



**Wisconsin Institute for Sustainable Technology**

# **Annual Report**

**October 2011**



**University of Wisconsin  
Stevens Point**

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## A note from the director



Paul Fowler  
Executive Director

I am delighted to introduce you to the first Annual Report since WIST's launch in September 2010. In the past twelve months, we have formed an advisory board, undertaken numerous industry-focused projects, supported the education of numerous undergraduate and graduate students, formed strategic relationships with the private sector and disseminated the message of WIST to a broad and diverse audience. This annual report is intended to provide a flavor of some of that activity.

I am indebted to the work of WIST's staff and directors and the support they have provided me in WIST's first year. Their efforts have been a significant contribution to WIST's successful first year and we are, more than ever, committed to advancing education, research and services in the sustainable technology arena. Our goal is to continually innovate the program to maintain its relevancy to the economy and well being of our region and state.

We believe we are well positioned to take forward a number of new and exciting initiatives over the next twelve months and look forward to reporting on those in our next annual report. For all the latest information on WIST and its program, please do not hesitate to contact me or visit our website at [www.uwsp.edu/wist](http://www.uwsp.edu/wist). In the meantime, I hope you enjoy reading this report.

## Sustainable solutions

Many chemicals used in industrial and personal care applications are derived from petroleum sources. Opportunity exists to instead derive these component chemicals from renewable sources, specifically Wisconsin's abundant agricultural and forest resources. Value-added processing of these materials could help grow the state's economy and add jobs. Cranberries, for example, are known to be high in antioxidants. Antioxidants receive a tremendous amount of press because of their putative health and wellness benefits. However, it is not common knowledge that there is a high-value market for industrial antioxidants which are used in applications ranging from cosmetics to lubricants, to plastics and polymers. Industrial antioxidants today are largely derived from petroleum sources. Production of antioxidants from cranberries represents an untapped opportunity with significant revenue potential.

Similarly, carbohydrates derived from oats, oils from hazelnuts, and starch from potatoes, all present potential new income sources. Importantly, these materials in many cases can be derived from residual materials, such as potato peels that otherwise must be disposed of, so there is no impact on food supply.

We believe innovation fueled by collaborative research will help unlock opportunities in value-added processing and move Wisconsin forward in creating a biobased economy.

WIST is an entrepreneurial group, and has secured support from federal, state and private sources, which has been critical to our success thus far. We have set out to build strong bridges to industry, to use and promote the expertise of University of Wisconsin-Stevens Point faculty and staff far beyond campus borders, to make a real difference in jobs and quality of life.



# WIST launches

The Wisconsin Institute for Sustainable Technology was officially launched at a UWSP event Sept. 8, 2010. More than 100 business leaders, government officials, university faculty and staff, community members and other university stakeholders attended the festivities.

Rep. Dave Obey, who helped secure major federal support for WIST, along with UWSP Chancellor Bernie Patterson and Deans Christine Thomas and Christopher Cirmo all offered remarks on the institute's founding and its potential benefits to the region.

The occasion also offered an opportunity for the community to meet Paul Fowler, the institute's executive director, who had been on board just a month.

Although WIST was formally launched just a year ago, its roots go back several years. The idea for the institute evolved from discussions involving Gerry Ring, professor of paper science and engineering, Christine Thomas, dean of the College of Natural Resources, and others both on and off the UWSP campus. Ring had noted a



Top right: UWSP Chancellor Bernie Patterson welcomes guests at the official WIST Launch Event, Sept. 8, 2010. Right: Patterson, with Rep. Dave Obey, center, and College of Natural Resources Dean Christine Thomas visit at the event.

void created when the Institute of Paper Science and Technology relocated from Wisconsin to Georgia, and early discussions about WIST's potential role focused on the paper and forestry industries.

However, planners soon realized that while biofuels research and paper science initiatives could provide an excellent springboard to launch WIST, the institute in the long term would be stronger, more effective and more relevant if its reach extended beyond the paper industry and biofuels. And there was already precedent for an interdisciplinary approach: the biofuels research was led by Eric Singaas, a biology professor in the College of Letters and Science, and Don Guay, a professor of paper science and engineering in the College of Natural Resources. Accordingly, by the time of its formal launch, WIST had evolved to become a multidisciplinary, campus-wide initiative at UWSP, strongly supported by UWSP administration.

Attendees at the WIST launch event viewed posters showing institute projects already underway, and enjoyed a buffet of appetizers featuring locally and sustainably grown food.



Congressman Dave Obey, right, shares a light moment with Chancellor Bernie Patterson, second from right, and students in attendance at the WIST launch event.



# WIST forms Advisory Board

In early 2011 WIST formed an advisory board comprising leaders from industry, business development groups and research organizations. The 12-member board will provide guidance to the institute as it shapes priorities and works to transfer new technology from the laboratory to commercial use.

The board held its initial meeting May 23 at UWSP and in its first order of business elected a chair, Leon Ostrowski, founder and coordinator of the Central Wisconsin Business Angels, LLC, and a founding partner in Planned Innovation Institute.

Other board members are Ed Buehler, vice president and business manager for NewPage's Specialty Papers; Tad Campana, paper mill superintendent at Thilmany's Kaukauna mill; Lori Dehlinger, executive director of the Portage County Business Council; Barb Fleisner, executive director of Centergy, Inc.; H. Tony Hartmann, chief executive officer of Great Lakes Ag Energy; Dave Mead, chief executive officer of C5•6 Technologies; Francis J. Podvin, chairman of the board of Ocean Spray Cranberries, Inc.; Kelly Rooney, area manager for Veolia Environmental Services in Central Wisconsin; Troy Runge, director of the Wisconsin Bioenergy Initiative; Tom Sweeney, a member of the preconstruction group at J.H. Findorff & Son, Inc.; and Theodore Wegner, acting director of the United States (U.S.) Forest Service, Forest Products Laboratory.

Executive Director Paul Fowler said the institute is fortunate to be able to draw on the considerable talent and experience represented on the board. "We are excited to have a cross-section of accomplished representatives from various sectors," Fowler said. "We appreciate their willingness to serve."

## Ed Buehler

Ed Buehler is the vice president and business manager for NewPage's Specialty Papers. His 27-year career in the paper industry has focused on coated papers with experience in Fine, Magazine, and Specialty markets. Buehler has a bachelor of science degree in paper science from the University of Wisconsin-Stevens Point and a master's degree from the Institute of Paper Chemistry.



Ed Buehler

## Tad Campana

Tad Campana graduated from the University of Wisconsin-Stevens Point with a degree in Paper Science and Engineering in 1996. After graduation, he took a position with International Paper's Nicolet mill, and has been with the company for the past 15 years, through its divestiture as Thilmany Papers. Campana has held positions in operations, sales, marketing, and quality management. He is currently a paper mill superintendent at Thilmany's Kaukauna mill. Campana received his master of business administration degree from Cardinal Stritch University in 2009. Tad currently resides in Appleton, Wisconsin with his wife Sara, daughter Ella, and sons Lucas and Ryan. In his free time, he enjoys spending time with his family, running, hunting, fishing and golf.



Tad Campana

## Lori Dehlinger

Lori Dehlinger is the executive director of the Portage County Business Council, a county-wide economic development corporation and Chamber of Commerce with approximately 500 members. A graduate of the University of Wisconsin-Stevens Point, Dehlinger serves on the board of directors for Centergy, North Central Wisconsin Development Corporation and the Association of Downtown Businesses. She is a member of the International Economic Development Council, Wisconsin Economic Development Association, Wisconsin Manufacturers and Commerce and Wisconsin Chamber of Commerce Executives. Dehlinger also served as the Executive Director of the Northeast Wisconsin Land Trust, a land conservancy organization covering a 12-county region and manager of an award-winning Wisconsin Main Street program focusing on downtown revitalization. She has more than 20 years of marketing and management experience in corporate and non-profit environments.



Lori Dehlinger

## Barb Fleisner

Barb Fleisner, executive director of Centergy, Inc., is involved with the collaborative regional economic development for Marathon, Portage, Wood, and Adams counties and the city of Merrill. Previous to this Fleisner was the vice president of economic development for the Green Bay Area Chamber of Commerce. In this capacity she led economic development initiatives for Advance, the non-profit economic development corporation for the Chamber, managed a business incubator and coordinated business development initiatives for Brown County. Prior to relocating to Green Bay, she was the executive director of the Marshfield Area Chamber of Commerce & Industry and Economic Development Corporation and part-time instructor for Mid-State Technical College.

Fleisner holds a bachelor's degree in business administration with minors in Marketing and Economics and a master's degree in public administration with a concentration in local government. She also received her Economic Development Finance Certification from the National Development Council and national certification in economic



Barb Fleisner

development from the International Economic Development Council.

Fleisner currently serves on the Commission on Workforce Investment, and on state boards including the Transportation Development Association, Mid-American Economic Development Council (which comprises ten Midwest states), and the Wisconsin Business Development Finance Corporation. She served eight years on the Wisconsin Economic Development Association Board of Directors and as its president in 2004.

## H. Tony Hartmann

H. Tony Hartmann is chief executive officer of Great Lakes Ag Energy. He cofounded Great Lakes' (then Great Lakes BioFuels) in 2005, to produce, buy/sell, and broker renewable, liquid transportation fuels. Since 2007 the company has been primarily focused on R&D related to feedstock development, biomass deconstruction, and pretreatment. The company's latest work includes organo-solv pulping, distributed processing, and a strategic partnership with Cellulose Sciences International for the development of Nanoporous Cellulose technology.

Hartmann has worked in the field of bioenergy since 2003, when he was the seventh hire (manager of business development) for Virent Energy Systems, now a \$200M (catalytic) biofuels company with investment from Honda, Cargill, and Shell Oil. He is past president of the Wisconsin Biodiesel Association and Green Diesel Wisconsin Foundation. Hartmann is a graduate of the Thunderbird School of Global Management, Glendale, AZ.

## Dave Mead

Dave Mead has 24 years of industrial experience in R&D, sales, and management at leading biotechnology companies, including Bio-Rad, Promega, Molecular Biology Resources, Key Scientific, and Chimex. In 1998 he founded Lucigen and in 2006 he cofounded C5•6 Technologies.

Mead is a recognized expert in gene cloning and genomics. He has published 35 professional articles, holds 5 patents, and has written more than 50 commercial articles in basic and applied molecular biology. He has developed more than 40 commercially successful products, including the TA cloning vectors and kits which are now manufactured by Life Technologies (previously Invitrogen). In 2000, Invitrogen's sales of these kits were greater than \$55 million. As a principal investigator he has been awarded \$3.9 million in U.S. government funded grants for basic research in genomics and biotechnology.



Tony Hartmann



Dave Mead

## Leon Ostrowski

Leon Ostrowski received his master of business administration degree from Central Michigan University and his bachelor's degree from the University of Wisconsin-Stevens Point. He completed the INSEAD Human Relations Management Program in France and the MIT Strategic Management Program. He has gained 35 years of extensive business experience through his international and domestic professional and managerial assignments for a Fortune 500 company and through personal ventures and consulting assignments. Ostrowski is founder and coordinator of the Central Wisconsin Business Angels, LLC, a founding partner in Planned Innovation Institute, and has served on WiSys Board of Trustees since 2001.



Leon Ostrowski

## Fran Podvin

Francis J. "Fran" Podvin is currently in his sixth year as the Chairman of the Board of Ocean Spray Cranberries, Inc., a grower-owned cooperative with revenues of \$2.2 billion and substantial receiving and manufacturing assets in Wisconsin. He is a general partner in City Point Cranberries, LLP, a 110-acre cranberry marsh located near City Point, Wisconsin, and has been active in its management since 1984.



Fran Podvin

A practicing attorney since 1965, Podvin heads Podvin Law Firm and concentrates his practice on water and wetland issues involving new and existing cranberry marshes, generational succession planning, estate planning, and business counsel and advice. He has been active in the cranberry industry since 1965 and has been a director and officer of many businesses including Gottschalk Cranberry, Inc., Flying Dollar Cranberry, Inc., American Cranberry Corp., and Superior Services, Inc. He received his Bachelor of Arts and Bachelor of Law degrees from Marquette University, Milwaukee, Wisconsin.

## Kelly Rooney

Kelly Rooney is the area manager for Veolia Environmental Services in Central Wisconsin responsible for a number of solid waste and recycling operations. Rooney currently manages the Cranberry Creek Landfill in Wisconsin Rapids, the Portage County Material Recovery Facility in Plover and collection operations in Marshfield, Medford and Wisconsin Rapids.



Kelly Rooney

Rooney is a seasoned environmental services professional with 20 years of experience in the solid waste and recycling industry. She is a progressive environmental leader with a proven track record. Recently, Rooney led the transition from dual stream to single stream recycling processing at the Portage County Material Recovery Facility and the establishment of an organics recycling operation at the Cranberry Creek Landfill.

Rooney lives in Stevens Point. She enjoys spending time outdoors, golfing and is working on her master's degree in organizational leadership.

## Troy Runge

Troy Runge is the director of the Wisconsin Bioenergy Initiative, a public-private partnership in bioenergy research, outreach, training and economic development based in the College of Agricultural and Life Sciences (CALs) at the University of Wisconsin-Madison. He is also an assistant professor in the Biological Systems Engineering Department in CALs where he performs research and teaches in the bioenergy field.

Runge is a lignocellulose chemist by training and has pulp and paper science degrees including a bachelor of science from UW-Stevens Point and master's and doctoral degrees from the Institute of Paper Science and Technology at the Georgia Institute of Technology.

Prior to coming to the University of Wisconsin, Runge spent 14 years working at Kimberly-Clark Corporation in a variety of research and engineering roles for pulp, tissue, nonwoven, and hygiene product production. He left the company as a research director and has been involved in commercialization of new products, product improvements, and commercial expansions around the world.

Runge is currently working in several aspects of bioenergy, with an emphasis on biomass composition impact on thermochemical bioprocessing systems, including combustion, pyrolysis, and catalytic reforming. As the director of the WBI he is concentrating on creating collaborative research with industry, renewable energy curriculum development, public outreach, and enhancement of University of Wisconsin capabilities for this field.

## Tom Sweeney

Tom Sweeney has worked for the past 14 years on the development and implementation of Findorff's database estimating, project management, bid solicitation and plan distribution, and Building Information Modeling software, as well as having been the director of information technology.

Currently, as a member of Findorff's Preconstruction Group, Sweeney watches construction and business trends to find business differentiators, and with others works to implement selected differentiators. He is currently investigating a variety of topics: an alternate technique for poured concrete decks, CO<sub>2</sub> generated in the manufacture of construction materials, the merger of manufacturing and construction scheduling software, as well as a number of other potential business differentiators.



Troy Runge



Tom Sweeney

## Theodore H. Wegner

Theodore "Ted" Wegner is acting director of the United States (U.S.) Forest Service, Forest Products Laboratory. He earned a bachelor of science degree in chemical engineering from the University of Wisconsin and received his master of science and doctoral degrees from the University of Illinois. Prior to joining the Forest Service in 1977, he worked for E. I. DuPont. Wegner is a Fellow of the Technical Association of the Pulp and Paper Industry and is a member of the Forest Products Society, The Society of Wood Science and Technology, the Pulp and Paper Education and Research Alliance, the American Institute of Chemical Engineers, the American Chemical Society, the Materials Research Society, Sigma Xi Research Society, and Alpha Chi Sigma—Chemistry and Chemical Engineering Fraternity. He also served on the Forestry Research Advisory Committee of the United States Department of Agriculture.

Wegner has been a leader in advancing nanotechnology within the U.S. forest products industry. He co-chaired the first U.S. workshop on nanotechnology for the Forest Products Industry and is co-editor of "Nanotechnology for the Forest Products Industry: Vision and Technology Roadmap." He was co-chair of the 2006, 2007, 2008, and 2011 International Conferences on Nanotechnology for the Forest Products Industry. He serves as Forest Service representative on the U.S. National Nanotechnology Initiative.

Wegner has been a leader in defining the U.S. Forest Service research agenda for the forest biorefinery and forest biomass to liquid transportation fuels. He served as the Forest Service lead on a consortium developing the science and technologies needed to economically produce ethanol from woodchips extracted prior to pulping. He directs Forest Service R&D on cellulosic ethanol production from forest biomass; serves as Forest Service lead in a biorefinery deployment consortium; and served on the organizing committee for an international forest biorefinery conference.



Ted Wegner



Laura Lorentz, who graduated from UWSP in 2011, assisted on a research project funded by WIST during the 2010-2011 academic year. She credits the experience with helping her obtain a graduate research assistantship at Virginia Tech. She is shown presenting her research poster at Chancellor Bernie Patterson's Inauguration.

## Student impact Making a positive difference

Laura Lorentz graduated from UWSP in 2011 after a successful college career that included work on a research project with College of Natural Resources forestry professor Paul Doruska, work that was funded in part by a WIST Scholar grant. She said her research experience here helped her land a research assistantship at Virginia Tech, where she is pursuing a master's degree in the department of Forest Resources and Environmental Conservation.

"The research project that I worked on with Dr. Doruska helped prepare me for graduate school in multiple ways including time management, field work and proper data collection, statistical analysis, and interpretation of results," Lorentz said in an email interview from Virginia Tech.

Lorentz is one of many students who are benefitting from the presence of the Wisconsin Institute for Sustainable Technology at UWSP. WIST provides opportunities for undergradu-

ate and graduate students in research and laboratory technical work and is making a positive impact on student education.

Don Guay, WIST's director of laboratory services, has supervised eight students in the WIST research and paper testing labs in the past year. He said the experience that students gain is invaluable in helping them prepare for careers after school. The work is different than lab experiments in college courses, where there is a predetermined result students are aiming for. "One of the biggest benefits is they're doing the work for customers, so there's pressure," Guay said. "There's no known answer. It's true research and development work."

Students gain skills beyond the labs as well. In spring 2011, WIST hired Waneta Kratz, a UWSP graduate student in soil science, to coordinate a special research project on campus (you can read about Project Fresh on page 24 in this report). She put together a team of students to work on all aspects of the project

from logistics to marketing.

"My position as project manager has enhanced my communication techniques and critical thinking and problem solving skills," Kratz said. "Realizing the implications of this project has also made me appreciate the fact that the career path I'm on is exactly where I want to be. Managing and researching environmental issues, especially waste and renewable resources is simply what I'm passionate about."

Meanwhile Lorentz, at Virginia Tech, said she feels very fortunate to have been able to present her research four times, including an oral presentation and poster presentation at the UWSP CNR Undergraduate Research Symposium, at the Posters in the Rotunda event in Madison, WI, and Chancellor Bernie Patterson's Inauguration.

"Undoubtedly all of these experiences have helped me prepare for the challenges that are to come throughout my graduate studies," Lorentz said. "I believe the biggest challenge lies in good time management, and achieving a balance



Dave Lieble, center, describes his laboratory internship work at WIST during the Legislative Breakfast hosted by UWSP and Chancellor Bernie Patterson and attended by area legislators and business and academic leaders in February 2011. Don Guay, WIST Director of Laboratory Services, left, and Paul Fowler, WIST Executive Director, listen.

between school and other aspects of one's life. Doing an undergraduate research project gave me the opportunity to do just that – balance school, life, work, and research."



WUWSP students get hands-on experience running the WIST pilot paper machine and paper testing equipment.



# Education

## New outreach courses to meet new challenges



Gerry Ring  
Director of Education

WIST's Education Division's primary mission is to support existing academic programs with student involvement in applied research and innovation. It is also involved in the creation and development of new undergraduate, graduate and outreach curricula at UWSP that are compatible with the mission and vision of The Wisconsin Institute for Sustainable Technology.

To fulfill its mission, the Education Division has been instrumental in the creation of WIST's Focal Point 2011 seminar. It is intended that Focal Point will be an annual event that will showcase the research efforts of WIST and bring UWSP faculty and students together with community, business and industry members to foster broad based communication that will lead to the development of innovative ideas.

The Education Division of WIST is also busy creating a new WIST outreach curricula of six courses that will provide current information about sustainability practices. Those six courses will cover green chemistry, sustainable manufacturing practices, energy policy, waste treatment, life cycle assessment and ideas in innovative business development.



Kelly Klaas, right, shows a student in the Hands-on Papermaking class how to make an adjustment on the pilot paper machine.

## WIST develops biofuels minor

Growing demand for oil, geopolitical concerns, and social and environmental pressures necessitate a transition from imported petroleum to renewable fuels. Biofuels will make up a portion of the nation's future energy. Meeting increasing biofuels demand will require a trained workforce of engineers and scientists to operate existing biorefineries and to develop next generation renewable fuels. These scientists and engineers will be educated in the basic science and natural resource programs at UWSP. This emerging industry will employ up to a million people nationwide. We have designed a biofuels engineering minor program that will augment students' education in the fields of biology, biochemistry, chemistry, natural resources, or paper science and engineering with specific knowledge of the scientific, engineering, and environmental aspects of producing liquid fuels from primary biomass.

Karyn Biasca, a professor of paper science and engineering, demonstrates the computer controls on the pilot paper machine. Biasca also has developed and teaches a course in Life Cycle Assessment for the WIST Education Division (see sidebar)



## Education courses developed

The Education Division has three courses already developed and offered.

### Hands-on Papermaking

This two-day class features morning lectures followed by afternoon sessions of guided exercises running UWSP's pilot paper machine, the fastest student-run paper machine in the country.

Lectures cover basics of the history of paper making, tree anatomy, pulping and bleaching, papermaking, equipment, and additives and coatings.

### Life Cycle Assessment

This is an introductory course on life cycle assessment (LCA), product category rules (PCR) and environmental product declarations (EPD). Participants gain an understanding of the scope, challenges and possibilities in applying life cycle assessment to decision-making processes. They also learn how LCAs, PCRs and EPDs are interconnected.

### Kraft Recovery

The kraft recovery process is an essential part of the kraft pulp mill and represents a complex integrated chemical and energy recovery process. This course presents a review of the technical fundamentals of the process, with an emphasis on solving typical process problems.

### Additional Courses

New courses are currently under development and expected to be offered within the next year. Topics include a color school for papermakers, environmental management systems, and biobased plastics. Course details are updated on the WIST website, [www.uwsp.edu/wist](http://www.uwsp.edu/wist)



Eric Singaas  
Director of Research

## Research

### Biofuels is just the beginning for WIST

The research division of WIST aims to support the research of WIST fellows by managing lab space and assets, assisting fellows with grant applications, and helping to make academic-industry contacts for WIST fellows to move their research from lab to commercial scale. The research division also assists in the WIST fellow grant programs. The past year saw progress in all of these areas, as described below. The progress in year one will help us to develop our capacities in these areas to broaden participation amongst WIST fellows and UWSP faculty in the following years.

#### Lab space and assets

The WIST lab moved into newly renovated area of about 2500 sq. ft. of floor space. It has a full complement of equipment and facilities needed for microbiology and molecular biology research (e.g., autoclaves, incubators, centrifuges, biocontainment hoods, lyophilizers, and shaker incubators). WIST researchers have access to a cell biology facility with Olympus fluorescence microscopes, digital cameras for photomicrographs, nanodrop spectrophotometers, digital gel documentation imager, and microarray readers. The lab houses a -86°C freezer, -20°C freezer, a general refrigerator, microcentrifuges, one laminar flow hood, a Dionex ICS3000 ion chromatograph for carbohydrate analysis, an Agilent 7890GC with 5975 mass spectrometer, and Gerstel MPS autosampler with headspace and SPME (solid phase microextraction) option for analysis of volatile products. The nearby biomass analysis lab has a Dionex solvent extractor, Wiley mills, autoclaves and membrane distillation apparatus. WIST researchers also have access to shared laboratory space in the Chemistry, Biology and Paper Science & Engineering departments with Liquid chromatography–mass spectrometry and gel permeation chromatography instruments. An office in Science houses WIST students and staff, as well as postdocs and visiting researchers.

### Patent published

Researchers at WIST published a patent application for the production of isoprene using genetically modified bacteria. Isoprene is a valuable industrial feedstock used in the production of latex, rubber, plastics and pharmaceuticals, and it can also be used to produce liquid aviation fuels; the global isoprene market is estimated at \$2 billion.

Isoprene is currently produced from oil. However, WIST has engineered microbes that convert sugars from biomass into energy-dense chemicals such as isoprene and related chemicals, thus creating the potential to obtain isoprene from renewable sources. WIST's published patent application covers the invention of a microorganism and comprises the steps of obtaining a host transgenic microorganism and observing isoprene production from that microorganism.

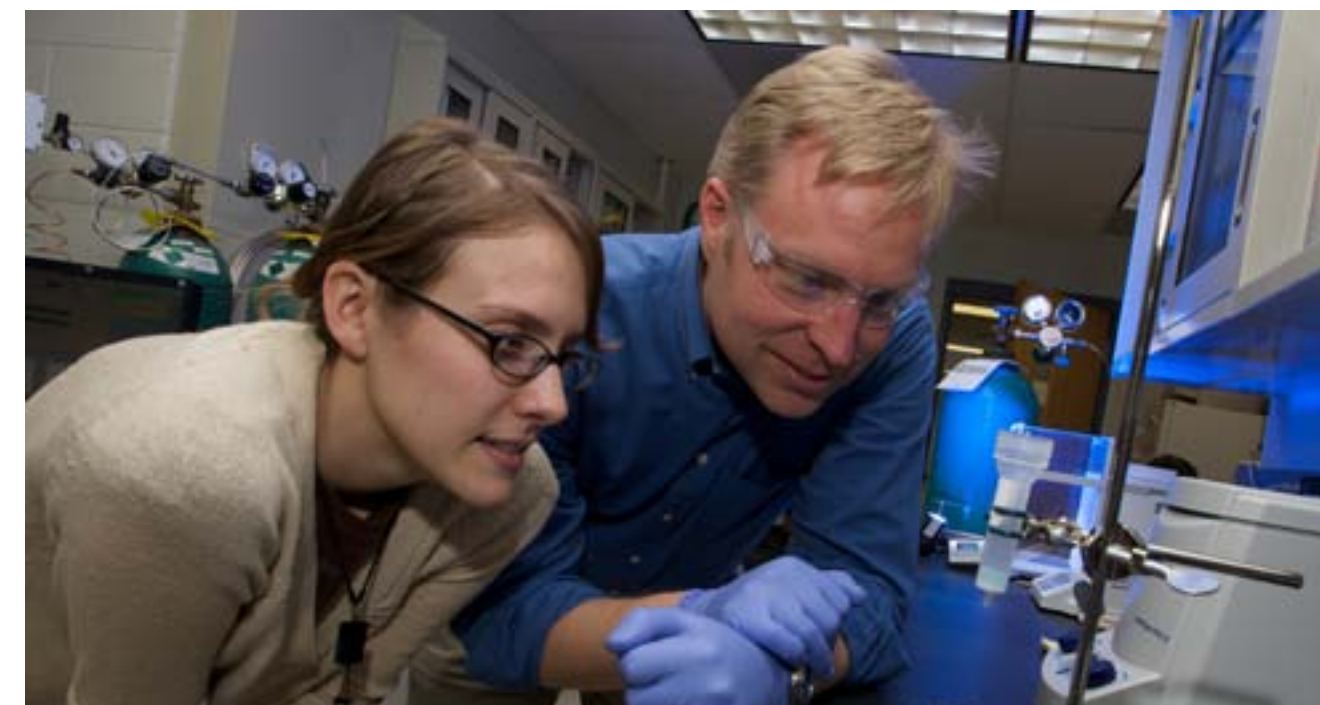
WIST proposes to produce isoprene from biomass from pulp and paper mill waste streams. The institute's goal is to develop an isoprene production unit that will integrate with a biorefinery being developed by WIST and a partner, American Science and Technology. This unit will use engineered microbes to ferment wood sugars to isoprene.

### Sustainable Alternative Energy for the Department of Defense

This program, funded by the U.S. Army Research Laboratory, is focused on developing an affordable and sustainable bio-mass based alternative energy that can be refined to produce JP-8 (jet) fuel with similar or better quality than current petroleum-based jet fuel that meets the U.S. Army Research Laboratory (ARL) and DOD requirements, while creating high-technology jobs in north central Wisconsin. Work is performed by University of Wisconsin at Stevens Point, American Science and Technology Corporation at Wausau, University of Wisconsin at Madison, and Argonne National Lab. The project team, working with ARL, is trying to develop affordable alternative new energy sources including fuel that can be dropped in to replace of the current JP-8 fuel. This replacement will allow an easy transition from a petroleum-based fuel to a 100% domestic renewable fuel. The goal of the project is to develop and to commercialize a process to produce alternative fuel especially Jet Propellant 8 (JP-8)—used by US and NATO militaries—from bio-feed-stocks.



Above, a pilot-scale biomass digester at American Science and Technology in Wausau, a WIST research partner. Below, Eric Singaas and a research assistant.



## Isoprene Production from Pulp Mill Residuals

In a project funded by the Wisconsin Small Companies Advancement Program, we are working to produce the chemical isoprene from pulp and paper mill waste streams commonly referred to as residuals. Our approach is to recover the cellulosic sugars contained in pulp and paper mill residuals and biologically transform these sugars into isoprene, a high-value chemical, displacing production of this chemical from fossil fuel. Using residuals to produce isoprene provides pulp and paper producers an opportunity to diversify their product stream, create new jobs, and reduce waste. This project augments and builds on our Department of Defense work.

## Non-food uses of agricultural and forest resources

The WIST research division is pursuing opportunities in new uses of agricultural and forest resources, with particular emphasis on development of nonfood materials such as waste from food processing and other residual biomass.

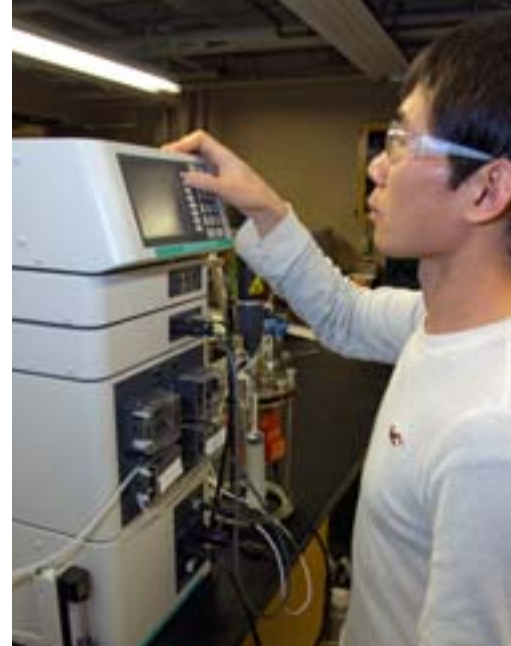
## Anaerobic Digestion

WIST researchers are working with students and with the UWSP campus community to demonstrate an anaerobic digestion demonstration system on campus.

Anaerobic digestion is a biological process in which food waste, grass clippings, animal manure, and other biodegradable waste is broken down by bacteria to make biogas. Biogas can be compressed and used to power vehicles or operate electrical generators. Anaerobic digestion can be deployed today throughout the rural Midwest, providing more than 15% of the region's energy while simultaneously eliminating solid waste. It is hoped that biogas from the UWSP demonstration project will power a campus vehicle and the remaining solids will be used to fertilize a campus garden. This system will be used for teaching, research and demonstration to help farms and businesses learn how to deploy this energy technology in their own situation.

## WIST Scholars

The research division reviewed 12 research project proposals in two rounds of proposal requests since its founding. Eight of these were selected for funding. (See story on WIST Scholars, page 30.)



## Biorefinery

Existing, and in certain cases idle, pulp and paper mill infrastructure provides an opportunity to build a biorefinery industry. In addition to pulp, the industry produces an estimated two million tons of fiber sludge annually. This material is either discarded in a landfill or burned, adding millions of dollars to the cost of paper production. The composition of this sludge is about 50 percent cellulose and hemicelluloses, which could be converted into their constituent five- and six-carbon sugars. The sugar streams could then be fermented into biobased chemicals and fuels as value-added co-products, thus earning pulp and paper companies increased sales and profits and, at the same time, reducing the environmental and fiscal burden of waste disposal.

Key technologies we have developed include a modified organosolv pulping process to separate biomass into lignin, cellulose, and hemicellulose fractions, and engineered microbes that convert sugars from biomass into energy-dense chemicals such as isoprene,  $\beta$ -pinene, prenol, and butanol. This yields sulfur-free lignin as a co-product, which is being studied for its utility as a feedstock for adhesives, fuel additives, carbon fiber and as a feedstock for fast pyrolysis oil.

WIST partner American Science and Technology in Wausau has built a pilot scale biorefinery. Bench-scale processes developed in WIST labs will next be scaled up for testing at the AST pilot biorefinery.



# Laboratory Services

## An expanding range of services



Don Guay  
Director of  
Laboratory Services

WIST Laboratory Services recently achieved a milestone when the Fibre Box Association, or FBA, certified WIST as a provider of recyclability and repulpability studies.

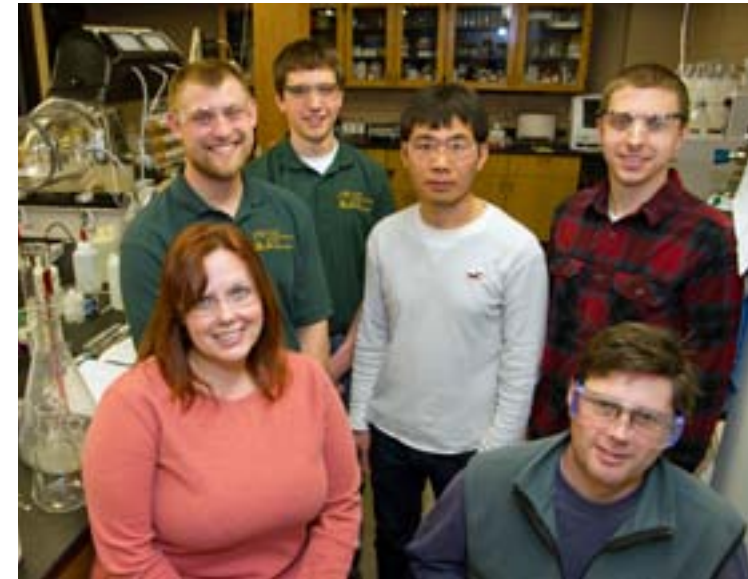
“Companies can come to us with their material that they want to certify for recyclability or repulpability,” said Don Guay, director of laboratory services. “We’re now one of only about five labs in the world certified to do this testing.”

WIST will offer the services in coordination with IPS Testing Services of Appleton, WI (see sidebar).

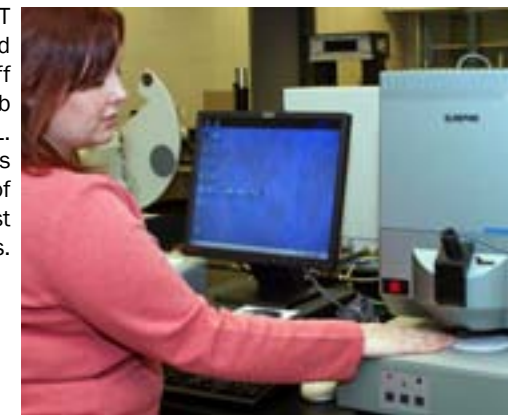
WIST Laboratory Services Division is building on the extensive experience and excellent reputation of the paper testing services that have been offered at UWSP in the past. WIST staff works with local, national and international companies to help them meet their research and development needs. WIST has extensive capabilities for the pulp and paper industry, including an analytical chemistry lab, wet lab, and paper testing lab. The pilot paper machine is versatile and can make a wide range of paper types with different additives. Instruments are calibrated on a regular basis by the manufacturers and instruments are monitored through our own internal quality assurance program.

Laboratory services helps support WIST research as well as the educational mission of UWSP. For example, revenue from provided services maintains the pilot paper machine, which is used in course work by the university’s department of paper science and engineering. The laboratory services division also provides opportunities for internships by UWSP students, who gain real-world experience to augment their classroom education.

While core services include paper testing and development work on the pilot paper machine, WIST labs also have capabilities in a range of biomaterials testing and analysis. Lab equipment includes a Dionex ICS3000 ion chromatograph for carbohydrate analysis and an Agilent 7890GC with 5975 mass spectrometer and Gerstel MPS autosampler with headspace and SPME (solid phase microextraction) option for analysis of volatile products.



Above, WIST laboratory and research staff pose in a WIST lab in February 2011. Right, Kelly Klaas operates one of the paper test instruments.



### Key developments in the past year:

- Collaborative agreement reached with IPS to offer more services in “one-stop shop”
- Certification by the Fibre Box Association
- Installation of a starch cooker that enhances the paper machine and its usefulness to the paper industry
- Upgrading and extensive servicing of the pilot paper machine
- Recruitment of laboratory staff including instrumentation specialists

## Joint marketing agreement

WIST has formed a joint venture with IPS Testing, the Appleton-based independent testing laboratory, that will allow both groups to add additional methods and services to better serve clients.

IPS Testing serves as one of the world’s largest independent and environmentally controlled testing laboratories, hosting more than 270 test instruments. IPS Testing and UW-Stevens Point have had a long-standing relationship. The recently signed memorandum formalizes this relationship. “The decision to formalize our agreement was made to pursue certification of the Fibre Box Association (FBA) Standard for Recyclability and Repulpability,” said IPS President, Bruce Shafer. “Our clients had requested that we add this service but neither group had the equipment to complete all portions. This agreement allows our clients access to IPS’ broad range of testing expertise as well as the UWSP pulping and papermaking pilot plant to perform the FBA standard.”

Executive Director Paul Fowler said the cooperative arrangement with IPS will benefit the paper industry as a whole by providing one-stop shopping for a range of services.

The mixture of analytical testing and physical testing combined with the pilot plant and paper making expertise will allow both groups to offer full service testing. Also, the joint venture will allow both groups to add a number of services addressing product stewardship. These services include recyclability and repulpability, biodegradability, compostability, and regulatory testing.

# Project FRESH

Two years ago UWSP dining services switched from Styrofoam to biobased service ware. That reduced the amount of petroleum-based service ware on campus but the full benefits of the switch weren't realized because the biobased plastics were still being disposed of by conventional means.

Now, through a student-led research effort, UWSP is implementing a separate collection program for the biobased plastic service ware. It's called FRESH, for Focused Research Efforts for Sustainable Habits.

"Students are helping to educate the campus on differences between various biobased products and testing the economic feasibility of diverting recyclable biobased plastics from the waste stream," said Waneta Kratz, a UWSP graduate student hired by WIST to coordinate the project. "Data we're collecting will help determine the environmental and economical sustainability of these products."

The project is funded by grants from the Wisconsin State Energy Office and the UWSP Student Government Association. It will divert clear PLA plastic from the regular waste and recycling stream. PLA stands for polylactic acid and it is the material used to make a type of biobased plastic available on the market today. PLA is produced using sugars derived from plants such as corn, potatoes, tapioca, sugarcane, sugar beets, soy protein or wheat. Research is underway across the globe to derive those sugars from non-food sources of biomass such as corn stover, yard waste or forest trimmings.

Kratz put together a team of students to develop a website and design a logo and other communication pieces for the recycling campaign. Working with WIST Executive Director Paul Fowler, Kratz worked out logistics ranging from placement of dedicated PLA recycling bins to collection methods and times to get the material to the campus waste and recycling building.

The recycling campaign kicked off with the beginning of fall semester, as the Project FRESH team unveiled a new website, posters, and videos to publicize the project and manned information booths to answer questions.

"Response has been extremely positive," Kratz said. "We've had students approach us and ask if we had any volunteer opportunities for them to help with the effort. Many stu-



The poster shown above is one element of the awareness campaign in Project FRESH. Other elements include website, videos, and social media elements.



Separate recycling bins for the PLA plastic were placed around campus.

dents seem to be interested when they hear of our mission and want to be informed so they can make an educated choice on participating."

The most rewarding thing has been the feeling that this project is contributing toward UWSP's overall "green" reputation," Kratz said. "Support from administration has been a real confidence booster and helps me keep my momentum for the project up. I feel that this research effort is really continuing a long legacy of UWSP being an environmentally conscious university. It is also very rewarding to know that results from this research effort will impact future decisions on the campus and also potentially pave the way for similar projects to be implemented at other schools."

Complete information about the project, including photos and videos, is on the WIST website.

## Composting site manager Central Wisconsin Resiliency Project



WIST provided financial support for a composting site manager with the Central Wisconsin Resiliency Project. Guy Pledger was hired and worked as site manager from November 2010 to September 2011.

Primary goals included development of a composting site in Stevens Point and use of the finished compost for the Giving Gardens Program, and developing an estimate of food waste quantity in the greater Stevens Point area.

The Resiliency Project sought collaborations in terms of space (i.e. the site itself), feedstocks, equipment (for turning / screening the compost), and manpower. Contacts began with the City of Stevens Point's Public Works and Forestry Departments, and were later made with the Town of Hull and the Village of Whiting.

In addition, a potential composting site was located at the Resiliency Project's headquarters, the former Jackson Elementary school. Ultimately, Jackson Elementary was chosen as a site. Its spatial capacity, while low, was adequate for the pilot composting program, and its proximity to the Resiliency Project Headquarters and minimal need for preparations made it the optimal choice.

Pledger approached the nonprofit Recycling Connections Corporation (Stevens Point, WI) to obtain advice about procuring food scraps for composting, and compiled a list of restaurants/groceries perceived as "compost friendly." Starting in May, food scraps were picked up from several area restaurants and brought to the Resiliency Project's compost-

ing site. Subsequently, the scraps were mixed with yard trimmings in order to produce compost for the Giving Gardens. Discussions are currently underway to determine the logistics of continuing/expanding the pilot after the position is terminated.

By using data from the DNR's 2010 Statewide Waste Characterization Study, rough estimates of food waste and general organic waste were obtained for the City of Stevens Point. In order to refine these numbers, a food scrap generation/disposal survey was developed. Seventeen local grocery stores and restaurants were subsequently surveyed about their food scrap generation/disposal practices. Data from the surveys were recently compiled and will be useful for future food scrap composting initiatives.

The Giving Gardens program is the primary beneficiary of the finished compost; all fruits and vegetables that are produced from these gardens are donated to food pantries, thus fighting hunger and enhancing community food security. The majority of the compost will be used as a component in "lasagna" raised garden beds. Moreover, finished compost has already been used for planting fruit trees and a small raised bed at Jackson Elementary's garden. Vermicompost was applied as a top dressing for spinach, and these plants' ensuing growth will be compared to adjacent spinach that received commercial composted manure as a top dressing.

Several education / outreach activities were carried out, including a vermicompost lecture to SPASH students, and a vermicompost presentation to Head Start youngsters. Pledger also collaborated in a compost workshop (with Recycling Connections Corporation) for area residents.

A grant proposal was submitted to the Gannett Foundation in February. The proposal was successfully funded, allowing Pledger to upgrade the vermicompost system. Money was also used for purchase of greenhouse and watering equipment which will assist future gardening and composting initiatives.

# Communications

## Getting the word out

WIST works to communicate its mission and the institute's activities and accomplishments to a wide audience to promote interest in collaboration and sharing of ideas in sustainable technology development.

WIST activities drew interest from a wide range of publications, from local media such as the *Stevens Point Journal* and *Portage County Gazette* to the *European Rubber Journal*, which picked up a story about WIST's patent application for isoprene production using genetically modified bacteria. Stories about WIST appeared in *City Pages* in Wausau, the *Pointer*, *Marketplace Magazine*, and other print publications. CNBC.com posted a story about WIST's collaboration with Scarab Genomics, a story that was also picked up by a host of other on-line journals. A public radio network out of Nebraska interviewed Paul Fowler about developments in the bioplastics industry as part of a series on environment and business; the story ran on a number of sister stations from California to Pennsylvania.

WIST's website, [www.uwsp.edu/wist](http://www.uwsp.edu/wist), grew "from scratch" in the institute's first year and is expanding as a main source of information and point of contact. The website is also a launch pad for WIST's social media presence (see sidebar).

The institute disseminated several short videos on its website and via YouTube, thanks to production work by Michael Martin in the UWSP information technology department. Further video work is planned for the coming year.

While digital media is prevalent in communications today, brochures and flyers provide a more traditional and still-useful method of reaching a target audience. WIST produced a series of these publications in its first year for distribution at conferences, trade shows and special events. In keeping with today's digital world, each publication was also posted on the WIST website for easy access anywhere in the world.

### Fingertip access:

It's easy to keep up with the latest developments at WIST. Digital connections as close as your computer or smart phone include the WIST website and a host of social media sites.

Website:  
<http://www.uwsp.edu/wist>



In addition to finding WIST on LinkedIn, Facebook and Twitter, anyone can subscribe to the institute's electronic newsletter, an "eblast" distributed monthly via email. An easy newsletter subscription sign-up form is on the WIST website home page.



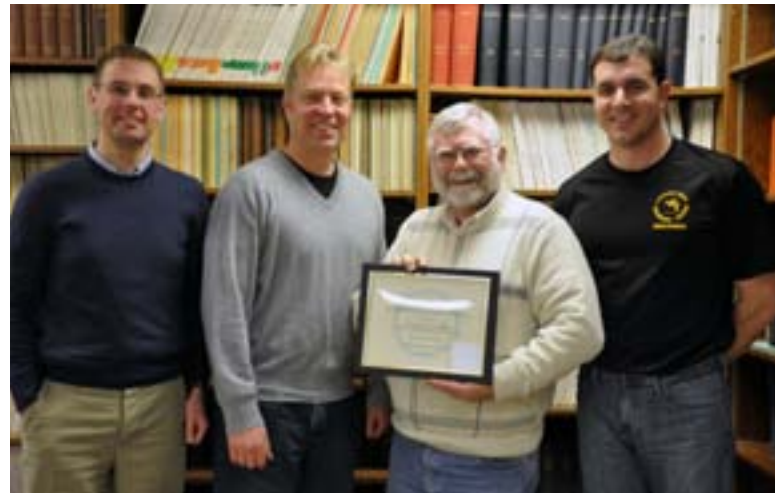
# EDA Innovation Award

The Wisconsin Institute for Sustainable Technology was named one of two finalists for the Economic Development Administration's "2010 Innovation in Economic Development Awards: Innovation in Green Technology."

WIST earned recognition for its work in biofuels research, a project that will culminate in the development of a biorefinery process that can be implemented in existing pulp mill infrastructure. This could breathe new life into Wisconsin's pulp and paper industries by providing new revenue sources.

The U.S. Department of Commerce Economic Development Administration presented the Innovation Awards (formerly known as the Excellence Awards) in four categories.

The EDA notes that the Innovation in Green Technology award "promotes innovative strategies in the development of environmentally-friendly technology, projects, or partnerships that attract substantial private-capital investment and create higher-skill, higher-wage jobs."



Pictured with the award from the Economic Development Administration are, from left, Paul Fowler, Eric Singaas, Gerry Ring, and Don Guay.

# Grant awards

**Major funding for WIST to date is through grants from the U.S. Department of Defense and the U.S. Department of Agriculture, with those grants totalling approximately \$3.9 million and allocated over a period of six years. In addition, successful grant activity over the past year includes the following awards:**

**Agency:** US Army Research Laboratory

**Title:** Sustainable Alternative Energy for Department of Defense, Task 3 Supplemental: Optimization of Isoprene Synthesis in *Scarab* K12 lines of *E. coli*

**Amount:** \$50,000

**Dates:** 9/1/10 – 8/30/11

**Agency:** US Navy NAVAIR STTR

**Title:** Phase I: Innovative Methods for the Conversion of Biomass to Short Chain Alkenes for the Production of Renewable Jet Fuels.

**Amount:** \$21,000

**Dates:** 1/15/11 – 7/15/11

**Agency:** Wisconsin State Energy Office

**Title:** Demonstrating the Chemical Recycling Potential of PLA Food Serviceware

**Amount:** \$12,500

**Dates:** 4/1/11 – 8/30/11

**Agency:** WiSys, WiSCAP

**Title:** Optimizing the Quality of Paper Manufactured from Two or More Component Pulps Using a Paper Pulp Pre-Processor

**Amount:** \$89,119

**Dates:** 9/15/10 – 9/30/2011

**Agency:** WiSys, WiSCAP

**Title:** Analysis of Pulp Mill Residuals Toward Optimization of Feedstock for Isoprene

**Amount:** \$33,735

**Dates:** 9/15/10 – 12/31/11

# WIST Scholars

American hazelnut may not be just for squirrels anymore. The hardy shrub, native to Wisconsin, could prove to be a valuable oilseed crop and generate additional jobs and income for the state.

Research on American hazelnut is one of four proposals awarded funding in 2011 through the WIST Scholars Program. The program aims to extend the institute's mission of improving the economy and environment of Wisconsin and the region by spurring collaborative research.

Plant oils have many uses from food to fuel and perennial plants such as hazelnut are particularly attractive because they require lower annual inputs than annual crops. Perennials also may provide environmental benefits such as wildlife habitat while still yielding an economically valuable crop. Initial research on American hazelnut has been promising. The WIST grant of \$24,435 will help researchers continue to characterize the genetic structure of American hazelnut, fine-tune micro-propagation techniques, and conduct field trials.

WIST Scholar applicants are encouraged to submit proposals that link researchers in different colleges across the UWSP campus and with external partners, said Paul Fowler, executive director of WIST, and the hazelnut research is a good example. Mike Demchik, a UWSP College of Natural Resources forestry professor, is joined in the project by Jason Fischbach, UW Extension; Brent McCown, UW-Madison; and Anthony Kern, Northland College.

"We encourage people to think broadly and laterally about sustainable technology," Fowler said. "These collaborations produce creative ideas and solutions, sometimes just by taking a new look at something that's been around forever."

Funding for this program is provided by the USDA National Institute of Food and Agriculture.

Other 2011 WIST Scholar Program grants awarded:

- \$34,724 to Gene Martin, Doug Miskowiak and Keith Rice, of the UWSP Geographic Information System (GIS) Center and the UWSP Department of Geology/Geography. The project will use a combination of GIS tools to model commuting routes, total miles traveled and other parameters of travel by UWSP staff and students. The research will estimate fuel consumption for transportation and identify the most productive changes to reduce fuel consumption.

- \$7,554 to John Leschke, UWSP College of Professional Studies School of Business, and Corky McReynolds, director of Treehaven, the College of Natural Resources education center near Rhinelander. The project will examine potential for Treehaven as a destination for nature-

based tourism in order to generate additional revenue to support the facility. While the project is focused on Treehaven, it aims more broadly to create a business model for other north-country communities and businesses to add jobs and increase market opportunities.

- \$10,038 to Amit Arora and Don Guay, UWSP Paper Science and Engineering, for research into a process that would decrease the need for chlorine-containing bleaching chemicals in paper production, leading to a more environmentally-friendly process. Guay is also Director of Laboratory Services for WIST.

This was the second round of research grants awarded through the WIST Scholar Program. In 2010, seven grants for a total of \$119,000 were awarded to UWSP faculty and staff:

- \$5,274.50 to Robert P. Wolensky and Edward J. Miller, Co-directors, Center for the Small City for development of the conference "Environmental Sustainability and Economic Growth: Two Educational Outreach Forums"

- \$25,000 to William M. DeVita for "Devel-

Students measure residual biomass as part of a research project.



oping an Economical Analytical Technique for Identifying Manure Contamination"

- \$25,000 Kevin M. Czerwinski and Gerry Ring for "Development of ACCCELL Highly Reactive Cellulose"

- \$5,000 Paul F. Doruska for "Residual Biomass Equations, Including Stand History Effects, for Plantation Grown Red Pine (*Pinus resinosa*) in Wisconsin"

- \$42,370 to Dr. Les Werner, Dr. Brian Sloss, Dr. Rob Michitsch, Dr. Aga Razvi for "Environmental Microbial Analysis and Research Laboratory"

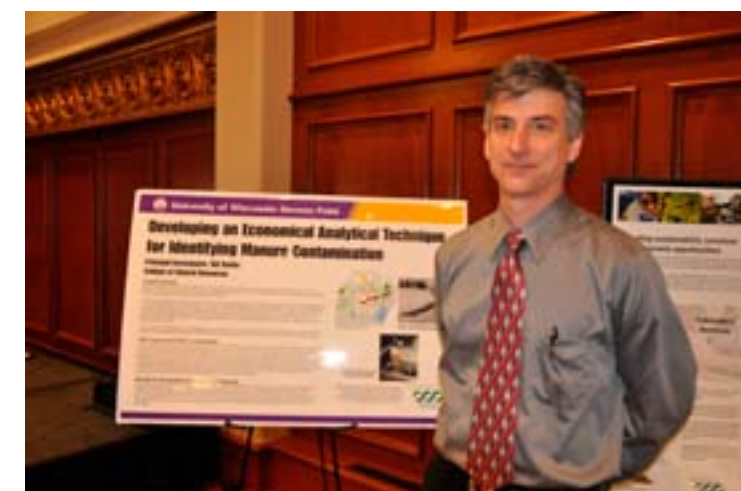
- \$7,935 to Karyn Biasca for development of the course "Life Cycle Assessment"

- \$4,276 to Robin Tanke for development of the course "Green Chemistry"

A WIST Scholar grant helped establish the Environmental Microbial Analysis and Research Laboratory, shown at right.



WIST Scholars were invited to display posters describing their work at the inauguration of UWSP Chancellor Bernie Patterson in spring 2011.





# Outreach

Executive Director Paul Fowler, Director of Education Gerry Ring, Director of Laboratory Services Don Guay, and Director of Research Eric Singaas traveled near and far over the past year in order to build the foundation for partnerships to increase WIST capacity.

On campus, WIST hosted a series of presentations outlining the institute's mission and goals and describing the WIST Scholar program, scheduling a presentation at each of the four colleges to inform faculty and staff.

Off campus, WIST directors traveled to conferences, business group meetings and special events to discuss the institute's goals and activities. They also visited individual businesses and organizations in Wisconsin and beyond the region to discuss opportunities for collaborations. Just a few examples: Singaas was invited to present his research at a conference in Europe and scheduled a visit with a major European rubber manufacturer on the same trip. The manufacturer is interested in WIST's isoprene research. Guay had meetings at several paper and pulp mills in Europe to provide information on WIST lab capabilities. Ring met with paper and pulp mill managers in Wisconsin to discuss potential research and development opportunities. Fowler attended the Biopolymers Symposium in Denver, presented at the Northwoods Research Summit at Treehaven, and traveled to Washington, D.C. to meet with Defense Department and Congressional representatives.

Paul Fowler addresses attendees at the annual Legislative Breakfast hosted by UWSP Chancellor Bernie Patterson in February.

In addition to presenting research at technical meetings and meeting with businesses, WIST reached a broader audience through special events. For example, Fowler was the featured speaker at Phi Kappa Phi Spring Colloquium at UWSP, and was invited to provide opening remarks at the premiere of the movie "Green Fire: Aldo Leopold and a Land Ethic for Our Time." Singaas presented at the Midwest Renewable Energy Association.

Eric Singaas, left, describes some of the instrumentation in the WIST lab to Chancellor Bernie Patterson, center, and Paul Jadin, CEO of the Wisconsin Economic Development Corporation.



WIST displays at special events included posters illustrating research projects underway.



# WIST Staff



Paul Fowler

Paul Fowler, WIST's executive director, came to WIST from Wales, UK, where he was director of the Welsh Institute for Natural Resources, a financially self-supporting unit at Bangor University. He has a dozen years' experience in contract research and development of new products and opportunities from biobased materials. As executive director of WIST, Paul is networking with public- and private-sector organizations and companies to develop new sustainable technologies with commercial applications to benefit the economy and the environment. Paul has a Ph.D. in organic chemistry and extensive knowledge of biobased, renewable materials and applications.



Angie Hauer

Angie Hauer is WIST's administrative associate. Angie coordinates daily office activities, supplies, and correspondence. She has a bachelor's degree in resource management from UWSP and a master's in outdoor recreation administration from Southern Illinois University at Carbondale.



Rebecca Vagts

Rebecca Vagts is WIST's business manager. As WIST Business Manager, Rebecca is responsible for the fiscal management of the WIST grants and contracts including developing budgets in grant narratives, budget review, account reconciliation, and fiscal reporting. Rebecca has an MBA with a Global Emphasis and a BS in Business Management from Upper Iowa University.



Ron Tschida

Ron Tschida is WIST's communications manager. Before coming to UWSP in 2005, Ron was city editor of the Bozeman Daily Chronicle in Bozeman, MT. He has a master's degree in journalism from the University of Montana in Missoula.



Don Guay

Don Guay, WIST Director of Laboratory Services, is an associate professor in Paper Science and Engineering at UWSP, where he has taught since 2004. Don received a bachelor of science degree in paper science from UWSP and a doctorate in chemistry from the University of Maine in Orono, Maine. His research interests include biofuels, pulping, bleaching, and fiber management.



Gerry Ring

As WIST's Director of Education, Gerry Ring has worked to develop a multidisciplinary bio-fuels minor at UWSP. The Education Division also offers outreach courses, such as hands-on papermaking. In addition to his WIST responsibilities, Gerry is Chair of the Department of Paper Science and Engineering. In 1980 Gerry began his paper industry career as a Research Scientist for Kimberly-Clark Corporation. In 1986, Gerry joined the faculty of UWSP. He has edited or contributed to 14 publications, including the Colloid Chemistry of Papermaking Materials textbook. He holds three patents and was recognized in the 1994, 2000 and 2004 editions of Who's Who Among America's Teachers. Gerry received an Award for Excellence from the University Continuing Education Association, Region IV in 1999. Gerry is a TAPPI Fellow, an honorary title bestowed upon less than one percent of TAPPI's membership, and is given to individuals who have made extraordinary technical or service contributions to the industry and/or the Association.



Eric Singaas

Eric Singaas is the Director of Research at the Wisconsin Institute for Sustainable Technologies. He applies his scientific training to research in biofuel and bioproduct production, focusing on developing microbial pathways to produce isoprene from biomass. Eric received his Ph.D. in botany from the University of Wisconsin – Madison in 1997 studying the production of isoprene from oak and kudzu leaves. He went on to investigate the impacts of increasing greenhouse gases on forest ecosystems in Free Air CO<sub>2</sub> Enrichment experimental systems in North Carolina and Wisconsin. He has studied biological hydrocarbon production and plant-atmosphere gas exchange, working on scales ranging from genes to ecosystems. Eric is an associate professor of biology at UWSP and teaches introductory biology, tree and forest function, plant physiology, and seminars in climate change biology and plant-environment interactions.



Justin Hall

Justin Hall is an instrumentation specialist at WIST. He is a 2011 graduate of UWSP with a bachelor's degree in water resources and a minor in chemistry.



Kelly Klaas

Kelly Klaas is the WIST laboratory manager. She takes care of contract laboratory services, as well as running and maintaining the pilot paper machine and other testing equipment. Kelly has a bachelor of science degree in paper science from UWSP, and is currently in graduate school for a master's degree in biological systems engineering at UW-Madison.

The Wisconsin Institute for Sustainable Technology —

*Creating sustainability solutions  
and economic opportunities*

**WIST offices are in the Science Building  
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