**SUSTAINABLE USE OF RENEWABLE RESOURCES - ENHANCEMENT OF THE ENVIRONMENT**

**BioBrief**

**High Performance Housing**
How BBE Faculty and Researchers are improving housing for both families and animals

Advanced Building Systems and Energy Efficiency, one of BBE’s four core areas, involves research and academic programs related to building systems, both for humans and for animals and livestock. The overall approach of this effort centers on using a systems engineering and integrated design approach for buildings.

**RESIDENTIAL HOUSING**

The Cold Climate Housing program (CCH), started in 1986, is an information and education program promoting the idea of the “house as a system.” The program grew out of the energy crisis in the late 1970’s and the desire to make homes more energy efficient. Home owners added insulation to walls and attics and caulked any spot where air leaked out. But, as is the case with any system, if one component is altered it affects the rest of the system. Increasing a home’s insulation decreases air flow; this can lead to moisture problems. Solving this type of problem with proper ventilation will improve the systems approach to home building and remodeling. Associate Extension Professor Pat Huelman and his research group, Research Fellow Tom Schirber and Senior Researcher Louise Goldberg, Ph.D (Eng), look at the big picture of residential building systems by breaking it down into 4 metrics: energy efficiency, durability, indoor air quality and safety.

In 2011, a group of researchers led by Huelman and John Carmody, of the U’s Center for Sustainable Building Research, was selected by the Department of Energy (DOE) to be part of the Building America Partnership (BA). The team, named NorthernSTAR, is exploring the next generation of high performance homes for cold climates. The long term goal of BA is to increase the energy efficiency of new homes by 50%, and existing homes by 20 to 30%. The original focus of BA was on new construction. Builders would be trained to construct energy efficient residences using advanced building technologies. For example, innovative framing methods, designed to save money on structural components, allow the builder to channel the savings into other energy saving measures such as insulation. More money spent on improving the envelope or enclosure of the home means that less money needs to be spent on the mechanical systems required to keep the home environment comfortable. Building America teams help train builders to reassign the dollars spent on newly constructed homes. Now, due to the change in the economy, they are also working with existing homes. Whereas new home construction is a somewhat uniform process, existing homes have individualized issues unique to that home. The NorthernSTAR group is meeting these challenges by experimenting with techniques and processes that will help to standardize energy efficient remodeling.

One example of the innovative techniques being researched by Huelman’s group is the Exterior Thermal and Moisture Management System (ETMMS). The research began when they...
THE RESIDENTS OF THESE HOMES ARE SEEING ENERGY SAVINGS OF UP TO 50%.

reexamined the placement of a home’s structural components, thermal layer, and moisture control layer. In Schirber’s words, ETMMS is the process of applying the moisture and air control layers on the outside of the house, providing continuous coverage. Once applied, the structure is air and water tight. ETMMS can be applied to almost any structural system. ETMMS, in combination with a new panel wall system has been used to construct four houses in the Twin Cities thus far (to learn more about wall systems, read: The Perfect Wall http://www.buildingscience.com/documents/insights/bsi-001-the-perfect-wall/). The residents of these homes are seeing energy savings of up to 50%. The cost of building this type of home is coming in line with traditional construction costs. The sky is the limit with this process and many new applications are in the works.

CLOQUET RESIDENTIAL RESEARCH FACILITY

Located at the U of M’s Cloquet Forestry Center, it was designed as a test bed to evaluate the long-term, cold-climate performance of full-scale building envelope components including foundation insulation, wall, wall/window interface and roofing systems.

ANIMAL HOUSING

With rising fossil fuel costs, increasing climate change, a growing public concern associated with air quality issues, and regulatory push for lower emissions, there is an increased need for the livestock and poultry industry to design and build more efficient and environmentally friendly animal housing systems.

BBE’s Animal Housing and Livestock Systems Program works with the animal agriculture community to develop these energy efficient and environmentally friendly practices and concepts. In order to accurately define the issues and their impact, in 2010, Professor and Extension Engineer Larry Jacobson lead a team of experts from several Midwestern universities and the private sector to develop a housing system for grow-finish pigs that lowers the environmental footprint of this important phase of pork production. The goal of the study was a 50% reduction in fossil fuel energy use and air emissions while increasing worker and animal wellbeing. The list of building features or criteria to meet this goal included elimination of deep pit manure storage inside the building, a tight and well insulation building shell, and the capability to cool the pigs with a non-evaporative system such as geothermal.

In the past, animal housing concerns were primarily focused on manure management to maintain surface and ground water quality, now these system are looking at other environmental impacts such as air quality and lowering the carbon footprint of confinement operations. By taking a holistic approach, the new conceptual design integrates all components, providing optimum conditions for animal production. The goal is to create building design components and management practices that can be used on both new and existing facilities.

Examples of research in BBE incorporating these ideas are the study of Geothermal Recovery Systems (GRS) by Jacobson, in addition to Professor and Extension Engineer Kevin Janni’s research involving the Compost Barn System and a new project assessing a cost effective method for monitoring and evaluating systems that mitigate gas emissions.

Dr. Jacobson is studying the use of a Geothermal heating and cooling systems for use in animal housing systems as a more cost effective source for cooling barns in the spring, summer, and fall. The GRS system captures energy from the earth and with a simple engineering design, pretempers the inlet ventilation air for the pig building, cooling the barn in the warm and hot weather and heating the barn in the winter. The preliminary results from this first study have shown the potential to provide large amounts of energy for cooling animal buildings which can improve animal productivity by improving feed efficiency and reducing days to market thus saving feed plus preventing health issues and mortalities. Because ventilation rates are reduced by 50% or more when cooling is used air emissions are reduced. The need for developing designs that utilize non-evaporative cooling systems such as geothermal are critical as we continue to experience a changing climate that is warmer and wetter.

Within the dairy industry, Dr. Janni has collaborated with animal science faculty to research Compost Dairy Barns in the upper Midwest. Compost Diary Barns are a new dairy housing option developed and used in the Upper Midwest which uses dry fine wood shaving or sawdust that is stirred twice a day in a loose housing system that replaces freestalls. The stirred bedded pack system provides a very comfortable resting pack area for exceptional cow comfort. The composting pact relies on microorganisms to break down organic matter in the animal waste and generates heat to drive off moisture. With good pack management and ventilation, results show cows are clean, comfortable, have fewer lameness problems, and increased milk production.

Currently, Janni is the lead investigator of an integrated research and extension project to assess a cost effective method for monitoring and evaluating systems that mitigate gas emissions. The research component will assess whether 24-hour bag samples are an effective method for measuring and monitoring biofilter performance.
The project’s stakeholder-driven Extension component is developing a web-based decision tool to assess the economics of different mitigation practices and six videos designed to help decision and policy makers understand key elements of effective researched mitigation technologies. The materials will be available on the web through the Livestock and Poultry Environmental Learning Center for continued technology transfer.

Although there are different sets of issues with residential homes and animal and livestock housing, there are common economic and environmental concerns. BBE, through unique collaborations within the department and with outside partners, helps identify issues, conduct research, and provide solutions, making significant contributions to the improvement of building performance.

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**NOTE FROM THE DEPARTMENT HEAD**

Greetings! Hope your summer is going well and staying cool from the record heat!

Things are going well on campus. We completed another successful year in BBE. I would like to start off this newsletter note by congratulating our graduates, this is a significant achievement and we are all proud of them. (refer to page 5 for a list of our graduates). On the employment front, things seem to be improving and our graduates have gone on to pursue many different career paths. Please join me in wishing them the very best!

On the education front, our undergraduate engineering program continues to attract top quality students with 481 fall student enrollment possibly reaching 140. We have more students entering BBE as freshmen through CSE this Fall. For our undergraduate programs through CFANS we are continuing to put more emphasis on student recruitment. With the advice and feedback from our advisory council and stakeholders, BBE faculty are exploring the concept of envisioning our CFANS undergraduate programs under a broader sustainable systems, technologies and products management perspective. We are continuing to diligently explore this concept, seeking input and feedback from faculty from all across the campus. We recently obtained funding from CFANS to further explore this concept. With several changes in some of our courses and some broad based introductory topics such as renewable energy and the environment, recycling, sustainable housing, our overall teaching productivity has improved dramatically thanks to all of our faculty and staff. We are hoping that in the long term this will help with funding for graduate students and strengthen our graduate program.

On the research front, BBE faculty continue to be excellent in receiving several research grants from state, federal and private industry spanning the whole spectrum of topics ranging from air quality, renewable energy, food, to sustainability. Last year we received a total of $9.7 million in grants with 46 grants being awarded, ranking among the top in the college. There were 80 peer reviewed journal publications; 19 book chapters, editorship etc., 38 non-peer reviewed publications, 26 Extension publications, with approximately 150 total current projects, and 80 graduate student advisees by BBE faculty across many programs on campus. In this issue of the newsletter we feature exciting work under the key area of Advanced Building Systems and Energy Efficiency, highlighting how our department’s researchers work with other professionals and community to resolve current issues around housing sustainability. Please stay tuned and in future newsletters we will try to cover other areas of exciting new research.

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**BIOFILTERS**

Many livestock facilities are known to emit ammonia, hydrogen sulfide, odors and greenhouse gases. Biofilters, which are biologically-active beds of solid substrates such as wood chips, can be used to clean air exhausted from livestock barns and manure storage units and are a continuing research focus for Dr. Janni and Dr. Jacobson. With the help of USDA NIFA funding, the team is collaborating with BBE faculty members Dr. Jonathan Schilling and PhD student Jason Oliver to learn more about the microbial communities residing within these filters. They are studying which organisms are present at different locations within the biofilters and how they affect biofilter performance, both individually and collectively. “I was sold on the biofilter technology,” says Schilling, “not with tables of data but by a picture of this group’s advisory board having lunch right next to a swine barn using biofilters to treat 100% of the ventilation exhaust. They work. To optimize and extend this technology, however, it will be useful to better define and understand the biological component driving performance. That is our role.”

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On the Extension front, I am pleased to inform you that Prof. Gary Sands has taken on the leadership role of Extension Program Leader for Water Resources.

This year we were very fortunate that several of our faculty were recognized for their service, contributions and leadership with number of prestigious and well-deserved honors and awards including the McKnight Land-Grant University professorship (Dr. Jason Hill) and U of M Alumni Horace T. Morse award for undergraduate education (Dr. Ulrike Tschirner) (additional department highlights can be found on page 7). Please join me in congratulating each of them for their accomplishments. It is indeed an honor and privilege to have truly award winning faculty in BBE.

Prof. Vance Morey after almost 42 years of dedicated service, leadership, and immense contributions to the profession, touching the lives of many, is moving into phased retirement as of this July and retiring at the end of 2013. I am sure many of you have fond memories of taking classes taught by Vance or working with him when you were a student or as a fellow colleague and friend. Please join me in thanking Vance for all of his valued contributions and wish him the very best for upcoming retirement.

I am pleased to announce that Dr. Beth Nelson was recently appointed as the Director of North Central Region Sustainable Agricultural Research and Education (NCR-SARE) program, a long standing highly successful USDA grant program promoting sustainable agriculture. I would also like to take this opportunity to thank Prof. Vance Morey for his leadership as the interim Director and Prof. Bill Wilcke for his visionary leadership in helping to bring the NCR-SRAE program to Minnesota several years ago. Thank you all!

On the building remodeling front, the remodeling of the BAE and Engineering and Fisheries building is still the #1 collegiate priority and it is one of the items in the University’s 6 year capital plan approved by the Board of Regents. We hope to be in the 2014 legislative bonding request and we need all of your help in making this happen.

Our Fall scholarship recognition luncheon, advisory council meeting, research poster session is scheduled for Thursday, October 25th in the St. Paul Student Center. We would like to invite you to participate in this event and recognize the accomplishments of our students. Please mark this date in your calendar.

I would like to thank you all again and hope you have an enjoyable rest of the summer and year. Please contact us or drop by. We would love to hear from you. Hope to see you on campus this Fall (October 25th), if not sooner.

Shri Ramaswamy, Professor and Head
BBE’s Capstone Design class Project is where students, working in teams, are challenged to design, develop, select, formulate, and complete an open-ended, comprehensive engineering design for a process/system/product solution. Once these teams have completed their design project, they present the details of their designs, results, projections, and conclusions to an audience.

**THIS YEAR’S DESIGN PROJECTS AND STUDENT TEAM MEMBERS:**

- **Integrating Fermentation and Ethanol Separation Processes**<br>  - Jenner Omodt, Brian Kuennen, Trevor Peterson, Yuxi Zhao

- **Algae Dewatering**<br>  - Kevin Chung, Vedansh Gupta, Chris Huelsnitz, Brady Krueger

- **Restoration of Stoney Creek for Flood Management and Trout Habitat Creation**<br>  - Mayank Gupta, Kayla Koenen, Jessica DeGennaro, Leigh Severson, Abby Morrisette

- **Lutsen Ski Resort Snowmaking and the Poplar River: A Designed System for Water Withdrawal**<br>  - Matias Valero, Nick Grewe, Karla Bussen, Robert Little, Cory Gieseke

- **Antioxidants Extraction Process from Grape Pomace**<br>  - Sharifah Syed, Vivian Zhang, Ngoc Nguyen, Connie Prom

- **Fungal Lipids from Lignocellulosic Material for Biodiesel Production**<br>  - Jeff Chambers, Keaton Meinel, Claire Dockter, Chris Rothstein
GRADUATION!

Some of the organizations where BBE students/graduates were offered intern/full time positions:

3M
Appleton Coated
Bose
Crystal Sugar
Land O’Lakes
MnTap
USGS
Viking Forest Products

Andersen Corp.
Barr Engineering
Clearwater Paper
Georgia Pacific
MTI Inc.
SSCO
U.S. Water Services
Weekes Forest Products

CORPORATE ENVIRONMENTAL MANAGEMENT
Britta Anderson
Orsan Kharbush
Go Matsumori
Luke Nichols

BIOPRODUCTS MARKETING & MANAGEMENT
Kevin Anderson
Sui Wah Cheung
Andrew Dahlin
Matthew Domski
Aaron Dotzauer
Mark Fahey
Christine Forland
Angelina Gandini
Eric Gunderson
Jeffrey Helseth
Matthew Holtz
Aaron Holzbauer
Thorn Houth
Alexander Jasko
Ryan Lang
Judd Larson
Jonathan Leitzke
Daniel May
Michael Raley
Gwendolyn Ruehle
Cody Schultz
Shawn Sullivan
Dean Tran

BIOPRODUCTS & BIOSYSTEMS ENGINEERING
David Buck
Kevin Chung
Claire Dockter
Mayank Gupta
Kayla Koener
Samuel Koerner
Brian Kuennen
Abigail Morrisette
Ngoc Vu Nhu Nguyen
Jenner Omodt
Trevor Peterson
Joby Irene Petronis
Adam Poetter
Connie Prom
Christopher Rothstein
Leigh Severson
Zachary Tauer
Matias Valero
Blake Wageman

GRADUATE STUDENTS
Amit Aggarwal, M.S.
Sunayana Chaudhry, M.S.
Geoffrie Kramer, M.S.
Yeong Li, Ph.D.
Yun Li, Ph.D.
Nagendra Prasad Palani, M.S.
Heidi Peterson, Ph.D.
Hao Sun, M.S.
Lei Xu, Ph.D.
Wanying Yao, Ph.D.

College of Food, Agricultural and Natural Resource Sciences
College of Science and Engineering
Leigh Severson graduated this past spring from Bioproducts and Biosystems Engineering specializing in Environmental and Ecological Engineering. Leigh, discovered the Department of Bioproducts and Biosystems Engineering while on a tour of the University of Minnesota her junior in high school.

How did you become interested in Environmental and Ecological Engineering?
I liked the idea of hands on research and having grown up on a lake, Professor Nieber’s research in the area of water sustainability appealed to me. I decided to pursue this interest and I have worked with Professor Nieber for two summers on research projects.

What were the projects you worked on?
The first project I worked on with Professor Nieber was a stream survey on the North Shore, collecting data to determine if and why sediment transport was happening. The second summer I worked with Professor Nieber on a project through the USGS (U.S. Geological Survey). We looked at evidence of toxic waste from oil damage related to an oil pipeline that ruptured. Retesting in the original test zone we learned that years later the ground was still repellent. The mix of taking classes and being able to do the summer work helped me with school.

What was your most memorable experience in BBE?
My favorite class was Agricultural Waste Management, taught by Chuck Clanton. At the beginning of the semester everyone was given a sample of cow manure which we analyzed for the following 3-1/2 months. I learned so many different things in this class: how to properly dispose of dead animals, about covered lagoons, and how to measure B.O.D. – which ties into more than just manure (it can also be used to measure oxygen in water and water quality). He is a strong teacher with a good personality, a sense of humor, and understands students. He sees where students need help and jumps in with suggestions and ideas.

Tell us about your study abroad
During fall semester I participated in the study abroad program in India. During part of the program the students went to different internships associated with their area of study. I went to Udaipur with a couple of other students and worked as an environmental intern at a non-governmental organization (NGO). We learned how the Indian government regulates ground water and surface water in rural areas and interviewed villagers and professionals on watershed projects they would like to see. Taking our research, we created a suggested outline that the NGO could use to write a grant proposal on behalf of the village.

What are you doing next?
This summer I am doing an internship with Minnesota Technology Assistance Program. I will be working with a laundry service in Saint Cloud to see if it is possible to reduce waste water and if it is viable to recycle the waste water. I will be helping to develop this process. 


In 2003, Jim Johnson, 1966 Agricultural Engineering graduate, opted to come out of retirement and start MC Electric Vehicles in Seattle Washington. Having a chance to talk with Jim and hear his life story it is clear that all of his experiences have lead him to where he is today; utilizing the skills he developed as an engineer, manager, and small business owner.

At an early age, growing up on a farm in Lindstrom, Minnesota, Jim wanted to get out and see the world. Inspired by a talk given by Dr. Flikke, of the U of M’s department of Agricultural Engineering, he applied to the University. “As an engineering major, I had to constantly work hard. It taught me fortitude, persistence, and hard work. This gave me the confidence that I could tackle anything.”

After graduation Jim was hired as a Development Engineer for Caterpillar (CAT). A year later, he transitioned into sales. This gave him the ability to travel around the country, eventually becoming a regional rep in the Pacific Northwest, settling in Seattle. He then went on to senior management positions at NC Machines playing a major role in the construction of Alaskan pipeline.

With his experience and awareness of the large machinery markets at CAT and NC, Jim founded MC Machinery starting with smaller lawn maintenance machinery. The company marketed to golf courses, school districts and municipal park departments. The company thrived up until 9/11 when everything collapsed - at this point he decided to retire.

But retirement only lasted a few years. …”I started looking at the world and the big picture -what is my role and what do I do. How can I use the skills that I developed?”

The Electric Car
In 2003, Jim established MC Electric Vehicles, originally focusing on the electric car. In the beginning there were many hurdles that he had to leap (enclosing the vehicles, adding seatbelts, working with the city …) to make these vehicles street legal in Seattle. Today, with the advancement in technology, such as replacing lead acid batteries with lithium batteries, coupled with the 2007 rise in fuel prices, the face of the electric vehicle and how it is used is changing.

With number of electric high speed vehicles appearing on the market today (Leaf, Volt, Ford Focus…) Jim feels MC Electric Vehicles niche market...
is the 35 mph electric vehicle. In the private sector, it is an affordable, environmentally friendly second car ideal for small trips.

In the public sector, as Seattle moves towards a 100% “clean and green fleet”, (including utilizing a Federal Grant to install 50 charging stations on city property), MC Electric Vehicles is seen as an active participant in that goal. A few years ago, the city purchased electric trucks from MC that were used to navigate the alleys in Seattle for garbage pickup. In the past few months, MC launched their latest vehicle, Firefly, a three-wheel Essential Service Vehicle (ESV) the city will use for parking enforcement.

With the current politics around fossil fuels and after experiencing firsthand the building of the Alaska pipeline and how it affected the economic serenity; Jim is enjoying taking the skills that he has developed and using them to develop a business that fits his values today. / / / /

A SPECIAL THANK YOU FOR GENEROUS DONATIONS

I would like to take this opportunity to thank you for your philanthropic contributions supporting our students and programs. Your support goes a long way in helping make the education of several of our highly qualified and deserving students possible. Thanks to your generosity last year were able to provide about $85,000 in total undergraduate scholarships. We were very fortunate to have two of our donors - Richard Fowler and Elizabeth Thompson - establish scholarship endowments. I would like extend our sincere thanks and appreciation to both of them and their families for their generosity.

Your continued support is vital to our future. Please visit our web site www.bbe.umn.edu/Gifts to learn more about how you can help and make a difference. Your support to any of our top priorities - undergraduate scholarships, graduate fellowships, professorships or building remodeling – is greatly appreciated.

Sincerely,
Shri Ramaswamy

Department Highlights

Professor Larry Jacobson was honored by CFANS during the Spring Faculty and Staff Awards with the Distinguished Extension/Outreach Award acknowledging his continued outstanding service and dedication.

Professor Jason Hill has been chosen this year as one of the recipients of the University of Minnesota McKnight Land-Grant Professors. The goal of the program is to advance the careers of the most promising junior faculty at a critical point in their professional lives.

Professor Kevin Janni received this year’s Richard C. Newman Award for Outreach and Community Impact. “Kevin is a very thoughtful colleague. His collaboration across the campus, state agencies, and in some cases other states, is impressive.”

Professor Gary Sands has been promoted to full Professor.

Professor Ulrike Tschirner has been awarded two distinguished teaching awards: Horace T. Morse Award - The University of Minnesota Alumni Association Award for Outstanding Contributions to Undergraduate Education. Recipients are honored for their performance as teachers and advisors to academic program development; and educational leadership.

George W. Taylor/CSE Alumni Society Award for Distinguished Teaching - Established in 1982, the Taylor/College of Science and Engineering Alumni Award for Distinguished Teaching recognizing outstanding contributions to undergraduate and/or graduate teaching.

Professor Jonathan Schilling received this year’s Richard C. Newman Award for The Art of Teaching. “He is an instructor that goes to great lengths to make sure his students are learning in his course.”

Professor Shri Ramaswamy

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Sincerely,
Shri Ramaswamy
UPCOMING EVENTS:

Thursday, October 25th

- 2012 Scholarship Award Luncheon and BBE Advisory Council Meeting
  
  Location: Saint Paul Student Center
  
  for more info: http://www.bbe.umn.edu/

IN THE NEXT ISSUE OF BIOBRIEF:

Water Sustainability

The Minnesota Legislature defines sustainable water use “as that which does not harm the ecosystems, degrade water quality, or compromise the ability of future generations to meet their own needs.” The next issue of BioBrief will explore how faculty and students are researching this important issue.