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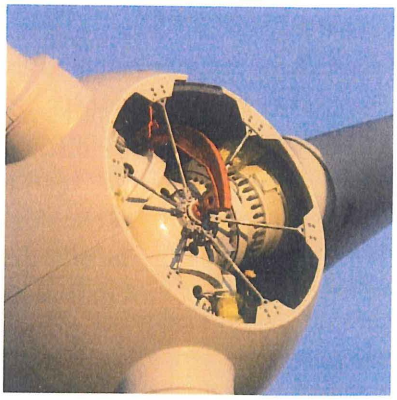
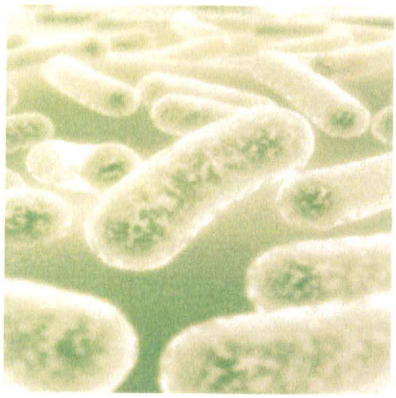
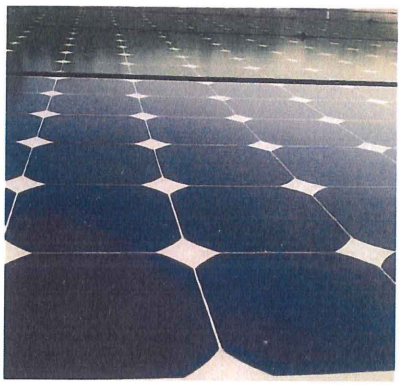
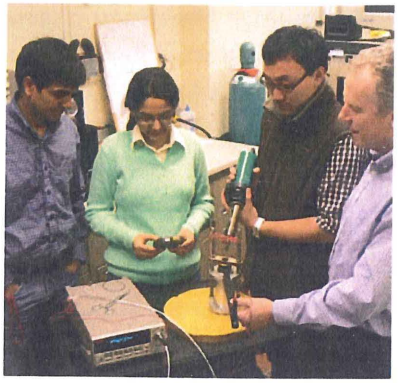






Initiative for Renewable Energy & the Environment (IREE)

2012 Annual Report

(FY11-2012)

IREE

INSTITUTE ON THE ENVIRONMENT

UNIVERSITY OF MINNESOTA

Driven to Discover℠

A Note from the Director

Richard A. (Dick) Hemmingsen

It is with deeply mixed emotions that I write the preface to this 2012 and- unfortunately – final IREE Annual Report. In the wake of the decision of the 2012 Legislature to discontinue direct funding from the Xcel Energy Renewable Energy Development Fund to IREE, the decision has been made to sunset the program.

Many of you have followed the development of this innovative program at the University of Minnesota, from early meetings in the fall/winter of 2003-04 to numerous educational symposia, to the highly successful annual E-3 conference, to ever-increasing interactions with University of Minnesota faculty.

Certainly, the time for the University and the state was ripe for the launch of this compelling program. With the foresight of key leadership and with broad, bi-partisan legislative support, significant resources from the Xcel rate-payer supported CIP and RDF funds have been strategically invested to propel renewable energy technology development in Minnesota.

I've been privileged to serve the University and the state as Director of these efforts. Working closely with visionary administrative and faculty leadership from the University, with forward-thinking legislators and agency officials, and with key business and industry partners, these efforts have collectively put Minnesota on the map with respect to innovative renewable energy technology development. Some of the metrics of this success are summarized later in this report so I won't repeat them here.

It is, however, safe to assert that–while there may be other Universities with deeper bench strength in certain areas of renewable energy technologies–there are none that have the depth and breadth of faculty expertise as the University of Minnesota. I'm proud that IREE has had a major role in sharpening that profile.

Why Minnesota? The answer is pretty straight forward….it's our resources. We're not blessed with any fossil-based energy sources to exploit. We are, however, blessed with an abundance of "traditional" (pre-petroleum) energy resources which are at our disposal: biomass, wind, solar, geothermal, etc.; along with innovative policy development; and deep reservoirs of capacity and expertise in our academic, business, government, and NGO community.

Driven by our mission, IREE sought to exploit their strengths to significantly advance the renewable energy economy for Minnesota. I believe those efforts, while unfinished and prematurely coming to an end, were successful.

It is my fervent hope and frankly, it is my expectation that the state and the University will soon acknowledge that these opportunities are simply too compelling and too costly to toss aside and that in the not-too-distant future, we'll come to the collective realization that "IREE had it right". Ultimately we will, in my judgment, "go back to the future" and continue to build on the legacy that IREE leaves our community. It's the right thing to do for our ec0nomy, for our environment, and for our future.

Sincerely

IREE Founding Director

A brief history of IREE

In fall 2002, a small group of faculty and administrators at the University of Minnesota began to discuss the need for a coordinating mechanism to raise the profile of renewable energy research and development at the university and across the Midwest. These discussions soon merged with those of government representatives who shared a similar goal.

By early 2003, the decision was made to form the Initiative for Renewable Energy and the Environment (IREE). A significant strategic choice was to ensure that the developing initiative be institution-wide, and not tied directly to a single college or unit. During that year's state legislative session, the Minnesota Legislature directed portions of the Xcel Energy Renewable Energy Development Fund (RDF) - supported by Xcel Energy electricity ratepayers - and Xcel's Conservation Improvement Program (CIP) to IREE to invest in a broad range renewable energy research and demonstration technologies. The 2003 legislation spelled out a specific, but comprehensive range of eligible renewable energy technologies. At the same time, University of Minnesota President Robert Bruininks designated the environment and renewable energy as an institutional priority.

With the initial influx of funding, IREE strategically chose to focus programmatic investments on "seed grant" opportunities, with the intent of drawing a broad cadre of University faculty expertise to pursue scholarly activities related to renewable energy. In late 2004, IREE began to expand the focus to include large, multi-year research projects, and to utilize these state-authorized funds to significantly leverage extramural funding. IREE established a strategic process to better target funding resources and to position the U of M and the state as national leaders in renewable energy. More than 25 multidisciplinary teams began utilizing IREE funds to conduct research and develop demonstration projects.

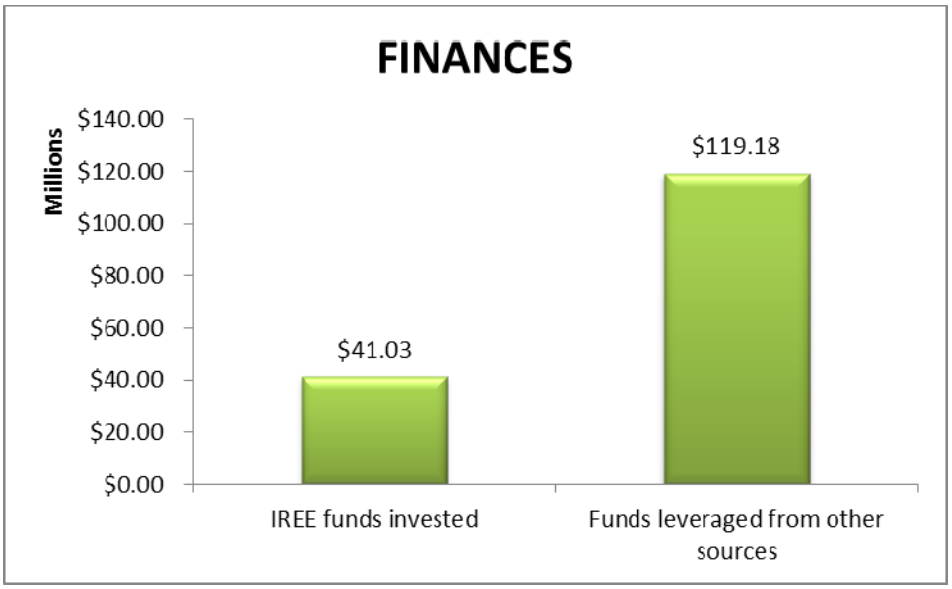
In 2007, the Minnesota Legislature chose to continue funding from the Xcel Energy Renewable Energy Development Fund for IREE. Passed with strong bi-partisan support, and signed by Gov. Tim Pawlenty, the legislation increased IREE support to $5 million annually (from the Xcel RDF - beginning in 2009), and expanded IREE's focus to include (1) environmentally sound production of energy from a renewable energy source Including biomass; (2) environmentally sound production of hydrogen from biomass and any other renewable energy source for energy storage and energy utilization; (3) development of energy conservation and efficient energy utilization technologies; (4) energy storage technologies; and, (5) analysis of policy options to facilitate adoption of technologies that use or produce low-carbon renewable energy. The legislation also provided the following clarification: "For the purposes of this subdivision; "renewable energy source means hydro, wind, solar, biomass and geothermal energy, and microorganisms used as an energy source and "biomass" means plant and animal material, agricultural and forest residues, mixed municipal solid waste, and sludge from wastewater treatment.

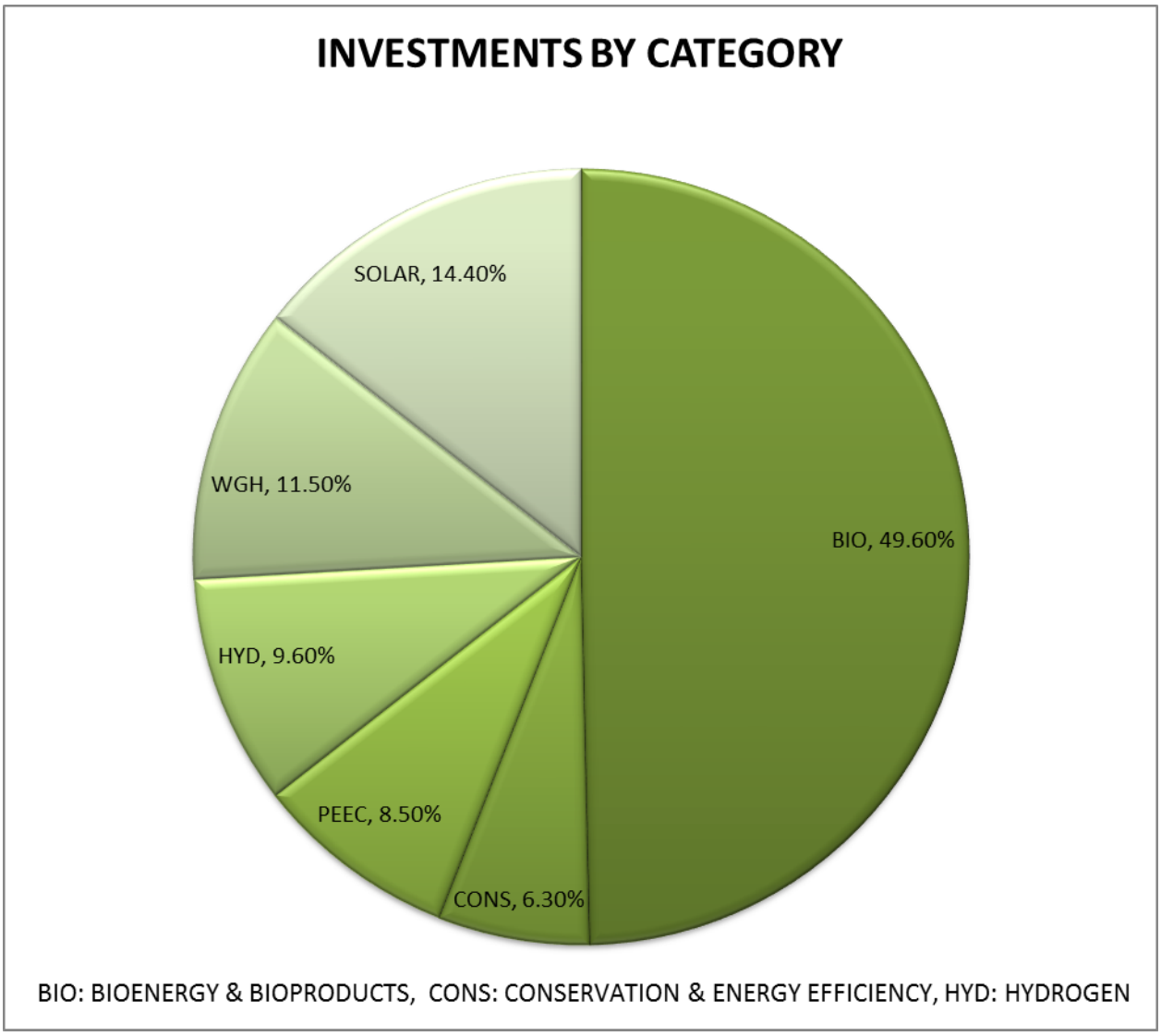
Another 2007 milestone was the central administrative decision to place IREE under the direction of the developing U of M's Institute on the Environment (IonE). As the IonE's signature program, IREE could build on a history of accomplishments to help achieve the primary goals of the IonE: "discovering new solutions to Earth's most pressing environmental problems through cutting-edge research, world-class leadership development and innovative partnerships."

In the ensuing years, IREE became a central part of the region's renewable energy economy, mobilizing more than 600 university experts around one vital mission: "to promote statewide economic development; sustainable, healthy and diverse ecosystems; and national energy security through development of bio-based and other renewable resources and processes." In addition to our investment program, IREE hosted numerous educational outreach symposia, and sponsored the highly successful "E-3" conference. Attendance at the E-3 conference peaked in 2010 with nearly 900 participants.

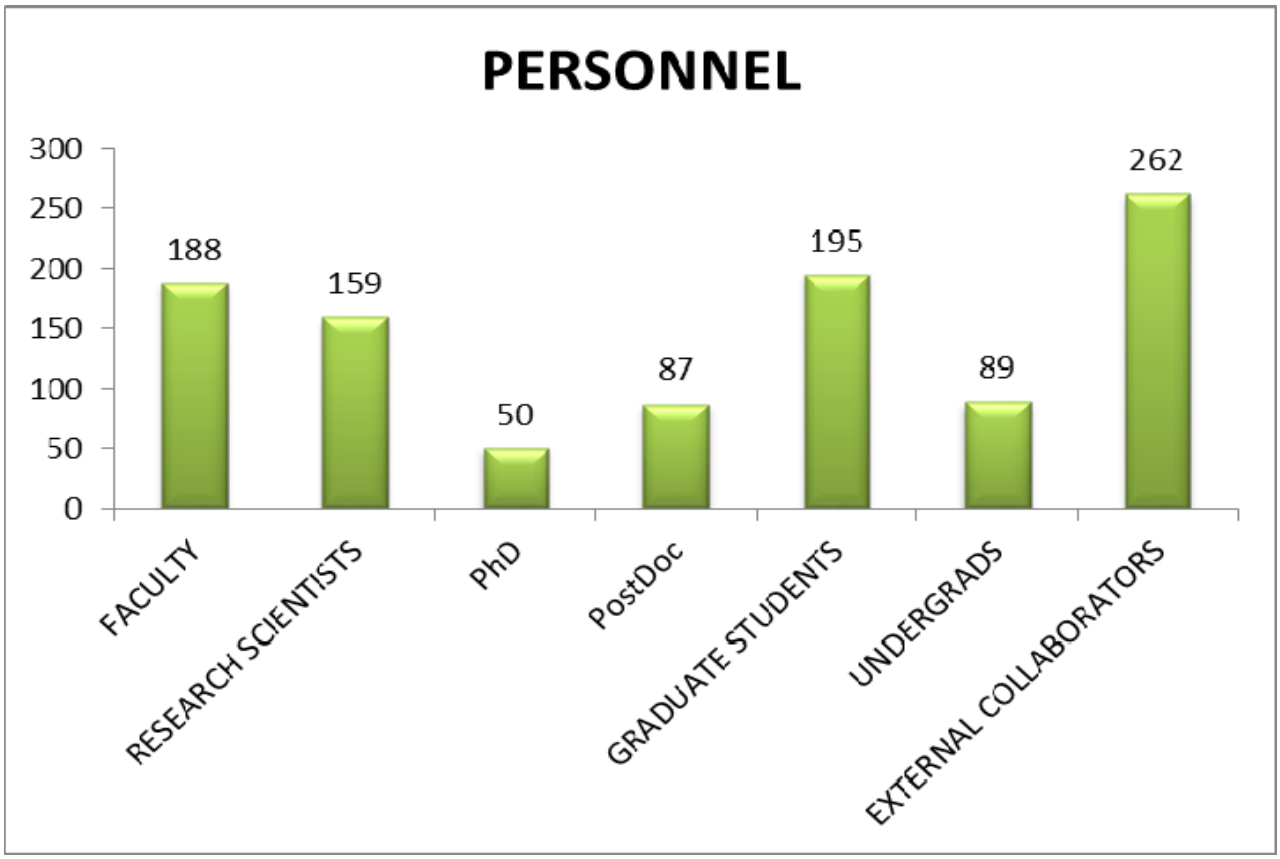
IREE has conducted four comprehensive rounds of new investments to help launch early-stage, high-potential projects in emerging fields of renewable energy. The selected projects are peer reviewed for scientific and technical merit and demonstrate a high degree of innovation; synergy with the U of M's and the state's competitive advantages; a potential contribution to the nation's renewable energy goals; and a clear strategy for attracting external funding support. In addition to our internal funding mechanisms, IREE has provided matching funds for a wide array of external research funding opportunities. IREE has invested in over 300 research projects to advance this critical mission. To date, IREE investments have leveraged nearly $120 million in additional renewable energy research support to the state of Minnesota. With IREE support, a community of over 750 University of Minnesota scholars has been actively engaged in IREE-sponsored research, including over 370 undergraduate and graduate students and post-doctoral fellows. These efforts have resulted in over 250 partnerships with business, industry, state and federal agencies, national labs, and higher education institutions. In addition to these programmatic investments, IREE sponsored a significant outreach program, including several technology-oriented workshops and the highly successful annual E-3 conference.

In the 2012 Legislative session (SF 2181), the decision was made to discontinue direct funding to IREE from the Renewable Energy Development Fund to support these innovative research and demonstration programs. Subsequently the decision was made by the University to sunset the IREE program. IREE completed a final round of investments in November, 2012. These new investments are described beginning on page 7 of this report and also on our public database at http://environment.umn.edu/forms/project_search_form.php





BIO: BIOENERGY & BIOPRODUCTS, CONS: CONSERVATION & ENERGY EFFICIENCY, HYD: HYDROGEN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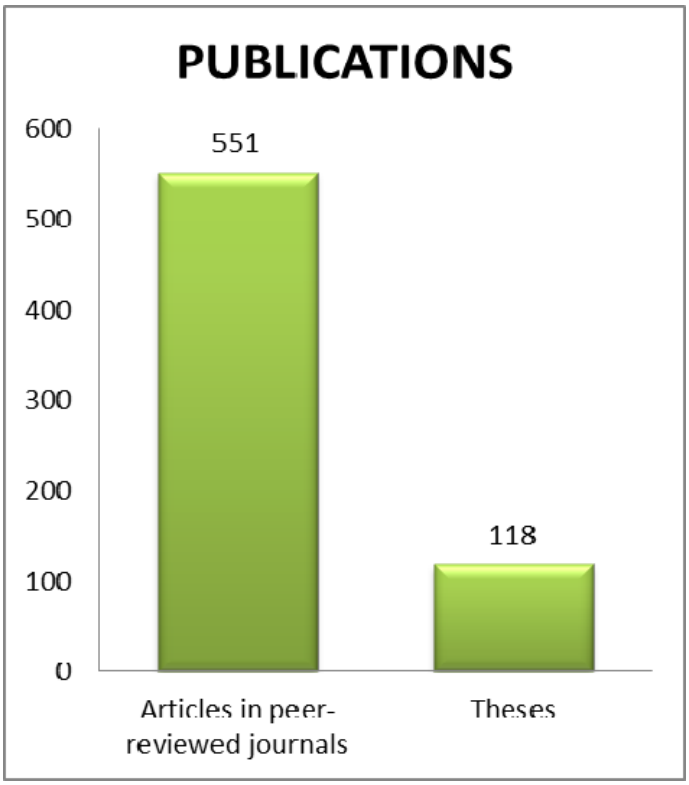
PUBLICATIONS
600
500
400
300
200
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551
118
Articles in peer-reviewed journals
Theses

2012 Activities

Peer-reviewed research investments – 2012 Request for Proposals

IREE completed a final round of peer-reviewed investments in 2012. In June, IREE issued a Call for Proposals and distributed it to the University community. The call specified

- high-impact, technology-focused proposals demonstrating a high likelihood of success for sustainable energy technologies in the near- to mid-term;
- proposals from highly integrated and interdisciplinary teams of systems thinkers;
- proposals related to biomass, solar, wind, hydropower, geothermal power, and energy conservation/efficiency (consistent with IREE's legislative mandate (Minnesota Statues 2009 – Chapter 116C.779. Subd. 3).

It was expected that proposals could range from $250,000 to $750,000. The time frame for grants was flexible, determined by the scope and realistic needs of the proposed work, however it was expected that funded projects not exceed three years in length.

Letters of Intent (LOI) were due on August 15, 2012. The LOI was required for consideration of a full proposal, but the LOI was not used to screen proposals. Rather, it was used for the purposes of identifying an appropriate field of external experts for the scientific peer review of proposals. A total of 27 LOIs were received.

Full proposals were due on Sept. 30, 2012. IREE received a total of 21 full proposals. An independent panel with expertise in appropriate technologies were recruited and assigned to review a set of proposals matching their technical expertise. Following independent off-site review for technical and scientific merit, utilizing both objective and subjective criteria spelled out by IREE staff, the panel convened for a day-long session to summarize findings, and coalesce around a set of recommended investments for IREE.

As a result of that process, seven projects were identified for funding. A brief summary of each is outlined below. Search our public database at http://environment.umn.edu/forms/project_search_form.php for details on all IREE projects.

Matching Grant Activity

IREE has historically provided matching funds to enable University faculty to leverage extramural research funding to the state of Minnesota. Most of these external funding sources (eg. US Department of Energy, US Department of Agriculture, US Department of Defense, Minnesota Next Generation Energy Board, etc.) require the recipient of the research funds to provide institutional cost share in order to apply for and receive these funds.

IREE typically shares this institutional cost-share requirement with the relevant University of Minnesota Departments and Colleges. Faculty are required to submit a matching grant request to IREE to be considered for these funds. Upon verification that the proposed work is synergistic with the IREE legislative mandate, funds are set aside for the proposed project. After scientific review by the appropriate funding agency, and upon receipt of the "Notice of Grant Award" from the funding agency, IREE funds are transferred to the appropriate departmental account to support the proposed research.

In FY 2012, IREE received and approved 15 requests to provide matching funds which were awarded by the funding agency. These active projects encumbered $583,221 from IREE resources, and have

leveraged a total of $8,744,642 in research activity at the University of Minnesota. Additionally 10 IREE-approved matching grant proposals are currently under review by the extramural funding agency. These proposals would encumber $ 359,492 of IREE funds, and-if funded by the granting agency-will leverage $9,122,475 in extramural research support to the University.

Search our public database at http://environment.umn.edu/forms/project_search_form.php for details on all IREE projects.

New 2012 IREE "Large Grant" Investments

In October, 2012, IREE awarded $2.6 Million to 7 new renewable energy research projects at the University of Minnesota. These projects will be getting underway in 2013. Search our public database at http://environment.umn.edu/forms/project_search_form.php for details on all IREE projects.

LandLabs: Developing sustainable bioenergy systems by integrating technology R&D with policy, economic and ecological analysis and innovation (RL-0001-13)
Total Awarded: $375,000
Project End date: May 31, 2015

Research Team: Nicholas Jordan - Lead PI (Agronomy and Plant Genetics – CFANS); Dennis Becker (Forest Resources – CFANS; William Lazarus (Applied Economics – CFANS); David Mulla (Soil, Water and Climate – CFANS); David Pitt (Landscape Architecture – Design); Carissa Schively Slotterback, - Humphrey School of Public Affairs): Bruce Dale (Chemical Engineering and Materials Science – Michigan State University)

Brief Description: With community and industrial partners, we will develop a new commercialization pathway for lignocellulosic bioenergy. Our pathway is based on an emerging biomass processing technology, ammonia fiber expansion (AFEX), which creates biomass commodities for bioenergy, bioproducts, ruminant animal feed, and combustion energy. Our work will promote commercialization by identifying biomass production and supply-chain systems that provide economic value, ecosystem services and social benefits for farmers, landowners and rural communities. To accomplish these objectives, we will take a 'Landlab' approach. We use the term 'Landlab' to describe a place-based coordinated effort that engages regional stakeholders and addresses site-specific conditions. Specifically, Landlabs will identify specific technical, economic, environmental and policy components of high-performance lignocellulosic biomass production systems and supply chains. These components must be identified to limit uncertainties and risks faced by farmers, landowners, and public and private investors. To identify these components, we will develop a multi-objective, multi-criteria spatial decision support tool (DST). The DST will help a large audience assess economic and environmental performance metrics for various choices of site-specific biomass feedstock production and management systems, harvest, transportation, storage and pre-processing options, and processing plant locations and capacities. Secondly, we will use the DST in multi-stakeholder deliberation and design processes that will identify technical, economic and environmental components of production systems and supply chains. If successful, our project will help expand cellulosic bioenergy production to scales that provide significant amounts of renewable bioenergy, while also enhancing production of critical ecosystem services such as water conservation, and promoting rural economic development.

Big Data and Control of Renewable Energy Sources in Microgrids (RL-0010-13)
Total awarded: $375,000
Project End date: December 31, 2014

Research Team: Dr. Georgios B. Giannakis – Lead PI (Electrical and Computer Engineering – CSE); Prodomonos Daoutidis (Chemical Engineering and Materials Science – CSE); Sairaj Dhople (Electrical and Computer Engineering – CSE)

Brief Description: Industry and communities concur that the time has come to uprise today's "passive" distribution system to sustainable microgrids with high penetration of renewable energy sources (RES). This project aspires to bring renewable energy generation to the neighborhood through a holistic framework, which entails geography-based RES configuration, in-house controller design, microgrid level power management, monitoring and scheduling driven by grid data analytics, electric vehicle integration, and technology adoption, all investigated jointly for the first time. The ultimate goal is to transform today's electricity consumer to tomorrow's "prosumer" who leverages RES to the maximum, while having his/her energy capacity and demand efficiently integrated into the distribution grid. Through this coordinated approach, efficiency, reliability, as well as sustainability of microgrids will be significantly enhanced, which in turn will markedly increase production of renewable energy, and reduce transmission congestion.

Innovating for Sustainable Electricity Systems: Integrating Variable Renewables, Regional Grids, and Distributed Resources (RL-0011 -13)
Total awarded: $375,000
Project End date: December 31, 2014

Research Team: Elizabeth Wilson – Lead PI (Humphrey School of Public Affairs); Bruce Wollenberg (Electrical and Computer Engineering – CSE); Sairaj Dhople (Electrical and Computer Engineering – CSE); Julian Marshall (Civil Engineering – CSE); Peter Seiler (Aerospace Engineering/Mechanics – CSE); Tim Smith (BBE – CFANS); Alexandra Klass (Law School); Hari Osofsky (Law School)

Brief Description: Creating sustainable electricity systems to provide reliable, affordable and environmentally-benign power will require fundamental transformations in both the technical components and the larger socio-political context. While it may appear that individual technological innovations can be assessed in isolation, the patchwork of state laws and regional market rules impact the performance of the entire power sector, making interdisciplinary analytic approaches crucial to evaluate new technology innovation in the electric sector. This research directly targets three integrated aspects of this complex system, developing control technologies, dispatch algorithms, policy analysis and market research important to the creation of sustainable electricity systems in the 11-state MISO region: 1) improve forecasting technology and cooperative control algorithms, along with legal, regulatory and market tools to enhance wind integration in the Midwest, (2) assess power system use and losses for the allocation of costs and benefits specific to transmission system flows, and 3) assess DR "islanding" for the facilitation of distributed generation integration and grid firming through ancillary markets. The products developed by this 2-year project will have direct implications for the development and sequencing of advancement in electricity markets, new technologies, electricity consumer integration, and the legal and policy communities. It will also serve to develop critical capacity with the UMN research community.

Enabling the Next Generation of Super Hybrid Transit Bus (RL-0013-13)
Total Awarded: $300,000
Project End date: December 31, 2014

Research Team: David Kittelson - Lead PI (Mechanical Engineering – CSE); Will Northrup, (Mechanical Engineering – CSE); Win Watts (Mechanical Engineering – CSE); Steve Taff (Applied Economics – CFANS); Jan Lucking (Center for Transportation Studies)

Brief Description: Only about 2% of the passenger miles travelled in urban areas is related to the use of public transit. Transit buses are the most cost effective form of urban transit, but they must improve significantly to compete with automobiles. Key features needed to improve bus ridership include scheduling, passenger comfort, and convenience. In addition, improved fuel efficiency, reduced capital and operating costs, lower emissions, and reduced noise will help to promote bus transit. The work proposed lays the foundation for implementation of dramatic improvements in fuel efficiency, emissions, noise and passenger comfort.

Bus usage today is driven by perceived local needs rather than system optimization. Bus manufacturers assemble buses that meet the specifications supplied by buyers. Frequently these specifications are driven by the requirements of Federal subsidies that foster improved fuel economy, bus turnover, and lower emissions. Buyers do not have a systematic process for determining what type of bus, and which features are best for the specific climate and routes. This is particularly true in Minnesota with our extreme climate. Greater investment in specific research is needed to develop the next generation of transit buses and guide the future direction of transit. Working in partnership with Metro Transit and others we will establish the research foundation for transformational improvements in bus technology providing the basis for the future selection and usage of buses with an appropriate level of hybridization ranging from electrification of accessories with traditional propulsion to fully electrified super-hybrids in northern climates.

Integration of Renewable and Efficient Energy Technologies to 'Green" Energy Consumed in Agricultural Production Systems (RL-0016-13)
Total Awarded: $350,000
Project End date: June 30, 2015

Research Team: Mike Reese – Lead PI (West Central Research and Outreach Center, CFANS), Lead; Eric Buchanan, (WCROC-CFANS); Prodomonos Daoutidis, (ChemE-CSE); Brad Heins, (WCROC-CFANS); Larry Jacobsen (BBE-CFANS); Lee Johnston, (WCROC-CFANS); Laura Kalambokidis (Applied Econ – CFANS); Arne Kildegaard, (Economics-UMM); Joel Tallaksen, (WCROC-CFANS)

Brief Description: The agricultural industry consumes an immense amount of fossil-fuel in the production of food, feed, and energy. From electricity that cools milk, to fuel that drives combines in grain fields, to trucks that bring goods to market, and to nitrogen fertilizer that nourishes plants; the industry is captive to large and constant supplies of fossil energy. Agriculture's dependence on fossil-fuel carries significant economic, environmental, and social risks. Through past investments and experience in renewable energy and energy efficient research, the University has a globally unique opportunity to lead a new green *energy* revolution.

The overall objective of the project is to reduce fossil-fuel consumption in agricultural production systems through renewable energy generation, energy conservation, and energy optimization. Base-line energy audits and life cycle analysis (LCA) will be performed on conventional and organic dairy and cropping systems by using measured energy inputs and outputs of products to calculate greenhouse gas emissions (GHG). Energy-optimized systems that significantly improve efficiency, increase on-farm generation, and decrease GHG emissions will be developed, evaluated, and demonstrated. An economic feasibility and suite of policy recommendations will be developed.

The West Central Research and Outreach Center (WCROC) provides an ideal setting for this collaborative work with its combination of novel and conventional renewable energy, crop, and livestock production systems. The project team extends across the University of Minnesota including collaborators from the Departments of Animal Science, Applied Economics, Bioproducts and Biosystems Engineering (Saint Paul), Chemical Engineering and Material Science (Minneapolis), Economics (Morris), and the Extension Service.

Integrated Thermochemical Biorefinery for Production of Biofuels and Agricultural Fertilizers from Animal Manures and Municipal Waste (RL-0019-13)

Total awarded: $500,000

Project End date: June 30, 2015

Research Team: Ken Valentas – Lead PI (Biotechnology Institute - BTI), Steve Heilmann (BTI); Marc Hillmyer (CSE), Lanny Schmidt (CSE), Steve Taff (CFANS), Bill Lazarus (CFANS), Carl Rosen (CFANS), JetE, City of Chisago Lakes Waste Water Facility

Brief Description: The Integrated Hydrothermal Carbonization (HTC) thermochemical biorefinery essentially converts feed stocks, such as manures and municipal waste water treatment sludge, with little or negative value and considerable negative environmental impact to useful and valuable products in an environmentally sound and sustainable manner that is carbon neutral. Manures and municipal wastes are broadly available and are renewable resources requiring no external input. Due to the size of feedlots and waste treatment plants they are concentrated point sources of significant quantity so that transportation of feed -stocks to the biorefinery will be greatly minimized by strategic location and scaling of the biorefineries and the particular business model selected.

Our previous experimental work has shown that the Hydrothermal Carbonization (HTC) process will convert a 3-4% solids manure or municipal waste feedstock to a low ash char with a heating value similar to high BTU coals with a significantly positive energy balance. It has also been shown that the resulting hydrochar adsorbs or binds the phosphorous and fatty acids dissolved in the manure and municipal waste. These can be economically and easily recovered by standard separation technologies. Phosphorous is a valuable and essential fertilizer component and fatty acids can be readily converted to jet fuel or biodiesel by existing technologies.

Compressed air storage (CAES) in Northern Minnesota Using Underground Mine Workings (RL-0021-13)
Total Awarded: $324,458
Project End date: December 1, 2014

Research Team: Donald Fosnacht – Lead PI (UMD-NRRI) Lead; Perry Li (CSE), Jeff Marr (CSE), Rebecca Teasley (UMD), Steveh Hauck (UMD-NRRI), Mark Severson UMD-NRRI), John Heine (UMD-NRRI), Julie Oreskovich (UMD-NRRI), Carlos Carranza-Torres (UMD), Elizabeth Wilson (HHHI)
Minnesota Power, Great River Energy, Duluth Metals, Barr Engineering.

Brief Description: This project will study the potential use of compressed air energy storage systems (CAES) using existing underground mine workings or created caverns from new mining operations for storing compressed air that can be used to generate electricity when it is released from the underground storage facility. CAES facilities are an alternative to pump hydro energy storage and can be used to store electricity from intermittent energy sources such as wind or solar energy for use during demand situations. These facilities would allow avoidance of natural gas peaking plants or curtailment of the intermittent systems when demand is low. The underground mining activities that have taken place on the Mesabi Iron Range will be evaluated to determine if they are suitable for use as a storage cavern for the compressed air systems. In addition, the project team will work with a non-ferrous mining company to determine if such caverns can be created as part of future mining activities so that they can serve as an energy storage facility when mining operations are completed.

IREE's CURRENT INVESTMENT PORTFOLIO

The following research projects are currently active. Search our public database at http://environment.umn.edu/forms/project_search_form.php for details on all IREE projects, both active and closed.

BIOENERGY & BIOPRODUCTS

Developing genomic tools in Pennycress (Thlaspi arvense) for sustainable biofuel production and weed suppression (RM-0006-13) RESEARCH TEAM: M. David Marks (CBS), Donald Wyse (CFANS), Kevin Dorn (CBS); TOTAL FUNDING: $8,090

Expansion of Al-Corn Dry Grind Ethanol Plant to Second Generation Biofuel Production (RM-0008-12) RESEARCH TEAM: John Sheehan (IonE), William Lazarus (CFANS), Doug Tiffany (CFANS); TOTAL FUNDING: $8,000

Developing Native and Native-European Hybrid Hazelnut Germplasm and Agronomics for the Upper Midwest (RM-0010-11) RESEARCH TEAM: Donald Wyse (CFANS), Lois Braun (CFANS), Kevin Betts (CFANS), Molly Kreiser (CFANS); TOTAL FUNDING: $93,149

Hydrothermal Pretreatment to Improve the Energy Density and Processing Characteristics of Minnesota Biomass (RM-0010-12) RESEARCH TEAM: Andriy Khotkevych (UMD NRRI), Timothy Hagen (UMD NRRI), Matthew Aro (UMD NRRI), Donald Fosnacht (UMD NRRI); TOTAL FUNDING: $20,093

Using genomics to increase soybean biodiesel yield (RM-0016-12) RESEARCH TEAM: Sue Gibson (CFANS), James Orf (CFANS); TOTAL FUNDING: $22,000

Center for Sustainable Polymers (RM-0017-11) RESEARCH TEAM: Marc Hillmyer (CSE), Frank Bates (CSE), Thomas Hoye (CSE), Chris Macosko (CSE). William Tolman (CSE), Theresa Reineke (CSE); TOTAL FUNDING: $132,000

Development and commercialization of a biorefinery for processing DDGS in biofuels and other value-added products (RM-0018-11) RESEARCH TEAM: Pavel Krasutsky (UMD NRRI), Doug Tiffany (CFANS); TOTAL FUNDING: $60,000

Development and commercialization of a biorefinery for processing DDGS in biofuels and other value-added products (RM-0021-12) RESEARCH TEAM: Pavel Krasutsky (UMD NRRI), Doug Tiffany (CFANS); TOTAL FUNDING: $75,000

Conversion of Carbon Dioxide to Methanol (RM-0018-12) RESEARCH TEAM: Ping Wang (CFANS); TOTAL FUNDING: $20,000

Higher Value Product from Corn Ethanols (RM-0022-12) RESEARCH TEAM: Larry Wackett (CBS), Jack Richman (CBS); TOTAL FUNDING: $19,348

Demonstrating an Economically Viable Approach to Algal Bio-diesel Production (RM-0023-12) RESEARCH TEAM: Michael Mageau; TOTAL FUNDING: $99,551

High Efficiency Enabled by Hydrous Ethanol use in Dual-Fuel Diesel Engines (RM-0024-12) RESEARCH TEAM: Will Northrop (CSE), Dave Kittelson (CSE); TOTAL FUNDING: $23,701

Assessment of cattail cover in Northwest Minnesota and potential for concurrent bioenergy harvest and wetland management (RM-0025-12) RESEARCH TEAM: Daniel Svedarsky (UMC Center for Sustainability); TOTAL FUNDING: $6,934

Distributed production of DME based fuels using microwave technology and direct catalytic synthesis (RM-0026-12) RESEARCH TEAM: Roger Ruan (CFANS), Paul Chen (CFANS), Dave Kittelson (CSE), Louise Goldberg (CFANS); TOTAL FUNDING: $45,305

Evaluating Wood Energy Opportunity Zones (RM-0003-12) RESEARCH TEAM: Dennis Becker (CFANS), Laura Eaton (CFANS); TOTAL FUNDING: $29,460

Biomass torrefaction: understanding greenhouse gas emissions and potential financial opportunities (RS-0028-12) RESEARCH TEAM: Vance Morey (CFANS), Doug Tiffany (CFANS); TOTAL FUNDING: $69,978

Developing intermediate wheatgrass for sustainable co-production of fuel and food (RL-0015-12) RESEARCH TEAM: Donald L. Wyse (CFANS), James Anderson (CFANS), David Mulla (CFANS), William Lazarus (CFANS), Craig Sheaffer (CFANS), Baraem Ismail (CFANS), Devin Peterson (CFANS), Tonya Schoenfuss (CFANS), Mirko Bunzel (CFANS); TOTAL FUNDING: $695,000

Drop-in jet fuel from renewable resources via enzyme catalyst (RS-0038-12) RESEARCH TEAM: John Lipscomb (CBS), Larry Wackett (CSE), Lawrence Que Jr. (CSE), Carrie Wilmot (CBS); TOTAL FUNDING: $70,000

Engineering bacterial bioelectrical catalysts (RC-0003-12) RESEARCH TEAM: Jeffrey Gralnick (CSE), Daniel Bond (CSE), Claudia Schmidt-Dannert (CBS); TOTAL FUNDING: $150,000

Engineering of protein based nano-bioreactors for biofuel production and biocatalysis (RS-0005-12) RESEARCH TEAM: Claudia Schmidt-Dannert (CBS); TOTAL FUNDING: $58,000

Microbial communities for enhanced biofuel feedstock production (RC-0007-12) RESEARCH TEAM: Brett Barney (CFANS); TOTAL FUNDING: $150,000

Next-generation microbial systems for bioconversion (RS-0010-12) RESEARCH TEAM: Robert Blanchette (CFANS), Jonathan S. Schilling (CFANS); TOTAL FUNDING: $70,000

Production of lipids for biofuel production and human nutrition from cold-tolerant yellow-green alga (RS-0039-12) RESEARCH TEAM: Paul Lefebvre (CBS/CFANS), Carolyn Silflow (CFANS), Steven Heilmann (CBS), Miki Hondzo (CSE), Doug Mashek (CFANS); TOTAL FUNDING: $70,000

Biofuels for the farm: new technologies for the production of biofuels in small systems (RL-0004-09) RESEARCH TEAM: Michael Tsapatsis (CSE), Lanny Schmidt (CSE), David Kittelson (CSE), Edward L. Cussler (CSE), Aditya Bhan (CSE), Prodromos Daoutidis (CSE); TOTAL FUNDING: $600,000

Development and commercialization of an integrated biorefinery for processing DDGS into biofuels and value added products (RL-0010-11) RESEARCH TEAM: Pavel Krasutsky (UMD), Doug Tiffany (CFANS); TOTAL FUNDING: $250,000

Engineering of a multi-species fermentation platform for biofuel production (RL-0001-11) RESEARCH TEAM: Claudia Schmidt-Dannert (CBS), Friedrich Srienc (CSE), Yiannis Kaznessis (CSE); TOTAL FUNDING: $472,500

Corn Ethanol Transformed: Higher-Value Product, Greater Efficiency, Less CO2 Emissions (RO-0003-12), Larry Wackett (CSE); TOTAL FUNDING: $20,000

Exploiting genetic variation in soybean to increase oil (RM-0001-09)
RESEARCH TEAM: Sue Gibson (CBS/CFANS), Jane Glazebrook (CFANS), Fumiaki Katagiri (CFANS), James Orf (CFANS); TOTAL FUNDING: $17,500

Improving handling characteristics of herbaceous biomass (RM-0004-11)
RESEARCH TEAM: Vance Morey (CFANS), Michael Reese (CFANS); TOTAL FUNDING: $25,000

Innovative, diversified agroforestry plantings in support of energy security, environmental quality and local economies (RM-0016-10) RESEARCH TEAM: Dean Current (CFANS), Craig Sheaffer (CFANS), Kenneth Brooks (CFANS), Donald L. Wyse (CFANS), Gregg A. Johnson (CFANS), Joe Magner (CFANS); TOTAL FUNDING: $35,000

Mimicking fungal biomass decomposition using biphasic biocatalysis (RC-0008-11) RESEARCH TEAM: Jonathan S. Schilling (CFANS), Ping Wang (CFANS), Shona Duncan (CFANS); TOTAL FUNDING: $135,000

Pathways toward sustainable bioenergy feedstock production in the Mississippi River Watershed (RM-0002-11) RESEARCH TEAM: Jason Hill (CFANS), Tracy Twine (CFANS); TOTAL FUNDING: $31,914

Performance and emissions of second generation biofuel DME (RL-0024-11)
RESEARCH TEAM: David Kittelson (CSE), Steve Taff (CFANS), Win Watts (CSE); TOTAL FUNDING: $531,000

Renewable energy and sustainable chemistry across the undergraduate chemistry curriculum (RM-0018-09) RESEARCH TEAM: Ted M. Pappenfus (UMM); TOTAL FUNDING: $22,000

Shewanella as an ideal platform for producinghydrocarbon fuel (RM-0008-10)
RESEARCH TEAM: Larry Wackett (CSE), Jeffrey Gralnick (CSE), Aditya Bhan (CSE), Lanny Schmidt (CSE), Marc Von Keitz (CSE); TOTAL FUNDING: $300,000

Transforming corn from a commodity crop to a higher energy, multipurpose biofuel crop (RM-0032-10) RESEARCH TEAM: Rex Bernardo (CFANS), Ron Phillips (CFANS), Nathan Springer (CBS), Roger Ruan (CFANS), Doug Tiffany (CFANS); TOTAL FUNDING: $91,200

University of Minnesota Morris: Corn stover densification project (RM-0034-10) RESEARCH TEAM: Lowell Rasmussen (UMM); TOTAL FUNDING: $18,000

Hydrothermal Carbonization (HTC) of Stillage Products generated from Corn Ethanol production – New value-added products (RM-0022-11) RESEARCH TEAM: Ken Valentas (CBS), Steven Heilmann (CBS), Brandon Wood (CBS); TOTAL FUNDING: $31,250

SOLAR

Concentrated solar energy devices enabled by wavelength selective mirrors (RS-0011-12)
RESEARCH TEAM: Jane Davidson (CSE), Tejas Ulavi (CSE); TOTAL FUNDING: $69,830

Enhanced exciton harvesting in organic photovoltaic cells using engineered, graded film compositions (RC-0004-12) RESEARCH TEAM: Russell Holmes (CSE); TOTAL FUNDING: $149,034

High energy density, nanostructured supercapacitors for electrical energy storage (RL-0012-12) RESEARCH TEAM: Phil Buhlmann (CSE), William Smyrl (CSE), Andreas Stein (CSE); TOTAL FUNDING: $695,000 .

Materials for 1$/W CIGS-based photovoltaics (RL-0003-12) RESEARCH TEAM: Stephen Campbell (CSE), Eray Aydil (CSE), Wayne Gladfelter (CSE); TOTAL FUNDING: $695,000

Solar thermochemical CO2 capture (RC-0009-12) RESEARCH TEAM: Wojciech Lipinski (CSE); TOTAL FUNDING: $149,546

Converting sunlight into electricity with high-efficiency organic solar cells (RL-0006-11) RESEARCH TEAM: Daniel Frisbie (CSE), David Blank (CSE), Marc Hillmyer (CSE), Christopher Douglas (CSE), Russell Holmes (CSE); TOTAL FUNDING: $500,000

EFRI-RESTOR thermochemical routes to efficient and rapid production of solar fuels (RM-0030-10) RESEARCH TEAM: Jane Davidson (CSE), Wojciech Lipinski (CSE); TOTAL FUNDING: $60,000

Laterally integrated photovoltaic devices (RL-0019-09) RESEARCH TEAM: Philip Cohen (CSE), Joseph Talghader (CSE), James Leger (CSE), P.P. Ruden (CSE), Emmanuel Enemuoh (UMD); TOTAL FUNDING: $800,000

Materials innovation to enable solar home heating in cold climates (RL-0015-11) RESEARCH TEAM: Susan Mantell (CSE), Marc Hillmyer (CSE), Andreas Stein (CSE), Jane Davidson (CSE); TOTAL FUNDING: $300,000

High-throughput nanofabrication technologies for low-cost plasmonic photovoltaics (RC-0009-11) RESEARCH TEAM: Sang-Hyun Oh (CSE); TOTAL FUNDING: $135,000

Improving organic solar cells with graded interfacial modifications (RC-0016-11) RESEARCH TEAM: Aaron Massari (CSE); TOTAL FUNDING: $135,000

Solar daylighting project (RM-0003-11) RESEARCH TEAM: John Carmody (CDES); TOTAL FUNDING: $25,000

New environmentally benign sulfides for sustainable large-scale photovoltaics (RL-0004-11) RESEARCH TEAM: Eray Aydil (CSE), Stephen Campbell (CSE), Christopher Leighton (CSE) ;TOTAL FUNDING: $500,000

Solar recycling of CO2 to fuels (RL-0003-11) RESEARCH TEAM: Jane Davidson (CSE), Wojciech Lipinski (CSE), Andreas Stein (CSE), Thomas Chase (CSE); TOTAL FUNDING: $499,997

Thermochemical fuels: solar at night (RL-0001-09) RESEARCH TEAM: Jane Davidson (CSE), David Kittelson (CSE), Jerry Fruin (CFANS), Sean Garrick (CSE), Wojciech Lipinski (CSE), Andreas Stein (CSE); TOTAL FUNDING: $900,086

WIND, HYDRO & GEOTHERMAL

A pre-competitive consortium for advancing marine and hydrokinetic energy technologies in the US through cutting-edge science (RO-0004-12) RESEARCH TEAM: Fotis Sotiropoulos (CSE), Miki Hondzo (CSE), Michele Guala (CSE), Leonardo Chamorro (CSE); TOTAL FUNDING: $225,000

Development and Evaluation of a Novel, Small Pilot Scale Non-Thermal Plasma Process for the Production of Nitrogen Fertilizer from Wind and Other Renewable Resources (RM-0020-11) RESEARCH TEAM: Michael Reese (CFANS), Roger Ruan (CFANS); TOTAL FUNDING: $28,800

Turbine aeration design software for mitigating adverse environmental impacts resulting from conventional hydropower turbines (RM-0004-12) RESEARCH TEAM: John Gulliver (CSE), Fotis Sotiropoulos (CSE), Roger Arndt (CSE); TOTAL FUNDING: $31,500

High-resolution computational algorithms for simulating offshore wind turbines and farms: Model development and validation (RM-0005-12) RESEARCH TEAM: Fotis Sotiropoulos (CSE), Michele Guala (CSE), Leonardo Chamorro (CSE), Seok Koo Kang (CSE); TOTAL FUNDING: $120,000

Design tools for multivariable control of large wind turbines (RL-0010-12) RESEARCH TEAM: Gary Balas (CSE), Peter Seiler (CSE); TOTAL FUNDING: $278,600

Development of self-powered wireless sensor for structural health monitoring in wind turbine blades (RS-0029-12) RESEARCH TEAM: Rusen Yang (CSE), Susan Mantell (CSE); TOTAL FUNDING: $68,281

Distributed ammonia production using wind-generated hydrogen and power (RO-0001-12) RESEARCH TEAM: Alon McCormick (CSE); TOTAL FUNDING: $400,000

Evaluating wind farm performance under realistic thermal and complex terrain conditions: the first path towards optimization (RC-0005-12) RESEARCH TEAM: Michele Guala (CSE); TOTAL FUNDING: $150,000

Advanced water power project: improved structure and fabrication of large, high-power KHPS rotors (M5-2008) RESEARCH TEAM: Fotis Sotiropoulos (CSE); TOTAL FUNDING: $120,000

An industry/academe consortium for achieving 20% wind by 2030 through cutting-edge research and workforce training (RM-0002-10) RESEARCH TEAM: Fotis Sotiropoulos (CSE), Gary Balas (CSE), Mos Kaveh (CSE), Ned Mohan (CSE), Roger Arndt (CSE), Kim Stelson (CSE), Susan Mantell (CSE), Henryk Stolarski (CSE); TOTAL FUNDING: $400,000

Development of a high-resolution virtual wind simulator for optimal design of wind energy projects (M4-2008) RESEARCH TEAM: Fotis Sotiropoulos (CSE); TOTAL FUNDING: $180,000

Improving efficiency of wind turbines by means of model-based flow control (RC-0014-11) RESEARCH TEAM: Mihailo Jovanovic (CSE) TOTAL FUNDING: $134,992

A nationwide consortium of universities to revitalize electric power engineering education by state-of-the-art laboratories (RM-0017-10) RESEARCH TEAM: Ned Mohan (CSE), William Robbins (CSE), Bruce Wollenberg (CSE), Paul Imbertson (CSE); TOTAL FUNDING: $155,000

CONSERVATION & ENERGY EFFICIENCY

Understanding drivers of whole-household energy conservation in Minnesota using the Twin Cities household ecosystem project (RS-0016-12) RESEARCH TEAM: Lawrence Baker (CFANS), Jay Coggins (CFANS); TOTAL FUNDING: $69,365

Developing a reaction transport model that couples chemical reactions of mineral dissolution/ precipitation with spatial and temporal flow variations in CO2/brine/rock systems (RM-0018-10) RESEARCH TEAM: Martin Saar (CSE); TOTAL FUNDING: $64,368

NorthernSTAR Energy Efficient Housing Research Partnership Team (RM-0042-10) RESEARCH TEAM: Patrick Huelman (CFANS); TOTAL FUNDING: $650,000

New energy technology based on the direct conversion of heat to electricity using multiferroic alloys (RO-0002-12) RESEARCH TEAM: Richard James (CSE), Paul Strykowski (CSE), Christopher Leighton (CSE), Matteo Cococcioni (CSE); TOTAL FUNDING: $220,000

POLICY, ECONOMICS & ECOSYSTEMS

Rethinking how we manage traffic to reduce emissions while maintaining mobility: a new paradigm for traffic management (RS-0035-12) RESEARCH TEAM: Henry Liu (CSE), Saif Benjaafar (CSE), Shuzhong Zhang (CSE); TOTAL FUNDING: $70,000

Global renewable energy leadership fellows (RO-0002-10) RESEARCH TEAM: Jonathan Foley (IonE); TOTAL FUNDING: $497,318

Air pollution impacts of conventional and alternative fuels (RL-0026-09)
RESEARCH TEAM: Julian Marshall (CSE), Jason Hill (CFANS); TOTAL FUNDING: $599,786

Biofuels as an integral part of sustainable development (RO-0001-11)
RESEARCH TEAM: John Sheehan (IonE); TOTAL FUNDING: $141,989

Combining geothermal energy extraction and CO2 sequestration to produce clean, renewable, carbon-negative electricity (RL-0014-09) RESEARCH TEAM: Martin Saar (CSE), Elizabeth Wilson (HHH), Steve Taff (CFANS), Thomas Kuehn (CSE), William E. Seyfried (CSE), Harvey Thorleifson (CSE), Steven Hauck (UMD); TOTAL FUNDING: $600,000

Economic evaluation of deploying small- to moderate-scale nitrogen fertilizer production plants in Minnesota using wind and grid-based electrical energy sources (RM-0019-11) RESEARCH TEAM: Michael Reese (CFANS); TOTAL FUNDING: $6,611

Life cycle assessment of various petroleum reduction strategies (RO-0002-11) RESEARCH TEAM: Jason Hill (CFANS); TOTAL FUNDING: $50,000

Measuring the environmental footprint of corn feedstock for a new biobutanol facility in Luverne, MN (RO-0003-11) RESEARCH TEAM: John Sheehan (IonE); TOTAL FUNDING: $19,646

The unintended climate consequences of North American carbon sequestration from afforestation and reforestation (RC-0010-11) RESEARCH TEAM: Peter Snyder (CFANS); TOTAL FUNDING: $121,361

Next-generation biofuels and the ecosystem services they provide: sustainability and the biomass production landscape (RL-0023-11)
RESEARCH TEAM: Jason Hill (CFANS), Steve Polasky (CFANS), David Tilman (CBS), Tracy Twine (CFANS); TOTAL FUNDING: $500,000

Spatial modeling and collaborative landscape design to improve nutrient management, agricultural productivity and ecosystem services in the Mississippi River Basin (RM-0040-10) RESEARCH TEAM: Nicholas Jordan (CFANS), Paul Bolstad (CFANS), David Mulla (CFANS); TOTAL FUNDING: $74,937

Training for future biotechnology development (RM-0028-11) RESEARCH TEAM: Claudia Schmidt-Dannert (CBS), Wei-Shou Hu (CBS); TOTAL FUNDING: $30,000