



# SFI CHRONICLE

Highlights of Current Research and Education Projects

March 2009

Issue 5

## SFI Shares Funding for Biofuel Research Center

### MichiganTech

#### SFI Speaker Series

April 8

Jonah Levine Energy  
Storage Researcher,  
UC Boulder

Integration of Electric  
Generation Resources  
for the Next Generation  
Utility: Bringing Wind  
Energy onto the Grid



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Michigan Tech and Michigan State received \$1.4M from the US Department of Energy to establish a new Forestry Biofuel Statewide Collaboration Center to focus on cellulosic biofuels a commercial reality. SFI deputy director **David Shonnard** (ChemEng), who leads the new center, commented that this funding "will help solidify the SFI-MSU collaboration to help industry partners commercialize production of forest-based biofuels, bioenergy and bioproducts." He added that "Our collective goals are to create profitable enterprises, increase jobs, reduce

emissions, and promote energy independence."

Shonnard holds the Robbins Chair of Sustainable Materials and is a lead researcher in a \$2 million state-funded Center of Energy Excellence (CoEE), another collaborative effort of Michigan Tech, Michigan State and Frontier Renewable Resources.

New Center research will be identified in collaboration with industry partners. In general, faculty and students will develop solutions to a variety of barriers to commercialization of bio-

fuels. They will inventory available forest feedstock; develop a feedstock supply chain model; explore the economic and environmental implications of biofuel technology; continue innovation in forest cultivation, harvesting and energy conversion processes; support technology transfer and develop sustainability guidelines.

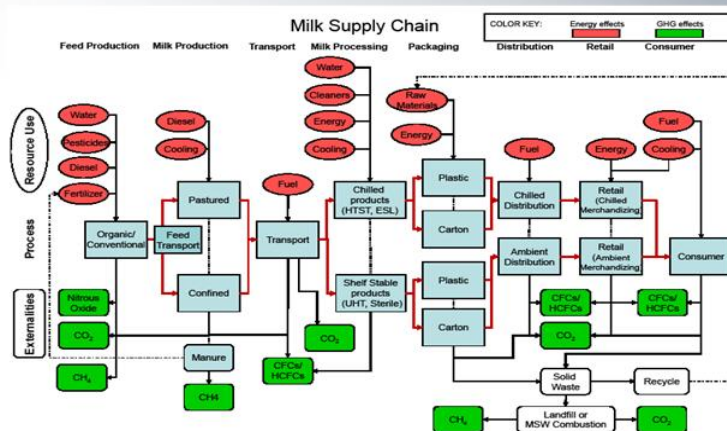
This new center is part of Michigan's Centers of Excellence Initiative in Alternative Energy in which for-profit companies team with universities to research, develop and commercialize technologies.

## Life Cycle Assessment of the Retail Supply Chain: Dairy Products

Previous life cycle assessment (LCA) studies of dairy products in the European Union (EU) have found that up to 5% of greenhouse gas emissions are derived from milk and other dairy products; however, few such studies have been undertaken in the United States. The University of Arkansas has commissioned SFI Deputy Director **David Shonnard** (Chemical Engineering) to undertake a life cycle analysis of dairy for Wal-Mart Corporation to assess impacts to the environment and human health for all of the significant stages in the life cycle of dairy products.

The results of this analysis will serve to identify opportunities for saving energy and reduce greenhouse gases. After conducting an extensive literature review, Dr. Shonnard's group will define the goal and scope of the study, formulate a functional unit definition, organize the inventory data, suggest allocation methods when appropriate, and simulate the LCA results using Michigan Tech's software (SimaPro 7.0). The study involves the design and implementation of life cycle inventory surveys distributed to dairy producers. The results will identify hot spots for subsequent detailed analysis with regard to greenhouse gas (GHG) mitigations options.

### Life Cycle Assessment Case Study: Carbon Equivalent GHG of Fluid Milk



The above schematic of the life cycle of fluid milk shows inputs (ellipses) and outputs (rectangles) at each stage of the supply chain. Items in red are the primary focus for the LCA. (Source: Life Cycle Assessment: U of Arkansas, Division of Agriculture)

## Boeing Grant for Light-Weight Composite Aircraft Metals

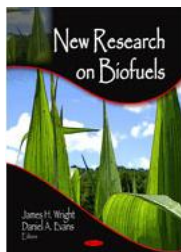
787 Dreamliner



Boeing awarded \$420K to SFI's spinoff Center for Fundamental and Applied Research in Nanostructured and Lightweight Materials to test various composite metals. Composites now account for 50 wt% of aircraft currently being developed, such as the new super efficient Boeing 787 Dreamliner. Their reduced energy consumption, greenhouse gases, and maintenance costs make them a favorite over traditional metals.

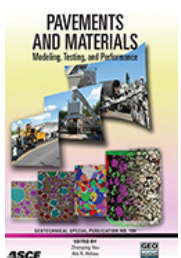
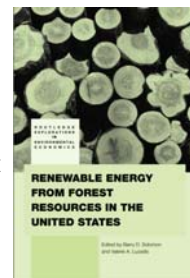
The goal of this project, entitled "Investigation into the Enhancement of Thermoplastic Polymers with Conductive Nano Materials" is to improve the material's electrical conductivity as well. Researchers are adding varying amounts of different conductive nano materials to thermoplastic polymers, and then measuring the resultant composites for their tensile and flexural properties, impact resistance, electrical and thermal conductivity, and viscosity. These improved materials may have several aerospace applications. Investigator: **Julia King** (Chemical Engineering)

## Recent Books by SFI members



**Claudio Mazzoleni** (Physics) and co-authors published “Pollution reduction using biofuels: from the laboratory to the real world,” for the book *New Research on Biofuels* by J. H. Wright and D. A. Evans. Mazzoleni came to Michigan Tech under the Strategic Faculty Hiring Initiative for sustainability research. He studies the effects of anthropogenic and natural aerosols on earth's climate and air quality. His goal is to provide new knowledge to advance the performances of future climate models and to improve air quality.

**Barry Solomon**, (Social Sciences) and Valerie A. Luzadis SUNY Syracuse, co-edited the book *Renewable Energy from Forest Resources in the United States*. The book covers issues in biomass energy markets in the US from an economic as well as technical perspective. The book shows that forests could displace sixteen per cent of domestic transportation fuel use in 2030. Twelve SFI members contributed to this book: **Kathleen Halvorsen** (also Social Sciences), **David Flaspohler**, **Robert Froese**, and **Christopher Webster** (School of Forestry and Environmental Sciences); **Timothy Jenkins**, **John Sutherland**, **Jeffrey Naber**, and **Jeremy Worm** (Mechanical Engineering-Engineering Mechanics) **Qiong Zhang**, (SFI and Civil and Environmental Engineering) and **Dana M. Johnson** (School of Business and Economic ).



**Zhanping You** (Civil and Environmental Engineering) and co-authors edited the book, *Pavements and Materials: Modeling, Testing and Performance*, published by the American Society of Civil Engineers. The book contains 16 papers addressing a variety of issues on the testing and modeling of pavement materials and structures.

## Roshan D'Souza Wins NSF Career Award for 2009

SFI member **Roshan D'Souza** received a prestigious and highly-competitive five-year National Science Foundation CAREER grant for untenured junior faculty. D'Souza, an assistant professor of Mechanical Engineering-Engineering Mechanics, heads a team of Michigan Tech researchers who are harnessing the power of graphics processing units (GPUs) to understand complex biological systems. This award is a significant recognition of the quality and creativity of D'Souza's research, as well as recognition of the research potential of a junior faculty member. The objective of D'Souza's latest SFI project is to leverage the massive computational capabilities of commodity computer graphics hardware to generate real-time feedback to designers.

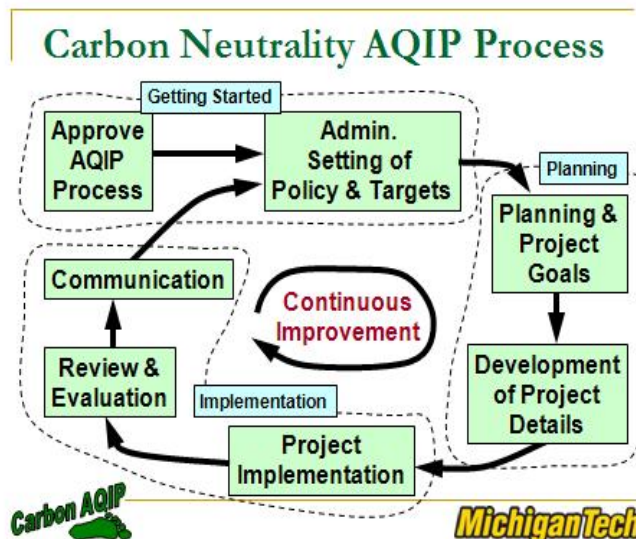
## Terra Preta Wins 2008 SFI Poster Session

Terra Preta @ MTU Working Group, dedicated to exploring the feasibility of creating and distributing biochar, a carbon-negative soil amendment, won the People's Choice Poster Award at the 2008 SFI Annual Banquet and Poster Session. Biochar is a slow-burning charcoal-creation process that can vastly improve soil fertility. Virtually any organic matter can be turned into biochar. The February 2009 issue of *Environmental Health Perspectives* quotes first-year Chemical Engineering major **Amanda Taylor** about the working group's efforts to study the production and use of biochar and how it fits into a framework of community and global sustainability. The biweekly *Science News* also cites the Terra Preta Working Group.

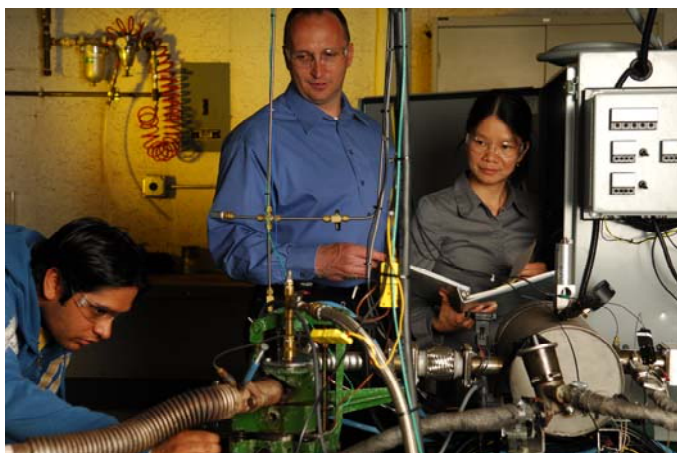


## Green Campus Enterprise

Michigan Tech's newly formed Green Campus Enterprise (GCE) is off to a quick start. The GCE is made up of several enthusiastic undergraduate students charged by the University's Academic Quality Improvement Program (AQIP) to design and implement projects that will reduce the campus carbon footprint. The Enterprise has formed three subgroups. The Clean Air - Cool Planet Calculator Group is committed to filling in missing pieces in the data to complete the baseline year of Michigan Tech's carbon footprint. The Campus Culture and Attitude Group is planning a dorm competition for energy reduction for next fall term. Along with the competition they will conduct educational sessions on conservation at the Forestry Building as a short term case study in energy education to see what energy reductions will result. Lastly, the Wind Turbine Group is conducting a feasibility study of wind turbines to power Michigan Tech. The group will propose detailed steps (e.g. wind metering locations, costs, etc.) needed to run the study under several turbine scenarios. Future Enterprise groups will gather data from the instrumentation and evaluate the feasibility of a turbine. The diagram on the right illustrates how the Green Campus Enterprise works. It collaborates closely with the Academic Quality Improvement Program (AQIP) that advises it.



## SFI Wins NSF Grant for Cooperative Research Center on Assembly Research



Dr. **Jeffrey Naber** and students in the Institute Cooperative Research Center on Assembly Research lab.

The National Science Foundation has awarded SFI and the University of Michigan funding for a cooperative research center devoted to research for assembly in the twenty-first century. To compete with products from low-cost regions around the world, the US manufacturing industry must shift its paradigm from batch mass production of standardized

manufacturers' overall competitiveness can be defined based on traditional criteria such as performance, quality, cost, and timeliness, but also on new criteria such as personalization, selective outsourcing, adaptability, and sustainability.

The rationale for forming this collaborative center between Michigan Technological University and the University of Michigan is that assembly will play critical roles in all of these competency criteria during the product realization process. This Institute Cooperative Research Center on Assembly Research is composed of faculty, graduate students, and laboratory facilities from the University of Michigan and Michigan Tech, and at least ten industry and/or government organizations that collectively fund and direct research activities. The vision of the Center is to maximize the global competitiveness of the American manufacturing industry through innovations in assembly design and manufacturing. Members participate directly in graduate student education and training, producing a workforce knowledgeable in industrially relevant research and providing access to those students as they prepare for industry employment.

## Highlights from the Center for Science and Environmental Outreach

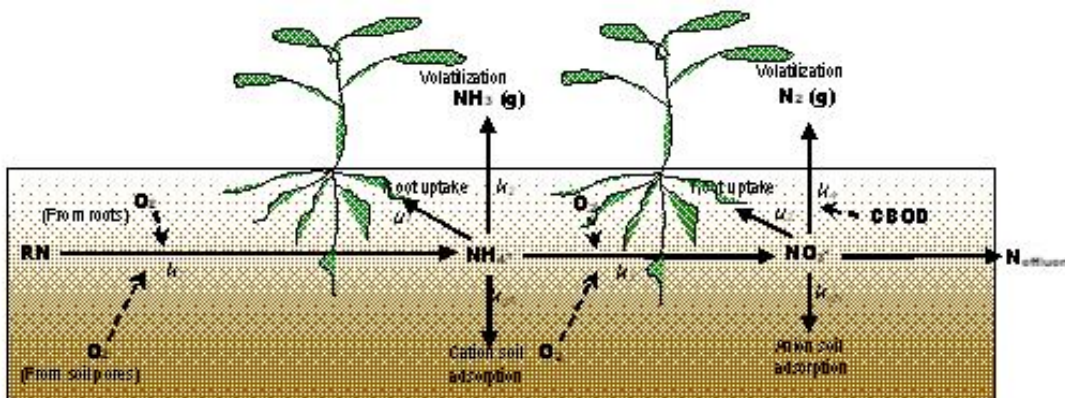


Bringing Environmental Education to Urban Schools in Michigan Initiative, submitted by Michigan Tech CSEO and the Michigan Alliance for Environmental & Outdoor Education (MAEOE), has been awarded \$10K from the Michigan Space Grant Consortium. The project will engage 24 grade 1-8 teachers in Detroit and Pontiac schools in a year-long environmental education immersion to acquire and/or strengthen their environmental education and Earth system science knowledge and teaching skills. The MAEOE will provide mentors for the 24 teachers for one year, drawing upon the expertise of board members, Belle Isle Nature Zoo staff, and Huron-Clinton Metroparks environmental educators. Throughout the year, the teachers will attend three professional development workshops in environmental education as they form a community of learners that will work together to support one another's efforts and troubleshoot each other's needs. The grant will provide professional development, college credit, environmental education teaching supplies, sub fees, and field trip stipends.

The vision and mission of the Michigan Space Grant Consortium are to foster awareness of, education in, and research on space-related science and technology in Michigan. Its mission is to create, develop, and promote programs that support its vision and reflect NASA strategic interests, and encourage cooperation between academia, industry, state and local government in space-related science and technology in Michigan.

## SFI Grant for Sustainable Design of Constructed Wetlands

The Water Environment Research Foundation awarded SFI a \$25,000 grant to model constructed wetlands for sustainability and optimization. Because their treatment mechanisms are still not well understood, SF IGERT graduate students are designing a column study and employing a comprehensive life cycle assessment technique to determine sustainable management strategies and technologies for constructed wetlands. This study is the first controlled comparison of vertical flow regimes in constructed wetlands. Advisor: **John Gierke** (GMES).



This figure illustrates how wetlands vegetation affects nitrogen directly through plant uptake and indirectly by transmitting oxygen through roots.

## 2009 SF IGERT Summit at Southern University in Baton Rouge



SFI partners with the Nelson Mandela School of Public Policy and Urban Affairs at Southern University and A&M College – Baton Rouge on an NSF Integrative Graduate Education and Research Program (IGERT) for American doctoral students interested studying sustainability from both an engineering and a public policy perspective. At this year's annual summit, students and faculty from both schools made presentations. SF IGERT student research projects range widely, from policy issues that impact nearby areas (such as Great Lakes Water Quality at Michigan Tech and Hurricane Katrina at SUBR) as well as those with world-wide impacts, such as energy, urban/rural sustainability, wetlands management, water distribution systems, materials, sustainable manufacturing, biofuel production, and green chemistry, among other topics.

**Dr. Lionel Lyles, SF IGERT Director at SUBR**

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