



sustainable futures
institute

MichiganTech

SFI CHRONICLE

August 2005

Issue 1

Sustainability Applications for Industry

The Sustainable Futures Institute is working with a number of companies on issues related to sustainability. These efforts are focused on developing product and process innovations that create more sustainable organizations. Industry partners include General Motors, BASF, Ford Motor Company, UOP, Caterpillar, and Rio Tinto. Sample projects include: developing innovative methods to improve air quality and reduce energy usage in the automotive industry, investigating the tech-

nological and commercial feasibility for supplying clean water and power to rural areas of developing countries, watershed modeling to evaluate and minimize ecosystem impacts of treatment systems in the mining industry, eco-efficient/clean manufacturing, and life-cycle assessment (LCA). For additional information on partnering with SFI, please contact Dr. John Sutherland (jwsuther@mtu.edu, 906-487-3395).

SF IGERT plus Industry equals INNOVATION

Industry participation in the Sustainable Futures IGERT is vital to the program's success. The IGERT research topics will be focused on industry needs. Every IGERT trainee is required to undertake an industry internship. Each trainee is expected to use IGERT support to develop an industry-sponsored project. "With over \$3.6 million in government funding, industry receives tremendous leverage on their projects," notes John Sutherland, SF IGERT Director.

SPECIAL POINTS OF INTEREST:

- > Links to faculty and student web pages can be found at www.sfi.mtu.edu
- > See the SFI Mission Statement –page 4
- > For more information on the MTU IGERT program and industry involvement, contact: Dr. John Sutherland jwsuther@mtu.edu 906-487-3395

We're on the Web:
www.sfi.mtu.edu

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SFI'S EDUCATIONAL OUTREACH Dr. David R. Shonnard

David Shonnard, Associate Professor in Chemical Engineering, has been involved in SFI outreach initiatives for 5 years. Since 1998, with the US EPA Office of Pollution Prevention and Toxics and the American Society for Engineering Education (ASEE), he has given workshops on Green Engineering: designing industrial processes to minimize environmental impact and improve profits. Workshops were held at universities, for the American Institute of Chemical

Engineers, at the ASEE Summer School, and at NSF's Engineering Research Center, University of Kansas. Professors and students have now implemented methods from his text (*Green Engineering: Environmentally Conscious Design of Chemical Processes*, Prentice Hall 2002) into courses and research. Dr. Shonnard engages industry in green engineering and life cycle assessment (LCA). From 2002-2003, he was a visiting professor in the EcoEfficiency Analysis

Group at BASF-AG in Ludwigshafen, Germany. He conducted LCAs on projects involving beneficial uses of chemical process waste streams. Last summer he advised Dow Corning and UOP LLC on best practices in applications of LCA to improve chemical products and processes. He is holding LCA courses at UOP LLC through February 2005. All of these SFI activities transfer expertise from MTU and promote sustainable development of industry in the Upper Midwest.

SCHEDULE OF
EVENTS

- > **Summer/Fall 2005—Many SFI students from MTU will leave the U.S. to begin their Peace Corps service**
- > **August 2005—Southern University IGERT students will travel north to study engineering at MTU**
- > **September 2005—First annual SFI joint research summit to be held at MTU.**

Students Gain International Recognition

The MTU and SUBR student team led by Dr. Jim Mihelcic won the **International Mondialogo Award** in May, 2005. The award funds will be used to build water tanks from appropriate construction materials onsite at the third partner school, Partido State University in the Phillipines. The group was also recognized as worthy of honorable mention in the U.S. EPA's P3 Competition.

MICHIGAN TECHNOLOGICAL UNIVERSITY AND SOUTHERN UNIVERSITY A&M COLLEGE PARTNERSHIP ON EDUCATION AND RESEARCH

Dr. James R. Mihelcic

During the fall of 2001, Michigan Technological University (Houghton, MI) began a formal affiliation with Southern University and A&M College (Baton Rouge, LA). This established an inter-institutional effort to support minorities in the fields of science, engineering, and mathematics. The partnership includes sharing faculty resources and expertise, as well as facilitating exchanges of undergraduate and graduate students from each university.

Michigan Tech's SFI has been collaborating with Southern's College of Engineering and the Nelson Mandela School of Public Policy and Urban Affairs on several education and research initiatives. Michigan Tech and Southern applied for and were awarded a \$3.6-million National Science Foundation IGERT grant to focus on research and training in the field of sustainability.

Another research partnership includes a joint submission of an NSF proposal focused on sustainability that would pair 20 social science and engineering students between the schools for a summer research experience.

The partnership creates a whole greater than the sum of its parts and expands the interdisciplinary reach of each school. Michigan Tech offers a Ph.D. in national-ranked engineering disciplines, but does not offer a doctoral degree in Social Science. On the other hand, Southern has a Public Policy Ph.D. program, but no doctoral degree in engineering. Michigan Tech is located in a rural setting along the shores of Lake Superior, while Southern is in Louisiana's capitol city, on the banks of the lower Mississippi River. The two universities are different in almost every re-

spect: student/faculty ethnicity, locale, focus. The partnership between the schools broadens the cultural, technical, and world views that each offers individually.

The MTU-SUBR partnership continues to grow. An MTU-SUBR team of students led by Dr. James R. Mihelcic gained recognition for their design project developing appropriate construction materials. In Berlin last May, they competed against over 400 teams around the world to win the prestigious International Mondialogo Award from DaimlerChrysler and the United Nations Education, Scientific and Cultural Organization (UNESCO). They also received an honorable mention in the U.S. EPA's first annual "[P3 Student Design Competition for Sustainability](#)" held recently in Washington, DC.

Further information about the Michigan Tech/Southern partnership can be obtained by contacting the Directors of the Sustainable Futures Institute:

Dr. John W. Sutherland
jwsutherland@mtu.edu
 906-487-3395
 and
 Dr. James R. Mihelcic
jm41@mtu.edu
 906-487-2324



At Southern University A&M College (left to right): Chris Seifert, Dr. Khashruz Choudhury, Mehmet Ulupinar, Ginger Richardson, and Solomon Abdi.

RESEARCH HIGHLIGHT

Dr. John S. Gierke and Deborah M. Beach, Graduate Student

Sequestration of carbon dioxide is important for reducing anthropogenic carbon emissions. Much sequestration work to date has focused on the use of oceans, geologic formations, and the terrestrial biosphere as sinks for carbon. Another promising sequestration route is mineral carbonation. Carbon dioxide reacts naturally with mineral and metal oxides to form stable mineral carbonates. These reactions proceed slowly unless the system is heated and/or placed under intense pressure. Carbonation rates can also be increased by energy-intensive

techniques, where the reactive surface area of the oxide is increased. Another option is to utilize oxides that are already available in powdered or fine-grained form.

IGERT Trainee Deborah Beach and Dr. John Gierke (Department of Geological and Mining Engineering and Sciences), in conjunction with Drs Kawatra and Eisele (Chemical Engineering), are studying carbon sequestration using cement kiln dust (CKD), a waste product of the cement industry. Cement manufacturing produces CKD in the preheating and calcining (driving off CO₂) proc-

esses. CKD contains 20-60% by weight calcium oxide (CaO), is produced in vast quantities, and is often disposed in landfills or stored in on site. Preliminary column experiments show that CKD readily sequesters CO₂ at ambient temperatures and pressures. Influent concentrations of CO₂ as high as 100,000 ppm_v were reduced to below detection limits (50 ppm_v) with short exposure times (on the order of minutes) without any amendments.

These experiments suggest that CKD can serve

as an effective sink for CO₂. Based on reported production and emissions rates for cement manufacturing, the CKD disposed of by the U.S. cement manufacturing industry alone has the potential to sequester almost 15% of the CO₂ emitted from the calcining process. Beach and Gierke are currently conducting additional laboratory experiments, along with mathematical modeling to further develop this promising application of alkaline waste products for sequestration of CO₂.

SFI EARNS \$3.6 MILLION NSF AWARD

Karl Haapala, Graduate Student

Michigan Tech and Southern University – Baton Rouge have received a \$3.6 million award from the National Science Foundation to work in the area of sustainable futures. The award is part of NSF's Integrative Graduate Education and Research Traineeship (IGERT) program. The project will focus on developing the Sustainable Futures Model introduced by Michigan Tech, which recognizes the need to address complex sustainability issues via research on industrial, societal, and environmental systems as well as integrative efforts that address all three of these areas. In addition to research, the Sustainable Futures IGERT will focus on educating engineers and policy makers to consider life cycle product issues and policy decisions.

"A rapidly increasing world population, over-consumption of resources and contamination of the environment are jeopardizing the ability of future generations to have the same quality of life that we enjoy," according to the Sustainable Futures IGERT Director, John Sutherland, Richard & Elizabeth Henes Chair Professor of Mechanical Engineering at Michigan Tech. The project includes an international and internship experience for all IGERT trainees. Faculty and students from Michigan Tech and Southern University will participate in an innovative inter-institutional doctoral program focused on understanding and integrating technology and policy, while developing tools and methods for sustainability education at all levels—from primary schools to college to educating the public and industry.

Announcements:

Faculty win MUSES award:

A team of SFI faculty has been awarded \$1.7 million from the National Science Foundation to investigate the technological, ecological, social, economic, and political issues and their interrelationships - associated with lignocellulosic based ethanol production from forest lands in the Upper Midwest. The research team includes Ann Maclean (Principal Investigator), David Flashpohler and Christopher Webster (Forest Resources and Environmental Sciences), David Shonard (Chemical Engineering), Kathleen Halvorsen and Barry Solomon (Social Sciences), David Hokanson (Civil and Environmental Engineering), and John Sutherland (Mechanical Engineering and Engineering Mechanics).

IGERT Trainee Receives NSF Fellowship:

IGERT Trainee Valerie Fuchs, (Civil and Environmental Engineering), has been awarded a National Science Foundation Graduate Research Fellowship. This will allow her to continue her research in Sustainable Futures at MTU. The project proposal was to study the Optimization of Sustainability for Wastewater Treatment, and she plans to focus specifically on alternative and natural systems for wastewater treatment, such as evapotranspiration and constructed wetlands.

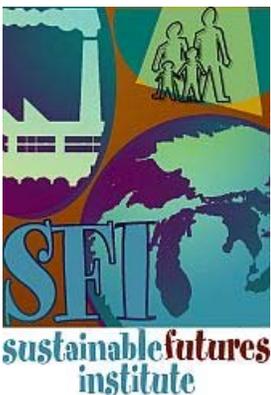
SFI MISSION: The mission of the **Sustainable Futures Institute** is to create and disseminate new tools, methods, knowledge, and technologies that promote, enable and support environmental, economic, and societal sustainability principles. The vision of the **SFI** is to become internationally recognized for its teaching, research, and outreach contributions to the field of sustainable systems. We will develop a new meta-discipline in sustainability science that integrates engineering and technology elements of industrial ecology; the scientific elements of environmental assessment and modeling; and the economic, human behavioral elements of the social sciences that support environmental decision making.

EDUCATIONAL INITIATIVES OF THE SUSTAINABLE FUTURES INSTITUTE **Dr. James R. Mihelcic**

Society, environment, and economic development are inherently interconnected, both locally and worldwide. Healthy survival requires a sustainable future, in which human and industrial systems enhance quality of life by recognizing and understanding this interconnectivity.

In recognition of the emerging importance of sustainability, Michigan Tech founded the Sustainable Futures Institute in January 2004. SFI's mission is to create and disseminate new methods and processes to generate scientific knowledge and engineering products for sustainability decisions. SFI has several education initiatives:

1. Creation of a "Graduate Certificate in Sustainability" to recognize curricular breadth in: policy, society, and economics, and environmental and industrial systems. New courses include Sustainability Graduate Seminar and Sustainability Undergraduate Colloquium, Sustainable Futures I and II, Developing Indicators of Sustainability, and Water Conflict.
2. A \$3.6-million National Science Foundation Integrative Graduate Education and Research Traineeship grant creates an interdisciplinary graduate program for students to develop an integrated scientific and social basis for decision-making in sustainability.
3. A unique partnership with the U.S. Peace Corps allows graduate students to combine education and research with two years of service overseas. Students work on sustainable development in engineering, forestry, and geology.
4. Creation of middle school curricula for water, energy, and pollution prevention/sustainability. Curriculum modules are being developed and tested to deliver them to middle schools throughout the state of Michigan.
5. Development of design guidelines for decision makers, planners and citizens to enhance community appearance and natural resources.



MichiganTech

1400 Townsend Drive
Houghton, MI 49931
Phone: 906-487-3366
Fax: 906-487-2943
E-mail: sfi@mtu.edu