Sustainable Futures
Institute

Annual Report
June 2007 – July 2008
Letter from the Director

I wish to extend a warm greeting to all our friends, colleagues, associates, and partners who have a shared interest in creating a sustainable future. This 2007-08 Annual Report for the Sustainable Futures Institute (SFI) describes many of the ongoing projects related to SFI and recent accomplishments and honors by students, staff, and faculty.

Since it was formally established in 2003, the students, staff, and faculty of the SFI have been collaborating on a variety of research, education, and outreach initiatives related to sustainability. Currently, SFI has in excess of $15M in project funding through companies, government agencies, and private foundations. SFI owes its success to the various groups, centers, and initiatives operating within SFI. The figure below displays some of these entities that have a focus on specific issues relative to sustainability.

Some of the most challenging sustainability issues can only be addressed through collaborative research efforts that bridge traditional boundaries. SFI plays an important role in nurturing and facilitating interactions among faculty from different academic units to address these issues. For instance, our Wood to Wheels research covers the entire transportation value chain; our Great Lakes water Muses project defines water as a material so its use, value, and governance can be examined from a new perspective; and our graduate education program (IGERT) is directed at achieving industrial, environmental, and societal sustainability from several disciplines.

This year SFI’s place as a leader in sustainability was enhanced by a generous gift by Richard and Bonnie Robbins. The Robbins committed $6 million dollars to establish three Robbins Chairs in the area of Sustainability. This gift was reinforced by a generous investment of the University to create ten new interdisciplinary faculty positions dedicated to sustainability. Thanks to support like this and to on-going SFI efforts, Michigan Tech is fast becoming an international leader in sustainability.

At its heart, the Sustainable Futures Institute is all about people – from interdisciplinary collaborations on research initiatives to student-faculty course interactions to volunteers greening the campus. In our research, education, and outreach efforts we work closely with one another on campus and with partners off-campus to tackle many exciting projects. The challenge of sustainability can only be addressed when everyone works together to pursue excellence.

John W. Sutherland, SFI Director
Richard & Elizabeth Henes Chair Professor of Mechanical Engineering
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## List of Abbreviations

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<th>Abbreviation</th>
<th>Full Form</th>
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<tbody>
<tr>
<td>AEESP</td>
<td>Association of Environmental Engineering and Science Professors</td>
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<td>APSRC</td>
<td>Advanced Power Systems Research Center</td>
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<td>AQIP</td>
<td>Academic Quality Improvement Program</td>
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<td>ASME</td>
<td>American Society of Mechanical Engineers</td>
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<td>BS</td>
<td>Department of Biological Sciences</td>
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<td>CSEO</td>
<td>Center for Science and Environmental Outreach</td>
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<td>CEBFM</td>
<td>Center for Environmentally Benign Functional Materials</td>
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<tr>
<td>CEE</td>
<td>Civil and Environmental Engineering Department</td>
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<td>CFARNLM</td>
<td>Center for Fundamental and Applied Research in Nanostructured and Lightweight Materials</td>
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<td>CH</td>
<td>Department of Chemistry</td>
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<td>ChE</td>
<td>Chemical Engineering Department</td>
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<td>CLS</td>
<td>School for Cognitive Learning Sciences</td>
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<td>CSERI</td>
<td>Computational Science and Engineering Research Institute</td>
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<td>CSEOE</td>
<td>Center for Science and Environmental Outreach</td>
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<td>DNR</td>
<td>Department of Natural Resources</td>
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<td>DOE</td>
<td>Department of Energy</td>
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<td>EEF</td>
<td>Department of Engineering Fundamentals</td>
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<td>EHS</td>
<td>Environment, Health and Safety</td>
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<td>ESC</td>
<td>Ecosystem Science Center or Environmental Sustainability Committee</td>
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<td>ExCit</td>
<td>Expanding Cities: People, Water and Infrastructure</td>
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<tr>
<td>FA</td>
<td>Visual and Performing Arts</td>
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<td>FY</td>
<td>Fiscal Year</td>
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<td>GMES</td>
<td>Geological Mining Engineering and Sciences</td>
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<td>GOALI</td>
<td>Grant Opportunity for Academic Liaison with Industry (NSF)</td>
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<td>HC</td>
<td>Hydrocarbon</td>
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<td>IGERT</td>
<td>Integrative Graduate Education and Research Traineeship</td>
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<td>ISDERE</td>
<td>International Sustainable Development Engineering Research Experiences</td>
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<td>LCA</td>
<td>Life-cycle Analysis</td>
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<td>MA</td>
<td>Department of Mathematical Sciences</td>
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<td>MEDC</td>
<td>Michigan Economic Development Corporation</td>
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<td>MDEQ</td>
<td>Michigan Department of Environmental Quality</td>
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<td>MEEM</td>
<td>Department of Mechanical Engineering—Engineering Mechanical</td>
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<td>MiSTI</td>
<td>Center for Materials in Sustainable Transportation Infrastructure</td>
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<td>MTCWS</td>
<td>Michigan Tech Center for Water and Society</td>
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<td>MUSES</td>
<td>Materials Use: Science, Engineering, and Society (NSF)</td>
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<td>NGO</td>
<td>Non-governmental Organization</td>
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<td>NSF</td>
<td>National Science Foundation</td>
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<td>PH</td>
<td>Department of Physics</td>
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<td>PHAs</td>
<td>polyhydroxyalkanoates</td>
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<td>Pub Policy</td>
<td>Public Policy</td>
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<td>REU</td>
<td>Research Experience for Undergraduates</td>
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<td>RTILs</td>
<td>room temperature ionic liquids</td>
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<tr>
<td>SFI</td>
<td>Sustainable Futures Institute</td>
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<tr>
<td>SME</td>
<td>Society of Mechanical Engineers</td>
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<tr>
<td>SS</td>
<td>Department of Social Sciences</td>
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<td>SFRES</td>
<td>School of Forest Resources and Environmental Sciences</td>
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<td>SUBR</td>
<td>Southern University A&amp;M College at Baton Rouge</td>
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<tr>
<td>UNESCO</td>
<td>United Nations Education, Scientific and Cultural Organization</td>
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<td>USDA</td>
<td>United States Department of Agriculture</td>
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<tr>
<td>W2W</td>
<td>Wood-to-Wheels</td>
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SFI Projects Listed by Center/Activity

Michigan Tech Center for Water and Society

**Director: Alex Mayer (GMES)**
The Michigan Tech Center for Water & Society (MTCWS) was founded in June of 2005 as part of Sustainable Futures Institute (SFI). Under the direction of Dr. Alex Mayer, Professor of Geological & Mining Engineering & Science, the MTCWS has 49 faculty/staff participants, 45 graduate students, and 3 undergraduate student participants in 13 units across the Michigan Tech campus.

Center research and education efforts are described below.

**Current MTCWS Projects**

**Project: Intergovernmental Personnel Act Agreement with US Army Corps of Engineers**
**Investigator: David Watkins (CEE)**
This project involved the development of a design document for the next generation of the HEC-FDA (Flood Damage Analysis) software tool. The design document incorporates suggestions and research items discussed during two previous workshops. It also accommodates those recommendations that the Corps concurred with from the National Research Council (2000) report on the Corps implementation of risk analysis for flood damage reduction, and it will aide in implementing the Chief of Engineers' "Actions for Change." This new tool may include event sampling, the ability to do scenarios analysis, structure-by-structure analysis, cost analysis, and agricultural damage analysis.

**Project: Erosion Reduction by Air Entrainment Phase 1**
**Investigator: Brian Barkdoll (CEE) and Mohan Rao (MEEM)**
The primary objective of Phase I of this project is to demonstrate that the introduction of an air curtain downstream of the terminal structure of a gated spillway reduces the scour depth. Excessive scour of sediment can be a problem at hydraulic structures if the scour depth is such that it undermines the structure’s foundation, which can lead to sliding, tilting, and potentially to the collapse of the structure. Use of an air-bubble curtain downstream of the terminal structure may be an inexpensive method of scour reduction.

**Project: Engaging Social Scientists in the WATERS Initiative: Special Sessions at the 2008 International Symposium on Society and Resource Management**
**Investigators: Alex Mayer (GMES) and Kathleen Halvorsen (SS)**
This project conducted two special sessions at the International Symposium on Society and Resource Management (ISSRM) Conference in Burlington, Vermont, June 11, 2008. The purpose of Session One was to familiarize the audience with the WATERS program and to present initial ideas about key fundamental social science questions and approaches that could be answered through participation in the WATERS program. Session Two was a facilitated discussion of potential fundamental social science questions and approaches to answer them that could fit within the overall structure of WATERS. WATERS provides an excellent opportunity to support the intensive, panel-based (repeated surveys over time) investigation of important research questions important to theory development about human relationships to water.

**Project: Expanding Cities: People, Water and Infrastructure (ExCit)**
**Investigator: Alex Mayer (GMES)**
ExCit stands for Expanding Cities: People, Water and Infrastructure. ExCit is a student exchange program consortium of six universities in Canada, Mexico, and the U.S. The focus area for the program is decision making for meeting the growing demands on urban water resources systems. Student activities will consist of three stages: intensive language training, coursework in water resources and sustainable development, and professional or research internships with local businesses, municipalities, agencies or at the host university.
Project: The Carbon Balance of Lake Superior: Modeling Lake Processes and Understanding Impacts on the Regional Carbon Budget
Investigator: Noel Urban (CEE), Galen A. McKinley, Chin Wu, and Ankur Desai (U of Wisconsin – Madison)
Motivated by the need for improved knowledge of the Great Lakes CO2 fluxes, this project will couple an exosystem-carbon module to an existing hydrodynamic model of Lake Superior to estimate these fluxes and their spatial and temporal variability. Development of the lower-food web model is being conducted. Cory is using information theory to derive an optimized food web model with a minimum number of components. Results from this work have been presented at four international conferences, and the first manuscript will be submitted in August 2008 to Ecological Modeling.

Project: Herring Gull BioSentinel Sampling Program
Investigator: Judith Perlinger (CEE)
The purpose of the overall project is to develop a contaminant monitoring protocol for Michigan using herring gull (Larus Argentatus) eggs. As part of a proposed Cooperative Agreement between Michigan Technological University, Clemson University, Michigan State University, Michigan Tech personnel collect gull eggs once annually from Gull Island in Lake Superior off W. Marquette County, Michigan, utilizing Michigan Tech’s research vessel, the R/V Agassiz, and coordinate gull egg collection from Net Island off of Isle Royale with National Park Service personnel. Gull eggs collected from Gull Island and Net Island will be shipped according to specifications to the University of Windsor for chemical analysis and publication of the results of the monitoring work.

Project: Modeling and Analyzing the Use, Efficiency, Value and Governance of Water as a Material in the Great Lakes Region through an Integrated Approach
Investigators: Alex Mayer (GMES), David Watkins (CEE), Qiong Zhang (SFI), James Mihelcic (USF), Julie Zimmerman (Yale), and Sheila Olmstead (Yale)
This multidisciplinary 5-year research project (funded by the National Science Foundation MUSES program) will determine, through integrated physical and economic models and under various scenarios of population growth, climate change, land use, and emissions, the impact of direct and indirect drivers on water quality, quantity, and availability in the Great Lakes region. Though nearly every product in global commerce is dependent on water, water has not traditionally been considered a material characterized by integrated analyses to quantify flows and stocks, opportunity costs, and full valuation (i.e., social, environmental, and service costs) through its myriad of uses. This had led to an undervaluing of water as a finite resource. The Great Lakes region was chosen due to its large volume of available freshwater (but low rate of replacement), high economic impact, complex governance issues including an international border, and increasing competition for water allocation among industrial, agricultural, municipal, recreational, and ecosystem needs, as well as existing and future threats of water quality deterioration.

Project: Streamside Lake Sturgeon Culture for the Ontonagon River
Investigators: Nancy Auer (BS) and Edward Baker (DNR)
The objective of this project is to raise lake sturgeon in a streamside hatchery using ambient Ontonagon River water so that fish will imprint to the river to assure less chance of fish straying to other rivers as well as increase the greater likelihood of successful rehabilitation of the Ontonagon population. During the course of the summer, the facility was open to the public and hosted over 1000 visitors. Operations were monitored in the streamside facility and public tours were conducted. Also studied was maximum raceway rearing densities and possible disruptions the exotic ruffe (Gymnocephalus cernuus) may have on sturgeon recruitment and feeding.
Project: Evaluating Riparian Timber Harvesting Guidelines: Evaluate Aquatic Habitat Impacts  
Investigator: Casey Huckins (BS)

The primary objective of this effort is to assess long-term effects of riparian harvest techniques on stream ecosystem function at the LCMR sites and Pokegema Creek sites. The following objectives are included into the study plan: (i) Quantify available food resources for stream food webs (periphyton and detrital standing crops), and macroinvertebrate response (biomass of functional feeding groups and diets) in stream reaches subjected to various riparian harvest treatments; (ii) Evaluate breakdown rates of leaf litter and wood in streams under the different riparian treatments. Results from this research will be used to validate or revise the State of Minnesota’s riparian forest management guidelines and demonstrate the use of functional measures of ecological integrity for assessment of stream health.

Project: Huron Creek Watershed Management Plan  
Investigator: Alex Mayer (GMES)

The Huron Creek Watershed, located in north-central Houghton County of the Upper Peninsula of Michigan, has been affected by human activity for decades such as historical mining activities, aging septic systems, and now-closed landfills constructed before modern environmental requirements. This project is to develop a community-made watershed management plan to address water quality issues in the Huron Creek watershed. A series of chemical, physical, and biological surveys were conducted by the Michigan Tech Center for Water and Society, which indicated that the defined designated uses of the watershed were either impaired or threatened by metals, nutrients, sediment, “Flashy Flow,” invasive plant species, and bacteria. Best Management Practices (BMP) were identified as part of, or in combination with, several of the recommended actions. Suggestions for potential project partners have been identified for each recommended action, along with an estimated implementation schedule, suggested milestones, estimated costs, and possible funding sources.

Investigators: John Gierke (GMES) and Carla Alonso (GMES)

These tests will help characterize the cavity network in karst systems. Groundwater in bedrock aquifers occurs in fracture networks, making them incredibly difficult to characterize because of the inadequate information available from drilling records and conventional mapping. This research is aimed at helping develop methods for characterizing the cavity network in a Puerto Rican karst system known as Northern Karst, which is a series of mogotes (hills) underlain by a network of cavities connecting sinkholes. The Northern Karst is the main supply of water for inhabitants and surface water bodies. Karst areas are more susceptible to drought, subsidence, and contamination. By analyzing remote sensing data to delineate fractures in volcanic terrains, the results will improve well siting strategies.

Project: Associations between Groundwater-Surface Water Dynamics and Coaster Brook Trout Spawning Habitat in the Salmon Trout River, Marquette County, Michigan  
Investigators: Alex Mayer (GMES), Casey Huckins (BS), and Matthew VanGrinsven (GMES)

The Salmon Trout River (STR) is the only river on the south shore of Lake Superior known to sustain a reproducing coaster brook trout population. In this study, high-resolution data collection methods are implemented to quantify the interaction between the groundwater and surface water in order to verify the presence or absence of groundwater discharge into the river at sites that support a reproducing population of coaster brook trout. By independently inverting temperature and pressure measurements the exchange of water between groundwater and surface water can be simultaneously analyzed, permitting a more precise estimate of groundwater velocity.
Project: Limnological Research in Lake Superior for Middle/High School Students, Teachers & Communities
Investigator: Joan Chadde (CSEO)
This program provides scientific excursions aboard Michigan Tech’s research vessel The Agassiz on Lake Superior and connecting waters for community members and middle/high school students and teachers. These scientific excursions provide firsthand experience in how Great Lakes research is conducted, the equipment used, and what research is telling us about the health of the Great Lakes. Project goals are to: (i) increase middle/high school students’ interest in science by providing real-world science applications; (ii) enhance citizen understanding of Great Lakes science and how research is conducted; and (iii) introduce teachers and students to careers in earth science and Great Lakes research. The scientific excursions are led by MTU scientists and graduate students from the CEE and BS departments.

Project: Sedimentation in Schoharie Reservoir: Temporal Dynamics
Investigator: Noel Urban (CEE)
This project seeks to determine the spatial and temporal patterns of sediment accumulation within the Schoharie Reservoir in New York through sediment cores obtained at six sampling stations down the length of the Reservoir. Sediments were characterized physically, chemically, and radiometrically. Schoharie Rates of sediment accumulation in this reservoir are well within the range reported for other reservoirs. Highest rates of sediment accumulation occur at the southern end of the reservoir near the entrance of Schoharie Creek. A significant portion (15-40%) of the total sediment accumulated at each station was deposited during storm events. Rates of sediment accumulation have changed over time.

Project: Air: A Conduit between Water, Society, and Space
Investigator: Alex Mayer (GMES)
This project supports the acquisition of advanced analytical instrumentation for CO2 (CO2 analyzer) and for mercury (mercury analyzer and mercury air sampling equipment). The equipment is suitable for study of climate-change related issues and mercury contamination, two of the more pressing water resources issues facing the world as well as the Great lakes region. The new instrumentation will be integrated with an existing package of micrometeorological equipment currently in use on Michigan Tech’s campus to enable researchers to measure fluxes of CO2 and mercury between the Great Lakes and the atmosphere. This enhanced system will be used extensively in other Great Lakes research projects.

Wood-to-Wheels Initiative
Leader: David Shonnard (ChE)
The Wood-to-Wheels (W2W) research and education projects address technical and societal barriers that fall into four main categories: (1) the production of sustainable forest resources, (2) the process of producing ethanol and co-products from biomass, (3) the re-design of vehicles and engines to more efficiently utilize biofuels, and (4) assessment and decision making. Currently 22 faculty participate in the W2W initiative.

Research projects falling under the umbrella of the Wood-to-Wheels initiative include the following:
Current Wood-to-Wheels Projects

Project: Renewable Energy from Forest Resources: An Investigation of the Complex Interrelated Issues Associated with Generating Automotive Fuels from Lignocellulosic Biomass
Investigators: Ann Maclean (SFRES), David Flasphohler and Chris Webster (SFRES), David Shonnard (ChE), John Sutherland (MEEM), Kathy Halvorsen (SS/SFRES), and Barry Solomon (SS).
This project is part of the NSF MUSES funding program that places strong emphasis on multidisciplinary research and education on complex issues related to materials use in the environment. The search for renewable fuels is a timely and urgent matter requiring research that can span the entire energy production chain from feedstock analysis, to processing technology, to delivery to the consumer. Determining the “best” processing conditions for conversion to biofuel, optimum distance from feedstock to refinery, environmental impacts, and total economic costs are a few of the factors to consider. In addition, the success of a revolutionary new energy system depends on public understanding and social policy. This project is investigating the technological, ecological, social, economic, and political issues associated with using wood- or grass-based ethanol products in the emerging biofuel industries. Among the issues included in this project are forest resource availability, avian biodiversity, bioprocess engineering, transportation logistics, societal attitudes, and regional input-output economic analyses.

Project: Expanded Life Cycle Assessments of Biofuels, Petroleum, Diesel, and Synthetic Diesel: Screening and Detailed Assessments
Investigator: David Shonnard (ChE)
Alternative bio-based transportation fuels have a great potential to decrease climate change emissions from vehicular transportation. The magnitude of this emission reduction can only be accurately determined through a comprehensive evaluation of the biofuel production and use systems using the methods of life cycle assessment (LCA). This study is quantifying the greenhouse gas emissions and fossil energy consumption of emerging biofuels such as biodiesel, green diesel, synthesis diesel, and ethanol and comparing them to conventional diesel refined from crude oil. The study focuses in particular on the source of plant oil feedstock and on inventory allocation methods, but also considers land use change emissions and on-farm releases of N2O, a potent GHG. Another area of interest is gaining life cycle perspectives about additional alternative fuels, such as green jet fuel, synthetic diesel derived from coal and/or biomass, and synthetic gasoline derived from the pyrolysis and hydrogenation of biomass.

Project: A Systems Approach to Improve Processing Efficiency of Forestry Biomass for Co-Production of Biofuels and Biopolymers
Investigators: David Shonnard (ChE), Sue Bagley (BS), and Patricia Heiden (CH)
This project employs an integrated systems approach for conversion of forest-derived biomass into value-added products using two direct routes. The first involves optimizing generation of substrates for enzymatic conversion and fermentation to yield biofuels, such as ethanol or butanol, as well as microbial-based value-added products such as biopolymers (e.g., polyhydroxyalkanoates PHAs). Research in support of the first route includes optimizing dilute acid pretreatment of forest biomass mixtures and the use of novel room temperature ionic liquids (RTIL). The second route involves removal of unwanted or deleterious compounds (using RTIL) and subsequent conversion of these byproduct compounds into value-added products through innovative polymer chemistry.

Project: Direct Injection Ethanol Flex-Fuel Engine Optimization and HC Cold-Start Emissions reduction for Hybrid Applications
Investigators: Jeff Naber (MEEM), John Beard (MEEM), and Donna Michalek (MEEM)
This project seeks to better understand and characterize the opportunities available when operating an engine on various blends of ethanol and gasoline. This work is being conducted in part with a highly sophisticated and heavily instrumented single cylinder research engine based on an advanced four cylinder automotive engine.
Project: Characterizing Lessons Learned from Federal Biomass Removal Projects  
Investigator: Kathleen Halvorsen (SFRES/SS)
This project uses case studies to characterize biomass utilization efforts on federal land and identify barriers and lessons learned from biomass utilization projects on federal land. This study includes the collection of information about on-going biomass removal cases by region of the country on Forest Service, Bureau of Land Management, and tribal lands and the assessment of the degree to which project actions have successfully led to sustained biomass utilization. Under the National Fire Plan and Healthy Forest Restoration Act, biomass utilization is identified as a high priority for sustaining fuels reduction work necessary to reduce fire risk for communities. Both Michigan Technological University and the US Forest Service Northern Research Station are dedicated to discovering ways in which this utilization can take place that sustain both ecological and social systems.

Project: Biomass Co-Firing for the Wolverine Clean Energy Venture  
Investigators: Robert Froese, (SFRES), Dana Johnson (SBE) and David Shonnard (ChE)
This project funded by Wolverine Power Cooperative, a not-for-profit generation and transmission cooperative headquartered in Cadillac, is to conduct a feasibility study regarding the cooperative's Wolverine Clean Energy Venture near Rogers City, Michigan. The study confirmed the potential for homegrown biomass to reduce the use of fossil fuel while also decreasing carbon dioxide emissions from the generation of electricity. It is reported that if forest land were utilized to its full potential, Wolverine could count on sufficient fuel from residues alone to produce enough electricity from the Rogers City plant to serve 75,000 homes. Based on the findings of the study, Wolverine partnered again with Froese to install trial plantings to help understand the optimum way to cultivate energy crops.

Center for Fundamental and Applied Research in Nanostructured and Lightweight Materials  
Director: Michael E. Mullins (ChE)
Under the umbrella of the Sustainable Futures Institute, this newly established Center fosters collaborative research activities that will lead to a synthesis and application of novel lightweight materials to be used in fuel cell and battery applications, chemical synthesis, and biomedical systems. Previous work by the participating Michigan Tech researchers, funded by the U.S. DOE, developed the equipment and infrastructure for working with nanoscale materials. New funding under the Center is expected to increase and then sustain these research activities. Collaborative efforts within the Center will be interdisciplinary across campus, and most will involve partner arrangements with off-campus experts and researchers. The Center will conduct research in the following seven areas with base support from U.S. DOE: 1) Development of lightweight, thermally conductive bipolar plates for improved thermal management in fuel cells; 2) Exploration of pseudomorphic nanoscale overlayer bimetallic catalysts for CO removal following fuel reforming to minimize electrode poisoning; 3) Development of hybrid inorganic/organic polymer nanocomposites with improved ionic and electronic properties; 4) Development of polymeric materials for oriented cell growth in three dimensions; 5) Preparation of a graphitic carbon foam current collector for rechargeable battery applications; 6) Development of lightweight carbon electrodes using graphitic carbon foams for battery and fuel cell applications and; 7) Movement of water in fuel cell electrode.

Center for Environmentally Benign Functional Materials  
Directors: Gerard Caneba (ChE) and David Shonnard (ChE)
The mission of the CEBFM is to increase and then sustain research activities into the synthesis, characterization, and analysis of materials that are capable of performing multiple functions in a wide variety of applications. CEBFM brings together researchers and will create a knowledge-base that can assist in further development of technologies for challenging applications critical to the growing technological needs of the US and the world. The Center will promote and foster an environment that will cross the traditional departmental and disciplinary boundaries to advance knowledge and support the overall mission of the University.
Product and Process Architecture Alignment Consortium

**Director: John K. Gershenson (MEEM)**

The mission of P2A2 is threefold: (1) to develop tools and technologies directed at aligning product and process architectures to enable rapid innovation and high value products, (2) to transfer these technologies and tools to industry partners; and (3) and to educate the leaders of tomorrow. The over-arching scientific theme of the consortium is to explore architecture alignment in three focus areas: light (functional weight reduction), fast (engineering lead-time reduction), and extensible (product and process life-cycle extension). These areas focus on urgent issues, addressing them from the standpoint of architecture alignment with the goal of enabling rapid innovation and high value products. The consortium will provide proofs of concept for new technologies. Consortium members will provide direction in launching and continuing R&D initiatives.

**Project: MTU-CAT Collaborative Project: Defining Product Modules for Assembly Testability**
**Investigator: John Gershenson (MEEM)**

When subassemblies are not designed with testability in mind, the result can be subassemblies that are difficult or impossible to test for functionality before they are put into the final assembly. In this short project, we will identify feasible design improvements for a single product (one model of a Medium Wheel Loader family) that will enhance the testability of the subassemblies before and during final assembly. It is anticipated that, after this project, Michigan Tech can expand the work to generalize design heuristics for creating more testable subassemblies and modules that can be applied to all products across the enterprise.

Materials, Design, and Manufacturing for Sustainability

**Project: Reducing the Environmental Impact of Material Conversion Process**
**Investigator: Qiong Zhang (SFI), John Sutherland (MEEM), Dana Johnson (SBE)**

The project is evaluating the potential application of the by-products generated during the recovery process of silicone waste from the internal supplies of Dow Corning. Work under this project includes a thorough literature review, selection of potential reuse options, and market analysis.

**Project: Development and Modeling of Highly Conductive Carbon Filled Thermoplastic Resins for Fuel Cell Bipolar Plate Applications.**
**Investigators: Julia King (ChE), Jason Keith (ChE), Dr. Eve Steigerwalt (Dana Corporation)**

The overall goal this project entitled is to develop a new high temperature thermoplastic-based material containing several different carbon fillers (carbon black, synthetic graphite particles, and carbon fiber). These carbon fillers increase composite electrical and thermal conductivity. Often, as much of a single type of carbon filler is needed to achieve the desired conductivity while still allowing the material to be molded into a bipolar plate for a fuel cell. This project focuses on using combinations of carbon fillers in a thermoplastic material for fuel cell bipolar plates.

**Project: Predicting Environmental Performance of Manufacturing Operations**
**Investigators: John Sutherland (MEEM) and Karl Haapala (MEEM)**

A global manufacturer of heavy equipment is interested in improving the environmental performance, i.e., energy use, resource use, and wastes/emissions, of its manufacturing operations by selecting material and process inputs in order to minimize energy, resource consumption, and process wastes. Models have been developed to predict environmental performance measures for electric arc furnace (EAF) steelmaking, sand casting, and heat treatment, which are the main operations in the production of many steel parts. These process models can assist life cycle analysis, design for environment, and sustainability efforts by addressing the inadequacies of previous process modeling efforts. Process models are based on the physics/science of the operations and empirical data, which will facilitate more precise prediction of the economic, environmental, and social impacts of design changes on process inputs and outputs.
Project: Graphics Hardware Accelerated Real-Time Machinability Analysis of Free Form Surfaces  
**Investigator: Roshan D’Souza (MEEM)**  
The objective of this research is to investigate new geometric manufacturability/machinability analysis techniques that will leverage the massive computational capabilities of commodity computer graphics hardware to generate real-time feedback to designers. A long-term goal is to provide designers with tools to evaluate geometric machinability during the detailed design phase.

Project: Indicators and Methods to Address the Social Dimension of Sustainability in Decision-Making  
**Investigators: Margot Hutchins (MEEM) John Sutherland (MEEM), John Gierke (GMES).**  
This project seeks to improve and expand the ability of industrial and political actors to consider the social impacts of their decisions in conjunction with the related environmental impacts. The objective of the work is to demonstrate that social impacts can be a) reflected in quantitative indices and b) incorporated into models to facilitate decision-making that supports sustainability. The research associated with this project includes: identifying key indicators for the social aspect of sustainability, modeling social impacts independently, and modeling social, environmental and economic impacts in combination (i.e., with appropriate feedbacks).

Project: Preparation of Rice-Waste Reinforced Urea-Formaldehyde Composites with Improved Moisture Resistance  
**Investigator: Patricia Heiden (CH)**  
Agricultural waste is increasingly being considered as a valuable source of cellulose reinforcement, especially in parts of the world that do not have large forest resources. In this project new urea-formaldehyde (UF) composites are being prepared and studied using rice hull in place of wood reinforcement. The modifications are intended to improve the moisture resistance and longevity of the UF-bonded composite.

### SFI Education Programs

SFI’s education programs cover a variety of interdisciplinary activities, including an NSF Integrative Graduate Education and Research Traineeship project (IGERT), seminars, courses, as well as ongoing curriculum development efforts.

#### Sustainable Futures IGERT

**Director: John Sutherland (MEEM)**  
The Sustainable Futures (SF) Integrative Graduate Education and Research Traineeship (IGERT) project is one of involves graduate students at Michigan Technological University and Southern University at Baton Rouge, and addresses the sustainability challenges through a multidisciplinary, inter-institutional doctoral education program directed at achieving the integration of industrial, environmental, and societal sustainability.
### SF IGERT Students from 2004 to 2008

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<tr>
<th>Student</th>
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<tr>
<td>Abdi Solomon</td>
<td>Publ. Policy</td>
<td>Michelle Jarvie</td>
<td>Civ Env Engr</td>
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<tr>
<td>Rodwick Barton Carter</td>
<td>Chem Eng</td>
<td>Jill Jensen</td>
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<td>Michael Brodeur-Campbell</td>
<td>Chem Eng</td>
<td>Melanie Kueber</td>
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<tr>
<td>Justin Carlson</td>
<td>Chem Eng</td>
<td>George Lane</td>
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<tr>
<td>Carmon Choice</td>
<td>Chem Eng</td>
<td>Chelsey MacNeill</td>
<td>Mech Eng</td>
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<tr>
<td>Antoinette Christophe</td>
<td>Publ. Policy</td>
<td>Stacie Nwabueze</td>
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<tr>
<td>Abigail Clarke-Sather</td>
<td>Mech Eng</td>
<td>Denis Osuagwu</td>
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<tr>
<td>Josh Cowden</td>
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<td>Jeremy Rickli</td>
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<tr>
<td>Thomas Eatmon</td>
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<td>Julio Rivera</td>
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<tr>
<td>Lauren Fry</td>
<td>Civ Env Engr</td>
<td>Christian Seifert</td>
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<tr>
<td>Valerie Fuchs</td>
<td>Civ Env Engr</td>
<td>Jayanthi Sothirajah</td>
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<tr>
<td>Karl Haapala</td>
<td>Mech Eng</td>
<td>Tamiara Wade</td>
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<td>Peter Holman</td>
<td>Chem Eng</td>
<td>DerKirra Wilkerson</td>
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<tr>
<td>Deborah Huntzinger</td>
<td>Geo Engr</td>
<td>Edith Womack-Richardson</td>
<td>Publ. Policy</td>
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<tr>
<td>Margot Hutchins</td>
<td>Mech Eng</td>
<td>Heather Wright Wendel</td>
<td>Civ Env Engr</td>
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</tbody>
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### Other Education Projects

**Project: Civil and Environmental Engineering Education (CEE) Transformational Change: Tools and Strategies for Sustainability Integration and Assessment in Engineering Education**

**Investigators: Qiong Zhang (CEE/SFI) and James Mihelcic (CEE)**

This project is being undertaken in collaboration with Yale University and Polytechnic State University Foundation and focuses on addressing barriers to integrating sustainability into engineering education. The objectives of the project are to design, develop, implement, disseminate, and assess the success and effectiveness of transformational learning practices and peer-to-peer networks. Key elements of the CEEE Change project include the implementing and disseminating an innovative textbook that introduces sustainability into the discussion of fundamentals in civil and environmental engineering as well as in-course modules that can be used by faculty in other disciplines to introduce sustainability into their fundamentals discussions. Faculty expertise will be created by disseminating these materials through faculty workshops, an example of faculty-to-faculty networks. Educational innovations in the form of student-to-student networks between partner universities will be implemented for the purposes of conducting campus sustainability projects and international design experiences. These transformational learning practices and peer-to-peer networks will be evaluated and assessed for enabling implementation of sustainable practices, higher orders of significant learning in terms of sustainability, and increases in the factors shown to aid recruitment and retention of students in CEE.

**Project: Graduate Student Scholarships to Advance a Global Outlook of Economic and Social Prosperity that Protects the Environment**

**Investigators: Judith Perlinger, Veronica Griffis, James Mihelcic, Kurt Paterson, and Qiong Zhang (CEE)**

This S-STEM Program will provide scholarships and additional opportunities to selected Masters International and Environmental Engineering Program PhD students. In a nutshell, this program promotes teaming of Masters International students, PhD students, and faculty in advancing sustainability in the developed and developing world. It aims to increase diversity at Michigan Tech by providing resources to recruit graduate students from Puerto Rican Universities by providing scholarships for expenses normally incurred by full-time students.

**Project: CPATH CDP: Integrating Sustainability into Undergraduate Computing Education**

**Investigators: Yu Cai (Sch of Tech), Linda Ott (CS), Qiong Zhang (CEE), Kedmon Hungwe (Cognitive & Lrng Scences), Jingdong Tan (Elec & Comp Engg)**

This two-year Conceptual Development and Planning project will initiate sustainability integration into undergraduate computing education. Sustainability will remain a most important issue for the next few decades.
Information Technology (IT) plays a critical role in sustainability development. However, today’s computing education responds slowly to such changes and often fails to address its social and environmental responsibility. The goal of this project is to test, develop, implement, and evaluate an educational model that will successfully and effectively integrate sustainability into the undergraduate computing curricula. This model will prepare students with computing competencies, multi-disciplinary knowledge, and computational thinking to create a sustainable future. Development of computational thinking through discovery based learning & collaborative learning are strongly featured in this model.

**Sustainable Futures Courses**

SFI faculty have developed and teach the following four courses.

**ENG 3530 - Undergraduate Colloquium in Sustainability**
This undergraduate class uses readings and speakers to teach concepts of sustainable development and global sustainability.

**ENG 5510 - Sustainable Futures I**
This graduate–level course covers introductory and intermediate concepts of Sustainable Development, methods/tools for assessing sustainability (economic, environmental, societal impacts) of current and emerging industrial technologies. It provides students advanced training in life cycle assessment of technologies, processes, and products and other sustainability assessment tools in decision making in government and industry.

**ENG 5520 - Sustainable Futures II**
This course covers sustainability in developed and developing countries. Topics include policy analysis, regulatory impact & cost benefit analyses, trade & markets, laws & regulations, international disasters, GIS applications, green manufacturing, and evolution of environmental policy in U.S. and other countries.

**ENG 5530 - Graduate Colloquium in Sustainability**
This course introduces students to general and specific issues related to sustainability. The colloquium discusses historical readings that define the movement towards sustainability, international issues related to sustainable development, corporate leadership, consumption, and societal issues.

**Certificate Programs**

**Graduate Certificate in Sustainability**
The Graduate Certificate in Sustainability formally recognizes curricular breadth in the following areas: i) policy, societal, and economic systems, ii) environmental systems, and iii) industrial systems. The student has the opportunity to achieve specialized education in engineering, forestry, physical science, social sciences, humanities, business, and economics. This Certificate requires a total of 15 credits. Students must take Sustainable Futures I (ENG5510/SS5510) and Sustainable Futures II (ENG5520/SS5520) and a minimum of one class from each of the three areas listed above. To date, 37 Graduate Certificates in Sustainability have been awarded.
D80 Center – Engineering Development for Humanity

**Director: Kurt Paterson (CEE)**
The D80 Center (Development for the poorest 80% of the world’s population) is dedicated to assisting the poorest in meeting their basic needs for food, water, shelter, sanitation, waste disposal, energy, income, and education. Through numerous opportunities on campus and in developing communities, participants acquire the skills, knowledge, and attitude necessary to make a positive impact in the lives of the world's most under-served, while becoming leaders in their chosen fields. The D80 Center's programs encourage service, creativity and innovation, leadership, social justice, global thinking, and knowledge creation. The Center uses its international resources to innovate and transfer knowledge between both the developing and developed worlds. Many industry and government-funded projects concentrate research and education efforts on improving sustainability for the economically privileged top 20% of the world’s population. The mission of the D80 Center is to focus on the remaining impoverished 80%. More than 400 people attended the Center’s inaugural conference in 2007. Already more than 400 students and 20 faculty members are involved in one or more of the D80 programs. The following programs have coalesced under the D80 Center:

**Undergraduate Certificate Program**

**Program Director: Kurt Paterson (CEE)**
Michigan Tech’s International Sustainable Development Engineering Certificate, Michigan Tech’s Undergraduate Certificate in sustainability, is supervised by the D80 Center. It provides students curricular breadth in the areas of ethics, resource equity, interactions between technology and society, engineering connections with the environment, engineering materials and water/sanitation, all at a global perspective. An international senior design experience that requires students to work on an engineering problem in the developing world is required to complete the certificate. Requirements include courses from several departments including Civil and Environmental Engineering, the School of Business, Humanities, and Social Sciences. The Certificate program allows undergraduate engineering students to augment their technical education with the knowledge, skills, and experiences important to working on solutions in developing communities. The 22-semester hour certificate program is designed to be woven throughout any engineering baccalaureate degree program.

**Civil and Environmental Engineering Master’s International Peace Corps Program**

**Program Director: Kurt Paterson (CEE)**
The Peace Corps Master’s International (MI) program in civil and environmental engineering is the only one of its kind in the States. While there are nearly 50 universities with MI programs, Michigan Tech has the only programs in engineering. The MI program requires two semesters of on-campus graduate level coursework, focusing on engineering in emerging communities. Students then serve in the U.S. Peace Corps for twenty-seven months and use their major Peace Corps project as the basis of their master’s research report. MI students gain an unusual graduate engineering perspective by working closely with a community, NGO counterpart and faculty advisor to implement and evaluate development projects. Upon completion of their service the MI students return to campus to defend their research and share their knowledge with D80 members.

**Mechanical Engineering Peace Corps Master’s International Program**

**Program Directors: Michele Miller and John Gershenson (MEEM)**
The ME program is similar to the CEE MI program, but with a mechanical engineering emphasis. It was initiated in 2008 based on the decade of success in the civil and environmental engineering MI program. This is the first and only Master's International mechanical engineering program in the country. One focus of the new program in mechanical engineering will be identification and use of appropriate technologies in developing countries.
International Senior Design

Advisors: Linda Phillips and Dennis Magolan (CEE)

International Senior Design (ISD) is a six-semester-hour sequence that requires design and construction of an engineering project in a developing community. ISD projects are executed on multidisciplinary teams, augmented by professional mentoring. ISD meets the ABET requirement for a senior design project, while also providing an intensive international service-learning experience. Three D80 faculty members lead ISD, having formed working relationships with client NGOs and governmental organizations in Bolivia and the Dominican Republic to propose student projects.

Engineers Without Borders

Faculty Advisors: Kurt Paterson and David Watkins (CEE)

The Michigan Tech chapter of Engineers Without Borders includes 80 active students from across ten departments. More than 50% of its members are women. The chapter provides a venue for all students on campus to engage in international development projects. EWB-Michigan Tech currently has projects in Guatemala, Honduras, and Bolivia. To date more than 150 students have been active in EWB at Michigan Tech, including every engineering field, business, forestry, humanities, policy and psychology.

Aqua Terra Tech Enterprise

Program Director: John Gierke (GMES)

Aqua Terra Tech (ATT) is one of several groups in Michigan Tech’s innovative Enterprise Program (www.enterprise.mtu.edu). ATT works on water projects, simulates a small engineering consulting firm and provides three years of experience to students, from their sophomore to senior years. The three-year design program replaces the ABET requirement for senior design, while also providing international assessment and research experience. One faculty advisor leads ATT, with involvement from several other faculty as course teachers.

International Sustainable Development Engineering Research Experiences

Investigators: James Mihelcic, Brian Barkdoll, Kurt Paterson, David Watkins, and Qiong Zhang (CEE)

This program teams doctorate and undergraduate students from Michigan Tech with students at the Universidad Tecnologica Boliviana in La Paz, Bolivia, and with non-governmental organizations (NGOs) working near La Paz. These student teams research existing engineering development projects, notably their failures. The projects culminate in a one-month residency in the communities being served, which is followed by the development of a research report written by the students and provided to the communities. This program encourages the doctorate students to mentor and teach the undergraduates, while undergraduates gain a first-hand experience in participatory research. The project develops scientists and engineers with global perspectives by integrating sustainability and appropriate technology principles into international, community-based research projects. The project directly benefits society through the international research experience focused on community needs in a developing country. The results research will have real and measurable impacts on the quality of life worldwide, and this project will plant the seeds for future research in the generation that has the most at stake.
Center for Science and Environmental Outreach

Director: Neil Hutzler (CEE)
The Center for Science and Environmental Outreach comprises a team of professionals and volunteers who provide educational programs, technical expertise, and information to schools, organizations, governments, and individuals to promote awareness and informed personal actions and public policy concerning regional environmental issues.

Project: Family Engineering for Parents and Elementary-Aged Children
Investigators: Neil Hutzler (CEE) & Joan Chadde (CSEO)
The purpose of this project is to increase elementary students’ and parents/caregivers’ knowledge of engineering and potential careers in order to stimulate students’ interest in pursuing Science Technology Engineering and Math (STEM) careers. Workshops will be conducted to develop the ability of STEM majors, informal science educators, teachers, and engineering professionals to conduct informal engineering learning experiences. This Family Engineering Program is modeled after the successful Family Science and Family Math programs conducted nationally and internationally since the 1980s. It is essential that we inform and engage children in learning about engineering at an early age, because students’ attitudes about science, math, and careers are often formed before the high school years. Elementary children are at an ideal age for initiating career exploration and are much more likely than older children to enjoy doing educational activities with their parents.

Project: Bringing Engineering to Rural, Low Income, Native American Elementary Students & Families
Investigator: Joan Chadde (CSEO)
Three family engineering nights and three Engineering is Elementary teacher workshops will be conducted in order to engage rural, low income, and Native American elementary students and their parents in learning about the variety of engineering disciplines and engineering careers. The workshops and family nights will highlight the relevance of engineering to solving real-world problems such as designing bridges, windmills, water filters, plant pollinators, alarm circuits, erosion control, solar-powered homes, and prosthetics. Students will engage in engineering design challenges while meeting state content expectations for math and science.

Project: Lakes Superior Stewardship Initiative (LSSI)
Investigator: Joan Chadde (CSEO)
In partnership with Shawn Oppliger (CCISD) of the Western U.P. Center for Science, Mathematics and Environmental Education the first of three Great Lakes education hubs has been established as part of the statewide Great Lakes Stewardship Initiative. The Lakes Superior Stewardship Initiative (LSSI) partners 11 schools in Houghton and Baraga counties with 40 community organizations to implement community-based education that engages students in real-world learning and local stewardship activities. LSSI incorporates three strategies: (i) Implement 'community-based curricula' that engage students in learning about their cultural heritage, local watershed, and the Great Lakes; (ii) Conduct teacher-training and student programs to increase content knowledge about the Great Lakes and provide opportunities for students to visit and learn about Lake Superior, tributary streams, wetlands, forests, and other outdoor environments near their schools; (iii) Develop school-community partnerships to address local needs by working together on stewardship projects.
Project: Outdoor Science Investigations  
Investigator: Joan Chadde (CSEO)  
This program sponsors an outdoor science and environmental educational field trips serving K-8 students in 19 school districts in a five-county area of the western Upper Peninsula. Last year, more than 2,576 students participated in 117 field trips led by the Center's staff.

Project: Lake Superior Education Program for Teachers, Students and Communities  
Investigator: Joan Chadde (CSEO)  
The project, undertaken in partnership with the CCISD, has four major components: i) K-12 and community education programs aboard MTU’s research vessel (R/V) Agassiz; ii) educational workshops for decision-makers in shoreline communities; iii) Lake Superior Educators’ Teacher Handbook; and iv) a five-day Great Lakes Watershed Investigations Teacher Institute. This program will reach 500 middle/high school students, teachers and community members through the teacher institute and Lake Superior education programs aboard the R/V Agassiz.

Project: Great Lakes Education for Decision-makers  
Investigator: Joan Chadde (CSEO)  
This project conducts educational workshops for decision-makers in shoreline communities on Lake Superior aboard the R/V Agassiz to demonstrate the connection between land use and water quality.

Project: Great Lakes Maritime Transportation Education for Teachers, Students, and Communities  
Investigator: Joan Chadde (CSEO)  
This project has the goal of raising public and K-12 awareness and understanding of Great Lakes maritime transportation. Several activities were conducted: i) Teacher workshops were conducted in Sault Ste. Marie, Alpena and Paradise; (ii) a summer teacher institute was held in Duluth; (iii) a K-8 Activity Guide and a children’s book entitled *F is for Freighter: Introduction to Great Lakes Shipping* have been published; (iv) Great Lakes maritime transportation education “treasure chests” were assembled and distributed to maritime museums and education centers in the Great Lakes basin.

Summer Teacher Institutes for K-12 Educators  
Michigan Tech, in collaboration with the Western Upper Peninsula Center for Science, Mathematics and Environmental Education, offer several 5-day summer teacher institutes for K-12 educators.

1. Great Lakes Watershed Investigations Teacher Institute (funded by MDEQ Coastal Management grant to Copper Country ISD) is designed to teach educators about the physical, chemical, and biological components of the Great Lakes ecosystem, using the Lake Superior watershed as the classroom.

2. Future Fuels From Forests Teacher Institute (funded by NSF MUSES grant) engaged middle/high school teachers in working with an interdisciplinary research team of Michigan Tech scientists to investigate forest-based ethanol production from the perspectives of ecological economics, spatial statistics, conservation biology, forest and landscape ecology, silviculture, and chemical engineering through lecture, field trips, and computer investigations.

3. Global Change Teacher Institute (funded by an NSF grant, and led by Andy Burton, SFRES) provided an opportunity for middle and high school teachers to explore the effects of global change on ecosystems, including the impacts of climatic change, elevated carbon dioxide and ozone levels, nitrogen saturation, acid rain, and invasive species.

4. Great Lakes Maritime Transportation Institute (funded by Great Lakes Maritime Research Institute, University of Wisconsin Superior) gives teachers a firsthand opportunity to learn about the historical, economic, and environmental aspects of Great Lakes shipping at the “head of the lakes” in Duluth, MN.
Other University Sustainability Partners

The SFI is one of several entities at Michigan Tech with a focus or thrust directed at sustainability. Some of these organizations, centers, and institutes have formal relationships with SFI as have been described. Other entities have a less structured linkage with SFI – a brief summary of several of these units are provided below. Together, all of these Michigan Tech groups contribute their ideas and insights to advancing the goal of sustainability.

Environmental Sustainability Committee
Chair: Shalini Suryanarayana (Educ. Oppor.)
The ESC supports environmental initiatives and serves as a resource for campus environmental sustainability improvements. The ESC helps monitor utility use, sponsors environmental speakers and Earth Day activities, and provides leadership on other campus green opportunities to make the campus community aware of the importance of sustainability. http://www.esc.mtu.edu/

Advanced Power Systems Research Center (APSRC)
Director: Jeffrey Naber (MEEM)
The purpose of the Advanced Power System Research Center is to create a multidisciplinary organization that will foster large, collaborative, research efforts in the areas of clean, efficient, and sustainable Power Systems technologies. http://www.me.mtu.edu/research/power/

Advanced Sustainable Iron and Steel Center (ASISC)
Directors: S. Komar Kawatra (ChE)
This Center’s mission is to investigate and develop novel, advanced methods for producing the 130 million tons of iron and steel needed annually by the U.S. in a sustainable, environmentally-acceptable manner. http://www.chem.mtu.edu/chem_eng/news/2008/kawatra2_2008.html

Biotechnology Research Center (BRC)
Director: Chandrashekhar P. Joshi, (SFRES)
The mission of the Biotechnology Research Center (BRC) at MTU is to promote education and research in the areas of molecular biology, biochemistry, genetics, genomics, bioinformatics and biotechnology at both the graduate and undergraduate levels for the benefit of society and the environment. http://biotech.mtu.edu/

Ecosystem Science Center (ESC)
Director: David Karnosky (SFRES)
The Ecosystem Science Center (ESC) is designed to advance our understanding of how ecosystems function and how human activities influence ecosystem processes. http://ecosystem.mtu.edu/

Power & Energy Research Center (PERC)
Director: Bruce Mork (ECE)
Increased focus on alternate and renewable energy, development of new energy technologies, and deregulation of the utility industry are redefining the role of the Power Engineer and creating a wealth of technical and educational challenges. This Center is focused on addressing those challenges. http://www.ece.mtu.edu/perc/

University Transportation Center for Materials in Sustainable Transportation Infrastructure (MiSTI)
Director: Thomas VanDam (CEE)
MiSTI focuses on the identification and use of naturally occurring, industrial byproducts, and/or recycled materials in the design/construction of a more sustainable transportation infrastructure. http://www.misti.mtu.edu/index.php

Center of Excellence for Transportation Materials
Director: Zhanping You (CEE)
This Center partners with the Michigan Department of Transportation and Michigan Tech to maintain highly qualified technical staff and certified labs. The specific focus includes the behavior, performance, and sustainability of portland cement-based materials, asphalt-based materials, unbound granular materials, and soils. http://www.tmrc.mtu.edu/
Honors to SFI Students and Faculty

Doctoral student **Abigail R. Clarke-Sather** of the Department of Mechanical Engineering – Engineering Mechanics won a Fellowship from the American Association of University Women (AAUW) Educational Foundation. Fellowships are awarded to promising young women in traditionally male-dominated fields. Abbie's research is focused on the Siting of Manufacturing/Remanufacturing Facilities to Minimize the Combined Effects of Costs and Environmental Impacts.

Doctoral student **Lauren Fry** (Environmental Engineering) has been awarded a graduate scholarship from Qualitative Environmental Analysis (QEA), an environmental engineering consulting firm. QEA initiated its scholarship program in 2006 to support graduate student education in environmental analysis of natural systems.

**Valerie Fuchs**, a graduate student in Environmental Engineering, received a $5,000 DeVlieg Foundation Research Award in Wildlife and Environmental Studies to pursue her water-related project. Fuchs is investigating engineered wetlands as a sustainable alternative to conventional wastewater treatment, which is expensive and consumes a great deal of energy.

IGERT PhD student, **Thomas Eatmon** from Southern University, was one of ten recipients of the Association of American Colleges and Universities K. Patricia Cross Future Leaders Award for 2008. AAC&U received approximately 150 nominations from universities across the country, and all of those associated with the Award noted the incredibly impressive credentials of this year's nominees. As stated by Carol Geary Schneider, AAC&U's president: “They represent the finest in the new generation of faculty who will teach and lead higher education in the next decades.”

**Andrea Munoz-Hernandez** won an Outstanding Student Paper Award from the Hydrology section of American Geophysical Union (AGU) for her paper entitled "The Impacts of climate change and variability on water resources in a semi-arid region in Mexico: The Rio Yaqui-Basin."

For the second time, SFI Environmental Engineering PhD student **Helen Muga** received the prestigious Mondialogo Award sponsored by Daimler and the United Nations Education, Scientific and Cultural Organization (UNESCO) that recognizes innovative sustainable development. Muga was honored with the competition’s continuation award for a sustainable wastewater treatment project at the awards ceremony, held Dec. 10, 2007 in Mumbai, India. Over 809 teams competed, with 3,200 participants from 89 countries, but only 31 were selected to receive funding.

**Cory MacDonald** won the American Society of Limnology and Oceanography (ASLO) Outstanding Student Presentation Award for his paper entitled "An Information-Theoretic Approach to Aquatic Biogeochemical Modeling" at their Summer Meeting in St. John's, Newfoundland.

In April 2008, **Heather Wright Wendel**, a doctoral student in Environmental Engineering won the "Exceptional Graduate Student Leader" from the Graduate Student Council. Heather also helped develop the Drop~N~Shop program. This highly successful program allows departing students to drop off unwanted but still useful items for others to pick up. This program reduces the amount of usable items that are landfilled each spring when students depart.
**Professor Brian Barkdoll** (CEE) was invited by the International Great Lakes Joint Commission to serve as the US sediment transport modeling expert on a review panel on the Hydraulic and Sediment Modeling Strategy of the St. Claire River Task Team.

**Professor Mary Durfee** (SS) spent a year as a Fulbright Scholar in Malta. She taught public international law and US foreign policy at the University of Malta, Faculty of Laws, where she was awarded the Ambassador's Outstanding Award. Mary also delivered a talk entitled Policy Framework for the Great Lakes of North America at the Women in International Security—Malta (WIIS-M) and by the International Maritime Law Institute. While there, Dr. Durfee engaged in an environmental education activity for the US Embassy at the Malta College of Arts, Sciences, and Technology (MCAST). She also gave a talk to Rotary on the US Elections.

**Professor Robert Froese** (SFRES) is a finalist 2008 Distinguished Teaching Award in the Lecturer/Professor of Practice/Assistant Professor Category.

**Professor Jason Keith,** (ChE) won the 2008 Ray W. Fahien Award for Outstanding Teaching Effectiveness and Educational Scholarship from the American Society for Engineering Education.

**Professor Kurt Paterson** (CEE) was elected to a two-year position as the chair of the International Division of the American Society for Engineering Education. This position recognizes Paterson's national leadership in the area of engineering education and research that relates to the Civil and Environmental Engineering Department's global international sustainable development initiatives.

SFI Director **John Sutherland** (MEEM) was elected Fellow of the American Society of Mechanical Engineers (ASME). His citation states that he is a pioneer in the research field of environmentally responsible manufacturing.
Selected SFI Publications


Selected SFI Publications


Selected SFI Publications


Selected SFI Publications


Selected SFI Publications


Selected SFI Publications


Selected SFI Publications


Selected SFI Publications


Selected Presentations by SFI Participants


**Selected Presentations**


Chadde, J. Michigan Science Teachers Association, March 6-8, 2008, Lansing, MI. MEECS Water Quality Workshop (w/ Jessica Wagenmaker) Summer Teacher Institutes at MTU are Fun! Changing Land Uses: Engaging Students in Assessing Environmental Impacts! (w/ Gary Cousino, teacher, Hart Middle School, Rochester, MI) Great Lakes Maritime Transportation Why Don’t Those 1000’ Freighters Sink?

Chadde, J. Making A Great Lake Superior, October 29-31, 2007, Duluth, MN

Chadde, J. Ship Operations Cooperative Program, April 2-4, 2008, Baltimore, MD Great Lakes Maritime Transportation Teacher Education & Outreach Programs.


Selected Presentations


Huckins, C. J., Life History, Biology and Bottlenecks of Coasters - Lake Superior’s Brook Trout. Purdue University. April 2008.


Selected Presentations


Martin, S., Understanding the Links: Meteorology, Geology, and Religious Belief in the Lake Superior Basin. Duluth-Superior Archaeology Week, May 7, 2007, Duluth, MN.

Selected Presentations


Pypker, T. G., Forest hydrology and micrometeorology, In House Seminar Series, School of Forest Resources and Environmental Science, Michigan Technological University, Sept. 27, 2007.

Pypker, T. G., Forest Hydrology, Guest lecture, FW 3020 – Forest and Landscape Ecology, School of Forest Resources and Environmental Science, Michigan Tech, October 15, 2007.


Pypker T. G., Climate Change and Hydrology, Ecosystems and Climate change seminar series, Xi Sigma Pi National Forestry Honor Society, Michigan Technological University, April 4, 2008.


Selected Presentations


Sutherland, J. W. and K. R. Haapala, 2007, Optimization of Steel Production to Improve Lifecycle Environmental Performance, CIRP General Assembly, Dresden, Germany.

Sutherland, J. W., D. P. Adler, K. R. Haapala, and V. Kumar, 2008, A Comparison of Manufacturing and Remanufacturing Energy Intensities with Application to Diesel Engine Production, CIRP General Assembly, Manchester, UK.
Selected Presentations


Urban, N. R., Auer, M. T., Green, S. A., McDonald, C. P., Lu, X., and Apul, D., Are the Laurentian Great Lakes a source or sink of CO2 to the atmosphere?, 30th Congress of the Internat. Assoc. of Theoretical and Applied Limnology (SIL), Montreal, 8/06


Acknowledgements

The SFI Advisory Board is an indispensable means of seeing that we are abiding by our mission and vision. This board meets semi-annually to consult on ideas and strategies for continued success. The board also offers invaluable resources and connections to possible partners. We would like to thank the following people for their willingness to serve on this board:

Joseph W. Allen, Director of Sustainable Development and Lifecycle Products for Caterpillar's global Remanufacturing business and a member of Caterpillar's corporate Sustainable Development Team. Mr. Allen is working to increase awareness of the positive impact remanufacturing has on reuse, recycling, and sustainable development.

Christina Behr-Andres, Deputy Division Leader at Los Alamos National Laboratory (LANL) for the International, Space, and Response Division, has a PhD in Environmental Engineering from Michigan Technological University. Her research involves management of legacy wastes from nuclear weapons production, marine and terrestrial spill response, hazardous waste management and site remediation.


Damien Ejigiri is Dean and Director of the Nelson Mandela School of Public Policy and Urban Affairs, Southern University and A&M College (SUBR) in Baton Rouge, LA. SUBR partners with Michigan Tech in the direction of SFI’s IGERT program. Dr. Ejigiri’s researches primarily in Urban and Regional Planning. He has won several awards of excellence for his teaching.

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SFI Proposals, Awards and Projects

Project Portfolio

SFI Operation Funds
Sustainable Futures Institute Operations

SFI Proposals, Awards and Projects

Project Portfolio

SFI Operation Funds

Legend:
- Proposals
- Awards
- Projects
- Incentive - Income
- Carryforward
Sustainable Futures Institute

Our vision is to attain international impact from its teaching, research, and outreach contributions to the field of sustainable systems.