

Director's Letter



Dr. David Shonnard

I am very pleased to summarize accomplishments and other activities of the Sustainable Futures Institute (SFI) faculty and students for the academic year 2011 - 2012. In the following pages you will find information on new and ongoing projects in the various thrust areas of the Institute as well as core education and outreach activities. Included also is a list of scholarly output from the faculty and students affiliated with the SFI. At the very end can be found information on the financial and other aspects of SFI operations. We continue to benefit from an active and engaged advisory board.

Progress in all areas of SFI could not have been achieved without the efforts of Professor Ann Maclean, Deputy Director, and the SFI professional staff, Dr. Richard Donovan, Dr. Robert Handler, and Melanie Yang. Financial support from the Richard and Bonnie Robbins endowment fund is much appreciated.

I invite your comments and continued interest and support in sustainability research, education, and outreach at Michigan Tech through the Sustainable Futures Institute.

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List of Abbreviations

ASEE	American Society for Engineering Education
AQIP	Academic Quality Improvement Program
BS	Department of Biological Sciences
CEBFM	Center for Environmentally Benign Functional Materials
CEE	Civil and Department
CFARNLM	Center for Fundamental and Applied Research in Nanostructured and Lightweight Materials
CH	Department of Chemistry
ChE	Chemical Engineering Department
CLS	School for Cognitive Learning Sciences
CSEO	Center for Science and Environmental Outreach
DoE	Department of Energy
ECE	Electrical and Computer Engineering
ERC	Engineering Research Center, an NSF funding program
ESC	Ecosystem Science Center or Environmental Sustainability Committee
GMES	Geological Mining Engineering and Sciences
GOALI	Grant Opportunity for Academic Liaison with Industry (NSF)
IGERT	Integrative Graduate Education and Research Traineeship (NSF)
LCA	Life-cycle Analysis
MA	Department of Mathematical Sciences
MEDC	Michigan Economic Development Corporation
MDEQ	Michigan Department of Environmental Quality
MEEM	Department of Mechanical Engineering—Engineering Mechanical
MiSTI	Center for Materials in Sustainable Transportation Infrastructure
MI	Peace Corps Master's International
MTCWS	Michigan Tech Center for Water and Society
MUSES	Materials Use: Science, Engineering, and Society (NSF)
NGO	Non-governmental Organization
NSF	National Science Foundation
PH	Department of Physics
Publ. Policy	Public Policy
SB&E	School of Business and Economics
SFI	Sustainable Futures Institute
SFRES	School of Forest Resources and Environmental Sciences
SME	Society of Mechanical Engineers
SS	Department of Social Sciences
STEM	Science, Technology, Engineering, and Math
SUBR	Southern University A&M College at Baton Rouge
W2W	Wood-to-Wheels

1.0 Institute Thrust Area Projects

1.1 SFI Highlight of the Year – Research Coordination Network for Pan American Bioenergy and Biofuels Sustainability

The goal of the RCN project is to link together biofuels/bioenergy researchers, industry, government and NGO practitioners concerned with the sustainability of biofuels and bioenergy development across the Americas. The project seeks to: **i.** Establish and sustain an international research coordination network with a focus on biofuels / bioenergy sustainability and with a geographic context of the Pan American region; **ii.** Develop coordinated research programs; and **iii.** Create new knowledge on social, environmental, and economic sustainability implications of large-scale biofuels/bioenergy production from biomass grown in this region. The sustainability themes that the network primarily focuses on include:

- **Community Impacts;**
- **Water/Energy Nexus Issues;**
- **Biodiversity and Ecosystems;**
- **Energy Policy;**
- **Life Cycle Environmental Assessment;**
- **Food and other systems;**
- **Biogeochemical Cycles;**
- **Biomass Supply Transportation Logistics;**

In addition to the creation of the network itself, the RCN has two main deliverables; **1.** a research roadmap report on sustainability of biofuels and bioenergy in the Pan American region; and **2.** a graduate course in sustainability of biofuels/bioenergy to be developed within the network and disseminated to the network through the internet. The members of the RCN connect through a comprehensive cyber-infrastructure to support real time dissemination of the RCN products, enable real time collaboration across the network, and provide for the growth of the proposed RCN.

Participants of this program come from a variety of academic disciplines, nationalities and organizational affiliations and participate in many ways. For example, a significant group (from the US, Brazil, Argentina and the host Mexico) recently attended a workshop in Merida, Mexico to discuss and develop strategies for guiding research into the Community Impacts, Biodiversity and Ecosystems, Water/Energy Nexus Issues and Biogeochemical Cycles (see details below). Other groups have been engaged in proposal development for broad based projects like the PIRE program (Dr. Kathy Halvorsen, PI) and more focused efforts such as the PEER program (Dr. Julio Sacramento [Universidad Autonoma de Yucatan], PI) described under the Sustainable Energy section below.

Year 1 Activities: Research Coordination Network

The 1st Workshop for the Pan American Biofuel and Bioenergy Sustainability RCN project was held in Merida, Yucatan, Mexico from May 29-31, 2012 at the UNAM-CEPHCIS campus. The main items in the agenda for this workshop were:

- (1.) Introduce research and teaching interests of each participant;
- (2.) Discuss overall projects goals;
- (3.) Present and refine the education plan and make initial graduate course preparation assignments;
- (4.) Present, discuss, and refine year 3 conference goals and objectives and identify lead coordinators for the preparation of review papers in each bioenergy sustainability dimension;
- (5.) Review the approach for communication through a hub based cyber-infrastructure for the RCN; and
- (6.) Participate in the pre and post evaluation sessions plus selected interviews.

Summaries of these activities are provided below.



Presentations, lunch and seminars at the RCN Merida Workshop hosted by UNAM-CEPHCIS

(1.) Research and Teaching Interests

Each invited participant presented an oral summary of key research and teaching interests in bioenergy sustainability in the four focus areas of the workshop. These summaries have been posted to the sustainability hub (<https://hubzero.admin.mtu.edu/>) that has been developed under this project. Workshop participants also prepared and presented posters at the Piedre de Agua Hotel (where most of the participants stayed during the workshop) in order to provide more details on specific research projects. Overall, this was an effective way for workshop participants to learn of the wide scope of research expertise and projects within the RCN and to begin the process of research collaboration.

(2.) RCN Project Goals

This session at the Workshop started with an overview presentation by David Shonnard on the broad goals, objectives, milestones, and deliverables of the project. Jackie Huntoon presented on the project's assessment plan followed by four breakout sessions addressing different aspects of the project: (a) Research Collaboration; (b) Expanding Topics in the RCN; (c) Increasing Participation; and (d) Diversity.

For increasing research collaborations across Pan American countries, it was noted that common research methods and protocols should be implemented to assure consistency and that there is a need to select a common set of sustainability metrics / indicators for case studies in different countries. Suggestions of possible sources of funding for interdisciplinary bioenergy research included: Canada (CIDA), Mexico (CONACYT), international sources (CYTED), US (USAID), and embassies. In order to increase participation it was suggested that we leverage existing international networks such as the Inter-American Institute of Agricultural Science (IICA and PROCISUR (part of IICA)), the Inter-American Institute (IAI), and the Latin American Organization of Energy (OLADEO).

(3.) RCN Education Plan and Assignments

Dr. Shonnard for Michigan Tech, Mr. Jorge Hilbert (Instituto Natiobnale de Argentina [INTA] for Universidad Tecnológica Nacional (UNT), and Dr. Rodrigo Medeiros for Universidade Federal Rural do Rio de Janeiro (UFRR) presented details regarding existing sustainability education programs. The Michigan Tech program is an interdisciplinary Graduate Certificate in Sustainability featuring two required courses and three elective courses, for 15 semester-credits total. The certificate appears on the students MS or PhD diploma. At UNT in Argentina, the program is a master's degree in renewable energy, which includes a focus area on biomass based energy production. The program is 2 ½ years and including 650 hours of instruction, involves professors from Argentina and abroad, the possibility of research experiences in labs of international collaborators, and original investigations into thesis topics. At UFRR, the program involves a Global Masters of Development Practice (MDP) degree in sustainable development that is part of an international program organized out of the Earth Systems Institute at Columbia University (<http://globalmdp.org/>). The Global MDP is a 2-year program featuring a core curriculum in health sciences, natural sciences, social sciences, and management sciences; a global classroom, and field training experiences for 54 credits.

David Shonnard provided an overview presentation of the proposed 3-semester credit graduate course on Pan American Biofuels and Bioenergy Sustainability. It is anticipated that the course lectures and reading materials will be developed and identified by participants in the RCN and delivered by video conference between the collaborating

universities and institutions. Recording of lectures should take place for archiving and for posting on the RCN hub site for students to review if there are scheduling conflicts with the course period. Student-led teams will lead a presentation and in-class discussion of more advanced concepts, readings, and case studies. There will be interdisciplinary teams working on term projects where applications of concepts, methods, and analysis tools from the course is to be targeted at bioenergy case studies in different Pan American regions.

1.2 Sustainable Energy

Sustainable energy continues to be an important thrust for research and education initiatives and projects for the SFI, for its affiliated faculty and students, and for Michigan Tech. Many projects are focused on sustainability of biofuels and biofuel production systems, including feedstock supply chain analyses, life cycle environmental assessments, and the Wood to Wheels (W2W) forest-based biofuels projects.

Featured Projects in Development

National Science Foundation Partnerships for International Research and Education (PIRE), Kathy Halvorsen, PI

Science, Engineering and Education for Sustainability (SEES) researchers and practitioners grapple with one of our greatest challenges: Given enormous climate change-related uncertainty, how can we manage natural resources such that “Development . . . meets the needs of the present without compromising the ability of future generations to meet their own needs?” (Brundtland Commission 1987). Bioenergy will play a major role in meeting these challenges. This project concentrates on one form of bioenergy--liquid transportation fuels or “biofuels”--to investigate the impact of biofuel development on socio-ecological systems and associated ecosystem services, and how can those impacts best be measured, modeled, and mitigated? Project efforts focus on biodiesel from palm, soy, jatropha, and eucalyptus, and ethanol from sugarcane and woody biomass in four case studies across Brazil, Argentina, Mexico, and the United States (US). The project will integrate these case studies across the Americas to address the following questions:

- **How will biofuel development affect socioeconomic systems?**
- **How will biofuel development affect ecological systems?**
- **What sustainability indicators and metrics best assess biofuel sustainability across highly variable Pan American socio-ecological systems? and**
- **How will policy address biofuel-related socio-ecological impacts?**

Data collection and analyses will include: 1) biofuel- and ecosystem service-related cultural values, beliefs and norms, and economic and sociological impacts; 2) on-the-ground biofuel production-related ecosystem service impacts, including carbon storage, water quality and quantity, and biodiversity; 3) new sustainability science indicators and metrics using results from the socio-economic and ecosystem service studies; and 4) biofuel policy analysis tied to project ecosystem service and sustainability metrics.

National Science Foundation Sustainable Energy Pathways (SEP), Dr. David Shonnard, PI

The four-year Wood to Wheels (W2W) SEP project will conduct transformative, multidisciplinary, comprehensive, and integrated research in the area of forest-based infrastructure-compatible liquid biofuel for vehicular transportation. New knowledge generated will span the entire value chain, from forest biomass production to thermochemical processing, fuel combustion, and systems-level sustainability analyses. Project deliverables will help establish a new forest-based biofuels industry featuring high productivity forest energy crops, sustainable forest management practices, catalysts and process technologies, innovations in engine systems, sustainable decision-making databases, and analysis methods/software tools. Researchers from multiple disciplines will work at the cusp of emerging discoveries to develop new knowledge about complex coupled natural/industrial/societal systems. The project’s research will focus on the production of “infrastructure compatible green diesel” derived from a novel two-stage torrefaction / fast-pyrolysis treatment and catalytic conversion of bio-oil derived from woody feedstocks. The resulting fuel product will be a direct hydrocarbon replacement for fossil diesel. Fundamental combustion and emissions studies using both surrogate and synthesized green diesel will guide catalysis and pyrolysis research to achieve biofuel products with desired compositions and cost-effective engine emissions reduction. Similarly, fundamental research in torrefaction, pyrolysis and catalytic upgrading will inform studies to improve properties of

forest feedstocks. Through novel education and training programs, our students – postdoc, Ph.D.s, and undergraduates - will emerge as globally-aware, technically advanced, and innovation-focused engineering and science professionals.

Research is organized into three main thrusts plus a cross-cutting thrust integration activity; 1) **Sustainable Forest Systems** (forest productivity modeling, sustainability of ecosystem nutrition and productivity, genomics-guided feedstock improvement), 2) **Two-Stage Torrefaction/Pyrolysis-Based Conversion Processes** (pyrolytic production of bio-oil with catalytic upgrading to an *infrastructure-compatible green diesel*), 3) **Energy Utilization of Advanced Biofuels** (spray combustion kinetics, emissions characterization), and 4) **Integrated Sustainability Assessment and Decision Making** (decision support tools including indicator sets, process simulation and optimization, technoeconomic analyses, life cycle assessment, greenhouse gas analyses and energy balances).

Hypothesis-driven research in the W2W SEP will be conducted in an interconnected fashion (*Figure 1*), with the goal of producing an infrastructure-compatible green diesel (GD) with system-wide benefits; such as clean combustion in engines (low particulates and NO_x), reduced life-cycle greenhouse gas emissions compared to fossil fuel, low cost per gallon, rural job creation, increased energy independence, high productivity per acre of forest biomass, plant genotypes with favorable composition for conversion, and engines optimized to use the prescribed component make-up of the GD.

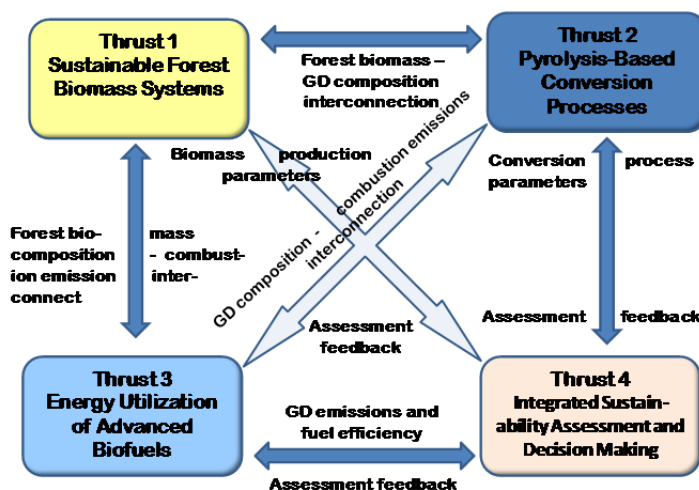


Figure 1. W2W SEP: Overall Integrated Research Program

National Science Foundation/USAID Partnerships for Enhanced Engagement in Research (PEER), Dr. Julio Sacramento PI, Universidad Autonoma de Yucatan, Merida MX

This PEER-PIRE proposal seeks complementary funding for Mexican collaborators of the PIRE proposal “Sustainability, Ecosystem Services, and Bioenergy Development across the Americas” The PIRE proposal addresses these themes by proposing answers to four main questions, including: “How is bioenergy development affecting social systems?” and “What sustainability indicators and metrics best assess biofuel sustainability across highly variable Pan American socio-ecological systems?” This PEER-PIRE proposal aims to provide answers to these two questions, in line with the LCA and community-impacts overarching themes. This work will be performed in the context of the jatropha-oil industry currently under development in the Yucatan state, Mexico. This case study is unique in that it presents evaluation of both universal and idiosyncratic aspects of sustainability. The research team will have strong input from international partners through the RCN and OISE-PIRE participants, through RCN workshops and conferences, and co-supervision of three graduate students. The expected project impacts are closely aligned with USAID’s interests on Environment, Agriculture, and Water, and more prominently on Global Partnerships with a focus on Sustainability. The main benefits of this research will be:

- Contributing to enhance the understanding of sustainability as a multicriteria problem including natural resource management, land and water use and availability, and socio-economic impacts on local communities;
- Elaborating new case studies on the application of sustainability-evaluation methodologies, for use in graduate education and policy decision-making;

- Enhancing the understanding on how location, feedstock source, and sustainability indicators impact decisions about sustainability of biofuels/bioenergy systems; and
- Increasing the research capacity of the Pan American partner institutions for graduate and postgraduate student education specialized in sustainability issues.

Pending Projects

Project: LCA and Evaluation of Techno-Economic Analyses of APB Expansion Project

Sponsor: American Process Inc, \$27,632,

Investigator: Dr. David R. Shonnard

Project: Life Cycle Assessment of Hydropyrolysis Integrated with a Petroleum Refinery

Sponsor: Gas Technology Institute, \$198,654

Investigator: Dr. David R. Shonnard

Project: OISE-PIRE: Sustainability, Ecosystem Services, and Bioenergy Development across the America's

Sponsor: National Science Foundation, \$2 (pre-proposal)

Investigator: Dr. Kathy Halvorsen

Project: Section C Management and Life Cycle Assessments of the MSU BRDI

Sponsor: US Department of Agriculture, \$322,825

Investigator: Dr. David Shonnard

Project: Life Cycle Assessments to Support LanzaTech BRDI: Platform Chemicals and Fuels From Biomass - An Integrated Systems Approach

Sponsor: US Department of Agriculture, \$337,542

Investigator: Dr. David R Shonnard

Project: Life Cycle Assessments (LCAs) in Support of UOP-USDA BRDI Proposal 2011

Sponsor: US Department of Agriculture, \$300,000

Investigator: Dr. David R. Shonnard

Project: SEP: Sustainable Forest-Based Biofuel Pathways to Hydrocarbon Transportation Fuels: Biomass Production, Torrefaction, Pyrolysis, Catalytic Upgrading, and Combustion

Sponsor: National Science Foundation, \$1,996,585

Investigator: Dr. David R. Shonnard

Project: Collaborative Research: Electrochemical Reduction of CO₂ to Small Organic Fuels on Encapsulated Metal Catalysts in Gas Diffusion Electrode Environment

Sponsor: National Science Foundation, \$184,567

Investigator: Dr. Wenzhen Li

Project: High Power Density and Durability, Low Cost Hydroxide Exchange Membrane Fuel Cells (HEMFCs) Directly Fed with Biodiesel Residual Crude Glycerol

Sponsor: US Department of Energy, \$-

Investigator: Dr. Wenzhen Li

Project: A Pan American Biofuels and Bioenergy Sustainability Research Network

Sponsor: National Science Foundation, \$11,266,071

Investigator: Dr. David R. Shonnard

Project: Life Cycle Assessments to Support the Terrestrial Carbon Analytics (TCA) BRDI Preproposal

Sponsor: US Department of Agriculture, \$-

Investigator: Dr. David Shonnard

Project: Life Cycle Assessment Research to Support MRIGlobal BRDI Preproposal

Sponsor: US Department of Agriculture, \$-

Investigator: Dr. David Shonnard

Project: Life Cycle Assessments to Support the Avello BRDI Preproposal

Sponsor: US Department of Agriculture, \$-

Investigator: Dr. David Shonnard

Project: Bimetallic Overlay Catalysts for Sustainable Fuel Production From Lactose

Sponsor: National Science Foundation, \$299,998

Investigator: Dr. Tony Rogers (Joe Holles)

Project: Environmental Life Cycle Assessments of PyGasoline and PyDiesel From Different Feedstocks: Hardwoods, Corn Stover, and Diseased Softwoods

Sponsor: US Dept of Energy w/ UOP, \$257,076

Investigator: Dr. David Shonnard

Project: Life Cycle Assessments to Support LanzaTech: DOE FOA 0000467

Sponsor: US Dept of Energy w/ LanzaTech, \$149,960

Investigator: Dr. David Shonnard

Project: LCA and Evaluation of Techno-Economic Analyses of APB Expansion Project

Sponsor: American Process Inc., \$27,632

Investigator: Dr David Shonnard

Project: Determinants of Citizen/Private Landowner Participation in Voluntary Land Management Programs

Sponsor: National Science Foundation, \$299,684

Investigator: Dr. Audrey Mayer

Project: Roll-Printed, Nano-Architected, Swiss-Roll Columns for Oil-Water Demulsification and Separation

Sponsor: National Science Foundation, \$850,000

Investigator: Dr. Dennis Meng

Project: A Novel Two-Stage Torrefaction-Pyrolysis for the Production of High-Grade Bio-Oil

Sponsor: National Science Foundation, \$332,407

Investigator: Dr. Ezra Bar Ziv

Project: Engaging Students & Families in Learning About Forests

Sponsor: Michigan Dept of Natural Resources, \$9,992

Investigator: Joan Chadde

Project: Bioprocess Synthesis for Enhanced Cellulosic Biofuel Production

Sponsor: National Science Foundation, \$66,326

Investigator: Dr. Wen Zhou

Project: EPA San Luis Basin Regional Sustainability Project

Sponsor: Environmental Protection Agency, \$199,580

Investigator: Dr. Audrey Mayer

Project: Development of the New Forest-Based Biofuels Research Laboratory and Pilot Plant

Sponsor: Herrick Foundation, \$75,000

Investigator: Dr. David Shonnard

New Projects

Project: RCN-SEES: A Research Coordination Network on Pan American Biofuels and Bioenergy Sustainability

Sponsor: National Science Foundation, \$749,996, (1/1/2012-12/31/2015)

Investigator: Dr. David Shonnard

Project: RCN-SEES: A Research Coordination Network on Pan American Biofuels and Bioenergy Sustainability (Supplementals)

Sponsor: National Science Foundation, \$20,000

Investigator: Dr. David Shonnard

Project: Collaborative Research: EAGER: Studying Lignocellulosic Fine Structure and Its Dynamics in Enzymatic Hydrolysis of Biomass using Molecule-recognizing AFM and Computational Modeling

Sponsor: National Science Foundation, \$44,670, (9/1/2011-3/31/2013)

Investigator: Dr. Wen Zhou

Project: LanzaTech Proposal to Federal Aviation Administration: Integrated Life Cycle and Techno-economic Assessments of Industrial Waste Gas to Jet Fuel Conversion

Sponsor: US Department of Transportation, \$150,016, (4/1/2012-3/31/2013)

Investigator: Dr. David Shonnard

Project: A forest Based Biofuels Pilot Plant for Wood-to-Wheels at Michigan Tech

Sponsor: Gerstacker and Strosacker Foundations, \$125,000, 1/01/2011-12/31/2014

Investigator: Dr. David Shonnard

Ongoing Projects

Project: Life Cycle Assessments to Support Sustainable Algae-Based Biofuels Production for the National Alliance for Advanced Biofuels & Bioproducts

Sponsor: UOP LLC/Honeywell, \$89,995, (10/01/2010-06/30/2012)

Investigator: David Shonnard

Project: Life Cycle Assessments of LanzaTech Conversion Technologies: Greenhouse Gases, Energy, and Water Impacts

Sponsor: Lanza Tech Limited, \$75,300, (10/29/2010-05/01/2012)

Investigators: David Shonnard and Robert Handler

Project: Life Cycle Assessments of PyGasoline and PyDiesel From Different Regional Feedstocks: Corn Stover, Switchgrass, Sugar Corn Bagasse, Waste Wood and Forest Residues

Sponsor: UOP LLC/Honeywell, \$125,002 (5/1/2010-7/31/2011)

Investigator: David Shonnard (ChE)

Project: Carbon Footprint Analysis of IH2 Biofuels: Proposed Detailed Analyses

Sponsor: Gas Technology Institute (GTI), \$50,001 (6/1/2010-3/31/2011)

Investigator: David Shonnard (ChE)

Project: Working Bugs/MTU Center of Energy Excellence: Hydrolysis Research to Produce Sugars and Amino Acids from Defatted Dry Mill Syrup and other Renewable Resources

Sponsor: Working Bugs LLC, \$119,999 (2/15/2009-2/14/2012)

Investigator: David Shonnard (ChE)

Project: Life Cycle Assessments (LCAs) in Support of UOP and Envergent Renewable Energy and Chemicals Projects in 2010

Sponsor: UOP LLC/Honeywell, \$80,503 (5/1/2010-4/30/2011)

Investigator: David Shonnard (ChE)

Project: Planning Grant: IUCRC for Joining the Center for Bioenergy Research and Development

Sponsor: National Science Foundation, \$12,978 (5/15/2010-8/31/2011)

Investigators: David Shonnard (ChE) and Richard Donovan (SFI)

Project: COEE Project 1 - Feedstock Supply Chain Model

Sponsor: State of Michigan \$385,000 (1/1/09 – 4/11)

Principal Investigators: David Watkins (MTU) and Christopher Peterson (MSU)

MTU Investigators: Dana M. Johnson (SB&E), Bill Knudsen (CEE), James Pickens (SFRES), James Friendewey (SB&E), Barry D. Solomon (SS), Greg Graman (SB&E) .

Project: COEE Project 3 - Improving Forest Feedstock Harvesting, Processing and Hauling Efficiencies

Sponsor: State of Michigan \$274,837 (1/1/09 – 4/12)

Principal Co-leaders: Ajit Srivastava (MSU Dept of Biosystems & Ag Eng) and David Shonnard (MTU ChE)

MTU Investigators: Robert E. Froese (SFRES), Robert Handler (SFI), Pasi Lautala (CEE) and Terrence McNinch (Transportation Inst.)

Project: Fermentation Improvement Project: An MTU Subcontract to Alpina Prototype Biorefinery Center of Energy Excellence.

Sponsor: American Process Inc., \$321,138 (2/1/09 to 8/20/11)

Investigators: David Shonnard (ChE) and Susan Bagley (Biological Sciences)

Project: BE/MUSES: Renewable Energy from Forest Resources: An Investigation into the Viability of Large-Scale Production of Sustainable Transportation Fuels from Lignocellulosic Biomass

Sponsor: National Science Foundation, \$1,700,002 (9/1/2005-8/31/2011)

Investigators: Ann Maclean (SFRES), David Flaspohler (SFRES), Christopher Webster (SFRES), David Shonnard (ChE), Barry Solomon (SS), John Sutherland (MEEM)

Project: Michigan Tech Research Year 1: Forestry Biofuel Statewide Collaboration Center

Sponsor: Michigan Dept of Labor & Economic Growth, \$646,850 (3/11/2009-12/31/2011)

Investigator: Dr. David Shonnard

Project: Life Cycle Assessments to Support Sustainable Algae-Based Biofuels Production for the National Alliance for Advanced Biofuels and Bioproducts (NAABB): Year 3

Sponsor: UOP, LLC, \$47,999

Investigator: Dr. David Shonnard

1.3 Sustainability Education

Featured Projects in Development

National Science Foundation Transforming Undergraduate Education in Science, Technology, Engineering and Mathematics, Audrey Mayer, PI

Because individual decisions have a profound effect on quality of life for current and future generations, a paramount educational objective for sustainability education is to empower students to become better decision-makers. To achieve this objective within the context of sustainable development, this course must present to students its historical context and its multiple interpretations, enabling students to analyze complex human/natural systems, and motivating students to explore more advanced sustainability topics in discipline-specific courses. The proposed course topics for accomplishing this sustainability education objective are; **a.** sustainability concepts – origins of sustainable development and global challenges it addresses, **b.** systems analysis – the ability to understand and assess interactions in complex human/natural systems, **c.** environmental life cycle assessment – the ability to analyze and compare product systems from the standpoint of environmental impacts, **d.** development theories – the knowledge of different approaches for development and their advantages and disadvantages, **e.** economic sustainability – contrast ecological economics with traditional concepts, **f.** social sustainability – policy and societal dimensions of sustainable development, **g.** developing world issues, and **h.** innovation for sustainable development. These diverse topics will be explored using an active-learning approach where there will be an emphasis on

developing student skills, on engaging students in higher-order thinking (analysis, synthesis, evaluation), on participatory activities (case study presentations and leading discussions on readings), and in exploring their own attitudes and values. Students will use computer-aided software to apply methods of life cycle assessment to the analysis, to comparisons, and to decisions on the environmental compatibility of product systems in homework assignments and in a term project. Both formative and summative evaluations will address the project's progress toward its overall goal by measuring its effectiveness at meeting specific objectives, as outlined in the proposal.

Pending Projects

Project: A Sustainability and Sustainable Development Program for all Undergraduate: Engaging Content Experts with Active Learning by Students

Sponsor: National Science Foundation, \$199,976

Investigator: Audrey L Mayer

Project: Scholarships to Create Professionals for Engineering Community Resilience

Sponsor: National Science Foundation, \$619,488

Investigator: Dr. Kurtis Patterson

Project: RET Site: "Wood-to-Wheels (W2W)" - Research Experiences for High School Teachers in Sustainable Transportation Technologies (Supplemental)

Sponsor: National Science Foundation, \$20,000

Investigator: Dr. David R. Shonnard

New Projects

Project: Building Community Capacity to Manage Private/Public Forests and Develop Forest Stewards

Sponsor: US Dept of Agriculture, \$81,510, (9/8/2011-9/30/2013)

Investigator: Joan Chadde

Ongoing Projects

Project: RET Site: Wood to Wheels-Research Experiences for High School Teachers in Sustainable Transportation Technologies

Sponsor: National Science Foundation, \$358,942, (01/15/2011-12/31/2013)

Investigators: David R Shonnard (ChE), Brad Baltensperger (CLS), S. Joshi (SFRES), Jeffrey Naber (MEEM), K. Hungwe (CLS), Shawn Oppliger (CCISD), Christine Anderson

Project: Great Lakes Maritime Education for K-12 Teachers

Sponsor: University of Wisconsin-Superior, \$8750, (10/01/2010-09/15/2012)

Investigator: Joan Schumaker Chadde

Project: Bringing Environmental Education to Urban Schools in Detroit

Sponsor: US Dept of Agriculture, \$13,999, (08/18/2010-09/20/2012)

Investigator: Joan Schumaker Chadde

Project: Great Lakes Maritime Education for K-12 Teachers

Sponsor: University of Wisconsin-Madison, \$22,500, (10/01/2010-09/30/2012)

Investigator: Joan Schumaker Chadde

Project: Family Engineering for Parents and Elementary-Aged Children

Sponsor: National Science Foundation, \$1,652,835, (5/15/2008-4/30/2012)

Investigators: Neil Hutzler (CEE), Joan Schumaker Chadde

Project: Outdoor Science Investigations Field Trip Program

Sponsor: Kinship Foundation, \$125,000 (07/2007-06/2012)

Investigator: Joan Schumaker Chadde

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

Sponsor: National Science Foundation, \$78,258, (6/11/2008-5/31/2012)

Investigator: Judith A Perlinger (CEE)

Project: CPATH CDP: Integrating Sustainability into Undergraduate Computing Education

Sponsor: National Science Foundation, \$144,555, (07/01/2008-06/30/2012)

Investigator: Yu Cai (ECE)

Project: ADVANCE: Partnerships for Adaptation, Implementation, and Dissemination (PAID) Award: Changing the Face of Michigan Tech

Sponsor: National Science Foundation, \$499,496, (9/01/2008-8/31/2012)

Investigator: Lesley M. Lovett-Doust

Project: Enhancing the Capacity for Sustainable Forest Management in Chiapas and Oaxaca

Sponsor: Higher Education for Development, \$459,562, (02/16/2009-09/30/2012)

Investigator: Alex Mayer (CEE)

Project: SustR; Sustainable Development for Rural Communities: Social, Health, Economic, and Environmental Advances

Sponsor: US Dept of Education, \$150,000, (09/01/2008-08/31/2012)

Investigator: Alex Mayer (CEE)

Project: New GK12 GlobalWatershed: Integrating Rural and Global Perspectives with Research and Technological Advances

Sponsor: National Science Foundation, \$2,418,351, (08/26/2009-08/31/2014)

Investigator: Alex Mayer (CEE)

1.4 Complex Systems Analysis

Featured Projects in Development

National Science Foundation Partnership for Innovation (PFI), Dr. Richard P. Donovan, PI

The Building Innovation Capacity in Science, Engineering and Education for Sustainability Assessment (SEES-A) project is designed to bridge the gap between academic research and application development for bioenergy and biofuel sustainability. The proposed project seeks to establish an integrated sustainability analysis/assessment testbed to serve as a platform that pushes the extensive sustainability research activities of the Sustainable Futures Institute (SFI) at Michigan Technological University out to appropriate stakeholders, and pulls information from the stakeholders back into the SFI research programs. The logic model for SEES-A, illustrated below, shows three interrelated activities: (i) Development of a Knowledge Enhancement Partnership (KEP) Program consisting of small businesses and other stakeholders who will co-develop applications for their markets; (ii) Establishment of a Sustainability Assessment Extension Center; and (iii) Creation of a Graduate Enterprise for Sustainability Assessment. Overall, the program will create field-tested sustainability assessment tools to position our KEPs to take advantage of the results of sustainability science research while providing outreach and formative evaluation for the sustainability research efforts at partner organizations. The program is designed to prepare students, researchers and practitioners for careers in sustainability science by providing opportunities to professionally interact with stakeholders such as landowners, community leaders and government policy makers.

Pending Projects

Project: EPA San Luis Basin Regional Sustainability Project

Sponsor: Environmental Protection Agency, \$199,580

Investigator: Dr. Audrey Mayer

Project: Building Innovation Capacity in Science, Engineering and Education for Sustainability Assessment

Sponsor: National Science Foundation, \$599,899

Investigator: Dr. Richard P. Donovan

New Projects

Project: Planning Visit for US-Australia Collaborative Research on Climate-Related Infrastructure Adaptation for Natural Hazards

Sponsor: National Science Foundation, \$17,655, (4/1/2011-3/31/2013)

Investigator: Dr. Yue Li

Project: Integration of Mainshock-Aftershock into Performance-Based Engineering using Publicly Available NEEShub Data

Sponsor: National Science Foundation, \$286,000, (5/1/2011-4/30/2014)

Investigator: Dr. Yue Li

Project: US-Vietnam Workshop on Multiple Natural Hazards Assessment and Mitigation under the Impact of Climate Change

Sponsor: National Science Foundation, \$39,450, (5/15/2012-4/30/2013)

Investigator: Dr. Yue Li

Ongoing Projects

Project: Monitoring Zebra Mussel Phosphorus Excretion

Sponsor: Michigan Dept of Environmental Quality, \$61,103 (9/1/2009-8/31/2011)

Investigator: Martin T. Auer (CEE)

Project: Bioavailability and Phosphorus Management for Onondaga Lake

Sponsor: Upstate Freshwater Institute Inc, \$85,555 (1/1/2010-8/31/2011)

Investigator: Martin T. Auer (CEE)

Project: Integrated Modeling and Experimental Evaluation of Hydrodynamic and Microbial Controls on DNAPL Dissolution and Detoxification

Sponsor: National Science Foundation, \$376,192 (12/28/2009-8/31/2012)

Investigator: Jennifer G. Becker (CEE)

Project: Enhancing the Capacity for Sustainable Forest Management in Chiapas and Oaxaca

Sponsor: Higher Education in Development/USAID \$250,000 (1/1/2009 - 12/31/2011)

Investigators: Alex Mayer (CEE/GMES), Kathleen Halvorsen (SFRES/SS)

Project: Streamside Lake Sturgeon Culture for the Ontonagon River

Sponsor: Michigan DNR \$ 33,846 (10/1/07 to 9/30/2011)

Investigators: Nancy Auer (BS) and Edward Baker (DNR)

Project: Modeling and Analyzing the Use, Efficiency, Value and Governance of Water as a Material in the Great Lakes Region through an Integrated Approach

Sponsor: National Science Foundation MUSES program \$1,078,322 (9/1/07 to 8/31/2012)

Investigators: Alex Mayer (GMES), David Watkins (CEE), Qiong Zhang (SFI), James Mihelcic (USF), Julie Zimmerman (Yale), and Sheila Olmstead (Yale)

Project: Evaluating Riparian Timber Harvesting Guidelines: Phase 3, Result 2 Evaluate Aquatic Habitat Impacts

Sponsor: USDA, \$45,648, (5/24/2007-5/24/2012)

Investigator: Casey Huckins (BL)

Project: IDR: Collaborative Research: Sustainable Water Resources for Communities Under Climate Change: Can State-of-the-Art Forecasting Inform Decision-Making in data Sparse Regions?

Sponsor: National Science Foundation, \$317,390, (09/15/2010-08/31/2013)

Investigator: Alex Mayer (CEE)

Project: Predicting Ecosystem Changes in Lake Superior

Sponsor: US Environmental Protection Agency, \$306,015, (09/01/2010-04/30/2013)

Investigator: Nancy Auer (BL)

1.5 Developing World Sustainability

Pending Projects

Project: Sustainable Bioenergy for the Americas: Research and Development through Peace Corps Masters International Engagement for Pan American Bioenergy Sustainability

Sponsor: US Department of State, \$1,491,434

Investigator: Dr. Richard P. Donovan

Ongoing Projects

Project: Sustainable Development for Rural Communities: Social, Health, Economic, and Environmental Advances

Sponsor: US Department of Education \$180,000 (9/1/2008 - 8/31/2012)

Investigators: Alex Mayer (CEE/GMES), Carol MacLennan (SS), and Blair Orr (SFRES)

Project: International Developing Global Engineers and Scientists through Collaborative Technology Innovation for Public Health Improvements in Tanzania

Sponsor: National Science Foundation, \$145,467 (7/1/2009-6/30/2012)

Investigator: Kurt Paterson

Project: S-STEM Program: Graduate Student Scholarships to Advance a Global Outlook of Economic and Social Prosperity that Protects the Environment

Director: Judith A. Perlinger (CEE)

Sponsor: National Science Foundation, \$599,978 (6/2008 to 9/2012)

Faculty: Veronica Griffis (CEE), Alex Mayer (CEE), Kurtis Paterson, (CEE) and Jacqueline Huntoon, Graduate School

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

Sponsor: National Science Foundation, \$78,258, (6/11/2008-5/31/2012)

Investigator: Judith A Perlinger

Project: Enhancing the Capacity for Sustainable Forest Management in Chiapas and Oaxaca

Sponsor: Higher Education for Development, \$459,562, (02/16/2009-09/30/2012)

Investigator: Alex Mayer

Project: SustR; Sustainable Development for Rural Communities: Social, Health, Economic, and Environmental Advances

Sponsor: US Dept of Education, \$150,000, (09/01/2008-08/31/2012)

Investigator: Alex Mayer

Project: New GK12 GlobalWatershed: Integrating Rural and Global Perspectives with Research and Technological Advances

Sponsor: National Science Foundation, \$2,418,351, (08/26/2009-08/31/2014)

Investigator: Alex Mayer

1.6 Materials, Design, and Manufacturing for Sustainability

Pending Projects

Project: Selective Electrocatalytic Oxidation of Biorenewable Polyols over Bimetal Catalysts

Sponsor: National Science Foundation, \$299,999

Investigator: Dr. Wenzhen Li

Project: Life Cycle Assessments to Support LanzaTech: Department of Energy Innovative Manufacturing Initiative

Sponsor: Department of Energy, \$145,319

Investigator: Dr. David R. Shonnard

Project: Environmentally Responsible Treatment and Generation of Useful Products from Aluminum Extraction Waste Materials

Sponsor: US Environmental Protection Agency, \$14,711

Investigator: Dr. Gerard T. Caneba

Project: Biomediated Geomechanical Processes for Dust Mitigation and Monitoring at Mine Tailings Impoundments

Sponsor: National Science Foundation, \$210,287

Investigator: Dr. Eric Seagren

Project: Collaborative Research: Nexus of Simulation, Sensing and Control for Aerodynamic Loads Reduction of Wind Turbine Blades

Sponsor: National Science Foundation, \$270,200

Investigator: Dr. Qingli Dai

Project: Oil Dispersion Studies and Dispersants from FRRPP-based Surfactants

Sponsor: University of Alabama at Birmingham, \$449,998

Investigator: Dr. Gerard Caneba

Project: MTU Support of "Circular Manufacturing for Improved Material Efficiency (CMIME)"

Sponsor: Purdue University (re: National Science Foundation), \$23,999

Investigator: Dr. David R. Shonnard

Project: Hyphenated SEC-IR Instrumentation for Studies of Water-based Gel Propellants

Sponsor: US Department of Defense, \$305,961

Investigator: Dr. Gerard Caneba

New Projects

Project: REF-TC: Benchmark Performance Testing of Michigan Tech Rechargeable Carbon Foam Supported by Nickel Asymmetric Capacitors

Sponsor: Internal, (7/1/2011-8/31/2012)

Investigator: Bahne C. Cornilsen

Project: Novel Techniques for Stabilization and Conservation of Ferrous Metals in Industrial Heritage

Sponsor: US Department of the Interior, \$25,000, (5/1/2012-6/30/2013)

Investigator: Dr. Timothy Scarlett

Ongoing Projects

Project: Collaborative Research: Institute/University Cooperative Research Center (IUCRC) on Assembly Research

Sponsor: National Science Foundation, \$10,000 (11/1/08 to 10/31/2012)

Investigators: Jamie Camelio (MEEM), and John Gershenson (MEEM)

Project: The Nano-Interface between Material Science and Organometallic Chemistry

Sponsor: American Chemical Society, \$100,000 (9/1/2010-8/31/2012)

Investigator: Dario J. Stacchiola

Project: Investigation into the Enhancement of Thermoplastic Polymers with Conductive Nano Materials

Sponsor: Boeing \$420,391 (5/1/08 to 8/31/12)

Investigator: Julia King (ChE)

2.0 SFI Core Education Activities

Courses

SFI has developed the following sustainability related courses in order to support sustainability education on campus as well as off campus.

ENG 5510 - Sustainable Futures I (3 credits)

Instructor: Dr. David Shonnard

Students registered during Fall 2009: 28 (including 9 online students)

This course covers introductory and intermediate concepts of Sustainable Development. The course explores methods/tools for assessing sustainability from economic, environmental, societal perspectives for current and emerging industrial technologies. It also explores applications of Life Cycle Assessment in the public policy arena and in the private sector. Industrial applications of sustainable development are further explored through case studies and guest lectures.

ENG 5520 - Sustainable Futures II (3 credits)

Instructors: Dr. Richard Donovan and Dr. Robert Handler

Students registered during Spring 2010: 12 at MTU and 4 at SUBR

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 (1 credit)

Instructor: Dr. Richard Donovan and Dr. Robert Handler

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.

Graduate Certificates in Sustainability

SFI has developed the Graduate Certificate in Sustainability to recognize curricular breadth in the following three areas: 1) Policy, societal, and economic systems; 2) Environmental systems; and 3) Industrial systems. The Sustainable Futures Model takes a systems approach that combines information and insight from a meta-disciplinary perspective to help students understand how disciplinary information connects to larger systems. To students seeking employment or further education in this field, the SFI Graduate Certificate provides a competitive edge - through the study of current, accurate information and research surrounding the impact of society's ecological footprint. The systems approach provides a platform for critical and responsive analysis of the interdependence of each structure. As the need for sustainable development and management becomes more important in an increasingly interdependent world, a well-trained problem-solver is a valuable asset to the global environmental system. A graduate student can integrate the certificate into a specialized education in engineering, forestry, science, social sciences, humanities, business, and economics. To achieve the Graduate Certificate in Sustainability, students need to have earned a total of 15 credits, including SF 1 and SF 2 as described above. Graduate students can integrate the certificate into a specialized education in engineering, forestry, science, social sciences, humanities, business, and economics.

The remaining 9 credits are to be divided equally among the three pillars of sustainability, listed below:

Industry and Society (requires minimum of one course – 3 credits)

Courses in the Industry and Society section bridge the gap between these two pillars.

OSM4100 (or OSM5100) Operations Strategy

BA5610 Business Process Management

BA5780 Managing in the Global Environment

CE5408 Public Transit

CE5993 Engineering with Developing Countries

EC5640 Natural Resource Economics

EC5650 Environmental Economics

HU4625 Risk Communication

CE/CSE 5710 Modeling and Simulation Applications for Decision-Making in Complex Dynamic Systems

SS3800 Energy Technology and Policy

SS 4390 Seminar in Sustainability Issues

SS3820-Ethical, Legal and Societal Implications (ELSI) of Nanotechnology

EC4620/EC5620 Energy Economics

Environment and Society (requires minimum of one course – 3 credits)

Courses in the Environment and Society section bridge the gap between these two pillars.

BL4120 Environmental Remediation and Toxicology---note prerequisites

EC5650 Environmental Economics

FW3110 Natural Resource Policy

FW3410 Conservation Biology

FW3760/SS3760 Human Dimensions of Nat. Resources

FW 5150 Institutions and Natural Resource Management

FW5180 Conservation Ethics

SS3620 International Environmental Technology Policy

SS5300 Environmental Policy and Politics

SS 5313 Sustainability Science, Policy and Assessment

 SS5350 Environmental Policy Analysis

 SS5400 Sociology of the Environment

 SS5550 Global Environmental History

Industry and Environment (requires minimum of one course – 3 credits)

Courses in the Industry and Environment section bridge the gap between these two pillars.

 BL4220 Applied and Industrial Microbiology

 ENVE4504 Air Quality Eng. and Science

 ENVE 4508 Water and Wastewater Treatment

 CE4050/CE5050 Green Building Design

 CE 5666 Water Resources Planning and Mgmt

 ENVE5511 Air Quality/Built Environment

 CE5920 Civil Engineering Independent Study (TBD)

 CE5930 Environmental Engineering Independent Study (TBD)

 CE 5710- Modeling and Simulation Applications for Decision-Making in Complex Dynamic Systems

 CM4550 Industrial Chemical Production

 CM4710 Biochemical Processes

 CMG 4800- Sustainable Construction

 EE5260 Wind Power

 FW 5413 Sustainable Biomass

 FW5550 GIS for Resource Mgmt.

 GE4630 Mineral Industry Economics

 MEEM/ENVE 5453 and 5454 See Think Design Delight

 MEEM5685 Environmentally Responsible Design & Mfg.

Since 2004, the following **89** students from throughout Michigan Tech and the SF IGERT program have received Graduate Certificates of Sustainability:

Student Name	Completion Date
Banerjee, Bibaswan	28-Apr-12
Bunker, Kaitlyn J	28-Apr-12
Hassell, Trever J	28-Apr-12
Sengupta, Syamantak	28-Apr-12
Shields, Jedediah D	28-Apr-12
VanArsdale, Christopher D	28-Apr-12
Ekneligoda, Nishantha C	17-Dec-11
Nayak, Nikhil B	17-Dec-11
Poramapojana, Poowanart	17-Dec-11
Schoenherr, Steven D	17-Dec-11
Adom, Felix K	13-Aug-11
Brodeur-Campbell, Michael J	13-Aug-11
Champagne, Ted M	13-Aug-11
Pringle, Justine M	13-Aug-11
Seib, Matthew D	13-Aug-11
Drees, Andrew M	30-Apr-11
Fan, Jiqing	30-Apr-11

Freitag-Engstrom, Jaime R	30-Apr-11
Jeter, Kali L	30-Apr-11
Obergfaell, Christian	30-Apr-11
Ballard LaBeau, Meredith M	18-Dec-10
Blaisi, Nawaf I	18-Dec-10
Cass, Darrell J	18-Dec-10
Kozich, Andrew T	18-Dec-10
Nielsen, Matthew T	18-Dec-10
Roda, Cesar R	18-Dec-10
Watson, Katelyn A	18-Dec-10
Barkley, Matthew D	1-May-10
Johnson, Jaclyn E	1-May-10
Lawyer, Kristina M	1-May-10
Luttinen, Matthew E	1-May-10
Prindle, Daniel B	1-May-10
Tomioka Matsukawa, Luis Manuel	1-May-10
Manser, Nathan D	19-Dec-09
Satchell, Erin M	19-Dec-09
Shellenberger, Matthew C	19-Dec-09
Casey, Colin M	15-Aug-09
Green, Kaitlin E	15-Aug-09
Mo, Weiwei	15-Aug-09
Tarte, Andres B	15-Aug-09
Demeny, Kevin A	2-May-09
Fry, Lauren M	2-May-09
Pawelzik, Paul	2-May-09
Robles Morua, Agustin	2-May-09
Rowe, Mark D	2-May-09
Sothirajah, Jayanthi	2-May-09
Cowden, Joshua R	20-Dec-08
Jenkins, Timothy L	20-Dec-08
Wright Wendel, Heather E	20-Dec-08
Anderson, Mark J	16-Aug-08
Barton Carter, Rodwick L	16-Aug-08
Hansen, Linda D	16-Aug-08
Dumpert, James W	3-May-08
Jensen, Jill R	3-May-08
Yao, Meng	3-May-08
Chow, Jack T	22-Dec-07
Fuchs, Valerie J	22-Dec-07
Garcilaso Vejar, Luis R	22-Dec-07
Kucharski, Matthew J	22-Dec-07
Liermann, Theresa A	22-Dec-07
Ocwieja, Sarah M	22-Dec-07
Pettit, Brendon L	22-Dec-07
Ghimire, Santosh R	18-Aug-07
Christophe, Antoinette S	5-May-07
Clarke-Sather, Abigail R	5-May-07
Rivera, Julio L	5-May-07
Womack-Richardson, Edith V	5-May-07
Muga, Helen E	12-Aug-06
Suzuki, Ryu	12-Aug-06
Ye, Xiaoli	12-Aug-06
Daily, Brian N	29-Apr-06

Eatmon, Thomas D	29-Apr-06
Haapala, Karl R	29-Apr-06
Huntzinger, Deborah N	29-Apr-06
Hutchins, Margot J	29-Apr-06
Ilija Ojeda, Monica	29-Apr-06
Mehl, Jessica A	29-Apr-06
Schweitzer, Ryan W	29-Apr-06
Seifert, Christian W	29-Apr-06
Shaw, Ryan P	29-Apr-06
Shonsey, Cara W	29-Apr-06
Welling, Lisa C	29-Apr-06
Chen, Rui	17-Dec-05
Shapiro, Jesse S	17-Dec-05
Eggart, Michelle E	30-Apr-05
Henry, Brian P	30-Apr-05
Snauffer, Andrew M	30-Apr-05
Tillison, Naomi L	30-Apr-05
Troschinetz, Alexis M	30-Apr-05

3.0 Outreach

Members of the SFI were engaged in numerous outreach activities throughout the year. Highlighted activities are described below.

Aquaponics Laboratory

Aquaponics is a term to describe the integration of aquaculture (fish farming) with hydroponics (growing plants without soil) in a closed-loop, mutually-supporting system (see Figure 1). Fish wastes provide fertilizer for plant growth, while the plants filter and clean water to maintain a healthy environment for the fish. Several important bacterial species are involved to convert ammonia present in fish waste to nitrate, a form of nitrogen that is non-toxic to fish, and mediate other important reactions in the system. Improved technology and a resurgence of interest in the field has spawned a new wave of engineered systems in recent years, focusing on optimizing the interactions of fish and plants through improved aeration, efficient water movement, feed management, and nutrient cycling. In areas where good soil is not in abundance or in urban settings, aquaponics has been investigated as a means of locally-grown sustenance for a community, and community-based aquaponics projects have been spreading throughout the country, even in the colder Great Lakes region (e.g., Sweetwater Organics and Growing Power in Milwaukee, WI).

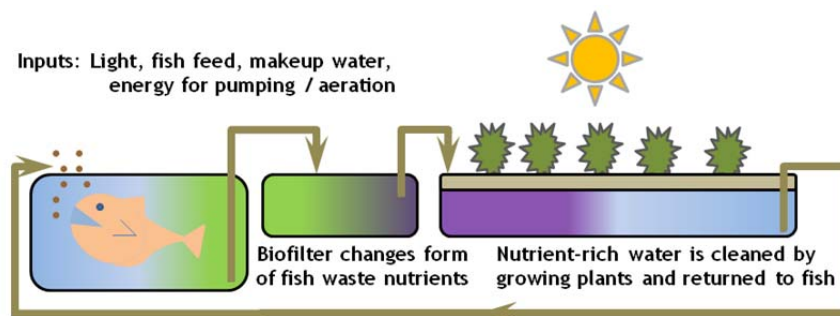


Figure 1: Basic depiction of aquaponics system.

In December 2011, SFI postdoctoral researcher Robert Handler and Biological Sciences faculty Nancy Auer received funding from the internal Michigan Tech Century II Campaign Endowed Equipment (C2E2) Fund to purchase an aquaponics system to be operated in the Dow building greenhouse. C2E2 is a program aimed at providing equipment money to improve the lives of faculty, students, and staff campus-wide. After the system was ordered, delivered, and constructed, plants and bacteria were introduced in April 2012 (Figure 2a). Tilapia was the initial fish species chosen for the system, and 72 tilapia fingerlings were added to the system in May 2012. The fish

have grown well since then, as have the variety of plants and herbs grown in the 6 months of operation (Figure 2b). In the first four months alone, nearly 18 kg of basil was grown in only 20 ft² of growing space!

A)



B)



Figure 2 – One of the two aquaponics systems after installation in the Dow 905 greenhouse (A) and after 3 months of operation (B) in summer 2012.

Dr. Handler and Dr. Auer propose to use the aquaponics system as a tool to illustrate a variety of science, technology, engineering, and mathematics (STEM) concepts. Properly functioning aquaponics systems seem simple, but a great deal of biological and chemical activity is occurring in a thoughtfully-engineered system, resulting in many teachable moments and illustrative scenarios for students in a variety of disciplines. In the 6 months of system operation, we have used the system for teaching modules in 4 Michigan Tech classes. Several undergraduate student groups have toured the system, two students have completed independent study projects related to the project, and the Consumer Product Manufacturing (CPM) Enterprise group has a team of engineering students dedicated to devising process improvements for the system. We hosted roughly 100 5th-7th graders as part of the Lake Superior Water festival held in October 2012 (Figure 3), and have proposed to include an aquaponics module in a Summer Teacher Institute organized by the Western UP Center for Science, Math, and Environmental Education. Three students in the Michigan Tech Entrepreneurship Club have also formed a project team focused on the commercial feasibility of aquaponics, and with guidance from Dr. Handler and Michele Loughhead (Business & Economics) they have performed well in two business plan competitions in 2012. They look forward to continuing their current collaboration with a variety of Michigan Tech groups on various aspects of the aquaponics system, and leveraging this successful experience into larger opportunities in the future.



Figure 3 – Students learning about the aquaponics system during the first annual Lake Superior Water Festival in October 2012.

IN2WOOD International Conference. May 3-4, 2012

IN2WOOD is an EU-funded program to foster collaboration among 13 participating organizations representing wood and forest products cluster in Slovakia, Ukraine, Italy, Switzerland, Germany and Austria. Operations Manager, Senior Engineer and Scientists of the SFI, Dr. Richard P. Donovan, was invited to participate in the conference through podium presentations (“Sustainable Futures Institute: Wood-to-Wheels and Sustainable Bioenergy Pathways”) as well as panel discussions. The podium presentation provided an overview of on-going and

proposed work at SFI. This activity was the direct result of SFI partnering with the MEDC in sponsoring a related European group's (BIOCLUS) tour of the UP last year.

Association of Consulting Foresters National Convention, Grand Rapids MI June 23-26 2012

The Association of Consulting Foresters was founded to advance the professionalism, ethics and interests of consulting foresters throughout the country. Bioenergy represents a new and potentially transformative market for forest products throughout the US. Operations Manager, Senior Engineer and Scientist of SFI, Dr. Richard P. Donovan, was invited to present at the National Convention held June 23-24 2012. The presentation, ("Sustainable Futures Institute: Wood-to-Wheels and Sustainable Bioenergy Pathways", provided an overview of SFI bioenergy projects that have the potential to impact the work of consulting foresters throughout the US.

4.0 Other University Sustainability Partners

The SFI is one of several entities at Michigan Tech with a focus or thrust directed at sustainability. As the only center/institute on campus with a campus wide mission of developing large inter-disciplinary projects, SFI has partnered with these campus centers as well as sustainability related centers across the US. Together, all of these Michigan Tech groups contribute their ideas and insights to advancing the goal of sustainability.

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: Andrew Burton, School of Forest Resources & Environmental Science



The Biotech Research Center fosters interdisciplinary research at Michigan Tech. Biotechnology encompasses the applications of various science and engineering disciplines for industrial utilization of living organisms or their products. The mission of the Biotechnology Research Center (BRC) at Michigan Tech 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.

The multidisciplinary nature of the BRC is reflected in the diverse expertise of the BRC faculty. Participation includes faculty from the Biology, Chemistry, Mathematics, Biomedical Engineering, Mechanical Engineering and Engineering Mechanics, and Forest Resources and Environmental Science departments. Faculty, staff and students are open to collaborating on research projects and joining together for research symposiums, seminars and conferences. Working together helps to achieve their common goal: the advancement of biotechnology. <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: Larry Sutter**

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.

5.0 SFI Publications

Books

2012, "The Great Lake Sturgeon", editors: Auer, N., Dempsey, D., MSU press, Lansing, MI, *Accepted*.

, 2011, "Sediment Dynamics upon Dam Removal", American society of Civil Engineers (ASCE), REston, VA, *Published*.

, 2011, "Readings in American Socioeconomic Institutions", editors: Solomon, B., Gale, W., Pearson, Boston, *Published*.

Caneba, Gerard T., Yadunandan, Dar, , 2011, "Emulsion Free-Radical Retrograde-Precipitation Polymerization (EFRPP) and Related Topics", editors: Caneba, G., Springer-Verlag, Heidelberg, 193, *Published*.

Halvorsen, Kathleen E., , 2011, "NRC-NAS Committee on Economic and Environmental Impacts of Increasing Biofuels Production (Lave, L.B. (chair), I.C. Burke (co-chair), W.E. Tyner (co-chair), V.H. Dale, K.E. Halvorsen, J.D. Hill, S.R. Kaffka, K.C. Klasing, S.J. McGovern, J.A. Miranowski, A. Patrinos, J.L. Schnoor, D.R. Schweikhardt, T.L. Selfa, B.L. Sohngen, and J.A. Soria). 2011. Renewable Fuel Standard: Potential Economic and Environmental Effects of U.S. Biofuel Policy. Natural Research Council of the National Academies.", *Published*.

Hand, David W., 2012, "Water Treatment: Principles and Design - MWH", Water Treatment: Principles and Design - MWH, John Wiley & Sons, New York, NY, No. 3rd Edition, *Published*.

MacLennan, Carol A., 2011, "Sovereign Sugar: Industry and Environment in Hawai'i", University of Hawai'i Press, Honolulu, Hawai'i, *Accepted*.

Roberts, Mark C., Nelson, Paul A., Gale, James R., 2011, "Economic Decision Analysis, Fourth Edition, 2011", editors: Roberts, M., Pearson Custom Publishing, Boston, MA, 228, ISBN/ISSN 1-256-08599-7, *Published*.

Book Chapters

- 2011, "Y. Cai and X.Y. Zheng, "Towards Energy Efficient Web Server Clusters," Handbook of Energy-Aware and Green Computing, Chapman & Hall/CRC, 2011.", *Published*.
- Auer, Martin T., Auer, Nancy A., Barkdoll, Brian D., Bornhorst, Theodore J., Brooks, Collin, Dempsey, David, Doskey, Paul V., Green, Sarah A., Hyslop, Michael D., Kerfoot, W. Charles, Mayer, Alex S., Perlinger, Judith A., Shuchman, Robert A., Urban, Noel R., Watkins, David W., 2012, "Physical process in the Great Lakes", editors: Schnoor, J., The Great Lakes: Foundations and Perspectives for a Sustainable Future, Elsevier e-book, Maryland Heights, MO, *Accepted*.
- Auer, Nancy A., 2012, "Form and Function in Lake Sturgeon", editors: Auer, N., Dempsey, D., The Great Lake Sturgeon, MSU, Lansing, MI, *Accepted*.
- Auer, Nancy A., 2012, "Future Management and Stewardship of Lake Sturgeon", editors: Auer, N., Dempsey, D., The Great Lake Sturgeon, MSU, Lansing, MI, *Accepted*.
- Auer, Nancy A., Baker, Edward A., 2012, "Sturgeon Habitat, Foods and Feeding", editors: Auer, N., Dempsey, D., The Great Lake Sturgeon, MSU, Lansing, MI, *Accepted*.
- Bielefeldt, Angela R., Pearce, Joshua, 2012, "Service Learning in Engineering", Thomas H. Colledge (Ed), Convergence: Philosophies and Pedagogies for Developing the Next Generation of Humanitarian Engineers and Social Entrepreneurs, 24-52, *Published*.
- Branker, K., Pearce, Joshua, 2012, "Hybridizing Virtual- and Field-based Service Learning", Brian A. Nejmeh (Ed.) Service-Learning in the Computer & Information Sciences: Practical Applications in Engineering Education, *Published*.
- Chimner, Rodney A., Cooper, D.J., 2011, "Fens of the San Juan Mountains", editors: Chimner, R., Eastern San Juan Mountains, Colorado: Geology, Ecology and Human History, *Published*.
- Cooper, D.J., Chimner, Rodney A., Merritt, D.M., 2011, "Mountain Wetlands of North America", editors: Chimner, R., Wetland Habitats of North America: Ecology and Conservation Concerns, *Published*.
- Gorman, Hugh S., 2011, "Thinking in Cycles: Flows of Nitrogen and Sustainable Uses of the Environment", editors: Luebken, U., Uekotter, F., Managing the Unknown: Natural Reserves in Historical Perspective, *Accepted*.
- Hand, David W., 2012, "Chapter 10: Gravity Separation", Water Treatment: Principles and Design - MWH, John Wiley & Sons, New York, NY, No. 3rd Edition, *Published*.
- Hand, David W., 2012, "Chapter 14: Air Stripping and Aeration", Water Treatment: Principles and Design - MWH, John Wiley & Sons, New York, NY, No. 3rd Edition, *Published*.
- Hand, David W., 2012, "Chapter 16: Ion Exchange", editors: MWH, Water Treatment: Principles and Design - MWH, John Wiley & Sons, New York, NY, No. 3rd Edition, *Published*.
- Hand, David W., 2012, "Chapter 20: Removal of Selected Constituents", Water Treatment: Principles and Design - MWH, John Wiley & Sons, New York, NY, No. 3rd Edition, *Published*.
- Hand, David W., 2012, "Chapter 9: Coagulation and Flocculation", editors: MWH, Water Treatment: Principles and Design - MWH, John Wiley & Sons, New York, NY, No. 3rd Edition, *Published*.
- Huntoon, Jacqueline E., Dubiel, R.F., 2011, "Geologic Road Guide to the Shafer Trail, Island in the Sky District, Canyonlands National Park, Utah", Geologic Road, Trail, and Lake Guides to Utah Parks and Monuments: Utah Geological Association Publication, Vol. CD-ROM, *Published*.

- Huntoon, Jacqueline E., Stanesco, J D., Dubiel, R F., Dougan, J, 2011, "Geologic Trail Guide to the Sipapu Bridge Trail, Natural Bridges National Monument", Geologic Road, Trail, and Lake Guides to Utah Parks and Monuments: Utah Geological Association Publication, Vol. CD-ROM, *Published*.
- Kitalong, Karla M., 2011, "From Collision to Collaboration: A New Role for Project Evaluators in the Development of Interactive Media", editors: Bowdon, M., Carpenter, R., Higher Education, Emerging Technologies, and Community Partnerships: Concepts, Models, and Applications, IGI Global, *Published*.
- Li, Wenzhen, 2012, "Anode Catalysts for Low Temperature Fuel Cells", Advanced Materials for Fuel Cells, Wiley-VCH, *Published*.
- Mayer, Audrey L., 2012, "Principles of Sustainability from Ecology", editors: Cabezas, H., Diwekar, U., Sustainability: Multidisciplinary Perspectives, Bentham e-Books, *Published*.
- Mirchi, Ali, Madani, Kaveh, Roos, Maury, Watkins, David W., 2011, "Climate Change Impacts on California's Water Resources", editors: Schwabe, K., Drought in Arid and Semi-arid Regions: A Multi-disciplinary and Cross-Country Perspective, Springer Publishing, Dordrecht, *Accepted*.
- Mushtaq, Pearce, Joshua, 2012, "Open Source Appropriate Nanotechnology", editors: Maclurcan, Radywyl, Nanotechnology and Global Sustainability, CRC Press, 191-213, *Published*.
- Nguyen, Ha T., Pearce, Joshua, 2011, "Community-scale Wind-powered Desalination for Selected Coastal Mekong Provinces in Vietnam", M.A. Stewart and P.A. Coclanis (eds.), Environmental Change and Agricultural Sustainability in the Mekong Delta Advances in Global Change Research 2011, Vol. 45, 371-398, *Published*.
- Pearce, Joshua, 2012, "Open Source Appropriate Technology", Gupta, V. (Ed). The Future We Deserve: 100 Visions of the Future, 29-30, *Published*.
- Pearce, Joshua, 2012, "Solar Photovoltaic Energy Replication", Gupta, V. (Ed). The Future We Deserve: 100 Visions of the Future, 50-51, *Published*.
- Pypker, Thomas G., Levia, D F., Staelens, J, Van Stan, J T., 2011, "Chapter XVII. Canopy structure in relation to hydrological and biogeochemical fluxes", editors: Pypker, T., Forest Hydrology and Biogeochemistry: Synthesis of Past Research and Future Directions. Ecological Studies Series, Springer-Verlag, Heidelberg, Vol. 216, *Accepted*.
- Rogers, Tony N., Bulleit, W., Evensen, H., 2012, "Chapter 1 - Why Electrical Engineering?", Electrical Engineering: Concepts and Applications, Pearson Higher Education, Upper Saddle River, New Jersey, 1-12, ISBN/ISSN 0-13-253918-7, *Published*.
- Scarlett, Timothy J., Sweitz, Samuel R., 2011, "Constructing New Knowledge in Industrial Archaeology", editors: Harold Mytum, Global Perspectives on Archaeological Field Schools: Constructions of Knowledge and Experience, Springer, New York, NY, 119-146, ISBN/ISSN 1461404320, *Published*.
- Seely, Bruce E., 2011, "'Engineering Education'", editors: William Sims Bainbridge, Leadership in Science and Technology: A Reference Handbook, Sage Publications, Inc., Thousand Oaks, CA, Vol. 2, 833-41, *Published*.
- Solomon, Barry D., Heiman, Michael K., 2012, "Integrity of the Emerging Global Markets in Greenhouse Gases", editors: Aspinall, R., Geography of Climate Change, Routledge, London, *Published*.
- Wallner, Thomas, Miers, Scott A., 2012, "Alternative Fuels for Internal Combustion Engines", Encyclopedia of Sustainability Science and Technology, Springer Science+Business Media, *Published*.

Journal Articles

- , 2011, "X.Y. Zheng and Y. Cai, "Energy-aware Load Dispatching in Geographically Located Internet Data Centers," *Green Computing: Informatics and Systems, 2011*", *Published*.
- , 2011, "X.Y. Zheng and Y. Cai, "Optimal Server Allocation and Frequency Modulation on Multi-core Based Server Clusters," *International Journal of Green Computing*, vol. 1, no. 2, pp. 18-30, 2011.", *Published*.
- Y. Cai., "Mobile Agent based Network Defense System in Enterprise Network," *International Journal of Handheld Computing Research*, vol. 2, no. 1, pp. 41-54, 2011.", *Published*.
- "Measurement of Contact Resistance of Multiwall Carbon Nanotubes by Electrical Contact Using a Focused Ion Beam", editors: Libao, A., Friedrich, C., *Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms*, Vol. 272, 169-172, *Published*.
- Anameric, Basak, Kawatra, Surendra K., 2011, "Shrinking Core Model for Pig Iron Production", editors: Kawatra, S., *Minerals and Metallurgical Processing*, Vol. 28, No. No. 1, 24-32, *Published*.
- Andrews, R., Pearce, Joshua, 2011, "Environmental and Economic Assessment of a Greenhouse Waste Heat Exchange", *Journal of Cleaner Production*, Vol. 19, 1446-1454, *Published*.
- Andrews., Rob, Pollard, Andrew, Pearce, Joshua, 2012, "Improved parametric empirical determination of module short circuit current for modelling and optimization of solar photovoltaic systems", *Solar Energy*, *Published*.
- Ayele Bekele, T., Gailing, Oliver, Finkeldey, R., 2011, "Conservation genetics of *Hagenia abyssinica* (Bruce) J.F. Gmel: a remarkable but gravelyendangered tropical tree species", *Journal for Nature Conservation*, Vol. 19, 8-17, *Published*.
- Baechler, Christian, DeVuono, Matthew, Pearce, Joshua, 2012, "Distributed Recycling of Waste Polymer into RepRap Feedstock", *Rapid Prototyping Journal*, *Published*.
- Baron, Colbert, You, Zhanping, 2012, "Properties of Modified Asphalt Binders Blended with Electronic Waste Powders", *Journal of Materials in Civil Engineering*, American Society of Civil Engineers, United States, ISBN/ISSN 0899-1561, *Published*.
- Baron, Colbert, You, Zhanping, 2012, "The Determination of Mechanical Performance of Laboratory Produced Hot Mix Asphalt Mixtures Using Controlled RAP and Virgin Aggregate Size Fractions", *Construction and Building Materials*, Construction and Building Materials, England, 655-662, ISBN/ISSN 0950-0618, *Published*.
- Baron, Colbert, You, Zhanping, 2012, "The Properties of Asphalt Binder Blended with Variable Quantities of Recycled Asphalt Using Short Term and Long Term Aging Simulations", *Construction and Building Materials*, Construction and Building Materials, England, 552-557, ISBN/ISSN 0950-0618, *Published*.
- Bjarnadottir, Sigridur, Li, Yue, Stewart, Mark G., 2012, "Hurricane Risk Assessment of Power Distribution Poles Considering Impacts of A Changing Climate", *Journal of Infrastructure Systems*, ASCE, Reston, VA, *Published*.
- Bjarnadottir, Sigridur, Li, Yue, Stewart, Mark G., 2012, "Risk-Based Economic Assessment of Mitigation Strategies for Power Distribution Poles Subjected to Hurricanes", *Journal of Structural and Infrastructure Engineering*, *Published*.
- Branker, Pathak., Pearce, Joshua, 2011, "A Review of Solar Photovoltaic Levelized Cost of Electricity", *Renewable & Sustainable Energy Reviews*, Vol. 15, 4470-4482, *Published*.
- Branker, K., Shackles, E., Pearce, Joshua, 2011, "Peer-to-Peer Financing Mechanisms to Accelerate Renewable Energy Deployment", *The Journal of Sustainable Finance & Investment*, Vol. 1, No. 2, 138-155, *Published*.

- Breffle, William S., Morey, E. R., Thacher, J., 2011, "A joint latent-class model: combining Likert-scale preference statements with choice data to harvest preference heterogeneity", *Environmental and Resource Economics*, Vol. 50, 83-110, *Published*.
- Burton, Andrew J., Jarvey, Julie C., Jarvi, Mickey P., Zak, Donald R., Pregitzer, Kurt S., 2012, "Chronic N deposition alters root respiration-tissue N relationship in northern hardwood forests", *Global Change Biology*, Vol. 18, No. 1, 258-266, *Published*.
- Carlson, Joshua J., Kawatra, Surendra K., 2011, "Effects of CO₂ on the Zeta Potential of Hematite", editors: Kawatra, S., *International Journal of Mineral Processing*, Vol. 28, No. No. 1-2, 8-14, *Accepted*.
- Cheam, Daw Don, Walczak, K., Acharya, M., Friedrich, Craig R., Bergstrom, Paul L., 2011, "Leakage Current in Single Electron Device due to Implanted Gallium Dopants by Focused Ion Beam", *Microelectronic Engineering*, Vol. 88, No. 8, 1906-1909, *Published*.
- Chou, Chiung-Wen, Seagren, Eric A., Aydilek, Ahmet H., Lai, Michael, 2011, "Biocalcification of sand through ureolysis", *Journal of Geotechnical and Geoenvironmental Engineering (ASCE)*, American Society of Civil Engineers, Reston, VA, *Published*.
- Clarke-Sather, Afton E., Solomon, Barry D., 2012, "Grantocracy: Conservation Grant-Making and the Territorialization of Neoliberalism in Michigan's Keweenaw Peninsula", *Geoforum*, Oxford, Vol. 43, No. 1, 68-80, *Published*.
- Cooke, Colin A., Balcom, Prentiss H., Kerfoot, W. Charles, Abbott, Mark B., Wolfe, Alexander P., 2011, "Pre-Columbian Mercury Pollution with the Smelting of Argentiferous Ores in the Bolivian Andes", *AMBIO*, Vol. 40, 18-25, *Published*.
- Dai, Qingli, , 2012, "Investigation of Electromechanical Properties of Piezoelectric Structural Fiber Composites with Micromechanics Analysis and Finite Element Modeling", editors: Ng, K., *Mechanics of Materials*, *Accepted*.
- Dai, Qingli, Ng, k, Zhou, J, Kreiger, E L., Ahlborn, Theresa M., 2012, "Damage Investigation of Single-Edge Notched Beam Tests with Normal Strength Concrete and Ultra High Performance Concrete Specimens using Acoustic Emission Techniques", *Construction and Building Materials*, Elsevier, Vol. 31, 231-242, *Published*.
- Dai, Qingli, Yu, X, Ng, K, Liu, Z, 2011, "Development of Micromechanics Models and Innovative Sensor Technologies to Evaluate Internal-Frost Damage of Concrete", *Journal of the Transportation Research Board*, National Academies, Vol. 2240, 50-58, *Published*.
- Dai, Qingli, 2011, "A Three-Dimensional Micromechanical Finite Element Network Model for Damage-Coupled Elastic Behavior of Stone-Based Composite Materials", editors: Dai, Q., *ASCE Journal of Engineering Mechanics*, ASCE, Virginia, Vol. 137, No. 6, 410-421, *Published*.
- Darbah, Joseph N. T., Jones, Wendy S., Burton, Andrew J., Nagy, John, Kubiske, Mark E., 2011, "Acute O₃ damage on first year coppice sprouts of aspen and maple sprouts in an open-air experiment", *Journal of Environmental Monitoring*, Vol. 13, No. 9, 2436-2442, *Published*.
- Darrell, Cass, Mukherjee, Amlan, 2011, "Calculation of Greenhouse Gas Emissions Associated with Highway Construction Projects", *Journal of Construction Engineering and Management*, ASCE, Vol. 137, No. 11, 1016-1025, *Published*.
- Dawdy, David R., Griffis, Veronica W., Gupta, Vijay K., 2012, "Regional flood frequency analysis: how we got here and where we are going", *Journal of Hydrologic Engineering*, *Accepted*.

- Dawney, B., Pearce, Joshua, 2012, "Optimizing Solar Water Disinfection (SODIS) Method by Decreasing Turbidity with NaCl", *The Journal of Water, Sanitation, and Hygiene for Development*, Vol. 2, No. 2, 87-94, *Published*.
- De Moraes, Sandra, Kawatra, Surendra K., 2011, "Laboratory Study of an Organic Binder for Pelletization of Magnetite Concentrate", editors: Kawatra, S., *Minerals and Metallurgical Processing*, Vol. 27, No. 3, 148-153, *Published*.
- Denkenberger, David, Brandemuehl, Michael, Pearce, Joshua, Zhai, John, 2012, "Expanded microchannel heat exchanger: design, fabrication and preliminary experimental test", *Proceedings of the Institution of Mechanical Engineers – Part A: Journal of Power and Energy*, Vol. 226, 532-544, *Published*.
- Derero, A., Gailing, Oliver, Finkeldey, R., 2011, "Maintenance of genetic diversity in *Cordia africana* Lam., a declining forest tree species in Ethiopia.", *Tree Genetics and Genomes*, Vol. 7, 1-9, *Published*.
- Ding, Xiaochu, Richter, Dana L., Matuana, Laurent, Heiden, Patricia A., 2011, "Efficient One-Pot Synthesis and Loading of Self-Assembled Amphiphilic Chitosan Nanoparticles for Low-Leaching Wood Preservation", editors: Heiden, P., *Carbohydrate Polymers*, Vol. 86, No. 1, 58-64, *Published*.
- Donofrio, Robert, Saha, Ratul, Besterveldt, Lori, Bagley, Susan T., 2012, "Molecular cloning of *Brevundimonas diminuta* for efficacy assessment of reverse osmosis devices", *Journal of Water and Health*, Vol. 10, No. 2, 278-287, *Published*.
- Ekue, Marius, Gailing, Oliver, Vornam, Barbara, Finkeldey, Reiner, 2011, "Assessment of the domestication state of ackee (*Blighia sapida* K.D. Koenig) in Benin based on AFLP and microsatellite markers", editors: Gailing, O., *Conservation Genetics*, Vol. 12, 475-489, *Published*.
- Fatima H., Pearce, Joshua, 2011, "Viability of Small-Scale Arsenic-Contaminated Water Purification Technologies for Sustainable Development in Pakistan", *Sustainable Development*, Vol. 19, No. 4, 223-234, *Published*.
- Fini, E. H., , 2011, "Bio-Binder from Swine Manure: A Sustainable Modifier for Asphalt Binder", editors: You, Z., *American Society of Civil Engineers (ASCE)*, Vol. 23, No. 11, 1506-1513, *Published*.
- Fini, Elham H., Al-Qadi, Imad, You, Zhanping, 2011, "Partial replacement of asphalt binder with bio-binder: characterisation and modification", *International Journal of Pavement Engineering*, *international Journal of Pavement Engineering*, *Published*.
- Fuchs, Valerie J., Gierke, John S., Mihelcic, James R., 2012, "Laboratory investigation of ammonium and nitrate removal in vertical flow regimes in planted and unplanted wetland columns", editors: Joel Burken, Assoc. Editor, *Journal of Environmental Engineering*, *American Society of Civil Engineers*, *Accepted*.
- Geng, X, Patel, P, Narain, Amitabh, Meng, Desheng, 2011, "A Self-Adaptive Thermal Switch Array for Rapid Temperature Stabilization under Various Thermal Power Inputs", *J. Micromech. Microeng.*, Vol. 21, 085018, *Published*.
- Ghimire, Santosh, Watkins, David W., Li, Ke, 2011, "Life Cycle Cost Assessment of a Rain Water Harvesting System for Toilet Flushing", *Water Science and Technology: Water Supply*, *Accepted*.
- Goh, Shu Wei, You, Zhanping, 2012, "Effect of deicing solutions on the tensile strength of micro- or nano-modified asphalt mixture", *Construction and Building Materials*, 195–200, *Published*.
- Goh, Shuwei, You, Zhanping, 2012, "Mechanical Properties of Porous Asphalt Pavement Materials with Warm Mix Asphalt and RAP", *ASCE Journal of Transportation Engineering*, *American Society of Civil Engineers, United States*, 90-97, *Published*.

- Gregoire, Kyla, Becker, Jennifer G., 2012, "Design and characterization of a microbial fuel cell for the conversion of a lignocellulosic crop residue to electricity", *Bioresource Technology*, Elsevier, *Accepted*.
- Gyawali, Rabi, Watkins, David W., 2012, "Continuous Hydrologic Modeling of Snow-Affected Watersheds in the Great Lakes Basin Using HEC-HMS", *Journal of Hydrologic Engineering*, American Society of Civil Engineers, Reston, VA, *Accepted*.
- Halt, Joseph A., Kawatra, Surendra K., 2011, "Biding Effects in Hematite and Magnetite Concentrates", editors: Kawatra, S., *International Journal of Mineral Processing*, *Accepted*.
- Harless, M L., Huckins, Casey J., Grant, J B., Pypker, Thomas G., 2011, "Effects of six chemical deicers on larval wood frogs", editors: Pypker, T., *Environmental Toxicity and Chemistry*, *Published*.
- Haskell, Dan, Flaspohler, David J., Meyer, Michael, Webster, Christopher R., 2012, "Variation in plant survival in shoreline restoration plots as a function of woody additions", *Restoration Ecology*, USA, Vol. 20, 113-121, *Published*.
- Henareh Khalyani, Azad, Falkowski, Michael J., Mayer, Audrey L., 2011, "Classification of Landsat images based on spectral and topographic variables for land cover change detection in Zagros forests", *International Journal of Remote Sensing*, Vol. 33, No. 21, 6956-6974, *Accepted*.
- Huntoon, Jacqueline E., Engelmann, Carol C., 2011, "Improving student learning by addressing misconceptions", *EOS Transactions of the American Geophysical Union*, *Published*.
- Huntoon, Jacqueline E., Wojick, Christopher L., 2011, "Rock-solid schooling, teaching teachers in the field", editors: Huntoon, J., *In the Trenches*, Vol. 1, No. 2, 1-4, *Published*.
- Huntoon, Jacqueline E., Wojick, Christopher L., 2011, "Rock-solid schooling, teaching teachers in the field", *In the Trenches*, *Published*.
- Hur, J. I., Meng, Desheng, Kim, C. -J., 2012, "Self-Pumping membraneless miniature fuel cell with an air-breathing cathode", *Journal of Microelectromechanical Systems*, Vol. 21, 476-83, *Published*.
- Hurley, Peter, Webster, Christopher R., Flaspohler, David J., Parker, George, 2012, "Untangling the landscape of deer overabundance: Reserve size vs. landscape context in the agricultural Midwest", *Biological Conservation*, UK, Vol. 146, 62-71, *Published*.
- Johnson, Dana M., Sanders, Nada R., 2011, "Benchmarking: Success Producer or Failure Preventer", *International Journal of Business Excellence*, UK, *Accepted*.
- Johnson, Dana M., Jenkins, Timothy L., Zhang, FEngli, 2012, "Methods for Optimally Locating a Forest Biomass-to-Biofuel Facility", *Biofuels*, United Kingdom, Vol. 3, No. 4, 489-503, *Accepted*.
- Johnson, Dana M., 2011, "Teaching Effectiveness as Measured by Student Evaluation of Teaching (SET): An Empirical Study", *International Journal of Information and Operations Management Education*, Vol. 4, No. 3/4, 212-228, *Published*.
- Johnson, J, Naber, Jeffrey D., Lee, Seong-Young, 2012, "Characterizing Diesel Fuel Spray Cone Angle from Back-Scattered Imaging by Fitting Gaussian Profiles to Radial Spray Intensity Distributions", editors: Johnson, J., GTP-11-1349, *Journal of Engineering for Gas Turbines and Power*, *Published*.
- Keating, S., Urquhart, M. G., McLaughlin, D. V.P., Pearce, Joshua, 2011, "Effects of Substrate Temperature on Indium Gallium Nitride Nanocolumn Crystal Growth", *Crystal Growth & Design*, Vol. 11, No. 2, 565-568, *Published*.
- Kerfoot, W. Charles, Yousef, Foad, Green, Sarah A., Regis, Robert S., Shuchman, Robert, Brooks, Colin N., Sayers, Mike, Sabol, Bruce, Graves, Mark, 2012, "Light detection and ranging (LiDAR) and multispectral

studies of disturbed Lake Superior coastal environments", *Limnology and Oceanography*, doi:10.4319/lo.2012.57.3.0749, Vol. 57, No. 3, 749-71, *Published*.

Kerfoot, W. Charles, Yousef, Foad, Green, Sarah A., Regis, Robert, Shuchman, Robert A., Brooks, Colin N., Sayers, Michael, Sabol, Bruce, Graves, Mark, 2012, "Light Detection and Ranging (LiDAR) and Multispectral Studies of Disturbed Lake Superior Coastal Environments", *Limnology and Oceanography*, *Limnology and Oceanography*, Vol. 57, No. 3, 749-771 doi:10.4319/lo.2012.57.3.0749, *Published*.

Kerfoot, W. Charles, Yousef, Foad, Hobmeier, Martin M., Maki, Ryan P., Jarnagin, S T., Churchill, James H., 2011, "Temperature, Recreational Fishing and Diapause Egg Connections: Dispersal of Spiny Water Fleas (*Bythotrephes longimanus*)", *Biological Invasions*, *Biological Invasions*, No. 13, 2513-2531 doi 10.1007/s10530-011-0078-8, *Published*.

Kim, Suyeon, Kim, Yeon-Ok, Lee, Yongjik, Choie, Inseong, Joshi, Chandrashekhar P., Lee, Kyehan, Bae, Hyeun-Jong, 2012, "Transgenic poplar as an efficient bioreactor system for the production of xylanase", *Bioscience, Biotechnology, and Biochemistry*, *Accepted*.

King, Julia A., Via, Michael D., Morrison, Faith A., Wiese, Kyle R., Beach, Edsel A., Cieslinski, Mark J., Bogucki, Gregg R., 2012, "Characterization of Exfoliated Graphite Nanoplatelet/Polycarbonate Composites: Electrical and Thermal Conductivity, and Tensile, Flexural, and Rheological Properties", editors: King, J., *Journal of Composite Materials*, Vol. 46, No. 9, 1029-1039, *Published*.

King, Julia A., Via, Michael D., Mills, Owen P., Alpers, Daniel S., Sutherland, John W., Bogucki, Gregg R., 2012, "Effects of Multiple Fillers on the Electrical and Thermal Conductivity and Tensile and Flexural Modulus of Polycarbonate Based Resins", editors: King, J., *Journal of Composite Materials*, Vol. 46, No. 3, 331-350, *Published*.

King, Julia A., Via, Michael D., King, Michelle E., Miskioglu, Ibrahim, Bogucki, Gregg R., 2011, "Electrical and Thermal Conductivity and Tensile and Flexural Properties: Comparison of Carbon Black/Polycarbonate and Carbon Nanotube/Polycarbonate Resins", *Journal of Applied Polymer Science*, Vol. 121, No. 4, 2273-2281, *Published*.

Kohlmeyer, Ryan R., Lor, Maika, Deng, Jian, Liu, Haiying, , 2011, "Preparation of stable carbon nanotube aerogels with high electrical conductivity and porosity", editors: Chen, J., *Carbon*, Vol. 49, 2352-2361, *Published*.

Lemmens, R, Meng, Desheng, 2011, "A Comparative Study on Bubble-Driven Micropumping in Microchannels with Square and Circular Cross Sections", *Sensors and Actuators A: Physical*, Vol. 169, *Published*.

Li, Yue, van de Lindt, John w., 2012, "Loss-Based Formulation for Multiple Hazards with Application to Residential Buildings", *Engineering Structures*, Elsevier, Vol. 38, No. 1, 123-133, *Published*.

Li, Yue, Aakash A., Padgett, Jamie, , 2012, "A Review of Methods to Assess, Design for, and Mitigate Multiple Hazards", *Journal of Performance of Constructed Facilities*, ASCE, Reston, VA, Vol. 26, No. 1, 104-117, *Published*.

Li, Yue, 2012, "Assessment of Damage Risks to Residential Buildings and Cost-Benefit of Mitigation Strategies Considering Hurricane and Earthquake Hazards", editors: Li, Y., *Journal of Performance of Constructed Facilities*, ASCE, Reston, VA, Vol. 26, No. 1, 104-117, *Published*.

Li, Yue, van de Lindt, John W., Dao, Thang, Bjarnadottir, Sigridur, Ahuja, Aakash, 2012, "Loss Analysis for Combined Wind and Surge in Hurricanes", *Natural Hazards Review*, ASCE, Reston, VA, Vol. 13, No. 1, 1-10, *Published*.

- Litzinger, T, Lee, Seong-Young, 2011, "Fuel Additive Effects on Soot across a Suite of Laboratory Devices, Part 2: Nitroalkanes", editors: Lee, S.-Y., *Combustion Science and Technology*, Vol. 183, No. 8, 739-754, *Published*.
- Liu, Y, You, Zhanping, Dai, Qingli, Mills-Beale, J, 2011, "Review of advances in understanding impacts of mix composition characteristics on asphalt concrete (AC) mechanics", *International Journal of Pavement Engineering*, 385-405, *Published*.
- Mayer, Audrey L., Henareh Khalyani, Azad, 2011, "Grass trumps trees with fire", *Science*, Vol. 334, No. 6053, 188-189, *Published*.
- Mayer, Audrey L., Shuster, William D., Beaulieu, Jake J., Hopton, Matthew E., Rhea, Lee K., Roy, Allison H., Thurston, Hale W., 2011, "Building green infrastructure via citizen participation - a six-year study in the Shepherd Creek (Ohio, USA)", *Environmental Practice*, Vol. 14, No. 1, 57-67, *Accepted*.
- McDonald, Cory P., Bennington, Val, Urban, Noel R., McKinley, Galen A., 2012, "1-D test-bed calibration of a 3-D Lake Superior biogeochemical model", *Ecological Modeling*, Elsevier, Vol. 225, No. 1, 115-126, *Published*.
- McDonald, Nicole C., Pearce, Joshua, 2012, "Renewable Energy Policies and Programs in Nunavut: Perspectives from the Federal and Territorial Government", *Arctic*, *Published*.
- McLaughlin, Dirk V., Pearce, Joshua, 2012, "Analytical Model for the Optical Functions of Indium Gallium Nitride with Application to Thin Film Solar Photovoltaic Cells", *Materials Science and Engineering: B*, Vol. 177, 239-244, *Published*.
- Mellor, Jonathon, Watkins, David W., Mihelcic, James, 2012, "Rural Water Usage in East Africa: Does Collection Effort Really Impact Basic Access", *Waterlines*, *Accepted*.
- Mirchi, Ali, Madani, Kaveh, Watkins, David W., Ahmed, Sajjad, 2012, "Synthesis of System Dynamics Tools for Holistic Conceptualization of Water Resources Problems", *Water Resources Management*, *Accepted*.
- Mirchi, Ali, Watkins, David W., 2012, "A systems approach to holistic TMDL policy: The case of Lake Allegan, Michigan", *Journal of Water Resources Planning and Management*, American Society of Civil Engineers, Reston, VA, *Accepted*.
- Morar, Doina L., Aydilek, Ahmet H., Seagren, Eric A., Demirkan, M. M., 2011, "Leaching of metals from fly ash-amended permeable reactive barriers", *Journal of Environmental Engineering (ASCE)*, American Society of Civil Engineers, Reston, VA, *Accepted*.
- Morsi, Samir M., Pakzad, Anahita, Amin, Amal, Yassar, Reza, Heiden, Patricia, 2011, "Chemical and Nanomechanical Analysis of Rice Husk Modified by ATRP-Grafted Oligomer", editors: Heiden, P., *Journal of Colloid and Interface Science*, *Published*.
- Mostofi, M., Nosrat, A. H., Pearce, Joshua, 2011, "Institutional-Scale Operational Symbiosis of Photovoltaic and Cogeneration Energy Systems", *International Journal of Environmental Science and Technology*, Vol. 8, No. 1, 31-44, *Published*.
- Ng, K, Dai, Qingli, 2012, "Tailored Extended Finite-Element Model for Predicting Crack Propagation and Fracture Properties within Idealized and Digital Cementitious Material Samples", *Journal of Engineering Mechanics*, ASCE, Vol. 138, No. 1, 89-100, *Published*.
- Ng, K, Dai, Qingli, 2011, "Investigation of Fracture Behavior of Heterogeneous Infrastructure Materials with EXtended Finite Element Method and Image Analysis", editors: Dai, Q., *Journal of Materials in Civil Engineering*, ASCE, Vol. 23, No. 12, *Published*.

- Nguyen, Ha T., Pearce, Joshua, 2012, "Incorporating Shading Losses in Solar Photovoltaic Potential Assessment at the Municipal Scale", *Solar Energy*, Vol. 86, No. 5, 1245–1260, *Published*.
- Nguyen, Ha T., Pearce, Joshua, Harrap, Rob, Barber, Gerald, 2012, "The Application of LiDAR to Assessment of Rooftop Solar Photovoltaic Deployment Potential on a Municipal District Unit", *Sensors*, Vol. 12, 4534-4558, *Published*.
- Nizzetto, L, Perlinger, Judith A., 2012, "Climatic, biological and land cover controls on the exchange of gas-phase semivolatile chemical pollutants between air and forest canopies", *Environ. Sci. Technol.*, Vol. 46, 2699-2707, *Published*.
- Nosrat, Amir, Pearce, Joshua, 2011, "Dispatch Strategy and Model for Hybrid Photovoltaic and Combined Heating, Cooling, and Power Systems", *Applied Energy*, Vol. 88, 3270–3276, *Published*.
- Pandey, Madhav, Gailing, Oliver, Hattemer, Hans, Finkeldey, Reiner, 2012, "Spatial genetic structure of sycamore maple (*Acer pseudoplatanus* L.)", *European Journal of Forest Research*, Vol. 131, 739-746, *Published*.
- Park, S, van de Lindt, John w., Li, Yue, 2012, "ABV Procedure for Combined Wind and Surge Loss Estimation in Hurricanes PBE for wind and surge", *Structural Safety*, Elsevier, *Published*.
- Pathak, M., Rubinelli, F., Pearce, Joshua, 2011, "The Viability of Spectral Splitting for the Reduction of Recombination Losses in Multi-Bandgap Solar Photovoltaic Devices", *Photons*, Vol. 9, No. 1, 53-55, *Published*.
- Pathak, M. J., Pearce, Joshua, Harrison, S. J., 2012, "Effects on Amorphous Silicon Photovoltaic Performance from High-temperature Annealing Pulses in Photovoltaic Thermal Hybrid Devices", *Solar Energy Materials and Solar Cells*, Vol. 100, 199-203, *Published*.
- Patterson, Sierra L., Zak, Donald R., Burton, Andrew J., Talhelm, Alan F., Pregitzer, Kurt S., 2012, "Simulated N deposition negatively impacts sugar maple regeneration in a northern hardwood ecosystem", *Journal of Applied Ecology*, Vol. 49, No. 1, 155-163, *Published*.
- Paul, Devproshad K., Fraser, Andrew, Pearce, Joshua, Karan, Kunal, 2011, "Understanding the Ionomer Structure and the Proton Conduction Mechanism in PEFC Catalyst Layer: Adsorbed Nafion on Model Substrate", *ECS Transactions*, Vol. 41, No. 1, 1393-1406, *Published*.
- Pearce, Joshua, 2012, "Effective Techniques for Achieving a Solar-Powered Campus", *Proceedings of the 9th Ball State University Greening of the Campus Conference*, 18-21, *Published*.
- Pearce, Joshua, Albritton, Scott, Grant, Gabriel, Steed, Garrett, Zelenika, Ivana, 2012, "Enabling Innovation in Appropriate Technology for Sustainable Development", *Sustainability: Science, Practice & Policy*, *Published*.
- Pearce, Joshua, 2012, "The Case for Open Source Appropriate Technology", *Environment, Development and Sustainability*, Vol. 14, 425–431, *Published*.
- Pearce, Joshua, 2012, "What Hackers Can Teach Academics: Open Source Research in Applied Sustainability", *Proceedings of the 9th Ball State University Greening of the Campus Conference*, 18-21, *Published*.
- Poonamallee, Latha C., , 2012, "Corporate Citizenship: Panacea or Problem? - The Complicated Case of Hindustan Unilever", editors: Poonamallee, L., *The Journal of Corporate Citizenship*, Greenleaf Publishing, USA, *Published*.
- Poonamallee, Latha C., 2011, "Transforming Realities: Reclamation of the Sacred as a source of Generative Capacities – a new theory of organizational change", *Journal of Management Inquiry*, Sage, CA, Vol. 20, No. 3, 242-262, *Published*.

- Ray, Patrick A., Kirshen, Paul K., Watkins, David W., 2011, "Stochastic Programming for Staged Climate Change Adaptation Planning for Amman, Jordan", *Journal of Water Resources Planning and Management*, American Society of Civil Engineers, Reston, VA, *Accepted*.
- Rivera, Julio L., Seely, Bruce E., John, Sutherland W., 2012, "Societal implications of nanotechnology: occupational perspectives", *Environment, Development and Sustainability*, Springer, *Accepted*.
- Robles, Agustin, Enrique, Vivoni, Mayer, Alex S., 2012, "Distributed Hydrologic Modeling in Northwest Mexico Reveals the Links between Runoff Mechanisms and Evapotranspiration", *Journal of Hydrometeorology*, Vol. 13, No. 3, 785-807, *Published*.
- Robles-Morua, A., Mayer, Alex S., Auer, Martin T., Vivoni, E., 2012, "Modeling riverine pathogen fate and transport in Mexican rural communities and its public health implications", *Journal of Environmental Management*, *Accepted*.
- Romero, Pearce, Joshua, et al., 2011, "DESARROLLO DE UN SISTEMA DE MONITOREO DE RADIACIÓN SOLAR BASADO EN UN ESPECTRÓMETRO DE AMPLIO ESPECTRO", *INVESTIGACIÓN & DESARROLLO*, Vol. 11, 73 – 84, *Published*.
- Rowe, M D., Perlinger, Judith A., , 2012, "Micrometeorological measurements of hexachlorobenzene and polychlorinated biphenyl compound air-water gas exchange in Lake Superior", *Atmos. Chem. Phys.*, *Atmos. Chem. Phys.*, Vol. 12, 4607-4617, *Published*.
- Rowe, M D., Fairall, C F., Perlinger, Judith A., 2011, "Chemical sensor resolution requirements for near-surface measurements of turbulent fluxes", *Atmos. Chem. Phys.*, Vol. 11, 5263-5275, *Published*.
- Rowe, Mark D., Perlinger, Judith A., Fairall, Christopher W., 2011, "A Lagrangian model to predict modification of near-surface scalar mixing ratios and air-water exchange fluxes in offshore flow", *Boundary-Layer Meteorol.*, Elsevier, Vol. 140, 87-103, *Published*.
- Santhanagopalan, S, Balram, A, Lucas, E, Marcano, F, Meng, Desheng, 2012, "High Voltage Electrophoretic Deposition of Aligned Nanoforests for Scalable Nanomanufacturing of Electrochemical Energy Storage Devices", *Key Engineering Materials*, Vol. 507, 67-72, *Published*.
- Santhanagopalan, S, Balram, A, Meng, Desheng, 2012, "Scalable Redox Capacitors with Aligned Nanoforests of Crystalline MnO₂ Nanorods by High Voltage Electrophoretic Deposition", *Published*.
- Seagren, Eric A., Davis, Allen P., 2011, "Integrating fundamental science and engineering concepts into a civil engineering sustainability course", *Journal of Professional Issues in Engineering Education and Practice (ASCE)*, American Society of Civil Engineers, Reston, VA, Vol. 137, No. 4, 183-188, *Published*.
- Seely, Bruce E., 2012, ""Pan American Highway: Roads and Politics"", *Routes-Roads*, France, *Accepted*.
- Seely, Bruce E., 2011, ""Der Pan American Highway – eine Straße zwischen zwei Kontinenten,"", *Zeitschrift für Weltgeschichte*, Germany, Vol. 12.2, 141-73, *Published*.
- Sertse, D., Gailing, Oliver, Eliades, N.G., Finkeldey, R., 2011, "Anthropogenic and natural causes influencing population genetic structure of *Juniperus procera* Hochst. ex Endl. in the Ethiopian highlands", *Genetic Resources and Crop Evolution*, *Published*.
- Shi, Xianming, Goh, Shuwei, M., Akin, S., Stevens, You, Zhanping, 2011, "Exploring the Interactions of Chloride Deicer Solutions with Nano/Micro-modified Asphalt Mixtures Using Artificial Neural Networks", *ASCE Journal of Materials in Civil Engineering*, American Society of Civil Engineers, United States, *Published*.

- Shin, D.H., Shokuhfar, T., Choi, Chang K., Lee, Seong-Young, Friedrich, Craig R., 2011, "Time Dependent Wettability Changes of TiO₂ Nanotubes", *Nanotechnology*, *Published*.
- Shonsey, Cara W., Gierke, John S., 2012, "Quantifying Available Water Supply in Rural Mali Based on Data Collected by and from Women Project", editors: Ed. D. Huisingh, Special Issue Assoc. Ed. Kathleen Kevany, *Journal for Cleaner Production - Special Issue on Water, Women, Waste, Wisdom and Wealth*, Elsevier, ISBN/ISSN 0959-6526, *Published*.
- Solomon, Barry D., Krishna, Karthik, 2011, "The Coming Sustainable Energy Transition: History, Strategies, and Outlook", *Energy Policy*, Oxford, Vol. 39, No. 11, 7422-7431, *Published*.
- Swanston, Chris, Burton, Andrew J., 2011, "Carbon in northern forests", *Forest Science*, Vol. 57, No. 6, 449-450, *Published*.
- Talhelm, Alan F., Pregitzer, Kurt S., Burton, Andrew J., Zak, Donald R., 2012, "Air pollution and the changing biogeochemistry of northern forests", *Frontiers in Ecology and the Environment*, *Published*.
- Talhelm, Alan F., Pregitzer, Kurt S., Burton, Andrew J., 2011, "No evidence that chronic nitrogen additions increase photosynthesis in mature sugar maple forests", *Ecological Applications*, Vol. 21, 2413-2424, *Published*.
- Tasdemir, Munir, Caneba, Gerard T., Wang, Bo, 2012, "Extrusion with Carbon Dioxide (CO₂) and Characterization of ABS/Mg (OH)₂/Nanoclay Composites", *International Journal of Polymeric Materials*, Taylor and Francis, London, Vol. 61, No. 2, 116-123, *Published*.
- Tasdemir, Munir, Caneba, Gerard T., Tiwari, Rajesh, Wang, Bo, 2011, "Characterization of /Clay/ Mg (OH)₂ Polymer Composites with Supercritical Carbon Dioxide", *The Journal Polymer-Plastics Technology and Engineering*, Vol. 50, 6 pages, *Published*.
- Tasdemir, Munir, Caneba, Gerard T., 2011, "Modification of Morphology of PS/LDPE/Mg (OH)₂ and PS/LDPE/SBS/ Mg (OH)₂ Polymer Composites with Supercritical CO₂", *Journal of Polymer Materials*, Vol. 28, 10 pages, *Published*.
- Via, Michael D., King, Julia A., Keith, Jason M., Miskioglu, Ibrahim, Cieslinski, Mark J., Anderson, Jonathan J., Bogucki, Gregg R., 2012, "Tensile Modulus Modeling of Carbon Black/Polycarbonate, Carbon Nanotube/Polycarbonate, and Exfoliated Graphite Nanoplatelet/Polycarbonate Composites", editors: King, J., *Journal of Applied Polymer Science*, Vol. 124, No. 3, 2269-2277, *Published*.
- Via, Michael D., King, Julia A., Keith, Jason M., Bogucki, Gregg R., 2012, "Electrical Conductivity Modeling of Carbon Black/Polycarbonate, Carbon Nanotube/Polycarbonate, and Exfoliated Graphite Nanoplatelet/Polycarbonate Composites", editors: King, J., *Journal of Applied Polymer Science*, Vol. 124, No. 1, 182-189, *Published*.
- Via, Michael D., Morrison, Faith A., King, Julia A., Beach, Edsel A., Wiese, Kyle R., Bogucki, Gregg R., 2012, "Effects of Multiple Fillers on the Rheology of Polycarbonate Based Composites", *Polymer Composites*, Vol. 33, No. 2, 306-316, *Published*.
- Via, Michael D., Morrison, Faith A., King, Julia A., Caspary, Jeffrey A., Mills, Owen P., Bogucki, Gregg R., 2011, "Comparison of Rheological Properties of Carbon Nanotube/Polycarbonate and Carbon Black/Polycarbonate Composites", *Journal of Applied Polymer Science*, Vol. 121, No. 2, 1040-1051, *Published*.
- Vornam, Barbara, Gailing, Oliver, Derory, Jeremy, Plomion, Christophe, Kremer, Antoine, Finkeldey, Reiner, , 2011, "Characterization and natural variation of a dehydrin gene in *Quercus petraea* (Matt.) Liebl.", editors: Gailing, O., *Plant Biology*, *Published*.

- Walczak, K. A., Bergstrom, Paul L., Friedrich, Craig R., 2011, "Light Sensor Platform Based on the Integration of Bacteriorhodopsin with a Single Electron Transistor", *Active and Passive Electronic Components*, Vol. 2011, *Published*.
- Wang, Hainian, You, Zhanping, 2012, "Laboratory Evaluation on High Temperature Viscosity and Low Temperature Stiffness of Asphalt Binder with High Percent Scrap Tire Rubber", *Construction and Building Materials*, ELSEVIER, 583–590, ISBN/ISSN 0950-0618, *Published*.
- Wei, Wenge, Watkins, David W., 2011, "Probabilistic Streamflow Forecasts Based on Hydrologic Persistence and", *Journal of Hydroinformatics*, IWA Publishing, Vol. 13, No. 4, *Published*.
- Wei, Wenge, Watkins, David W., 2011, "Data Mining Methods for Hydroclimatic Forecasting", *Advances in Water Resources*, Vol. 34, 1390-1400, *Published*.
- Whittinghill, Kyle A., Currie, William S., Zak, Donald R., Burton, Andrew J., Pregitzer, Kurt S., 2012, "Anthropogenic N deposition increases soil C storage by decreasing the extent of litter decay: analysis of field observations with a biogeochemical model", *Ecosystems*, *Accepted*.
- Xiao, Liangli, Li, Yue, Bulleit, William M., 2012, "Reliability Analysis on Shear Capacity of Reinforced Masonry Walls due to Earthquakes", *Journal of Applied Mechanics and Materials*, Vol. 105-107, 360-365, *Published*.
- Xiao, Zhihui, Jin, Shaohua, Wang, Xinkui, Li, Wenzhen, Wang, Junhua, Liang, Changhai, 2012, "Preparation, Structure and Catalytic Properties of Magnetically Separable Cu-Fe Catalysts for Glycerol Hydrogenolysis", *Journal of Materials Chemistry*, RSC, British, Vol. 22, 16598-16605, *Published*.
- Xin, Le, Zhang, Zhiyong, Qi, Ji, Chadderdon, David, Li, Wenzhen, 2012, "Electrocatalytic oxidation of ethylene glycol (EG) on supported Pt and Au nanoparticles in alkaline media: Reaction pathway investigation in three-electrode cell and fuel cell reactors", *Applied Catalysis B Environmental*, Elsevier, Netherland, Vol. 125, 85-94, *Published*.
- Xin, Le, Zhang, Zhiyong, Wang, Zhichao, Li, Wenzhen, 2012, "Simultaneous generation of mesoxalic acid and electricity from glycerol in anion exchange membrane fuel cell with Au anode catalyst", *ChemCatChem*, Wiley, Vol. 4, 1105-1114, *Published*.
- Yao, Hui, You, Zhanping, Li, Liang, Shi, Xianming, Goh, Shuwei, Mills-Beale, Julian, Wingard, David, 2012, "Performance of Asphalt Binder Blended with Non-Modified and Polymer-Modified Nanoclay", *Construction and Building Materials*, Construction and Building Materials, England, 159–170, ISBN/ISSN 0950-0618, *Published*.
- Yao, Hui, Liu, Yu, You, Zhanping, Li, Liang, Goh, Shuwei, 2012, "Discrete Element Simulation of Bending Beam Rheometer Tests for Nanomaterials Modified Asphalt", *International Journal of Pavement Research and Technology*, International Journal of Pavement Research and Technology, Taiwan, ISBN/ISSN 1996-6814, *Published*.
- Yin, Yuejun, Li, Yue, 2011, "Loss Estimation of Light-Frame Wood Construction Subjected to Mainshock-Aftershock Sequences", *Journal of Performance of Constructed Facilities*, ASCE, Reston, VA, Vol. 25, No. 6, 504-513, *Published*.
- You, Zhanping, Liu, Yu, Dai, Qingli, 2011, "Three-dimensional Microstructural-based Discrete Element Viscoelastic Modeling of Creep Compliance Tests for Asphalt Mixtures", *Journal of Materials in Civil Engineering*, ASCE, Virginia, Vol. 23, No. 1, 79-87, *Published*.
- You, Zhanping, Goh, Shuwei, Dong, J, 2012, "Predictive Models for Dynamic Modulus of Asphalt Mixtures using Weight Least Square Nonlinear Multiple Regression Model", *Canadian Journal of Civil Engineering*, Canadian Journal of Civil Engineering, Canada, 589-597, ISBN/ISSN 0315-1468, *Published*.

- You, Zhanping, Mills-Beale, Julian, 2011, "Evaluation of Low-Temperature Binder Properties of Warm Mix Asphalt, Extracted and Recovered RAP and RAS, and Bioasphalt", *Journal of Materials in Civil Engineering*, American Society of Civil Engineers, United States, 1569-1574, *Published*.
- Zak, Donald R., Kubiske, Mark E., Pregitzer, Kurt S., Burton, Andrew J., 2012, "Atmospheric CO₂ and O₃ alter intra- and interspecific competition for soil nitrogen in developing forests", *Global Change Biology*, *Published*.
- Zak, Donald R., Pregitzer, Kurt S., Burton, Andrew J., Edwards, Ivan P., Kellner, Harald, 2011, "Microbial responses to a changing environment: implications for the future functioning of terrestrial ecosystems", *Fungal Ecology*, Vol. 4, 386-395, *Published*.
- Zaveri, R A., Shaw, W J., Cziczo, D J., Schmid, B, Ferrare, R A., Alexander, M L., Alexandrov, M L., Alvarez, R J., Arnott, W P., Atkinson, D B., Baidar, S, Banta, R M., Barnard, J C., Beranek, J, Berg, L K., Brechtel, F, Brewer, W A., Cahill, J F., Cairns, B, Cappa, C D., Chand, D, China, S, Comstock, J M., Dubey, M K., Easter, R C., Erickson, M H., Fast, J D., Floerchinger, C, Flowers, B A., Fortner, E, Gaffney, J S., Gilles, M K., Gorkowski, K, Gustafson, W I., Gyawali, M, Hair, J, Hardesty, R M., Harworth, J W., Herndon, S, Hiranuma, N, Hostler, C, Hubbe, J M., Jayne, J T., Jeong, H, Jobson, B T., Kassianov, E I., Kleinman, L I., Luzek, C, Knighton, B, Kolesar, K R., Kuang, C, Kubatova, A, Langford, A O., Laskin, A, Laulainen, N, Marchbanks, R D., Mazzoleni, Claudio, Mei, F, Moffet, R C., Nelson, D, Obland, M D., Oetjen, H, Onasch, T B., Ortega, I, Ottaviani, M, Pekour, M, Prather, K A., Radney, J G., Rogers, R R., Sandberg, S P., Sedlacek, A, Senff, C J., Senum, G, Setyan, A, Shilling, J E., Shrivastava, M, Song, C, Springston, S R., Subramanian, R, Suski, K, Tomlinson, J, Volkamer, R, Wallace, H W., Wang, J, Weickamm, A M., Warsnop, D R., Yu, X Y., Zelenyuk, A, Zhang, Q, 2012, "Overview of the 2010 Carbonaceous Aerosols and Radiative Effects Study (CARES)", *Atmospheric Chemistry and Physics Discussion*, *Accepted*.
- Zelenika, Pearce, Joshua, 2011, "Barriers to Appropriate Technology Growth in Sustainable Development", *Journal of Sustainable Development*, Vol. 4, No. 6, 12-22, *Published*.
- Zelenika-Zovko, I., Pearce, Joshua, 2011, "Diverting Indirect Subsidies from the Nuclear Industry to the Photovoltaic Industry: Energy and Economic Returns", *Energy Policy*, Vol. 39, 2626–2632, *Published*.
- Zhang, Fengli, Johnson, Dana M., Johnson, Mark A., 2011, "Development of a Simulation Model of Biomass Supply Chain for Biofuel Production", *Renewable Energy: An International Journal*, Vol. 44, 380-391, *Accepted*.
- Zhang, Fengli, Johnson, Dana M., Johnson, Mark A., Froese, Robert E., 2012, "Development of an Optimization Model for Biofuel Facility Size and Location", *Journal of the operational research society*, *Accepted*.
- Zhang, Fengli, Johnson, Dana M., Sutherland, John W., 2011, "A GIS-Based Method for Identifying the Optimal Location for a Facility to Convert Forest Biomass to Biofuel", *Biomass & Bioenergy*, Vol. 35, No. 9, 3951-3961, *Published*.
- Zhang, Lan, Seagren, Eric A., Davis, Allen P., Karns, Jeffrey S., 2011, "Effects of temperature on bacterial transport and destruction in bioretention media: Field and laboratory evaluations", *Water Environment Research*, Water Environment Federation, Reston, VA, *Accepted*.
- Zhang, Lan, Seagren, Eric A., Davis, Allen P., Karns, Jeffrey S., 2011, "Long-term sustainability of Escherichia coli removal in conventional bioretention Media", *Journal of Environmental Engineering (ASCE)*, American Society of Civil Engineers, Reston, VA, *Published*.
- Zhang, Le, 2012, "Multiscale agent-based modeling of ovarian cancer", *International Journal of Data Mining and Bioinformatics*, *Published*.
- Zhang, Le, 2011, "Developing a multiscale, multi-resolution agent-based brain tumor model by", *Theoretical Biology and Medical Modelling*, Biomed Central, Vol. 8, No. 46, *Published*.

- Zhang, Zhiyong, Xin, Le, Qi, Ji, Wang, Zhichao, Li, Wenzhen, 2012, "Selective Electro-conversion of glycerol to glycolate on carbon nanotube supported gold catalyst", *Green Chemistry*, RSC, Vol. 14, 2150-2152, *Published*.
- Zhang, Zhiyong, Xin, Le, Li, Wenzhen, 2012, "Supported gold nanoparticles as anode catalyst for anion exchange membrane direct glycerol fuel cells", *International Journal of Hydrogen Energy*, Elsevier, Vol. 37, 9393-9401, *Published*.
- Zhang, Zhiyong, Xin, Le, Li, Wenzhen, 2012, "Electrocatalytic oxidation of glycerol on Pt/C in anion exchange membrane fuel cell: cogeneration of electricity and valuable chemicals", *Applied Catalysis B Environmental*, Elsevier, Vol. 119-120, 40-48, *Published*.
- Zhang, Zhiyong, Xin, Le, Li, Wenzhen, 2011, "Pd-Ni Electrocatalysts for Efficient Ethanol Oxidation Reaction in Alkaline Electrolyte", *International Journal of Hydrogen Energy*, Vol. 36, 12686-12697, *Published*.
- Zhu, Shilei, Zhang, Jingtuo, Vegesna, Giri, Luo, Fen-Tair, Green, Sarah, Liu, Haiying, , 2011, "Highly Water-soluble Neutral BODIPY Dyes with Controllable Fluorescence Quantum Yields", *Organic Letters*, United States, Vol. 13, No. 3, *Published*.
- Zhu, Shilei, Zhang, Jingtuo, Vegesna, Giri K., Pandey, Ravi, Luo, Fen-Tair, Green, Sarah A., Liu, Haiying, , 2011, "One-pot Efficient Synthesis of Dimeric, Trimeric, and Tetrameric BODIPY Dyes for Panchromatic Absorption", *Chemical Communications*, Vol. 47, 3508-3510, *Published*.

Proceedings

- Zheng, X.Y. and Cai, Y., "Reducing Electricity and Network Cost for Online Service Providers in Geographically Located Internet Data Centers," *Proc. IEEE/ACM International Conference on Green Computing and Communications (GreenCom2011)*, August. 2011.", *Published*.
- An, Liabo, Friedrich, Craig R., 2011, "Dielectrophoretic Assembly of Carbon Nanotubes and Stability Analysis", *International Conference on Nanoscience & Technology*, *Published*.
- Andrews, Pearce, Joshua, 2011, "Preliminary Analysis of The Effects of snowfall on PV systems", 1000 Island Energy Research Forum, *Published*.
- Andrews, Rob, Pearce, Joshua, 2012, "Prediction of Energy Effects on Photovoltaic Systems due to Snowfall Events", *Published*.
- Bjarnadottir, Sigridur, Li, Yue, Stewart, Mark G., 2011, "Probabilistic-based Framework for the Assessment of the Impacts of Climate Change on Hurricane Damage Cost and Adaptation Strategies", 11th International Conference on Applications of Statistics and Probability in Civil Engineering, *Published*.
- Bunker, Kaitlyn J., Rebb, Raven R., Brown, Laura E., Hein, Gretchen L., Onder, Nilufer, Bohmann, Leonard J., 2012, "Compositional Effects on the Persistence of Women Engineering and Computer Science Undergraduates", WE PAN, USA, *Published*.
- Cai, Zeit, Worm, Jeremy J., Brennan, Drew, 2012, "Experimental Studies in Ground Vehicle Coastdown Testing", *American Society of Engineering Education*, Washington DC, *Published*.
- Calvert, K., Pearce, Joshua, Mabee, W. E., 2012, "Geospatial analyses for a sustained renewable energy transition: considerations for policy and planning", 2012 Annual Meeting of the Association of American Geographers, *Published*.
- Colbert, Baron, You, Zhanping, 2011, "Low Temperature Cracking Potential of Aged Asphalts Using Simulated Aging Techniques", *proceedings of International Chinese Conference of Transportation Professionals*, American Society of Civil Engineers, *Published*.

- Cung, Khanh, Zhang, Anqi, Lee, Seong-Young, 2012, "Numerical Study on Soot Precursor of JP-8 Surrogate under Diesel Conditions Using a Two-Stage Lagrangian (TSL) Model", editors: Lee, S.-Y., COMODIA 2012, COMODIA 2012 FL-9, *Accepted*.
- Cung, Khanh, Zhang, Anqi, Lee, Seong-Young, 2012, "Soot Formation Study in JP-8 with Detailed Chemical Kinetics under Diesel Engine Conditions Using a Two-Stage Lagrangian (TSL) Model", editors: Lee, S.-Y., Central States Section the Combustion Institute, Combustion Institute, *Published*.
- DeDene, Chris, You, Zhanping, 2011, "Properties of Recovered Asphalt Binder Blended with Waste Engine Oil: A Preliminary Study", proceedings of International Chinese Conference of Transportation Professionals, American Society of Civil Engineers, *Published*.
- Einav, M., McLaughlin, D. V.P., Pearce, Joshua, 2011, "Bandgap and Microstructural Engineering of InGaN for Solar Photovoltaic Applications", ISPlasma 2011 Proceedings, 3rd International Symposium on Advanced Plasma Science, *Published*.
- Griep, M., Winder, E., Lueking, D., Garrett, S., Karna, S., Fonkoue, Ramon A., 2011, "Bio-Nano-Hybrid Electronics for Real-Time Target Sensing", Nanoelectronic Devices for Defense Security, *Published*.
- Griep, M., Martin, J., Rodriguez, V., Winder, E., Lueking, D., Mackay, R., Friedrich, Craig R., Karna, S., 2011, "Multi-Functional Protein-QD Hybrid Substrates for Photovoltaics and Real-Time Biosensing", IEEE 11th International Conference on Nanotechnology, *Published*.
- Gyawali, Rabi, Watkins, David W., Griffis, Veronica W., 2012, "Climate downscaling using regression and physically based watershed models", Proceedings World Water & Environmental Resources Congress 2012, ASCE, Reston, Virginia, *Published*.
- Hein, Gretchen L., Bunker, Kaitlyn J., Onder, Nilufer, Rebb, Raven R., Brown, Laura E., Bohmann, Leonard J., 2012, "UNIVERSITY STUDIES OF STUDENT PERSISTENCE IN ENGINEERING AND COMPUTER SCIENCE", ASEE, USA, *Published*.
- Hein, Gretchen L., Kempainen, Amber J., 2012, "Pumps and Programing", 2012 CE21 PI and Community Meeting, 2012 CE21 PI and Community Meeting, Washington, DC, *Published*.
- Jin, Yongliang, Mukherjee, Amlan, 2012, "Analysis of Heterogeneity in Infrastructure Condition Assessment Models", In Proceeding of the 2012 Construction Research Congress, ASCE, *Published*.
- Johnson, Dana M., Graman, Gregory A., 2011, "Modeling the Operations Strategy for Outsourcing of Non-core Operations in Institutions of Higher Education", Proceedings of the Decision Sciences Institute 42nd Annual Meeting, Nov. 19-22, 2012, Boston MA, *Published*.
- Johnson, J, Naber, Jeffrey D., Lee, Seong-Young, Kurtz, E, Robarge, N, Ge, H.-W., 2012, "Investigation of Diesel Liquid Spray Penetration Fluctuations Under Vaporizing Conditions", editors: Johnson, J., SAE 2012-01-0455, Society of Automotive Engineer, *Published*.
- Kale, Vaibhav, Worm, Jeremy J., Naber, Jeffrey D., Marriott, Craig, Santoso, Halim, 2012, "Combustion Robustness Characterization of Gasoline and E85 for Startability in a Direct Injection Spark-Ignition Engine", Society of Automotive Engineers, Warrendale, PA, *Published*.
- Kempainen, Amber J., Hein, Gretchen L., Jackson, Meral, Archer, Ruth, Fraley, Mary, Payment, Crystal, 2012, "Adaptation of Design Modules to First-Year Engineering Courses and K-12 Outreach – Update on IDEAS Project", ASEE, USA, *Published*.
- Li, Yue, van de Lindt, John W., Bjarnadottir, Sirry, Dao, Thang, Ahuja, Aakash, 2011, "Loss Analysis for Combined Wind and Surge in Hurricanes", 11th International Conference on Applications of Statistics and Probability in Civil Engineering, *Published*.

- Lim, ChoHui, Mullins, Michael E., 2011, "Synthesis of Core-Shell Biopolymer Particles Using Coaxial Electrospay", Proceedings of the Materials Research Society, Materials Research Society, *Published*.
- Lu, Qiaoyu, Mullins, Michael E., 2011, "In Situ Synthesis of High Refractive Index PDMS/Metal Oxide Nanocomposites", Proceedings of the Materials Research Society, Materials Research Society, *Published*.
- Madison, Daniel P., Miers, Scott A., Barna, Glen L., Richerson, Jay L., 2012, "Comparison of Piston Temperature Measurement Methods: Templug Versus Wireless Telemetry with Thermocouples", ASME Internal Combustion Engine Division, ASME, *Accepted*.
- Morgan, C, Arora, R, Nesbitt, J, Naber, Jeffrey D., Lee, Seong-Young, 2011, "Spray Characterization of Gasoline and E85 Direct Injection in a Constant Volume Vessel for Starting Conditions", editors: Lee, S.-Y., ASME ICEF2011, ASME ICEF2011-60009, *Published*.
- Mukherjee, Amlan, Cass, Darrell, 2011, "Organizational Challenges of Implementing Greenhouse Gas Emission Control Tools", Engineering Project Organization Conference, 2011, *Published*.
- Nesbitt, J, Naber, Jeffrey D., Lee, Seong-Young, 2011, "Characterizing Diesel Fuel Spray Cone Angle from Back-Scattered Imaging by Fitting Gaussian Profiles to Radial Spray Intensity Distributions", editors: Lee, S.-Y., ASME ICEF2011, ASME ICEF2011-60034, *Published*.
- Ng, K, Dai, Qingli, 2011, "Micromechanical analysis of constitutive properties of active piezoelectric structural fiber (PSF) composites", editors: Dai, Q., Proceedings of 2011 SPIE Smart Structure/NDE Conference, Proceedings of 2011 SPIE Smart Structure/NDE Conference, San Diego, CA, *Published*.
- Nguyen, H. T., Pearce, Joshua, 2011, "Towards Automated Quantification of Solar Photovoltaic Potential in Large Urban Areas for City-based Electric Utility Planning", Proceedings of the International Conference 2011 on Spatial Planning and Sustainable Development, A31-3, *Published*.
- Norconk, M, Lee, Seong-Young, Prausa, N, 2011, "3-D Stereo PIV Measurement of Swirling Flows In a Model Gas Turbine Combustor", editors: Lee, S.-Y., PIV11, PIV11, *Published*.
- Paul, D. K., Fraser, A., Pearce, Joshua, Karan, K., 2011, "Nafion Adsorption on Model Surface: Characterization by Variable Angle Spectroscopic Ellipsometry (VASE)", Meet. Abstr. - Electrochem. Soc., Vol. 1101, 631, *Published*.
- Pearce, Joshua, Babasola, Adegboyega, Andrews, Rob, 2012, "Open Solar Photovoltaic Systems Optimization", Proceedings of the 16th Annual National Collegiate Inventors and Innovators Alliance Conference, Open 2012, 1-7, *Published*.
- Poonamallee, Latha C., , 2011, "Corporate Citizenship: Panacea or Problem? - The Complicated Case of Hindustan Unilever", editors: Poonamallee, L., Eastern Academy of Management - International, Eastern Academy of Management, NY, NY, *Published*.
- Rittenour, Mike D., Weber, James C., Miers, Scott A., 2012, "Assessing the Effect of E22 Fuel on Two-Stroke and Four-Stroke Snowmobile Performance and Emissions", ASME Internal Combustion Engine Division, ASME, *Accepted*.
- Shokuhfar, T., Choi, Chang K., Friedrich, Craig R., 2012, "Morphological Evaluation of Osteoblast-TiO₂ Nanotube Interfaces", 2012 TMS Annual Meeting & Exhibition Biological Materials Science Symposium, *Published*.
- Shokuhfar, T., Friedrich, Craig R., Choi, Chang K., Chang, J. Y., 2011, "Titania Nanotubes-Based Medical Implants for Growth Improvement of Biological Cells", MRS Fall Meeting, *Published*.

- Shokuhfar, T., Daunais, T., Tewari, R., Zhong, X., Slough, W., Moser, T., Douglas, W., Blough, E., Kumar, A., Pandey, R., Bergstrom, Paul L., Choi, Chang K., Nalabothu, S., Friedrich, Craig R., 2011, "MicroRNA Nanosensor System for Early Detection of Disease in Humans", Lab on Chip Congress, San Francisco, CA, *Published*.
- Tang, Pei, Mukherjee, Amlan, 2012, "Activity Criticality Index Assessment Using Critical Path Segment Technique and Interactive Simulation", In Proceeding of the 2012 Construction Research Congress, ASCE, *Published*.
- Tang, Pei, Cass, Darrell, Mukherjee, Amlan, 2011, "Using schedule simulation approaches to reduce greenhouse gas emissions in highway construction project", Proceedings of the 2011 Winter Simulation Conference, *Published*.
- Wang, Hainian, You, Zhanping, 2012, "Laboratory Evaluation of High Percent Crumb Rubber Asphalt Binder", Transportation Research Board, *Published*.
- Wang, Hainian, You, Zhanping, 2011, "Intermediate Temperature Fatigue and Low Temperature Cracking Properties of Rubber Asphalt Binder", proceedings of International Chinese Conference of Transportation Professionals, American Society of Civil Engineers, *Published*.
- Weaver, Wayne W., Worm, Jeremy J., Beard, John E., Anderson, Carl L., Naber, Jeffrey D., Bohmann, Leonard J., Chen, Bo, Keith, Jason M., 2012, "An Interdisciplinary Program for Education in Hybrid and Electric Drive Vehicle Engineering", American Society of Engineering Education, Washington DC, *Published*.
- Weaver, Wayne W., Anderson, Carl L., Naber, Jeffrey D., Keith, Jason M., Worm, Jeremy J., Beard, John E., Chen, Bo, 2011, "An Interdisciplinary Program for Education and Outreach in Hybrid & Electric Drive Vehicle Engineering at Michigan Technological University", IEEE, 1-6, ISBN/ISSN 978-1-61284-246-2, *Published*.
- Worm, Jeremy J., Beard, John E., Weaver, Wayne W., Anderson, Carl L., Naber, Jeffrey D., 2012, "A Mobile Laboratory as a Venue for Education and Outreach Emphasizing Sustainable Transportation", American Society of Engineering Education, Washington DC, *Published*.
- Xiao, Liangli, Li, Yue, Bulleit, William M., 2011, "Structural Reliability Analysis of Unreinforced Masonry Wall under Lateral Loads", International Symposium on Reliability Engineering & Risk Management, *Published*.
- Yin, Yuejun, Li, Yue, 2011, "Effects of uncertainty effects on the seismic collapse risk on light-frame wood buildings", 11th International Conference on Applications of Statistics and Probability in Civil Engineering, *Published*.
- Yoon, S.H., Zhang, Anqi, Cung, Khanh, Johnson, J, Naber, Jeffrey D., Lee, Seong-Young, 2012, "Experimental Investigation of Flame Propagation and Combustion Characteristics of Methane - Air Mixtures under EGR Conditions in a Constant-Volume Combustion Vessel", editors: Lee, S.-Y., COMODIA 2012, COMODIA 2012, *Accepted*.
- Yoon, S.H., Zhang, Anqi, Cung, Khanh, Naber, Jeffrey D., Lee, Seong-Young, 2012, "Experimental Investigation of the Flame Propagation and Combustion Characteristics of Lean Methane-Air Mixture in a Constant-Volume Combustion Vessel", editors: Lee, S.-Y., Central States Section the Combustion Institute, Combustion Institute, *Published*.
- Zelenika-Zovko, Ivana, Pearce, Joshua, 2011, "Examining Social Barriers to Open Source Appropriate Technology and Innovation through Collaboration with Information and Communication Technology", 17th Annual International Sustainable Development Research Conference, 507-508, *Published*.

Zhang, Le, Struthers, Allan, 2011, "Accelerate numerical diffusion solver in 2D multi-scale, multi-resolution agent-based brain cancer model by employing graphics processing unit technology", editors: Zhang, L., Las Vegas, *Published*.

Acknowledgement of Advisory Board

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.

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Kevin Kuske General Manager, Turnstone and Wood, divisions of Steelcase North America, is dedicated to helping "create great experiences wherever work happens." All solutions are

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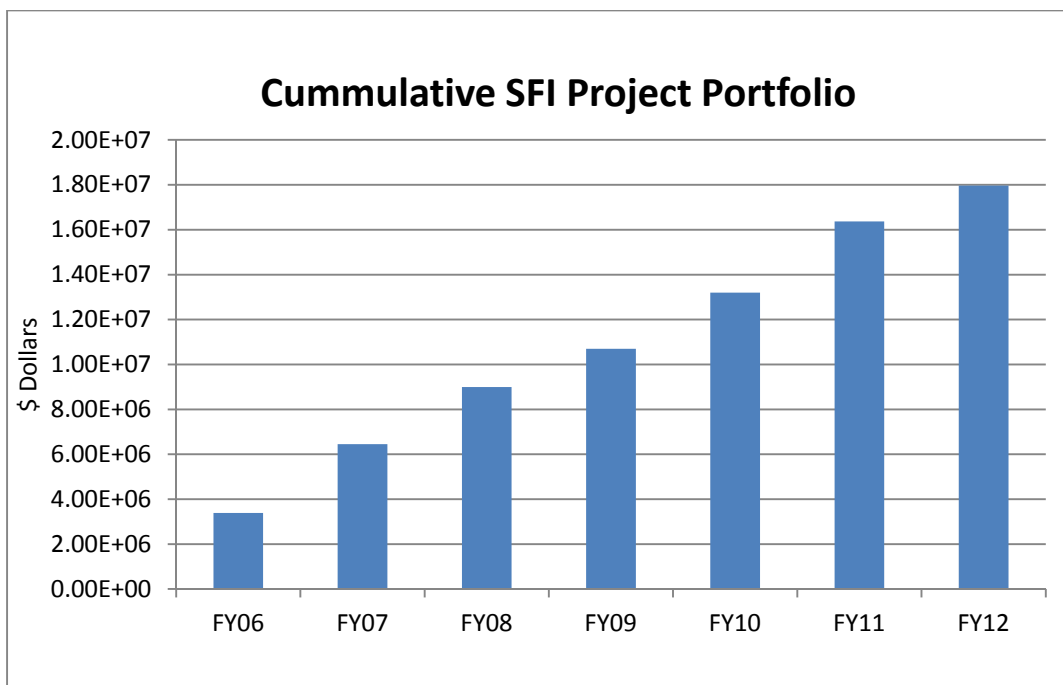
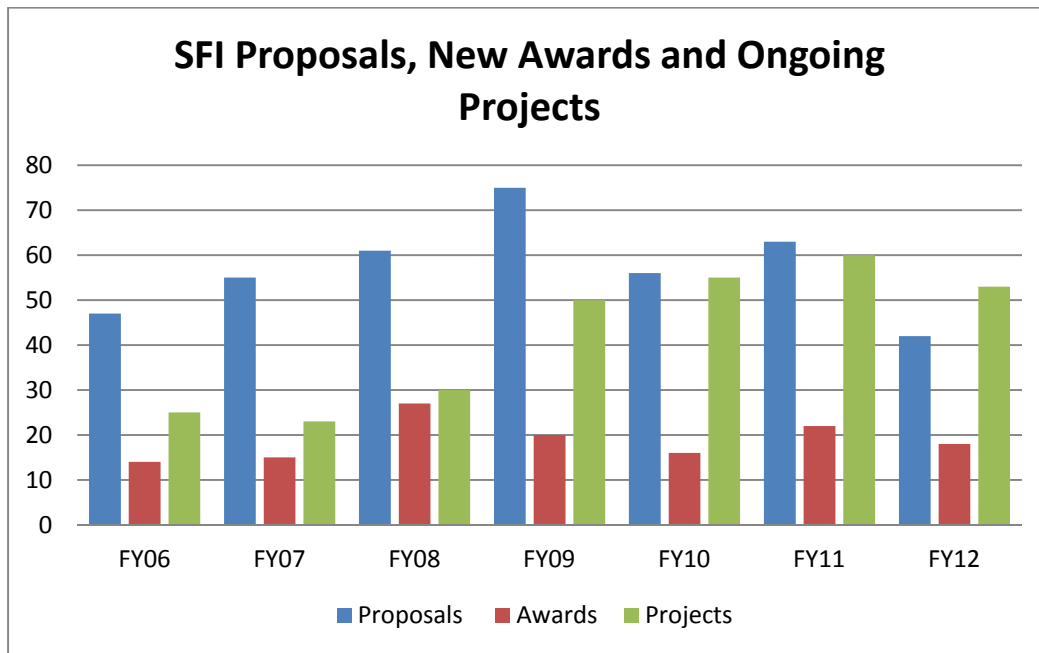
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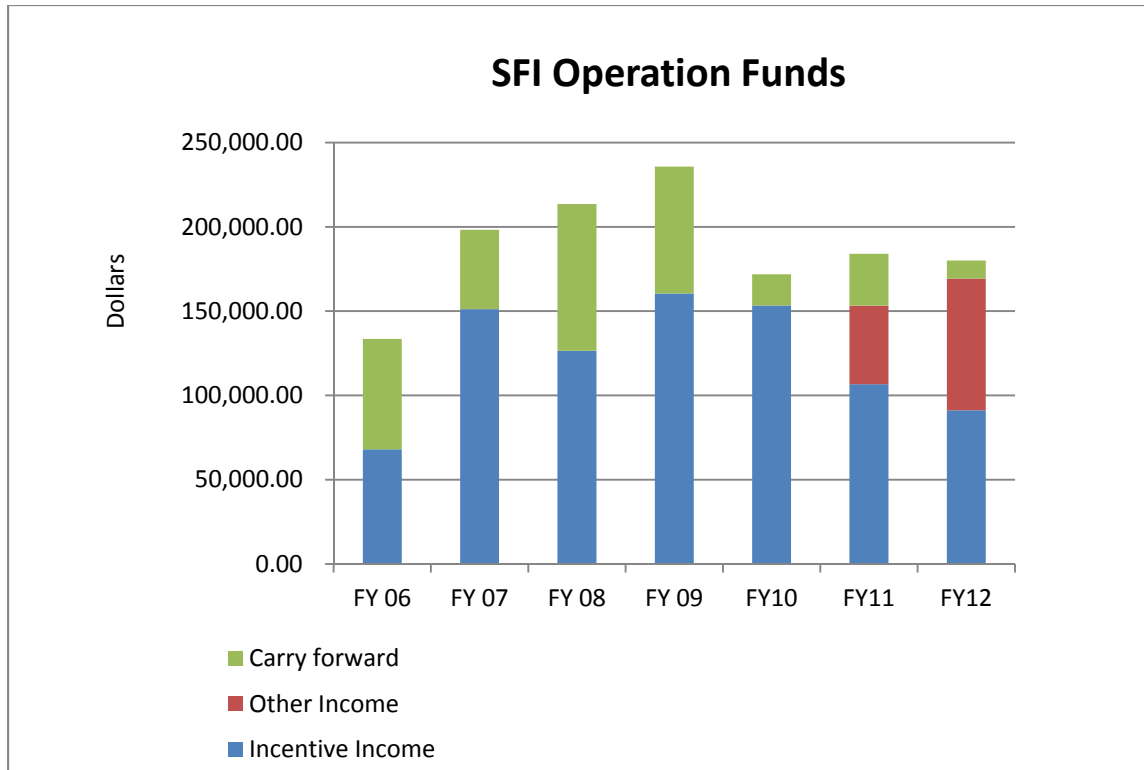
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Sustainable Futures Institute Operations

The graphs below contain data on numbers of proposals, new awards, ongoing active projects, as well as financial indicators of SFI operations.





Other Income includes direct support of SFI staff from ongoing funded projects, as opposed to staff support from internal research and development (IRAD) funds, also known as Incentive Income. IRAD represent funds from the Michigan Tech general account and is based on the Facilities and Administrative (F&A) costs on external grants to the university through the SFI.