also sponsors dedicated policy research on questions that have a significant impact on social and economic progress in public and private sectors.

Funding for four new projects on policy choices was approved in January. In one project, researchers will look at why domestic environmental regulations vary; how these variations affect economic performance and environmental protection; and how conflicts between environmental and commercial interests might be mitigated. In the second project, which looks at how lenders and other investors underwrite or evaluate environmental risk, researchers will develop case studies of brownfield redevelopment and environmental risk assessment in credit management. The goal is to better understand how principles of sustainability might be incorporated into routine investment analysis. The third project examines how US, Japan and the European Union attempt to negotiate enforcement of environmental laws and standards to encourage "green" innovation. Researchers plan to identify innovative infrastructure and measurement technologies that have the greatest potential for managing civil infrastructure in developing countries.

Major funding for the AGS is provided by support of the AVINA Foundation and numerous additional sponsors. 🌍

Initiatives in Environment and Sustainability is published by MIT's Center for Environmental Initiatives

For more information about the Center, please see the center's website: <http://environment.mit.edu> or contact the center staff at:

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environmental education AND *research guide* AVAILABLE

Environmental Studies at MIT, the guide to education and research opportunities on campus is just being released. This guide, published by the MIT Council on the Environment and the Center for Environmental Initiatives describes environmental activities at MIT and shows the breadth of the Institute's environmental education and research. The subjects offered at MIT address environmental issues from strict disciplinary, as well as interdisciplinary, perspectives.

Specific areas of research emphasis include: Air Quality, Business in the Environment, Energy, Environmental Planning and Management, Environmental Technologies, Global Climate Change, Green Design, Human Health, International Initiatives, Policy and Political Economy, and Water in a Sustainable Environment.

Guides are being distributed by the Program in Environmental Education and Research (PEER). To get a copy, contact Debra Fair, Room 6-227, (617) 252-1486. 🌍

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