Iowa EPSCoR 2014 Annual Project Report - Year 3

Iowa EPSCoR

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* What are the major goals of the project?

The vision of the Iowa NSF EPSCoR project “Harnessing Energy Flows in the Biosphere to Build Sustainable Energy Systems” is to establish Iowa as a leader in the world-wide transition in energy supply from mining subsurface (fossil) energy stores to harnessing renewable energy flows in the biosphere. The mission is to achieve organizational excellence, enhance Iowa’s research infrastructure, and prepare a diverse STEM educated workforce needed to advance Iowa’s competitive position in renewable energy and energy utilization. The research program is organized into four research platforms – BioEnergy, Wind Energy, Energy Utilization, and Energy Policy – and a Broader Impacts platform. Each of the five platforms has two or more Planks that focus on specific aspects of the platform and has identified various Strategic Priorities (goals) to focus efforts over this five-year project; these platforms and their Strategic Priorities (SP) are outlined below and the numbers correspond to the strategic priorities articulated in the strategic plan that was updated and approved by NSF on March 5, 2014.
BioEnergy (BE)

The BE platform’s goals are to assess the impact and sustainability of biomass production systems and establish nationally recognized research capabilities for thermochemical processing. The platform is divided into two specific research Planks. The BioEnergy Agriculture Plank focuses on SP 1.1: Expand research capacity for evaluating ecosystem sustainability of bioenergy agriculture by establishing two Bioenergy Agro-Ecosystem Research (BAER) sites, that will be equipped and staffed to monitor ecosystem changes over time. The Bioenergy Logistics and Conversion Plank is responsible for SP 1.2: Expand capacity to perform experimental and computational studies of thermochemical biomass conversion. Three thermochemical processing pilot plants and a biomass characterization laboratory are being equipped for this purpose.

Wind Energy (WE)

The WE platform consists of four research Planks working together to accomplish two strategic priorities. The Wind Energy Resource Characterization Plank focuses on SP 1.3: Advance the science of wind energy resource characterization, optimal multi-turbine performance, and effective energy delivery. The Blade Performance and Reliability Plank, Drivetrain Design Optimization Plank and Green Energy Grids Plank focus on SP 1.4: Optimize wind energy economics to compete with fossil fuels through engineering advancements in turbine reliability, manufacturability, and maintainability, and delivery of energy to the grid.

Energy Utilization (EU)

The EU platform consists of two Planks and involves Iowa communities and buildings as field laboratories with research efforts focused on building science, human behavior, and decision-making in energy utilization and consumption. The major goal of the Green Community Campaign Plank addresses SP 1.5: Utilize community-level laboratories to determine whether or not social marketing interventions can change energy conservation knowledge, attitudes, and behaviors by assessing the impact various intervention strategies have on the energy consumption within a community. The Building Science Plank focuses on SP 1.6: Study the relationship between building science, design, and human behavior in existing structures in Iowa by establishing community laboratories for building energy efficiency research and then implementing selected energy research activities within the identified buildings.

Energy Policy (EP)

The EP platform has a primary goal to encourage cross-disciplinary learning and collaborations between engineers, economists, and scientists, and is divided into two Planks: Policy Outlooks, Industry Outreach, Energy Policy Course, and Conference Support Plank and the Seminars and Workshops Plank. Both Planks focus on SP 1.7: Advance integrated engineering/economic modeling to project the impact of federal, state, and local policies on renewable energy markets, technology design and deployment; and SP 1.8: Analyze market and technology deployment impacts of policies designed
to promote renewable energy and communicate results to the public, federal and state legislators and regulators.

Broader Impacts (BI)

The BI platform’s goal is to assist Iowa’s economic development by helping prepare a skilled and diverse workforce that can effectively meet the needs of industry, academia, education, and government, and attract new businesses to Iowa, especially in the areas of renewable energy and energy utilization. BI activities have been updated in the revised strategic plan approved by NSF on March 5, 2014, and are integrated into the five planks. In this project, BI encompasses Faculty Development, Workforce Development, Diversity, Cyberinfrastructure (CI), and External Engagement and Communications (EE). There are several strategic priorities related to BI activities. Faculty development focuses on SP 1.9: Implement coordinated multi-institutional human resource development activities for assisting with the recruitment and mentoring of early career tenure-track faculty for Renewable Energy (RE)/Energy Utilization (EU) research and education capacity. Diversity is the focus of SP 2.1: Increase participation of women and underrepresented minorities (URMs) in STEM, especially in RE/EU fields through coordinated state-wide, multi-institutional efforts; and SP 2.2: Coordinate resources to help faculty, staff, and students create a more welcoming environment with sustainable support systems for success of women and URMs in STEM disciplines at Iowa Regents Universities, community colleges, and K-12 schools. Workforce Development is specifically addressed in SP 3.1: Create innovative and transformative approaches to educate the future workforce necessary to strengthen the state’s leadership in renewable energy and energy utilization; and SP 3.2: Expand the Iowa workforce that is technically qualified to support the growing renewable energy and energy utilization sectors. External engagement and communication efforts are described in SP 4.1: Facilitate communication between various constituencies within and outside the Iowa jurisdiction, and at the state and federal government level. Cyberinfrastructure (CI) is the focus of SP 5.1: Support overall project goals by providing connectivity, access, and CI-related training for EPSCoR members, educators, and industry partners.

Three additional strategic priorities address project evaluation and overall project sustainability and management. Project evaluation is addressed in SP 6.1: Implement an integrated, multi-year evaluation plan to measure progress towards the goals and objectives of the EPSCoR project; this includes internal evaluation, external evaluation, and a Science Expert Board (SEB) review. Project sustainability is covered in SP 7.1: Build a statewide RE/EU research and education enterprise that continues beyond the five-year project period. Finally, overall project management is described in SP 8.1: Maintain an effective, transparent, and multi-level management structure to provide oversight and coordinate the research, BI, and sustainability plans of the project.

* What was accomplished under these goals (you must provide information for at least one of the 4 categories below)?

Major Activities: Many activities were completed during Year 3 of the Iowa NSF EPSCoR project to address project goals. Highlights of the major activities are provided below. A detailed summary of the activities is provided in Appendix A, Section 1.2a.
BioEnergy (BE)

Activities in the two Bioenergy Agro-Ecosystem Research (BAER) sites continued. With three new University of Northern Iowa (UNI) faculty added to the team, an additional research site was added at the UNI Cedar River Natural Resource Area Biomass Research Site. Information from these sites is being used to develop methods and models for scaling agro-ecosystem impact assessment to broader regional scales.

Several seed grants were provided to new BioEnergy Logistics and Conversion plank faculty, as well as junior faculty currently involved in the plank. The new projects allowed project expansion into biocatalysis, photobioreactors, biopolymers, pyrolysis, and techno-economic analysis of these areas.

Wind Energy (WE)

The 2013 Crop/Wind Energy eXperiments (CWEX-13) field campaign included additional measurements of wind farm mean and turbulent winds by collaborators from NREL, NOAA, and NCAR. Faculty expertise was used to develop a portable measurement system for off-shore wind characterization. A new platform was developed to mentor learners and professionals at all levels to enhance academic and professional advancement in wind energy science, but especially members of at-risk and under-represented groups.

A computational tool for simulating unsteady dynamic yawing of wind turbines has been developed and tested; full rotor and nacelle motion can be simulated while accounting for multiple turbine interferences. A Physics-based model for thermal damage due to lightning strike in a composite wind turbine blade has been developed; the model describes surface interaction between the lightning arc and the composite structure. A new recirculating wind tunnel was constructed, and a precision-scaled wind turbine was installed and is currently undergoing testing.

The drivetrain dynamics simulation capability in GearDyn was augmented by integration with the Iowa Reliability-Based Design Optimization (I-RBDO) code. This work is being extended to include reliability analysis of turbine blades and hubs considering wind load uncertainty. Algorithms and methods have been developed to quantify the effects of uncertainties in electrical production from wind farms on grid performance.

Energy Utilization (EU)
The Green Community Campaign intervention campaign was completed in the two test communities. A final posttest survey was completed and energy use data were acquired from MidAmerican Energy.

The community laboratories in the Columbus Community High School in Columbus Junction, IA, and the Interlock House at Honey Creek Resort State Park, are fully established and operational. A third community laboratory was identified at Iowa Lakeside Laboratory, which is a field station for Iowa's state universities; a cabin has been identified for energy improvements. Two new faculty joined the Building Science plank and will focus on sustainable school design and energy loss in residential buildings in Iowa small towns.

**Energy Policy (EP)**

The EP platform seminars and workshops continued for faculty, postdocs, and graduate students working at the interface between economics and engineering within the jurisdiction. Seed grants were provided to several current and new EP faculty to expand the EP activities.

Biofuel policy research efforts produced several reports and were shared with the public, industry stakeholders, national and international sources for policy research, lobbying and decision-making groups, local governments, the Iowa legislature, U.S. Congress, and relevant federal agencies.

**Broader Impacts (BI)**

The Faculty Development plank provided several professional development programs for faculty, postdoctoral fellows, and graduate students. Seed grants were also provided to build and increase research capacity and engage external funding agencies.

The Diversity plank initiated faculty search training at UI and UNI by ISU Advance leaders and Equity Advisors for “train the trainers” sessions with participation from UI and UNI faculty, staff, and administrators. The plank also conducted several activities to improve engagement, retention and success of female and URM students in undergraduate research programs.

The Workforce Development plank continued and expanded efforts to provide elementary and middle school teachers with immersive hands-on experiences in STEM areas, specifically in RE/EU topics. The team expanded the scope of Project Lead the Way (PLTW) activities where they provide training to K-12 and community college instructors on STEM and diversity related topics to strengthen STEM pipelines. Faculty
Specific Objectives:

at ISU received Iowa Board of Regent approval to offer a coursework-only Masters of Engineering degree in energy systems.

The Cyberinfrastructure plank collaborated with faculty on the Wind and Energy Utilization platforms to develop CI capabilities that enhance their research activities. They also provided training and outreach activities through course development and deployment.

The External Engagement and Communications plank expanded the Iowa NSF EPSCoR website and used it to gather and disseminate information about the project. The team engaged student journalists to write stories and describe broader impacts and discoveries of Iowa NSF EPSCoR faculty and students. The plank also hosted and coordinated Iowa NSF EPSCoR workshops, the Annual Meeting, and “legislators in the lab” experiences for state and federal elected officials.

As part of project management, the Strategic Plan (SP) was reviewed and revised during Year 3. Each plank was first asked to review their respective sections of the SP, then the Project Director and Chief Operating Officer consolidated the recommended changes and submitted the revised SP to NSF. The revised SP was approved by NSF on March 5, 2014.

Many specific objectives were accomplished during Year 3; highlights of these accomplishments are provided below. Additional information and details regarding these accomplishments can be found in Appendix A, Section 1.2b.

BioEnergy (BE)

Data collection at the Bioenergy Agro-Ecosystem Research (BAER) sites are in full swing, thanks in large part to several pieces of new equipment that were provided by the Iowa NSF EPSCoR project. A hyper-spectral camera was purchased and is being used to develop remote sensing platforms for analysis of land use and agro-ecological impacts. Instrumentation for monitoring stream flow was purchased and installed at the BAER sites. Automated equipment for measuring greenhouse gas (GHG) emissions from soils was designed, built and used to quantify GHG emissions. Soil moisture and water quality monitoring equipment was purchased and installed. Data from both Big Creek and Clear Creek stream gauges, rain gauges, etc. are available on the Iowa Flood Center web site: http://ifis.iowafloodcenter.org/.

An open-source computer code for simulating biomass thermochemical conversion has been developed; this code has been released to the research community and is being continuously improved by researchers at ISU for its accuracy. Using information from UI’s thermochemical bioprocessing pilot plant, gasification products resulting from a chunk-based char-producing gasifier were determined to be different from
powdered char production. The biocatalysis work supported by this project was instrumental in obtain funding for additional work from the Iowa Energy Center. A laser laboratory to complete fundamental studies of biofuel combustion was completed. It was also shown that biomass-derived furan-2-carbonitrile, which is a precursor to a number of high efficiency conjugated polymers, can be synthesized in a single step from furfural.

Wind Energy (WE)

Supplemental funding from a successful proposal to the Iowa Alliance for Wind Innovation and Novel Development (IAWIND) has supported an industry-university partnership involving Iowa State University, Anemometry Specialists, Inc. (ASI, an Iowa company), WindLogics (a private wind industry meteorological firm), and NextEra (owner of the central Iowa 200-turbine wind farm). The expertise of the Iowa NSF EPSCoR team was leveraged to develop a marine-based balloon-borne wind resource characterization system, which was tested from a buoy located about 5 miles offshore near South Padre Island, TX.

An overset grid method was developed and implemented within an existing finite volume solver framework to account for the motion of wind turbine blades and nacelle yawing about the tower. A novel finite volume Computational Fluid Dynamics (CFD) solver capable of handling complex terrains, like those found in wind farms, has been developed and tested. A fatigue analysis procedure has been developed for large horizontal axis wind turbine blades and includes (1) random wind field simulations, (2) aerodynamic analysis, (3) stress analysis by finite element analysis, and (4) fatigue damage evaluation based on tested fatigue data. The proposed fatigue analysis procedure could facilitate the reliability analysis and reliability-based design optimization (RBDO) of wind turbine blades considering wind load uncertainty. A model of thermal damage in glass fiber polymer-matrix composites in wind turbine blades subjected to a lightning strike has been developed; the model describes surface interaction between the lightning arc and the composite structure.

A new wind tunnel and precision model wind turbine at UI has been completed, meeting the goal of enhancing the Blade Performance Laboratory at UI.

The GearDyn drivetrain simulation code developed in this project was integrated with NREL’s FAST and TurboSim codes to account for the variation of aerodynamic loads of rotor blades in the time-domain drivetrain dynamic analysis under random wind fields. By further integrating it into the RBDO code, it was demonstrated that the variability characteristics of the transmission error of wind turbines can be systematically predicted under the wind field and gear geometry imperfection uncertainties. A 2D multi-physics hydrodynamic numerical
analysis for the laser peening process was also developed to enhance the surface of the drivetrain components.

A strategic-level stochastic programming model for the design of a High-Voltage DC (HVDC) renewable energy grid was developed, accounting for weather and power demand uncertainties. In addition, general solution methods for mixed-integer risk-averse optimization problems have been developed that were also used to solve the grid optimization problem.

Energy Utilization (EU)

The Columbus Junction Community Laboratory is fully operational. The energy utilization data for the high school is also available to all students (and the community) through a school energy dashboard (http://buildingdashboard.com/clients/columbus/cchs/). Anyone who accesses the site can see current energy usage, as well as past usage for selectable time periods. The Interlock House Community Laboratory at Honey Creek State Park installed a GreenTouchscreen data display system. Various energy data can be accessed through the Internet at http://siemens.honeycreek.greentouchscreen.com/.

Broader Impacts (BI)

Over 18 faculty development programs delivered across the three Regent institutions engaged over 700 attendees from the faculty, post-doctoral, and graduate student ranks.

Diversity and BI leaders have successfully identified existing programs that Iowa NSF EPSCoR can work with to leverage and maximize impact – these include Upward Bound, LSAMP, and several other regional entities such as Girl Scouts, Regional STEM hubs and the Quad Cities Minority Science Partnership. Iowa NSF EPSCoR funds are also being utilized to promote research experience for female and URM undergraduates and community college students through collaboration with IINSPIRE-LSAMP.

To address the issue of increasing faculty diversity, the Diversity plank collaborated to establish search committee best practices training for STEM groups, and has expanded these activities to address implicit bias training in the faculty search process. Specifically, ADVANCE faculty from ISU provided search committee training at UI and UNI in Fall 2013; the best practices are being institutionalized at all three Regent universities.

The Workforce Development plank conducted several outreach programs to engage K-12 students and teachers in STEM related activities. For example, (1) several STEM summer camps will be held at
UNI, (2) a 3-week Summer Academy for middle school teachers and a 1-week workshop for elementary school teachers will be held at ISU, (3) a 3-week Energy Institute will be held at UNI for high school and middle school teachers, and (4) the UI Project Lead The Way (PLTW) Diversity/Implementation Coach added 25 new schools to the PLTW program.

The Cyberinfrastructure plank assisted the Building Science plank by creating a database and related CI tools specifically for the project involving the Interlock House. They also developed a platform to display the wind data from the Kirkwood Community College wind tower.

The External Engagement and Communications plank ensured timely updates and content management of the Iowa NSF EPSCoR website, recording over 1900 unique visitors between January and March, 2014. They have reached out to pertinent constituents to expand the Iowa NSF EPSCoR newsletter subscription list to 890. The team added a webpage featuring EPSCoR diversity programs and shared stories via the web, Twitter, and a newsletter.

Many significant results were realized during Year 3 of the Iowa NSF EPSCoR project and they are summarized below. Additional information can be found in Appendix A, Section 1.2c.

**BioEnergy (BE)**

An ISU/UI collaboration began to conduct aerial mapping of Miscanthus distribution in key Iowa regions, and to expand relationships with the UI power plant in hopes of moving to on-farm research as farmers begin planting bioenergy crops to meet UI power plant demand.

It was also determined that Nitrogen (N) management and harvest time influence both yield and sustainability of switchgrass production for bioenergy systems. Delaying harvest until after frost reduces the harvested biomass but also reduces the amount of N removed with the harvest, allowing more N to be stored in belowground tissues. Post frost harvest reduces N fertilizer requirements and helps prevent switchgrass yield declines in subsequent years. Biochar was explored as a possible soil amendment; the conclusion was that the addition of biochar increased water retention by 23% and decreased soil bulk density by 9% relative to controls.

The impacts of energy price uncertainty on the financial viability of advanced biorefineries was shown for various processing scenarios; significant technology development is required to lower capital costs for selected conditions. Biogas is another potential biofuels source; an interactive tool was developed for identifying potential biogas project sites in Iowa.
The laser laboratory for fundamental studies of biofuel combustion was able to detect fluorescence and Mie scattering of bio-oil, reactive boiling of model biomass compounds, Coherent Anti-Stokes Raman Scattering (CARS) of model biomass compounds, and transient in situ Fourier Transform Infrared (FTIR) spectroscopy of lignin and cellulose derived from biomass. Results indicate that experimental methods will enable in situ investigation of biomass conversion and utilization processes to understand the fundamental physics and chemistry of these processes.

A total of 26 journal papers, 74 presentations, conference papers or other publications, and 85 proposals were submitted this past year from the BE platform.

**Wind Energy (WE)**

The marine-based balloon-borne wind resource characterization system mounted on an ocean buoy anchored to the sea floor was successfully demonstrated; it operates continuously and unattended while delivering data to a shore-based receiver. This pilot project demonstrated a new and less expensive alternative to the currently used method for characterizing wind resources in offshore environments, especially deep water locations.

A bi-directional mentoring hierarchy was established, based on the assertion that mentoring for success in advancing students in STEM education needs to (1) be multi-level, (2) be continuous across programs, and (3) involve “mentoring of mentors”. Although the initial impact has been limited, anecdotal evidence is very promising.

A method for simulating specified yaw dynamics of a wind turbine was developed. The use of overset grids accounts for full body motion, including the rotation of the nacelle about the tower. A new formulation of the governing conservation equations for flow in complex geometries has been developed to be used in wind farm simulations. A new comprehensive fatigue analysis procedure for composite wind turbine blades, including a wind load uncertainty model, random wind field simulations, aerodynamic analysis, detailed stress analysis, and fatigue damage evaluation, was developed.

An integrated multi-physics gear dynamics simulation code under wind field uncertainty was developed and involves two codes developed at UI (GearDyn and I-RBDO) and two codes developed at NREL (FAST and TurboSim). To improve the reliability of wind turbine components, microstructural alterations during the hard drilling process has been studied using a multi-step numerical analysis.

It was determined that higher-order nonlinear risk measures, which estimate the risk through higher order moments of the tails of loss
distributions, allow for better control of uncertainties in renewable energy grids compared to more commonly used linear or lower-order risk functionals.

A total of 22 journal papers, 45 presentations, conference papers or other publications, and 25 proposals were submitted this past year from the WE platform.

**Energy Utilization (EU)**

A Mobile Energy Innovation Station (MEIS) (i.e., energy utilization demonstration trailer), was developed in collaboration with Kirkwood Community College students and instructors and the Iowa Renewable Energy Association (IRENEW).

Post occupancy thermal comfort and daylighting research was conducted with Post Occupancy Evaluation (POE) questionnaires and measured data at the Interlock House. Preliminary metrics were developed for a dynamic visual comfort (DViC) zone, which is a new addition to the existing comfort metrics for evaluation of indoor human behavior based on multiple dynamic environmental data and human behavior research.

Design proposals to improve the energy utilization of the Lakeside Lab Community Laboratory project have been completed and the final design and a proposal for the related data acquisition system will be drafted in summer 2014.

A total of 6 journal papers, 33 presentations, conference papers or other publications, and 17 proposals were submitted this past year from the EU platform.

**Energy Policy (EP)**

A total of 6 workshops and 6 seminars were organized by the EP platform and nearly 260 people attended these events. Two new energy policy graduate courses were offered at ISU in Year 3.

The new model of Renewable Identification Numbers (RINs) and corn markets incorporates uncertainty about future gasoline prices and corn yields in a way that is consistent with how traders in futures markets perceive markets to work and in a way that policy makers can understand and utilize in policy analysis. The newly developed model can be used to project the cost of meeting corn ethanol mandates under different expected market conditions and different future realizations of random corn yields and gasoline prices.
A total of 3 journal papers, 20 presentations, conference papers or other publications, and 18 proposals were submitted this past year from the EP platform.

**Broader Impacts (BI)**

Seed grants of $1,000-$3,000 awarded in summer 2012 to 12 UNI faculty (with the expectation that they would send in grant submissions within 3 months of the end of the seed grant) resulted in 11 submissions to federal funding agencies during the current year. Four of the submissions were awarded to UNI totaling over $1 million.

Based on evidence indicating sophomore level support was lacking for URM students in engineering, the RISE (Relgniting the Sophomore Experience) program was developed at ISU to provide such students with “lunch and learn” activities on topics to help bolster their academic success. More than 20 students participated in this year-long program and plans are in place to track the program’s impact on their academic success.

A significant result from the Diversity efforts at UI was the Sloan University Center for Exemplary Mentoring Minority Ph.D. Program Award. This project boasts 174 faculty mentors from 22 STEM programs. Twelve minority PhD students have been recruited in the first cohort of fellows.

The PLTW training programs are paying rich dividends in engaging female students. Two years ago, Iowa reported a 15.4% female enrollment in high school PLTW courses; this year the female enrollment was 18.2%. Iowa added 32 new PLTW schools in the 2012-13 school year and added an additional 25 schools in the 2013-14 school year.

A total of 1 journal paper, 7 presentations and 9 proposals were submitted this past year from BI platform team members.

**Key outcomes or Other achievements:**

Key outcomes and achievements relative to Strategic Plan milestones and metrics are found in Appendix A, Section 1.2d. Selected highlights are outlined below and additional details are found in the appendix.

**BioEnergy (BE)**

To assist with this transition of the UI power plant to biomass power, a stakeholder workshop and other statewide meetings were hosted in collaboration with UI to sign up farmers to plant 1000 acres of Miscanthus x giganteus in 2015. The UI plant is the most tangible near-term market for biomass energy in Iowa, and serves as an example project.
An open-source computer code for simulating biomass thermochemical conversion has been developed. Researchers in NREL and Oak Ridge National Lab are exploring the possibilities of adopting this code for their biomass reactor research. The code is being used by researchers at ISU to generate preliminary results for other NSF projects.

A new deoxysilylation route to transform metal oxide nanoparticles into silica-coated metal sulfide, selenide, or phosphide nanoparticles in a single step (one pot process) was developed. The resulting silica supported materials are known to be active and selective catalysts for hydrogenation and hydro-de-oxygenation of oxygenated and unsaturated substrates. Because the initial metal oxides are based on cheap, earth abundant first row transition metals such as nickel, this material could serve as excellent replacements for expensive and scarce noble metals such as Pt and Pd in the conversion and upgrading of biooils.

Wind Energy (WE)

Applications for major scholarships and fellowships by REU students was promoted through the bi-directional mentoring program. As an example, one REU student (Destenie Nock, an African American female student from North Carolina A&T) was encouraged to apply for prestigious interdisciplinary fellowships. Faculty mentors (Takle) supported her applications with letters of recommendation for the Mitchell, Fulbright, Marshall, and Rhodes Scholarships. As of this time, the outcomes are unknown, but a process has been established and has provided a new dimension for facilitating professional development of high-achieving REU students.

Machining-induced surface microstructural changes to wind turbine components were modeled through multi-step finite element-based models. It was shown that the machining surface integrity during hard drilling can be optimized by adjusting the process parameters.

The process physics during laser peening were modeled using the 2D multi-physics hydrodynamic numerical model to help design the laser peening process for wind turbine components.

Energy Utilization (EU)

A large number of national and international research presentations were presented by undergraduate research assistants working in the Building Science plank.

Based on knowledge gained through the Iowa NSF EPSCoR project, Passe was awarded an interdisciplinary NSF EFRI EAGER grant and is collaborating with colleagues at Harran University in Turkey.
Energy Policy (EP)

Several new faculty became involved in energy policy research through seed grants.

The six biofuel policy briefs released this reporting period have been downloaded as PDF files over 4,500 times.

Iowa NSF EPSCoR began collaborating with the UI Public Policy Center and provided support for a symposium on Iowa Extreme Weather that was held December 11, 2013. A renewable energy symposium will be co-sponsored in fall 2014.

Broader Impacts (BI)

Faculty development programs became decentralized to enable better development and delivery of programs at each Regent institution to allow facilitators to focus on the needs of a given location.

Best practices for recruitment of diverse faculty were shared among the Regent institutions; these practices are being institutionalized at each Regent university.

Over 600 female and URM students were engaged in more than 20 STEM related outreach activities this past year.

Leveraging Iowa NSF EPSCoR BI activities at UI, a SLOAN University Center for Exemplary Mentors was awarded to facilitate development of graduate students and faculty mentors to increase diversity presently in STEM graduate departments and ultimately in the professoriate.

Over the last year, more than 75 K-12 instructors received professional development training in the areas of bio-renewables via the ISU Summer Academy and in energy utilization and efficiency via UNI’s Energy Institute. As a result of these training opportunities, it is estimated that over 7,500 K-12 students have been exposed to the subject of finite energy sources to support the U.S. standard of living, and how the State of Iowa is addressing the shortfall by creating and implementing an extensive bio-based industry. These activities continue to provide STEM focus to K-12 students and will help strengthen workforce in these areas for the future.

The Energy Systems minor at ISU added 15 students to the program for a total of 29 students enrolled. Of these 29 students, 9 graduated with the minor in Year 3.

A coursework-only Masters of Engineering degree in energy systems at ISU was approved by the Iowa Board of Regents in Spring 2014. A graduate certificate in energy systems was approved by ISU in Fall 2013;
2 distance students are currently enrolled in the new certificate program.

The student team of Suncica Jasarevic (UE platform), Chloe Dedic (BE platform), and Bernardo Del Campo (BE platform) won the NSF EPSCoR Science Idol competition at the National NSF EPSCoR conference in Nashville, TN, in November 2013.

* What opportunities for training and professional development has the project provided?

Training and professional development opportunities were provided through all four research platforms. Details can be found in Appendix A, Section 1.3.

During Year 3 of this project, 15 post-docs (7 female and 1 URM), 121 graduate students (39 female and 7 URM), and 123 undergraduate students (58 female and 13 URM) were provided training opportunities through the Iowa NSF EPSCoR project. Note that the URM students were self-identified. Many of these students were able to attend workshops and conferences, domestically and internationally, for professional development and to present their research.

An example of successful student training and mentoring involves Mr. Esdras Murillo. Murillo was initially hired as an EPSCoR intern last summer. At the time, he was a student at the Des Moines Area Community College (DMACC). After his summer experience, he decided to transfer to ISU in the Electrical and Computer Engineering program, and was accepted into the prestigious McNair Scholarship program to prepare URM students for graduate research careers. Murillo continues to work in the Building Science plank as an ISU student.

Sustainable student training in energy systems has been realized through a new minor in energy systems at ISU that focuses on renewable energy and energy utilization (http://www.me.iastate.edu/energy-systems-minor/). The minor began accepting students in fall 2012. Currently, 29 students have officially registered for the minor (and 9 have graduated) and represent all engineering departments at ISU. A new graduate course at ISU entitled “ME531: Advanced Energy Systems and Analysis” was developed and offered for the first time in fall 2013, and enrolled 8 on-campus students and 13 off-campus (distance) students. The ME531 course is one of two required courses for the graduate certificate in energy systems, which was approved by the ISU Faculty Senate in Fall 2013; this course is also required for the Iowa Board of Regent-approved Masters of Engineering in Energy Systems Program, which was formally approved Spring 2014.

The graduate level courses in energy policy (BRT 515x) and international energy policy (BRT 516x) that were developed and offered through the Energy Policy platform have been well received. ISU believed these topics to be important enough to create a new tenure track position to teach these topics; a new faculty in political science has been hired and will start in the fall of 2014.

Collaborating with Ellsworth Community College, the Green Community Campaign plank sponsored an international lecture in October 2013 at UNI. The speaker was Dr. Peter Jahr from Germany who spoke on “Renewable Energies – What we should (not) learn from the European Union”.

Faculty development programs offered this year include those focused on (1) research planning for new faculty, (2) successful grant writing, (3) identification of resources on campus for collaborative research, and (4) invited talks to increase awareness of the needs of funding agencies. New programs aimed at developing the next generation of research leaders were also developed that typically engaged graduate students and postdoctoral fellows on developing research programs, funding opportunities, and planning for careers in academia, government and industry.
Diversity was the focus of several training and professional development programs within the Iowa jurisdiction. Mentoring people from diverse backgrounds was the topic of several mentoring workshops for faculty and graduate students/post-doctoral researchers where best practices in student recruitment, engagement, and retention were shared in order to maximize student success.

Specific training developed through the ISU NSF ADVANCE program was shared by ISU ADVANCE faculty with leadership at UI and UNI. The training provided information on best practices and recognition of how factors such as implicit bias can affect diversity in recruitment of faculty. In addition to the training being provided at ISU for all search committees through the institutionalization of NSF ADVANCE best practices, sharing of the training with UI and UNI has resulted in their adopting it across their campuses as well.

The summer programs for K-12 teachers offer extensive training on biorenewables (both fuels and chemicals) and Iowa’s bio-economy (ISU), and wind energy and energy efficiency (UNI). Participants at these training programs are also introduced to the concept of a green-collar workforce and the increased demand for skilled labor to meet the needs of Iowa’s extensive and growing bio-based industry.

All Project Lead The Way (PLTW) training programs are designed to engage instructors in effective delivery of the program to students, and have resulted in an increase in the number of PLTW female high school students.

The Cyberinfrastructure plank offered several workshops to provide opportunities for education, training, and professional development in CI; these workshops, as well as previously archived webinars, are available throughout the jurisdiction. For example, the CI team at UI has organized and hosted a series of hands-on workshops with the XSEDE program (https://www.xsede.org/). The CI team at UI also assisted with the course design of and taught sections of an information system class that exposes students to new concepts about renewable energy options available in Iowa - GOEG: 3560:0001 Spatial Analyses of Wind Energy - which uses the wind turbine data collected by Iowa NSF EPSCoR projects at Kirkwood College; 18 students attended this class as well.

The bioenergy infrastructure provided by Iowa NSF EPSCoR has enabled Dordt College to offer two new courses in project-based exploration of thermo-chemical reactors and bioenergy systems in their 2014-2015 course offerings. These new courses are EGR 344 – Fluidization Engineering (on theory and applications of fluidized bed reaction and conversion systems), and EGR 345 – Biorenewable Systems Engineering (on theory and applications of biorenewable technology, products and processes).

Selected members of the Iowa NSF EPSCoR team will be participating in the pilot NSF communications program Becoming EPSCoR Champions (BEC) on July 23-24, 2014. Follow-on activities will include putting the concepts into practice in the Iowa NSF EPSCoR project, and highlighting “best communications practices” on the Iowa NSF EPSCoR web site and in the newsletter.

* How have the results been disseminated to communities of interest?*

Results from the Iowa NSF EPSCoR project have been disseminated to communities of interest through publications, presentations, and outreach events. Highlights are outlined below, first by summarizing publications, then identifying selected dissemination activities within each platform.
BE Platform: 26 peer-reviewed journal publications, 3 conference proceedings, 67 presentations, 4 other publications.

WE Platform: 22 peer-reviewed journal publications, 13 conference proceedings, 27 presentations, 5 other publications.

EU Platform: 6 peer-reviewed journal publications, 3 conference proceedings, 28 presentations, 2 other publications.

EP Platform: 3 peer-reviewed journal publications, 18 presentations, 2 other publications.

BI Platform: 1 peer-reviewed journal publication, 1 conference proceeding, 4 presentations, 2 other publications.

BioEnergy (BE)

Ward participated in a radio interview and multiple popular media articles about nutrient export and agricultural productivity.

The open-source computer code for thermochemical processing that is being developed by Kong’s group was presented in numerous conferences and published technical papers. As a result of the interest received from the community, the open-source code has been disseminated to several domestic and international organizations including the National Renewable Energy Laboratory, Oak Ridge National Lab, University of Rome Tor Vergata, Italy, University of Limerick, Ireland, and the National Research Council of Italy.

Wind Energy (WE)

Results of field measurements taken in the outdoor wind laboratory have been widely used for educational and public interest venues as well as research publications. For example, meteorology majors at ISU have used the CWEX data in their senior theses.


Krokhmal chaired a session “Managing the grid under uncertainty” at the 20th Conference of the International Federation of Operational Research Societies (IFORS-2014) in Barcelona, Spain. He also present a talk at IFORS-2014 on “Risk-averse planning of HVDC grids”.

Dasgupta presented invited talks at the Australian National University and Melbourne University in November 2014.

Energy Utilization (EU)

Terpstra-Schwab presented preliminary findings at the Behavior, Energy and Climate Change (BECC) Conference in fall 2013 in Sacramento, CA.
He presented work on the Interlock House Community Laboratory to Iowa teachers at the “Iowa Council of Teachers of Mathematics and Iowa Academy of Science – Iowa Science Teaching Section Math Science Fall Conference 2013” on October 22, 2013.

The Building Science research with the Interlock House was presented at two major international research conferences: at PLEA (Passive Low Energy Architecture) 2013 in Munich and at the NCEUB (Network for Comfort and Energy Use in Buildings) Windsor Conference 2014 in Windsor near London in the UK. PLEA is a long standing meeting of the international low energy architecture community and the Windsor Conference is one of the most prestigious meetings for human comfort in buildings research. Both are peer-reviewed.

Passe presented the Building Science Plank research on the Interlock House as part of the Sustainable Buildings workshop at Harran University in Sanliurfa, Turkey, a trip funded through the NSF EFRI EAGER grant received by Passe, which is an extension of her Iowa NSF EPSCoR research activity.

The educational video series “Living with the Sun” was made available to various online video channels. It has already been incorporated into the ISU undergraduate Architecture curriculum and been shown in the building technology sequence co-taught by Passe in ARCH 341.

During summer 2014, Ahn will present some of the current Iowa NSF EPSCoR energy utilization and community laboratory activities to students, professors, and researchers from civil engineering, architecture, and construction management programs of several Korean universities and research institutes, as well as to the Korean Institute of Construction Engineering and Management.

**Energy Policy (EP)**

The EP platform has hosted an array of seminars and workshops to facilitate learning and collaboration among economists, engineers, and scientists. Each of the seminars and workshops were recorded and posted on the Iowa NSF EPSCoR web site for viewing. In addition, Babcock gave several presentations to professional and academic audiences throughout the year.

Wang and Hu gave several invited talks at the INFORMS conference, Minneapolis, MN, Oct 6-9, 2013.

Babcock and Pouliot have written several energy policy outlook reports evaluating the economic and technical feasibility of new renewable energy technologies.

Two congressional briefings on Renewable Fuel Standard Policies for U.S. House and Senate staff, reporters, and other were held November 12-13, 2013 in Washington, DC.

Damiano with the UI Public Policy Center leveraged Iowa NSF EPSCoR funds for a day long workshop “Adapting to Weather Extremes: the Economic Impact in Iowa” on December 11, 2013.

**Broader Impacts (BI)**

Evaluation on faculty development activities have been collected and will be shared with colleges and center directors in an effort to better tailor future programs to meet faculty/staff needs.

Diversity activities have been disseminated through presentations at regional and national meetings as well as through media outlets across the states, including: (1) presentations by faculty and student
researchers supported by Iowa NSF EPSCoR and LSAMP at the IINSPIRE LSAMP annual conference, including a presentation on “Impact of University of Iowa STEM Seminars 2013 on Enriching Upward Bound’s Science Curriculum”; (2) co-organization of the “Broader Impacts Infrastructure Summit” by Rover, held in Spring 2014; (3) participation by Peeples on at the National Academy of Engineering/American Society of Engineering Education workshop on “Surmounting Barriers: Ethnic Diversity in Engineering” in Fall 2013; and (4) articles on the event “Black Girls do Science” (http://now.uiowa.edu/2014/04/black-girls-do-science or http://www.dailyiowan.com/2014/04/14/Metro/37477.html).

The content and relevant information acquired during the STEM professional development programs was disseminated to all participants. This included students in formal settings, i.e., the students in the teacher participants’ classrooms, as well as in informal settings, e.g., after school programs, community events, etc.

Results of the PLTW training efforts have been disseminated to communities of interest through various presentations, including (1) at the national meetings of the American Society of Engineering Educators and the American Educational Research Association, and (2) the Governor’s STEM Council Executive Committee. Other modes of dissemination include a website (www.pltwiowa.org) and magazine entitled PLTW Iowa STEM Pathways for community members including parents, teachers, administrators, counselors and legislators.

Overall Iowa NSF EPSCoR project results and activities was disseminated to communities of interest via written articles which were (1) posted on the project web site, http://iowaepscor.org; (2) shared with congressional aides; (3) included in the Iowa EPSCoR Energy Innovator newsletter; (4) included in NSF Highlights; (5) shared with industries; (6) shared with all faculty, staff and students at the Regent universities; (7) shared in news releases to the Iowa press; and (8) shared with teachers involved in STEM programs.

* What do you plan to do during the next reporting period to accomplish the goals?

Activities that will be accomplished during year 4 of this project (September 1, 2014 – August 31, 2015) are outlined below. Additional details are provided in Appendix A, Section 1.5.

One new project-wide activity is a seed grant program to facilitate collaborations across platforms and institutions. Three $20,000 (total costs) seed grants will be provided to new collaborative efforts; this is being facilitated by a networking activity at the July Annual Meeting.

**BioEnergy (BE)**

Long-term monitoring of the Clear Creek (near UI) and Big Creek (near ISU) BAER sites, and at the UNI’s Cedar River Natural Resource Area Biomass Research Site will continue to improve understanding of flow, energy, and nutrient transport, as well as plant and wildlife community dynamics.

Building upon previous experiences with the BAER sites and furthering collaborations between the UI power plant and area farmers for energy crop production in on-farm research sites, demonstration planting first will begin at UI and then expand to collaborating farmers.

Biochar impact on soil water retention under field conditions will be quantified. Impacts of bioenergy cropping systems and biochar amendments on soil nutrient levels, biomass yields, and greenhouse gas emissions will be quantified.
The catalysts developed during Year 3 will be tested in Year 4 in both \textit{in situ} and \textit{ex situ} fast pyrolysis conditions to determine their effectiveness. Work will also continue to improve the instrumentation and testing procedures under relevant biomass conversion conditions (pyrolysis and gasification) for different biomass feedstocks, with the goal of understanding the basic physics and chemistry of these processes.

Novel techno-economic analysis frameworks will be developed to incorporate uncertainty parameters in the analysis; this will be used to evaluate innovative approaches to economic and environmental biofuel and biopower production, including duckweed as a potential biomass fuel source.

Work to increase the yield of furan-2-carbonitrile will continue with a focus on using biomass-derived materials as the feedstock. Additional conjugated polymers are currently being prepared to evaluate the performance of these materials in organic solar cells.

\textbf{Wind Energy (WE)}

Construction of a 120-m tall measurement tower in a Central Iowa wind farm for measurement of mean and turbulent wind characteristics, as well as temperature and humidity, within the lowest 120 m of the wind farm will be completed. This will enable the documentation of wind farm characteristics of turbine wakes and interactions of turbines.

Wind tunnel experiments and numerical modeling will be conducted with a multiple wind turbine array to explore the physics of wake interactions on model wind farm performance.

A method governing the yaw dynamics of the turbine based on the integrated aerodynamic loads will be developed. The developed fatigue analysis procedure will be integrated into the reliability analysis and reliability-based design optimization (RBDO) procedures. The work on a lightning strike progressive damage model will be continued. The RBDO approach will also be used in the design optimization of the wind turbine drivetrain using the approach developed in Year 3.

Laser-assisted machining, hardening, and peening experiments on wind turbine materials will be completed. A laser composite repairing (LCR) process will also be developed to enable a cost efficient repair of composite materials on wind turbine blades.

A semi-definite programming (SDP) relaxation model of alternating current will be developed for renewable energy grids. Solution techniques will also be developed for mixed-integer SDP models. A distributed control approach to dispatch will be extended to the problem of demand response, i.e., including loads in the process of dispatch to better accommodate variable generation.

\textbf{Energy Utilization (EU)}

The Green Community Campaign posttest analysis will be completed. Student and teacher energy knowledge evaluation surveys will be developed and administered at the Columbus Junction Community High School. The post occupancy evaluation at the Interlock House and the visitor survey will continue, as well as the Cyberinfrastructure data visualization and interface.

The Building Science team plans to develop the faculty cottage retrofit at Iowa Lakeside Laboratory as the third community laboratory. The stakeholders at this Regents resource center anticipate the retrofit to occur in fall 2014. In parallel, the Building Science team will develop the data acquisition

https://reporting.research.gov/rppr-web/rppr?execution=e1s14
system and survey instruments for the post occupancy evaluation planned to start in spring 2015 (assuming the retrofit is completed by then).

Residential towns for building energy efficiency performance research as the fourth community lab will be selected based on the cooperation of the pertinent Rural Electric Cooperatives.

**Energy Policy (EP)**

As in previous years, there are plans to offer 6 workshops and 6 seminars in 2014-15. A policy workshop in September 2014 will be organized in which economists and others will be invited to share their current forward-thinking ideas and research about the key policy issues that need to be addressed regarding renewable fuels.

In collaboration with the UI Public Policy Center, a renewable energy symposium will be co-sponsored, tentatively scheduled for October 16, 2014 in Iowa City, IA.

**Broader Impacts (BI)**

The Faculty Development team will continue to collaborate with existing programs on the Regent campuses to enhance faculty development and focus on what is needed on the respective campuses.

The Diversity team will provide activities that support STEM faculty who are writing NSF and other federal grants, and provide BI programming for junior faculty through cost and effort sharing. Additionally, current campus programs will be leveraged to recruit diverse students into the research activities. The leadership at the Regent institutions will be reminded of the best practices used in the faculty search process to ensure a diverse pool of faculty candidates and move towards institutionalization of the practices. Another focus will be on establishing consistent and reliable data for benchmarking and metrics for evaluation of long term impact of programs.

The Workforce Development team will continue to offer the Summer Academy and Energy Institute again, similar to this year.

Current Project Lead The Way activities will be expanded to strengthen this STEM pipeline, including (1) provide a dedicated area on the PLTW Iowa website for diversity guidance including STEM marketing materials for parents of girls, (2) provide recruiting “in a box” tools for teachers and counselors, and (3) provide profession development opportunities for PLTW teachers via community colleges.

The CI team will continue to work with Iowa NSF EPSCoR researchers to better support their activities. The External Engagement and Communication team will focus on diversity components of the Iowa NSF EPSCoR project during Year 4 to communicate successes and challenges in this area.

**Supporting Files**

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Appendix A contains additional details for the Accomplishment section.

### Products

#### Books


#### Book Chapters


#### Conference Papers and Presentations


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[https://reporting.research.gov/rppr-web/rppr?execution=e1s14](https://reporting.research.gov/rppr-web/rppr?execution=e1s14) 6/1/2014


Qi Li, Q. & Hu, G (). An optimization model for advanced biofuel production based on bio-oil gasification. INFORMS, Invited Talk.. Status = OTHER; Acknowledgement of Federal Support = Yes


Murillo, E., He, S. & Passe, U (). Annual Energy Consumption in a Community Lab and Analysis of the Electricity Energy Flow. 5th Annual Iowa State University Symposium on Sustainability. . Status = OTHER; Acknowledgement of Federal Support = Yes


Murillo, E. & Passe, U (). Annual Energy Consumption in a Community Lab and Analysis of the Electricity Flow. Research In the Capitol, Poster Presentation. . Status = OTHER; Acknowledgement of Federal Support = Yes


Yates, J., Osterberg, D., & Kuntz, K. (). Behaviors matter! Encouraging results from the field. RE-AMP, Webinar. Status = OTHER; Acknowledgement of Federal Support = Yes


Brown, R.C. (). Bioeconomy Institute and Affiliated Centers and Programs. President's Council. Iowa State University. Status = OTHER; Acknowledgement of Federal Support = Yes

Eaton, E.A (). Biomass for energy? Pros and cons in the big picture. Graduate Program in Sustainable Agriculture Colloquium. Iowa State University. Status = OTHER; Acknowledgement of Federal Support = Yes

Kazemzadeh, N. & Hu, G (). Biorefinery supply chain network design under uncertainty and evaluation of the impacts of policies. INFORMS, Invited talk. Status = OTHER; Acknowledgement of Federal Support = Yes

Hoksch, B.J., Myers, M.C., Mason, J.T., Pfirrimer, J.D., & Ridgway, A.J (). Birds and butterflies respond to soil-induced habitat heterogeneity in experimental plantings of native tallgrass prairie species in Iowa, USA. Society for Ecological Restoration SER2013 5th World Conference on Ecological Restoration. Status = OTHER; Acknowledgement of Federal Support = Yes

Hoksch, B.J. & Myers, M.C. (). Breaking Down Biofuels. Iowa Weed Commissioners Annual Conference. Status = OTHER; Acknowledgement of Federal Support = Yes


Peeples, T (). Coalitions of Conscience: Dreaming Down Barriers to STEM Inclusion. Martin Luther King Jr. Celebration, College of Liberal Arts and Sciences. University of Iowa. Status = OTHER; Acknowledgement of Federal Support = Yes
Just, C (). *Columbus Junction Schools Energy Dashboard.* U.S. Green Building Council student chapter meeting. . Status = OTHER; Acknowledgement of Federal Support = Yes

Yates, J., & Yates, C (). *Community is key: Community-wide energy efficiency works.* Behavior, Energy & Climate Conference. . Status = OTHER; Acknowledgement of Federal Support = Yes


Mathur, R.R., Lawrinenko, M., D.R. Lee, D.R., & Laird, D.A (). *Comparison of Techniques for Quantification of Total Inorganic Elements in Biochar.* American Society of Agronomy (ASA), Crop Science Society of America (CSSA), and Soil Science Society of America (SSSA) International Annual Meeting. . Status = OTHER; Acknowledgement of Federal Support = Yes

Rover, M., Johnston, P., Smith, R., & Brown, R.C (). *Comprehensive thermal degradation study of bio-oil phenolic oligomers.* TC Biomass-International Conference of Thermochemical Conversion Science. . Status = OTHER; Acknowledgement of Federal Support = Yes


Wheeler, A (). *Critical perspectives on sustainable architecture in the American Mid-West through the ethical philosophy of Luce Irigaray,* *Ethical Perspectives Following Luce Irigaray.* The Business School, University of Warwick. . Status = OTHER; Acknowledgement of Federal Support = Yes

Kumar, A., Mudumbai, R. & Dasgupta, S. (). *Distributed nullforming without prior frequency synchronization.* Third Australian Control Conference (AACC). . Status = OTHER; Acknowledgement of Federal Support = Yes


Walton, R.A., Takle, E.S. & Gallus Jr., W.A (). High wind shear and ramp events within the rotor layer across the Iowa Tall Tower Network. 5th Conference On Weather, Climate, and the New Energy Economy. . Status = OTHER; Acknowledgement of Federal Support = Yes


Reichert, M. D.; Lin, & C.-C.; Vela, J (). How Robust are Semiconductor Nanorods? Investigating the Stability and Chemical Decomposition Pathways of Photoactive Nanocrystals. 247th ACS (Spring) ACS National Meeting. . Status = OTHER; Acknowledgement of Federal Support = Yes

Ward, A.S (). How does hydrology control the mobilization, transport, and fate of solutes in agroecosystems. 9th Agro-IBIS Workshop. . Status = OTHER; Acknowledgement of Federal Support = Yes

Kim, K., Kieffer M., Bai, X., & Brown, R.C (). Hydrogen donor solvent assisted thermal decomposition of lignin. American Institute of Chemical Engineers AICHE Annual Meeting. . Status = OTHER; Acknowledgement of Federal Support = Yes

Kim, K., Bai, X., & Brown, R. C (). Hydrogen donor solvent assisted thermal decomposition of lignin to alkylphenols. TC Biomass-International Conference of Thermochemical Conversion Science. . Status = OTHER; Acknowledgement of Federal Support = Yes

Brown, R.C (). ISU’s Biorenewables Capabilities. City of Cedar Rapids. . Status = OTHER; Acknowledgement of Federal Support = Yes

Gevers, M., Bazanella, A. S., Coutinho, D. & Dasgupta, S (). Identifiability and Excitation of Polynomial Systems. Institute of Electrical and Electronics Engineers IEEE Conference on Decision and Control (CDC). . Status = OTHER; Acknowledgement of Federal Support = Yes


He, S. & Passe, U (). Improving Airflow Performance Models for Passive Solar and Natural Ventilation Design. 5th Annual Iowa State University Symposium on Sustainability. . Status = OTHER; Acknowledgement of Federal Support = Yes


Pfrimmer, J.D., Myers, M.C., & Mason, J. T. (2014). Interannual Shifts in Avian Community Composition in Heterogeneous Native Prairie Biofuel Feedstocks. 74th Midwest Fish & Wildlife Conference. Status = OTHER; Acknowledgement of Federal Support = Yes


Ou, L., Hu, G. & Brown, R.C (). Optimal design and operational planning for co-located ethanol plant. INFORMS, Invited Talk. . Status = OTHER; Acknowledgement of Federal Support = Yes


Wang, L. (). Potential competition for biomass between biopower and biofuel under RPS and RFS2. INFORMS. . Status = OTHER; Acknowledgement of Federal Support = Yes


Shen, N., Ding, H. & Li, W (2013). Predictive modeling of surface microstructure of hardened steel subject to drilling, In the Proceedings of SME 2013 International Mechanical Engineering Congress & Exposition,

Li, Q. & Hu, G. (. Production scheduling for fast pyrolysis fractionation with lot-sizing, Invited talk. INFORMS. Minneapolis, MN. Status = OTHER; Acknowledgement of Federal Support = Yes


Li, Y. & Hu, G (. Sequential facility location-allocation for fast pyrolysis biofuel production network. INFORMS, Invited Talk. . Status = OTHER; Acknowledgement of Federal Support = Yes


Rover, M., Johnston, P., Smith, R., & Brown, R.C (. Sugar and phenolic oligomer recovery from the heavy-ends of fractionated bio-oil. TC Biomass-International Conference of Thermochemical Conversion Science. Chicago, Ill. Status = OTHER; Acknowledgement of Federal Support = Yes


Thilakaratne, R., Ou, L., Wang, K., Kieffer, M., Bai, X., Wright, M.M, & Brown, R.C (). Techno-Economic Comparison of Thermochemical Liquefaction Pathways for Producing Drop-In Biofuels from Microalgae Remnants. TC Biomass-International Conference of Thermochemical Conversion Science. . Status = OTHER; Acknowledgement of Federal Support = Yes


He, S. & Passe, U (). The potential energy efficiency of a hybrid designed house: A post-occupancy case study on the heating and cooling system. 2014 ASHRAE Annual conference. . Status = OTHER; Acknowledgement of Federal Support = Yes

Brown, R. C (). Thermal Depolymerization of Carbohydrates and Proteins to Sugars and Hydrocarbons, Food for the Twenty-First Century. Bioprocessing and Biosensing Center. University of Missouri-Columbia. Status = OTHER; Acknowledgement of Federal Support = Yes


Wang, L (). Two robust optimization models for transmission planning. INFORMS, Invited talk. . Status = OTHER; Acknowledgement of Federal Support = Yes

Leysens, I. & Passe, U (). Understanding Illumination- Evaluating Daylight. 5th Annual Iowa State University Symposium on Sustainability. . Status = OTHER; Acknowledgement of Federal Support = Yes

Li, Y., Hu, G. & Tseng, C-L. (). Valuation of fast pyrolysis pathway via real options approach, Invited talk. INFORMS. . Status = OTHER; Acknowledgement of Federal Support = Yes

Brown, R.C., Bai, X., Kim, K., Kieffer, M (). What can we learn about fast pyrolysis of lignin from solvent liquefaction. American Institute of Chemical Engineering Annual Meeting (AICHE). . Status = OTHER; Acknowledgement of Federal Support = Yes

Brown, R.C (). Why Are We Developing Advanced Biofuels?. Agricultural Energy Curriculum Webinar, Iowa State University. . Status = OTHER; Acknowledgement of Federal Support = Yes
Takle, E.S (). *Will Climate Change Impact Renewable Energy Production?*. Advancing Renewables in the Midwest. Status = OTHER; Acknowledgement of Federal Support = Yes


**Inventions**

**Journals**


Boersma N.N. & Heaton E.A (). Does propagation method affect yield and survival? The potential of Miscanthus × giganteus in Iowa, USA. *Industrial Crops and Products*. Status = AWAITING_PUBLICATION; Acknowledgment of Federal Support = Yes

Boersma N.N. & Heaton E.A (). Propagation method affects Miscanthus × giganteus developmental morphology. *Industrial Crops and Products*. Status = AWAITING_PUBLICATION; Acknowledgment of Federal Support = Yes

Bonin C.L. Heaton E.A. & Barb J (). Miscanthus sacchariflorus: biofuel parent or new weed?. *Global Change Biology Bioenergy*. Status = AWAITING_PUBLICATION; Acknowledgment of Federal Support = Yes


Brown, R.C. & Wright, M.M (). A framework for defining the economic feasibility of cellulosic biofuel pathways. *Biofuels*. Status = UNDER_REVIEW; Acknowledgment of Federal Support = Yes


Thilakaratne, R., Wright M.M. & and Brown, R.C (). A techno-economic analysis of microalgae remnant catalytic pyrolysis and upgrading to fuels. *Fuel*. Status = AWAITING_PUBLICATION; Acknowledgment of Federal Support = Yes


Xiong, Q. & Kong, S.-C (). Assessment of reaction kinetics mechanisms in predicting product yield of biomass fast pyrolysis. *Environmental Progress & Sustainable Energy*. Status = ACCEPTED; Acknowledgment of Federal Support = Yes

Xiong, Q. & Kong, S.-C (). Modeling Effects of Interphase Transport Coefficients on Biomass Pyrolysis in Fluidized Beds. *Powder Technology*. Status = ACCEPTED; Acknowledgment of Federal Support = Yes


**Licenses**

**Other Products**

*Databases.*

**DATABASES**

Bioenergy:

Archives of real-time Big Creek stage data and of water quality and quantity metrics from the Clear Creek BAER site are available at http://ifis.iowafloodcenter.org/ifis/en/

Wind Energy:

CWEX-10 Field program database (surface measurements, lidar measurements)
CWEX-10 SCADA data
CWEX-11 Field program database (surface measurements, lidar measurements)
CWEX-11 SCADA data
CWEX-12 Field program database (surface measurements)
CWEX-13 Field program database (surface measurements, lidar measurements)
Iowa Wind Farm 000 SCADA data (171 turbines)

Energy Utilization – Building Science:

The Kirkwood data is currently accessible from the following URL: http://epscor2.cgeri.uiowa.edu/html/kirkwood.html. Access to the database is provided through a web interface.

The energy utilization data for the Columbus Junction Community Laboratory is also available to all students (and the community) through a school energy dashboard (http://buildingdashboard.com/clients/columbus/cchs/).

The Interlock House Community Laboratory at Honey Creek State Park installed a GreenTouchscreen data display system. Various data can be viewed through the Internet at http://siemens.honeycreek.greentouchscreen.com/.

Audio or Video Products.

External Engagement has produced several videos to increase public awareness of the project activities. YouTube and Vimeo are used to host materials

https://www.youtube.com/user/IowaNSFEPSCoR
http://iowaepscor.org/video

EU Building Science Plank completed an Interlock House-based educational series of four video chapters on improving energy efficiency are available on YouTube or Vimeo:

http://iowaepscor.org/research/energy/utilization/livingwiththesun

Energy Policy 2013-2014 workshop and seminar series are available as streaming videos at the following sites:

http://iowaepscor.org/energypolicyworkshops
http://iowaepscor.org/energypolicyseminars

Software or Netware.

The following have been generated:

https://reporting.research.gov/rppr-web/rppr?execution=e1s14
Multi-body dynamics simulation code for wind turbine drivetrain dynamics

Deterministic design optimization code for fatigue of composite wind turbine blade

http://isuepscorci.engineering.iastate.edu/EPSCoR_Prototype/tools/TSD/TSDinterface.php

A CI system was built for the Interlock house project with a broad range of tools to assist with the collection, storage, and analysis of the data:

Repository link can be found at:
http://isuepscorci.engineering.iastate.edu/EPSCoR_Prototype/InterLockHouse/DATA/

UI set up a real-time MongoDB on the UI server and ISU set up MySQL DB on ISU server:

http://epscor2.cgrer.uiowa.edu/apps/interlockexport?format=csv&mindt=0&maxdt=1380303301
http://isuepscorci.engineering.iastate.edu/EPSCoR_Prototype/InterLockHouse/DBQuery.php

Examples of interface pages:
http://isuepscorci.engineering.iastate.edu/EPSCoR_Prototype/InterLockHouse/EnergyUtilizing.php
http://isuepscorci.engineering.iastate.edu/EPSCoR_Prototype/InterLockHouse/DBQuery.php

DATA Report View pages: Examples:

Calender display: Outdoor average daily degree:
http://isuepscorci.engineering.iastate.edu/EPSCoR_Prototype/javascripts/mbostock-d3-41fece5/examples/InterlockData/dji.html

Each month hourly average display:
http://isuepscorci.engineering.iastate.edu/EPSCoR_Prototype/javascripts/mbostock-d3-41fece5/examples/InterlockData/HourLyHeatMapOrg.html

Plot display examples:
http://isuepscorci.engineering.iastate.edu/EPSCoR_Prototype/InterLockHouse/DATA/2013-08/ACindoor.png
http://isuepscorci.engineering.iastate.edu/EPSCoR_Prototype/InterLockHouse/DATA/2013-08/AirDegC.png
http://isuepscorci.engineering.iastate.edu/EPSCoR_Prototype/InterLockHouse/DATA/2013-08/AirGeneral.png

Experimental data for CFD validation obtained from MiDAS and desiccant dehumidification data has also been obtained.

Models.

Bioenergy:

Catalytic pyrolysis and hydrothermal processing chemical process models
Biomass supply logistics discrete event simulation model
Bio-oil stabilization chemical process model
Uncalibrated Agro-IBIS models of the State of Iowa under several land management scenarios

Wind Energy:
Precision scale wind turbine model
Multi-step finite element based model for machining-induced surface microstructural change during hard drilling.
2D multi-physics hydrodynamic numerical model for laser peening.

Energy Utilization-Building Science
Wall assembly mock – up for Interlock House constructed
Two retrofit mock-ups for Lakeside Laboratory were constructed

Educational aids or Curricula.

The following material was developed:

The WE Platform developed an online Wind energy lecture series; including lecture quizzes and notes, and a K-12 presentation and workshop on “Energy” with hands-on wind turbine activity.

External Engagement, with CenUSA and ISU Extension, worked to create an educational package for elementary through high school students to learn about Iowa's bioeconomy: http://iowaepscor.org/education/c6

The EU Platform completed educational video series featuring the Interlock house for high school curriculum: http://iowaepscor.org/research/energy/utilization/livingwiththesun

Workforce Development: Middle school teachers who complete the Summer Academy create performance tasks focusing on elements of biorenewables. Performance tasks are educational materials used as part of the middle school science curriculum that requires students to critically evaluate documents from different sources. These can be found at https://webspace.eng.iastate.edu/cbirc/precolled/ret/Shared%20Documents/Performance%20Tasks.aspx

Instruments or Equipment.

Bioenergy Platform:
StreamPro river discharge meter for streamflow and flood monitoring acquired.
A test cell for enabling optical access to biomass pyrolysis processes for in situ measurements was developed and tested. The test cell has been tested with Coherent Anti-Stokes Raman scattering (CARS) and transient Fourier Transform Infrared (FTIR) spectroscopy.
A Gas-Chromatograph Flame Ionization Detector (GC-FID) was installed and tested in a shared laboratory for analysis of pyrolysis products.
A camera and intensifier were acquired for transient spectroscopy and imaging of biomass conversion processes.
Water quality monitoring equipment (4 multiparameter sondes) acquired.
Land-atmosphere energy, water, and carbon exchange via eddy covariance (2 eddy covariance towers).
Water quality sampling during storm events (6 ISCO automatic water samplers).

Wind Energy Platform:
Establishment of a secure Wind Farm Data Analysis Laboratory. The need to maintain security on confidential data received from multiple utility scale wind farm operators in Iowa has created the need for a secure laboratory for research on these data. We have created such a lab with two new high speed Dell computers, two dedicated hard drive storage units and two designated single-purpose flash drive units for sole use in this secure facility. All
units are isolated from the internet for sole use on data for which we have a non-disclosure agreements. All major analyses will be done within this room, and only data that have been stripped of key identity will be allowed out of the room for analysis on other computers.

Completion of recirculating wind tunnel; completion of precision scale wind turbine model.

Energy Utilization Building Science:

High resolution infrared camera for energy usage monitoring acquired.
Custom designed mobile data acquisition (MiDAS) system designed and built.

Interlock House Field Lab including touch screen data interface completed.
Columbus Junction Field Laboratory completed.
Desiccatant system test facility set up.

Survey Instruments.

The EU Platform developed the following instruments:

Questionaire and survey for Interlock House Thermal and Visual Comfort studies
Student and teacher knowledge survey for Columbus Junction Community Lab
Posttest Survey of Knowledge, Attitudes & Efficiency Behavior for the Green Community Campaign
BI-Diversity developed an Upward Bound STEM Experience survey

Other Publications

Patents

Technologies or Techniques

Bioenergy Platform: A method for capturing the in situ, transient Fourier Transform Infrared (FTIR) spectrum during biomass pyrolysis was developed and installed in a shared facility at Iowa State University. Results allow temporal resolution of better than 100 ms to resolve the transient ~2 s pyrolysis process.

Wind Energy Platform: Laser Composite Repairing (LCR) to enable a cost efficient repair of composite materials on wind turbine blades

Thesis/Dissertations

Mykleby, E.. Analysis of HEC-RAS accuracy on rating curve development in the Big Creek Watershed.. (2013). Iowa State University. Acknowledgement of Federal Support = No


Shen, Y.. Syngas fermentation to biofuel using innovative biofilm-based reactors for enhancement of mass transfer and ethanol production.. (2013). Iowa State University. Acknowledgement of Federal Support = No


**Websites**
*Bioenergy: Biomass Crop Production and Physiology*
[http://faculty.agron.iastate.edu/heaton/](http://faculty.agron.iastate.edu/heaton/)

*Diversity at University of Iowa*

**EPSCoR Website Diversity page**
[http://iowaepscor.org/diversity](http://iowaepscor.org/diversity)

*Energy Utilization Building Science: Columbus Junction High School Dashboard*

*Energy Utilization Building Science: Interlock House*

**Websites mentioning CWEX or other EPSCoR wind work**
[http://www.meteor.iastate.edu/windresearch/index.html](http://www.meteor.iastate.edu/windresearch/index.html)

*Wind Energy: Kirkwood environmental and SCADA data*

*Wind Energy: Lidar and radiometer data*
[http://breeze.colorado.edu/jira3216/CWEX13Website/](http://breeze.colorado.edu/jira3216/CWEX13Website/)

*Wind Energy: research website for the Laser Materials Processing Lab*
[https://research.engineering.uiowa.edu/ding/EPSCoR-Wind](https://research.engineering.uiowa.edu/ding/EPSCoR-Wind)

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**Participants/Organizations**

*What individuals have worked on the project?*

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**Full details of individuals who have worked on the project:**

**Theodore J Heindel**  
**Email:** theindel@iastate.edu  
**Most Senior Project Role:** PD/PI  
**Nearest Person Month Worked:** 7
Contribution to the Project: PD/PI and Energy Utilization Platform Leader

Funding Support: NA

International Collaboration: No
International Travel: No

Robert C Brown
Email: rcbrown3@iastate.edu
Most Senior Project Role: Co PD/PI
Nearest Person Month Worked: 3

Contribution to the Project: Bioenergy Platform leader and Bioenergy Thermologistics and Conversion Plank leader

Funding Support: NA

International Collaboration: No
International Travel: No

Patrick B Butler
Email: patrick-butler@uiowa.edu
Most Senior Project Role: Co PD/PI
Nearest Person Month Worked: 1

Contribution to the Project: Wind Energy Platform leader

Funding Support: NA

International Collaboration: No
International Travel: No

Sriram Sundararajan
Email: srirams@iastate.edu
Most Senior Project Role: Co PD/PI
Nearest Person Month Worked: 3

Contribution to the Project: Broader Impacts Platform Leader

Funding Support: NA

International Collaboration: No
International Travel: No

Junyong Ahn
Email: junyong.ahn@uni.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 3

Contribution to the Project: Energy Utilization Building Science Plank research
Funding Support: NA
International Collaboration: No
International Travel: No

Georgeanne Artz
Email: gartz@iastate.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1
Contribution to the Project: Energy policy: Seed grant on developing enterprise budgets for perennial grasses for econ class exercises
Funding Support: NA
International Collaboration: No
International Travel: No

Bruce Babcock
Email: babcock@iastate.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1
Contribution to the Project: Energy Policy Platform leader
Funding Support: NA
International Collaboration: No
International Travel: No

John Beghin
Email: beghin@iastate.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1
Contribution to the Project: Energy Policy: Oversees energy policy seminars and workshops
Funding Support: NA
International Collaboration: No
International Travel: No

Peter Berendzen
Email: peter.berendzen@uni.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1
Contribution to the Project: Seed grant recipient in Y3, research on whole genome duplication in tetraploid fish
Funding Support: NA
International Collaboration: No
International Travel: No

James Buchholz
Email: james-h-buchholz@uiowa.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 2

Contribution to the Project: Wind Energy Blade Plank: Infrastructure development and wind turbine aerodynamics at UI

Funding Support: NA

International Collaboration: No
International Travel: No

Yong Chen
Email: yong-chen@uiowa.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: Wind Energy Green Energy Grids: Development of simulation models

Funding Support: NA

International Collaboration: No
International Travel: No

Kyung K. Choi
Email: kkchoi@engineering.uiowa.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: Wind Energy Drivetrain Plank leader. Carried out research to develop reliability-based design optimization method for wind energy system.

Funding Support: NA

International Collaboration: No
International Travel: No

Soura Dasgupta
Email: soura-dasgupta@uiowa.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: Wind Energy Green Energy Grids Plank Leader

Funding Support: NA
International Collaboration: Yes, Australia
International Travel: Yes, Australia - 0 years, 0 months, 13 days

Kavita Dhanwada
Email: kavita.dhanwada@uni.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 2

Contribution to the Project: BI Faculty Development team member, on UNI EPSCoR leadership team, also on IINSPIRE LSAMP campus leadership team

Funding Support: NA

International Collaboration: No
International Travel: No

Hongtao Ding
Email: hongtao-ding@uiowa.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 6

Contribution to the Project: Wind Energy Drivetrain Design Plank: laser based manufacturing of wind turbine components

Funding Support: NA

International Collaboration: No
International Travel: No

Kenneth Elgersma
Email: kenneth.elgersma@uni.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 2

Contribution to the Project: Bioenergy Agriculture Plank: Beginning investigator setting up lab

Funding Support: NA

International Collaboration: No
International Travel: No

Kristie Franz
Email: kfranz@iastate.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: Bioenergy Agriculture plank: hydrology studies, involved in project planning, supervised graduate student

Funding Support: NA
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<td>Wind Energy Resource Characterization Plank: wind farm data analysis</td>
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<td>Faculty</td>
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<td>Bioenergy Agriculture plank: Biomass crop production at ISU BAER site and UI Biomass Power Project</td>
<td>NA</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Richard Hichwa</td>
<td><a href="mailto:rich-hichwa@uiow.edu">rich-hichwa@uiow.edu</a></td>
<td>Faculty</td>
<td>1</td>
<td>Leads EPSCoR faculty dev programs at UI</td>
<td>NA</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>
Kirsten Hofmockel
Email: khof@iastate.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: Bioenergy Agriculture plank: Microbial ecology, develop and manage research program

Funding Support: NA

International Collaboration: No
International Travel: No

Guiping Hu
Email: gphu@iastate.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: Bioenergy Logistics and Conversion Plank/Energy Policy: Economic analysis, lifecycle assessment, supply chain design

Funding Support: NA

International Collaboration: No
International Travel: No

Laura Jackson
Email: laura.l.jackson@uni.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: Seed grant recipient in Y3, research on developing a multi-state research partnership for economic use of prairies on farms

Funding Support: NA

International Collaboration: No
International Travel: No

Keri Jacobs
Email: kljacobs@iastate.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: Energy Policy: Seed grant on exploring potential for agricultural marketing and supply cooperatives in IA

Funding Support: NA

International Collaboration: No
International Travel: No
Laura Jarboe
Email: ljarboe@iastate.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: Bioenergy Logistics and Conversion plank: direct research on sugar utilization

Funding Support: NA
International Collaboration: No
International Travel: No

Malika Jeffries-Ei
Email: malikaj@iastate.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: Bioenergy Logistics and Conversion plank: Seed Grant in Y3, Supervision of polymers synthesis

Funding Support: NA
International Collaboration: No
International Travel: No

Craig Just
Email: craig-just@uiowa.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 2

Contribution to the Project: Energy Utilization Building Science Plank: Leads the community laboratory efforts in Columbus Junction, Iowa.

Funding Support: NA
International Collaboration: No
International Travel: No

Pavlo Krokhmal
Email: pavlo-krokhmal@uiowa.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: Wind Energy Green Energy Grids Plank: Development of optimization models

Funding Support: NA
International Collaboration: No
International Travel: No
David Laird
Email: laird@iastate.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: BioEnergy Agriculture Plank leader
Funding Support: NA
International Collaboration: No
International Travel: No

Marc Linderman
Email: marc-linderman@uiowa.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 2

Contribution to the Project: Bioenergy Agriculture Plank: Remote sensing bioenergy plank
Funding Support: NA
International Collaboration: No
International Travel: No

Mary Losch
Email: mary.losch@uni.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: Co-leader of Energy Utilization Green Community Campaign Plank
Funding Support: NA
International Collaboration: No
International Travel: No

Gene Lutz
Email: gene.lutz@uni.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 3

Contribution to the Project: BI internal evaluation team leader: Coordinate SEB visit, liaise between external evaluator and project management. Oversee internal evaluation activities
Funding Support: NA
International Collaboration: No
International Travel: No

Erin MacDonald
Email: erinmacd@iastate.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: Wind Energy Resource Characterization Plank: optimization modeling
Funding Support: NA
International Collaboration: No
International Travel: No

Terrence Meyer
Email: trm@iastate.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: Bioenergy Logistics & Conversion investigator
Funding Support: NA
International Collaboration: No
International Travel: No

Colleen Mitchell
Email: colleen-mitchell@uiowa.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: Diversity team: Sloan Grant Development
Funding Support: NA
International Collaboration: No
International Travel: No

Raghumaran Mudumbai
Email: raghumaran-mudumbai@uiowa.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: Wind Energy Green Energy Grids: Distributed Control
Funding Support: NA
International Collaboration: No
International Travel: No

Douglas Mupasiri
Email: mupaasiri@uni.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 2
Contribution to the Project: BI Diversity team member, IINSPiRE LSAMP Campus Director.

Funding Support: NA
International Collaboration: No
International Travel: No

Mark Myers
Email: mark.myers@uni.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: Bioenergy Agriculture Plank investigator

Funding Support: NA
International Collaboration: No
International Travel: No

Ulrike Passe
Email: upasse@iastate.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 3

Contribution to the Project: Energy Utilization - Building Science Plank: Leads the state wide building science plank and coordinates interaction between the two main projects in the plank, also leads the interlock house community laboratory efforts at Honey Creek Resort State Park, coordinates all aspects of the research and BI parts of the project.

Funding Support: NA
International Collaboration: Yes, Turkey
International Travel: No

Tonya Peeples
Email: tonya-peeples@uiowa.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: Direction of Diversity and Collaboration across BI

Funding Support: NA
International Collaboration: No
International Travel: No

Andrey Petrov
Email: andrey.petrov@uni.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1
Contribution to the Project: Wind Energy Resource Characterization Plank: spatial mapping, seed grant recip in 2014

Funding Support: NA
International Collaboration: No
International Travel: No

Sebastien Pouliot
Email: pouliot@iastate.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: Energy Policy: Seed grant in Y3, Develop models to evaluate the feasibility and impact of proposed renewable fuel mandates.

Funding Support: NA
International Collaboration: No
International Travel: No

R. Ganesh Rajagopalan
Email: rajagopa@iastate.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: "Wind Energy Blade Plank leader. aerodynamic interference and dynamic simulation for performance enhancement and optimization

Funding Support: NA
International Collaboration: No
International Travel: No

Krishna Rajan
Email: krajan@iastate.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 3

Contribution to the Project: Cyberinfrastructure leader

Funding Support: NA
International Collaboration: No
International Travel: No

Albert Ratner
Email: Albert-ratner@uiowa.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1
Contribution to the Project: BioEnergy Logistics and Conversion Plank: Investigator for Biomass Gasification

Funding Support: NA

International Collaboration: Yes, Brazil

International Travel: Yes, Brazil - 0 years, 0 months, 18 days

David Rethwisch
Email: david-rethwisch@uiowa.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 6

Contribution to the Project: BI Workforce Development: PLTW Co-Affiliate Director: K-12 STEM Outreach and teacher Professional Development

Funding Support: NA

International Collaboration: No

International Travel: No

Alicia Rosburg
Email: alicia.rosburg@uni.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: Energy Policy: Bioenergy research projects

Funding Support: NA

International Collaboration: No

International Travel: No

Diane Rover
Email: drover@iastate.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: Diversity team, disseminate diversity best practices

Funding Support: NA

International Collaboration: No

International Travel: No

Thomas Schnell
Email: thomas-schnell@uiowa.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: Bioenergy and Wind Energy Planks Instrumentation support
Funding Support: NA
International Collaboration: No
International Travel: No

Zengyi Shao
Email: zyshao@iastate.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 7

Contribution to the Project: Biorenewables research, Concept design, research planning
Funding Support: NA
International Collaboration: No
International Travel: No

Anupam Sharma
Email: sharma@iastate.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: Wind Energy Resource Characterization Plank: wind farm simulation
Funding Support: NA
International Collaboration: No
International Travel: No

Mark Sherrard
Email: mark.sherrard@uni.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: Bioenergy Agriculture Plank: physiology of bioenergy feedstocks
Funding Support: NA
International Collaboration: No
International Travel: No

Laura Smarandescu
Email: smarand@iastate.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 2

Contribution to the Project: Energy Policy: Seed grant on consumer perceptions of gas with ethanol, formulate research question, design research instrument, analyze data.
Funding Support: NA
Hiroyuki Sugiyama
Email: hiroyuki-sugiyama@uiowa.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: Wind Energy Drivetrain Plank: Drivetrain dynamics simulation

Funding Support: NA

Eugene Takle
Email: gstakle@iastate.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 2


Funding Support: NA

Nickolas Terpstra-Schwab
Email: nicholas.schwab@uni.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: Energy Utilization Green Community Campaign Plank investigator

Funding Support: NA

Jean-Philippe Tessonier
Email: tesso@iastate.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 5

Contribution to the Project: Bioenergy logistics and conversion plank: Catalyst synthesis for pyrolysis, Supervisor and mentor

Funding Support: NA
Andrew Vanloocke
Email: andyvanl@mail.iastate.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

**Contribution to the Project:** Wind Energy Resource Characterization Plank: Field program design

**Funding Support:** NA

**International Collaboration:** No
**International Travel:** No

R. Dennis Vigil
Email: vigil@iastate.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

**Contribution to the Project:** Bioenergy Logistics and Conversion plank: Seed grant in Y3, supervised algal photobioreactor modeling

**Funding Support:** NA

**International Collaboration:** No
**International Travel:** No

Lizhi Wang
Email: lzwang@iastate.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 8

**Contribution to the Project:** Participates in the energy policy platform

**Funding Support:** NA

**International Collaboration:** No
**International Travel:** No

Adam Ward
Email: adam-ward@uiowa.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 4

**Contribution to the Project:** Bioenergy Agriculture Plank: Establish ecological monitoring network. Analysis of nitrate data.

**Funding Support:** NA

**International Collaboration:** No
**International Travel:** No
Andrea Wheeler
Email: andrea1@iastate.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: Energy Utilization Building Science Plank: Faculty seed grant researching school buildings

Funding Support: NA
International Collaboration: Yes, United Kingdom
International Travel: No

Mark Mba Wright
Email: markmw@iastate.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 5

Contribution to the Project: Bioenergy Logistics and Conversion Plank/Energy Policy: Research, teaching, and broader impacts outreach, seed grant recipient in Y3

Funding Support: NA
International Collaboration: No
International Travel: No

Shaoping Xiao
Email: shaoping-xiao@uiowa.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 2

Contribution to the Project: Wind Energy Drivetrain Plank: gear-tooth and bearing failure analysis, mentoring graduate student

Funding Support: NA
International Collaboration: No
International Travel: No

Jack Yates
Email: jack.yates@uni.edu
Most Senior Project Role: Faculty
Nearest Person Month Worked: 1

Contribution to the Project: Co-leader of Energy Utilization Green Community Campaign Plank

Funding Support: NA
International Collaboration: No
International Travel: No
Olesya Zhupanska  
Email: ozhupans@engineering.uiowa.edu  
Most Senior Project Role: Faculty  
Nearest Person Month Worked: 1  
Contribution to the Project: Wind Energy Blade Plank: composite blade failure analysis  
Funding Support: NA  
International Collaboration: No  
International Travel: No

Sotirios Archontoulis  
Email: sarchont@iastate.edu  
Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)  
Nearest Person Month Worked: 1  
Contribution to the Project: Cropping systems modeling  
Funding Support: NA  
International Collaboration: No  
International Travel: No

Santanu Bakshi  
Email: sbakshi@iastate.edu  
Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)  
Nearest Person Month Worked: 1  
Contribution to the Project: Soil-nutrient-biochar research  
Funding Support: NA  
International Collaboration: No  
International Travel: No

Catherine Bonin  
Email: cbonin@iastate.edu  
Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)  
Nearest Person Month Worked: 3  
Contribution to the Project: Miscanthus invasion spectral remote sensing  
Funding Support: NA  
International Collaboration: No  
International Travel: No

Elke Brandes  
Email: ebrandes@iastate.edu
Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)
Nearest Person Month Worked: 1

Contribution to the Project: bioenergy life cycle analysis and outreach

Funding Support: NA

International Collaboration: No
International Travel: No

Zhanyou Chi
Email: chizhy@dlut.edu.cn
Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)
Nearest Person Month Worked: 6

Contribution to the Project: performs research on sugar and acetate utilization

Funding Support: NA

International Collaboration: No
International Travel: No

Caroline Davis
Email: caroline-davis@uiowa.edu
Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)
Nearest Person Month Worked: 6

Contribution to the Project: Analysis of water quality data, field campaign planning, hydrological modeling and data analysis. Management of field equipment. Maintenance of field sites and equipment.

Funding Support: NA

International Collaboration: No
International Travel: No

Shan He
Email: shanhe@iastate.edu
Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)
Nearest Person Month Worked: 10

Contribution to the Project: Assists with research conducted the Interlock house community laboratory efforts at Honey Creek Resort State Park, coordinates the CFD, and air flow evaluation work, designed and coordinatee the work for the MiDAS and the Cyberinfrastructure data integration

Funding Support: NA

International Collaboration: No
International Travel: No

Jieni Lian
Email: lianjieni@gmail.com
Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)
Nearest Person Month Worked: 11
Contribution to the Project: performs research on sugar utilization
Funding Support: NA
International Collaboration: No
International Travel: No

James Michael
Email: jmichael@iastate.edu
Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)
Nearest Person Month Worked: 2
Contribution to the Project: Spectroscopy for pyrolysis
Funding Support: NA
International Collaboration: No
International Travel: No

Daniel Rajewski
Email: drajewsk@iastate.edu
Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)
Nearest Person Month Worked: 10
Contribution to the Project: Wind Resource Characterization field data analysis
Funding Support: NA
International Collaboration: No
International Travel: No

Qingang Xiong
Email: xiong@iastate.edu
Most Senior Project Role: Postdoctoral (scholar, fellow or other postdoctoral position)
Nearest Person Month Worked: 12
Contribution to the Project: Developing open-source computer codes to simulate biomass thermochemical conversion
Funding Support: NA
International Collaboration: No
International Travel: No

Mitchell Avery
Email: mitchell.avery@uni.edu
Most Senior Project Role: Other Professional
Nearest Person Month Worked: 2
**Contribution to the Project:** Provided technical assistance to EPSCoR participants, assisted in updating of BI milestones/metrics

**Funding Support:** NA

**International Collaboration:** No

**International Travel:** No

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**Ryan Baumert**  
**Email:** ryan-baumert@uiowa.edu  
**Most Senior Project Role:** Other Professional  
**Nearest Person Month Worked:** 2

**Contribution to the Project:** Research Support (financial/accounting)

**Funding Support:** NA

**International Collaboration:** No

**International Travel:** No

---

**Scott Black**  
**Email:** scott-black@uiowa.edu  
**Most Senior Project Role:** Other Professional  
**Nearest Person Month Worked:** 2

**Contribution to the Project:** Upward Bound STEM instructor

**Funding Support:** NA

**International Collaboration:** No

**International Travel:** No

---

**Lynne Bleeker**  
**Email:** lynnebleeker@mchsi.com  
**Most Senior Project Role:** Other Professional  
**Nearest Person Month Worked:** 2

**Contribution to the Project:** Facilitates Professional Development Teacher Training for RET Program

**Funding Support:** NA

**International Collaboration:** No

**International Travel:** No

---

**Nicholas Boersma**  
**Email:** nboersma@iastate.edu  
**Most Senior Project Role:** Other Professional  
**Nearest Person Month Worked:** 10

**Contribution to the Project:** overall operations management, ISU BAER site
Funding Support: NA
International Collaboration: No
International Travel: No

Christian Borqwardt
Email: christian-bogwardt@uiowa.edu
Most Senior Project Role: Other Professional
Nearest Person Month Worked: 3

Contribution to the Project: instrumentation support

Funding Support: NA
International Collaboration: No
International Travel: No

Chris Coretsopoulos
Email: ccoretso@engineering.uiowa.edu
Most Senior Project Role: Other Professional
Nearest Person Month Worked: 3

Contribution to the Project: Outreach Specialist

Funding Support: NA
International Collaboration: No
International Travel: No

Larry Detweiler
Email: larry-detweiler@uiowa.edu
Most Senior Project Role: Other Professional
Nearest Person Month Worked: 1

Contribution to the Project: wind platform instrumentation support

Funding Support: NA
International Collaboration: No
International Travel: No

Lisa Digman
Email: lisa-digman@uiowa.edu
Most Senior Project Role: Other Professional
Nearest Person Month Worked: 9

Contribution to the Project: PLTW Diversity/Implementation coach for PLTW

Funding Support: NA
International Collaboration: No
International Travel: No

Kolie Eko
Email: kolie-eko@uiowa.edu
Most Senior Project Role: Other Professional
Nearest Person Month Worked: 2

Contribution to the Project: Upward Bound STEM instructor
Funding Support: NA

International Collaboration: No
International Travel: No

Qiying Ann Fu
Email: annfu@iastate.edu
Most Senior Project Role: Other Professional
Nearest Person Month Worked: 10

Contribution to the Project: Systems Analyst
Funding Support: NA

International Collaboration: No
International Travel: No

James Goss
Email: james-goss1@uiowa.edu
Most Senior Project Role: Other Professional
Nearest Person Month Worked: 2

Contribution to the Project: instrumentation support
Funding Support: NA

International Collaboration: No
International Travel: No

Eric Hall
Email: eric.hall@dsmschools.org
Most Senior Project Role: Other Professional
Nearest Person Month Worked: 3

Contribution to the Project: Facilitates Professional Development Teacher Training for RET Program
Funding Support: NA

International Collaboration: No
International Travel: No
Erin Heiden  
**Email:** erin.heiden@uni.edu  
**Most Senior Project Role:** Other Professional  
**Nearest Person Month Worked:** 2  

**Contribution to the Project:** Provided technical assistance to EPSCoR participants, assisted in updating of BI milestones/metrics  

**Funding Support:** NA  

**International Collaboration:** No  

**International Travel:** No  

Patricia Higby  
**Email:** patricia.higby@uni.edu  
**Most Senior Project Role:** Other Professional  
**Nearest Person Month Worked:** 3  

**Contribution to the Project:** BI-WFD development leader at UNI  

**Funding Support:** NA  

**International Collaboration:** No  

**International Travel:** No  

Tolif Hunt  
**Email:** tolf.hunt@uni.edu  
**Most Senior Project Role:** Other Professional  
**Nearest Person Month Worked:** 1  

**Contribution to the Project:** PI for UNI EPSCoR project  

**Funding Support:** NA  

**International Collaboration:** No  

**International Travel:** No  

Samantha Irvin  
**Email:** sirvin@iastate.edu  
**Most Senior Project Role:** Other Professional  
**Nearest Person Month Worked:** 10  

**Contribution to the Project:** Field technician  

**Funding Support:** NA  

**International Collaboration:** No  

**International Travel:** No  

Nancy Jeffs  
**Email:** njeffs@iastate.edu
<table>
<thead>
<tr>
<th>Most Senior Project Role:</th>
<th>Other Professional</th>
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<td>Nearest Person Month Worked:</td>
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<tr>
<td>Contribution to the Project:</td>
<td>K-12 Engineering Outreach Program Coordinator</td>
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<td>International Travel:</td>
<td>No</td>
</tr>
</tbody>
</table>

Thomas Kasang  
Email: thomas-kasang@uiowa.edu  
Most Senior Project Role: Other Professional  
Nearest Person Month Worked: 2  
Contribution to the Project: wind blade plank effort  
Funding Support: NA  
International Collaboration: No  
International Travel: No

Asrun Kristmundsdottir  
Email: ayk@iastate.edu  
Most Senior Project Role: Other Professional  
Nearest Person Month Worked: 12  
Contribution to the Project: COO of IA NSF EPSCoR  
Funding Support: NA  
International Collaboration: No  
International Travel: No

Jacob Lamb  
Email: jacob-lamb@uiowa.edu  
Most Senior Project Role: Other Professional  
Nearest Person Month Worked: 2  
Contribution to the Project: Upward Bound STEM instructor  
Funding Support: NA  
International Collaboration: No  
International Travel: No

Adah Leshem  
Email: adah@iastate.edu  
Most Senior Project Role: Other Professional  
Nearest Person Month Worked: 1
**Contribution to the Project:** On Workforce Development BI team, leads teacher training programs

**Funding Support:** NA

**International Collaboration:** No
**International Travel:** No

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**Leigh Ann Ann Longou**  
**Email:** lalong@iastate.edu  
**Most Senior Project Role:** Other Professional  
**Nearest Person Month Worked:** 6

**Contribution to the Project:** water and plant tissue quality analysis, ISU BAER site

**Funding Support:** NA

**International Collaboration:** No  
**International Travel:** No

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**Wendy Meyers**  
**Email:** wendy-meyers@uiowa.edu  
**Most Senior Project Role:** Other Professional  
**Nearest Person Month Worked:** 1

**Contribution to the Project:** PLTW College Credit Coordinator

**Funding Support:** NA

**International Collaboration:** No  
**International Travel:** No

---

**Robert Mills**  
**Email:** rmills@iastate.edu  
**Most Senior Project Role:** Other Professional  
**Nearest Person Month Worked:** 4

**Contribution to the Project:** EPSCoR Communication and outreach

**Funding Support:** NA

**International Collaboration:** No  
**International Travel:** No

---

**Jerry Mount**  
**Email:** jerry-mount@uiowa.edu  
**Most Senior Project Role:** Other Professional  
**Nearest Person Month Worked:** 12

**Contribution to the Project:** Systems Analyst

**Funding Support:** NA
International Collaboration: No
International Travel: No

Kandace Munson
Email: kandace-munson@uiowa.edu
Most Senior Project Role: Other Professional
Nearest Person Month Worked: 12

Contribution to the Project: PLTW Program Assistant
Funding Support: NA

International Collaboration: No
International Travel: No

Marc Peterson
Email: marc@iastate.edu
Most Senior Project Role: Other Professional
Nearest Person Month Worked: 12

Contribution to the Project: Financial manager
Funding Support: NA

International Collaboration: No
International Travel: No

Tracy Peterson
Email: tracy-peterson@uiowa.edu
Most Senior Project Role: Other Professional
Nearest Person Month Worked: 2

Contribution to the Project: Diversity and K-12 Outreach, Internship programs
Funding Support: NA

International Collaboration: No
International Travel: No

Chitra Rajan
Email: rajanc@iastate.edu
Most Senior Project Role: Other Professional
Nearest Person Month Worked: 3

Contribution to the Project: Member of BI faculty development team
Funding Support: NA

International Collaboration: No
International Travel: No
Samuel Rathke
Email: sjrathke@iastate.edu
Most Senior Project Role: Other Professional
Nearest Person Month Worked: 12

Contribution to the Project: Coordinate lab, greenhouse field plot research

Funding Support: NA
International Collaboration: No
International Travel: No

Stacy Renfro
Email: srenfro@iastate.edu
Most Senior Project Role: Other Professional
Nearest Person Month Worked: 1

Contribution to the Project: Coordinates the workforce development programs Iowa State Uni

Funding Support: NA
International Collaboration: No
International Travel: No

Carl Richey
Email: carlton-richey@uiowa.edu
Most Senior Project Role: Other Professional
Nearest Person Month Worked: 1

Contribution to the Project: Engineering and instrument installation

Funding Support: NA
International Collaboration: No
International Travel: No

Katie Schnedler
Email: katie-schnedler@uiowa.edu
Most Senior Project Role: Other Professional
Nearest Person Month Worked: 2

Contribution to the Project: PLTW College Credit Coordinator

Funding Support: NA
International Collaboration: No
International Travel: No

Gregory Wagner
Email: gregory-wagner@uiowa.edu
**Melissa Ward**
**Email:** melissa-ward-1@uiowa.edu
**Most Senior Project Role:** Other Professional
**Nearest Person Month Worked:** 2
**Contribution to the Project:** Assists with the community laboratory efforts in Columbus Junction, Iowa.
**Funding Support:** NA
**International Collaboration:** No
**International Travel:** No

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**Danielle Wilson**
**Email:** dwilson@iastate.edu
**Most Senior Project Role:** Other Professional
**Nearest Person Month Worked:** 2
**Contribution to the Project:** data collection, analysis, management and publications
**Funding Support:** NA
**International Collaboration:** No
**International Travel:** No

---

**Carole Yates**
**Email:** carole.yates@uni.edu
**Most Senior Project Role:** Other Professional
**Nearest Person Month Worked:** 1
**Contribution to the Project:** Content expert - Energy Utilization Green Community campaign plank participant
**Funding Support:** NA
**International Collaboration:** No
**International Travel:** No

---

**James Akkala**
**Email:** james-akkala@uiowa.edu
**Most Senior Project Role:** Graduate Student (research assistant)
**Nearest Person Month Worked:** 1
Contribution to the Project: Wind lab experiments and data analysis
Funding Support: NA
International Collaboration: No
International Travel: No

Deborah Aller
Email: dmaller@iastate.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 6

Contribution to the Project: Soil-water-biochar research
Funding Support: NA
International Collaboration: No
International Travel: No

Aaron Baker
Email: anbaker@iastate.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 6

Contribution to the Project: SCADA data analysis
Funding Support: NA
International Collaboration: No
International Travel: No

Bryne Berry
Email: bryne-berry@uiowa.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 9

Contribution to the Project: electrical and impact characterization of woven carbon fiber composites, Diversity and K-12 Outreach, Wind Research
Funding Support: NA
International Collaboration: No
International Travel: No

Tristan Brown
Email: trb6x4@iastate.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 9

Contribution to the Project: Research, teaching
<table>
<thead>
<tr>
<th>Name</th>
<th>Email</th>
<th>Most Senior Project Role</th>
<th>Nearest Person Month Worked</th>
<th>Contribution to the Project</th>
<th>Funding Support</th>
<th>International Collaboration</th>
<th>International Travel</th>
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<tbody>
<tr>
<td>Ruth Burke</td>
<td><a href="mailto:rburke@iastate.edu">rburke@iastate.edu</a></td>
<td>Graduate Student (research assistant)</td>
<td>1</td>
<td>biomass workshop assistance</td>
<td>NA</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Nandith Chandy</td>
<td><a href="mailto:ngchandy@iastate.edu">ngchandy@iastate.edu</a></td>
<td>Graduate Student (research assistant)</td>
<td>12</td>
<td>Spectroscopy for pyrolysis</td>
<td>NA</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Le Chen</td>
<td><a href="mailto:chenle86@gmail.com">chenle86@gmail.com</a></td>
<td>Graduate Student (research assistant)</td>
<td>12</td>
<td>CWEX data analysis</td>
<td>NA</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Bokan Chen</td>
<td><a href="mailto:bokanc@iastate.edu">bokanc@iastate.edu</a></td>
<td>Graduate Student (research assistant)</td>
<td>8</td>
<td>conducting research and disseminating results</td>
<td>NA</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>
International Collaboration: No
International Travel: No

Eric Chon
Email: ericchon@iastate.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 6
Contribution to the Project: Spectroscopy for pyrolysis
Funding Support: NA

International Collaboration: No
International Travel: No

Clark Colby
Email: cacolby3@gmail.com
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 2
Contribution to the Project: Research Assistant with CBER
Funding Support: NA

International Collaboration: No
International Travel: No

Joseph Cullin
Email: joe-cullin@uiowa.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 1
Contribution to the Project: Collection of water quality samples
Funding Support: NA

International Collaboration: No
International Travel: No

Tannon Daugaard
Email: daugaard@iastate.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 12
Contribution to the Project: Research, mentoring K-12
Funding Support: NA

International Collaboration: No
International Travel: No
Chloe Dedic
Email: cededic@iastate.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 6

Contribution to the Project: Gas-phase spectroscopy

Funding Support: NA

International Collaboration: No
International Travel: No

Daniel Diaz
Email: ddiaz@iastate.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 3

Contribution to the Project: Aerosol imaging for pyrolysis

Funding Support: NA

International Collaboration: No
International Travel: No

Deng Ding
Email: deng-ding@uiowa.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 3

Contribution to the Project: Modeling and remote sensing analyses

Funding Support: NA

International Collaboration: No
International Travel: No

Pallavi Dubey
Email: pdubey@iastate.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 1

Contribution to the Project: Developing tools for analysis of spectral data

Funding Support: NA

International Collaboration: No
International Travel: No

David Escudero
Email: drescude@iastate.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 2

Contribution to the Project: Computed tomography of fluidized beds

Funding Support: NA

International Collaboration: No
International Travel: No

Matthew Even
Email: mattew-even@uiowa.edu

Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 2

Contribution to the Project: Collection of water quality samples

Funding Support: NA

International Collaboration: No
International Travel: No

Rivka Fidel
Email: rfidel@iastate.edu

Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 6

Contribution to the Project: Biochar-greenhouse gas emission Research

Funding Support: NA

International Collaboration: No
International Travel: No

Megan Fowler
Email: meganf@iastate.edu

Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 2

Contribution to the Project: Research Assistant

Funding Support: NA

International Collaboration: No
International Travel: No

Xi Gao
Email: gaoxi@iastate.edu

Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 1
Contribution to the Project: Carried out simulations of bioreactor
Funding Support: NA
International Collaboration: No
International Travel: No

Daniel Garrick
Email: dgarrick@iastate.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 3

Contribution to the Project: Unsteady model for yawing wind turbines
Funding Support: NA
International Collaboration: No
International Travel: No

Mir Ali Ghaffari
Email: ali-ghaffari@uiowa.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 12

Contribution to the Project: research assistant
Funding Support: NA
International Collaboration: No
International Travel: No

Mohsen Ghamari
Email: mohsen-ghamari@uiowa.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 1

Contribution to the Project: Researching Biomass Gasification
Funding Support: NA
International Collaboration: No
International Travel: No

Qiang Guo
Email: guo@iastate.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 12

Contribution to the Project: CWEX data analysis
Funding Support: NA
**Benjamin Hale**  
*Email: bjhale@iastate.edu*  
*Most Senior Project Role: Graduate Student (research assistant)*  
*Nearest Person Month Worked: 5*

**Contribution to the Project:** Synthesis of furan based materials  
**Funding Support:** NA  
**International Collaboration:** No  
**International Travel:** No

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**William Headlee**  
*Email: wheadlee@iastate.edu*  
*Most Senior Project Role: Graduate Student (research assistant)*  
*Nearest Person Month Worked: 12*

**Contribution to the Project:** tree production, ISU BAER site  
**Funding Support:** NA  
**International Collaboration:** No  
**International Travel:** No

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**Thomas Hoff**  
*Email: thoff@iastate.edu*  
*Most Senior Project Role: Graduate Student (research assistant)*  
*Nearest Person Month Worked: 6*

**Contribution to the Project:** Synthesis & Characterization, UG mentoring  
**Funding Support:** NA  
**International Collaboration:** No  
**International Travel:** No

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**Benjamin Hoksch**  
*Email: bhoksch@uni.edu*  
*Most Senior Project Role: Graduate Student (research assistant)*  
*Nearest Person Month Worked: 1*

**Contribution to the Project:** Coorinated/managed field research activities/logisitics; writing MS thesis using data from project.  
**Funding Support:** NA  
**International Collaboration:** No  
**International Travel:** No
Wenhao Hu
Email: wenhaohu@iastate.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 12
Contribution to the Project: Research
Funding Support: NA
International Collaboration: No
International Travel: No

Weifei Hu
Email: weifei-hu@uiowa.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 12
Contribution to the Project: composite blade fatigue analysis
Funding Support: NA
International Collaboration: No
International Travel: No

Tao Jin
Email: tjin@iastate.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 12
Contribution to the Project: performs research on sugar utilization
Funding Support: NA
International Collaboration: No
International Travel: No

Ryan Johnson
Email: ryan-a-johnson@uiowa.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 6
Contribution to the Project: Field data collection
Funding Support: NA
International Collaboration: No
International Travel: No

Kelsey Kaufman
Email: Kelsey-Kaufman@uiowa.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 2

Contribution to the Project: Researching Biomass Gasification
Funding Support: NA
International Collaboration: No
International Travel: No

Amy Kumar
Email: amy-kumar@uiowa.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 2

Contribution to the Project: research on distributed control for economic dispatch
Funding Support: NA
International Collaboration: No
International Travel: No

Andrei Kushkin
Email: kushkina@uni.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 12

Contribution to the Project: Analysis of CWEX data
Funding Support: NA
International Collaboration: No
International Travel: No

Michael Lawrinenko
Email: lawrinen@iastate.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 6

Contribution to the Project: Biochar chemistry research
Funding Support: NA
International Collaboration: No
International Travel: No

Wenqin Li
Email: wenqin@iastate.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 12
Contribution to the Project: Research
Funding Support: NA
International Collaboration: No
International Travel: No

Boyan Li
Email: boyan@iastate.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 12

Contribution to the Project: Research
Funding Support: NA
International Collaboration: No
International Travel: No

Chia-Cheng Linderman
Email: cclin@iastate.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 6

Contribution to the Project: Worked under the supervision of Dr. Vela on new catalysts for lignin and biooil transformations
Funding Support: NA
International Collaboration: No
International Travel: No

Huaxia Linderman
Email: huaxia-li@uiowa.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 1

Contribution to the Project: Drivetrain dynamics simulation
Funding Support: NA
International Collaboration: No
International Travel: No

Guangyi Liu
Email: gliu@iastate.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 12

Contribution to the Project: Research
Funding Support: NA

International Collaboration: No
International Travel: No

Willem Lubberden
Email: willeml@iastate.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 12
Contribution to the Project: Spectroscopy for pyrolysis
Funding Support: NA

Greg Matson
Email: gmatson@iastate.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 12
Contribution to the Project: Balloon-based offshore measurements
Funding Support: NA

Caitlin Mitchell
Email: caitlm2@vt.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 1
Contribution to the Project: Summer Intern greenhouse gas emissions
Funding Support: NA

Timothy Morgan
Email: tbmorgan@iastate.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 2
Contribution to the Project: Computed tomography data management
Funding Support: NA
Avinaash Murali  
**Email:** avinaash@iastate.edu  
**Most Senior Project Role:** Graduate Student (research assistant)  
**Nearest Person Month Worked:** 4  
**Contribution to the Project:** Development of CFD method for complex terrain analysis on wind turbine performance  
**Funding Support:** NA  
**International Collaboration:** No  
**International Travel:** No

Eric Mykleby  
**Email:** emykleby@iastate.edu  
**Most Senior Project Role:** Graduate Student (research assistant)  
**Nearest Person Month Worked:** 6  
**Contribution to the Project:** completed creative component using Big Creek watershed equipment and data  
**Funding Support:** NA  
**International Collaboration:** No  
**International Travel:** No

Jordan Null  
**Email:** jordan-null@uiowa.edu  
**Most Senior Project Role:** Graduate Student (research assistant)  
**Nearest Person Month Worked:** 2  
**Contribution to the Project:** Design of wind tunnel experiments and models  
**Funding Support:** NA  
**International Collaboration:** No  
**International Travel:** No

Mary Nyaema  
**Email:** mary-nyaema@uiowa.edu  
**Most Senior Project Role:** Graduate Student (research assistant)  
**Nearest Person Month Worked:** 12  
**Contribution to the Project:** Diversity and K-12 Outreach, Camp Instructor  
**Funding Support:** NA  
**International Collaboration:** No  
**International Travel:** No
Todd Ontl
Email: taontle@gmail.com
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 12

Contribution to the Project: soil dynamics ISU BAER site
Funding Support: NA
International Collaboration: No
International Travel: No

Naghmeh Pak
Email: npak@iastate.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 1

Contribution to the Project: Research Assistant
Funding Support: NA
International Collaboration: No
International Travel: No

Gabriel Palacios
Email: gbravop@iastate.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 12

Contribution to the Project: Research
Funding Support: NA
International Collaboration: No
International Travel: No

Sara Parks
Email: sbp@iastate.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 8

Contribution to the Project: EPSCoR communication and outreach
Funding Support: NA
International Collaboration: No
International Travel: No

Benjamin Peiffer
Email: benjamin-peiffer@uiowa.edu
Most Senior Project Role: Graduate Student (research assistant)  
Nearest Person Month Worked: 3

Contribution to the Project: Wind lab experiments and data analysis

Funding Support: NA  
International Collaboration: No  
International Travel: No

Chelsey Pence  
Email: chelsey-pence@uiowa.edu  
Most Senior Project Role: Graduate Student (research assistant)  
Nearest Person Month Worked: 6

Contribution to the Project: laser peening

Funding Support: NA  
International Collaboration: No  
International Travel: No

Kara Prior  
Email: kara-prior@uiowa.edu  
Most Senior Project Role: Graduate Student (research assistant)  
Nearest Person Month Worked: 3

Contribution to the Project: Collection of water quality samples, deployment and maintenance of water quality monitoring equipment

Funding Support: NA  
International Collaboration: No  
International Travel: No

Fenglei Qi  
Email: fqi@iastate.edu  
Most Senior Project Role: Graduate Student (research assistant)  
Nearest Person Month Worked: 12

Contribution to the Project: Research

Funding Support: NA  
International Collaboration: No  
International Travel: No

Mohammad Rahdar  
Email: rahdar@iastate.edu  
Most Senior Project Role: Graduate Student (research assistant)  
Nearest Person Month Worked: 8
**Contribution to the Project:** conducting research and disseminating results

**Funding Support:** NA

**International Collaboration:** No

**International Travel:** No

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**Rachel Reetz**  
**Email:** reetzr@uni.edu  
**Most Senior Project Role:** Graduate Student (research assistant)  
**Nearest Person Month Worked:** 2

**Contribution to the Project:** Serves as liaison between EPSCoR and IINSPIRE LSAMP on campus, is in charge of communication with URM students, develops and maintains a repository of resources for students and the leadership team, contributes to the development and dissemination of recruitment materials and planning for summer camps.

**Funding Support:** NA

**International Collaboration:** No

**International Travel:** No

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**Malinda Reichert**  
**Email:** reichm@iastate.edu  
**Most Senior Project Role:** Graduate Student (research assistant)  
**Nearest Person Month Worked:** 6

**Contribution to the Project:** Worked under the supervision of Dr. Vela on new catalysts for lignin and biooil transformations

**Funding Support:** NA

**International Collaboration:** No

**International Travel:** No

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**Mahdi Remanzani**  
**Email:** mramz@iastate.edu  
**Most Senior Project Role:** Graduate Student (research assistant)  
**Nearest Person Month Worked:** 1

**Contribution to the Project:** Carried out mass transfer studies in bioreactor

**Funding Support:** NA

**International Collaboration:** No

**International Travel:** No

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**Tesfay Russell**  
**Email:** russellt@uni.edu  
**Most Senior Project Role:** Graduate Student (research assistant)  
**Nearest Person Month Worked:** 2
Contribution to the Project: Wind energy research

Funding Support: NA

International Collaboration: No
International Travel: No

Arun Sakthinarayanan
Email: aruns@iastate.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 2

Contribution to the Project: research assistant

Funding Support: NA

International Collaboration: No
International Travel: No

Sai Samudrala
Email: sai@iastate.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 1

Contribution to the Project: Cyber infrastructure for automated data analysis

Funding Support: NA

International Collaboration: No
International Travel: No

Suganthi Selvaraj
Email: suganthi026@gmail.com
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 12

Contribution to the Project: Model validation wCcWEX data

Funding Support: NA

International Collaboration: No
International Travel: No

Tejasvi Sharma
Email: Tejasvi-Sharma@uiowa.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 1

Contribution to the Project: Researching Biomass Gasification

Funding Support: NA
International Collaboration: No
International Travel: No

Ninggang Shen
Email: ninggang-shen@uiowa.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 9
Contribution to the Project: laser-assisted machining
Funding Support: NA

International Collaboration: No
International Travel: No

Yunye Shi
Email: yunye-shi@uiowa.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 3
Contribution to the Project: Researching Biomass Gasification
Funding Support: NA

International Collaboration: No
International Travel: No

Samuel Smidt
Email: samuel-smidt@uiowa.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 1
Contribution to the Project: Collection of water quality samples
Funding Support: NA

International Collaboration: No
International Travel: No

Daniel Stoecklein
Email: stoeckd@iastate.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 3
Contribution to the Project: Aerosol imaging for pyrolysis
Funding Support: NA

International Collaboration: No
International Travel: No
Bo Sun
Email: bo-sun-1@uiowa.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 9

Contribution to the Project: Development and implementation of optimization models

Funding Support: NA
International Collaboration: No
International Travel: No

Jordan Tiarks
Email: tiarksj2@iastate.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 12

Contribution to the Project: Spectroscopy for pyrolysis

Funding Support: NA
International Collaboration: No
International Travel: No

Mohammad Usman-Anwar
Email: uanwar@iastate.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 12

Contribution to the Project: water quality/quantity, ISU BAER site

Funding Support: NA
International Collaboration: No
International Travel: No

Kevin Wabick
Email: kevin-wabick@uiowa.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 2

Contribution to the Project: Wind lab experiments and data analysis

Funding Support: NA
International Collaboration: No
International Travel: No

Renee Walton
Email: rshowers@iastate.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 12
Contribution to the Project: Wind farm data analysis
Funding Support: NA
International Collaboration: No
International Travel: No

Yeqing Wang
Email: yeqing-wang@uiowa.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 12
Contribution to the Project: composite blade lightning strike analysis
Funding Support: NA
International Collaboration: No
International Travel: No

Guiyan Zang
Email: guiyan-zang@uiowa.edu
Most Senior Project Role: Graduate Student (research assistant)
Nearest Person Month Worked: 2
Contribution to the Project: Researching Biomass Gasification
Funding Support: NA
International Collaboration: No
International Travel: No

Reem Alkhali
Email: reem@iastate.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 3
Contribution to the Project: Summer Intern, LSAMP scholar
Funding Support: NA
International Collaboration: No
International Travel: No

Mitch Amundson
Email: mitcha11@iastate.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 9
Contribution to the Project: Research
Funding Support: NA
International Collaboration: No
International Travel: No

Meghan Applegate
Email: mja@iastate.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 3

Contribution to the Project: NCAR SOARS participant
Funding Support: NA
International Collaboration: No
International Travel: No

Ryan Arce
Email: ryan-arce@uiowa.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 3

Contribution to the Project: Summer Research Intern, LSAMP scholar
Funding Support: NA
International Collaboration: No
International Travel: No

Victoria Arreola
Email: arreolav@uni.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: physiology of bioenergy feedstocks
Funding Support: NA
International Collaboration: No
International Travel: No

Spencer Babcock
Email: sbabcock@iastate.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 2

Contribution to the Project: literature review, data collection
Funding Support: NA
International Collaboration: No
International Travel: No

Katie Baber
Email: baberk@uni.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: physiology of bioenergy feedstocks
Funding Support: NA

Eric Behrens
Email: ebehrens@uni.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: physiology of bioenergy feedstocks
Funding Support: NA

Brent Berns
Email: bberns@iastate.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 2

Contribution to the Project: data collection, processing of biomass samples, ISU BAER site
Funding Support: NA

Richard Boyle
Email: boyler2@central.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 2

Contribution to the Project: Aerosol imaging for pyrolysis
Funding Support: NA
Sophia Brainbridge
Email: smbainbr@mtu.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 3
Contribution to the Project: Summer Research Intern
Funding Support: NA
International Collaboration: No
International Travel: No

Colleen Brehm
Email: colleen-brehm@uiowa.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 3
Contribution to the Project: Assistance with instrumentation
Funding Support: NA
International Collaboration: No
International Travel: No

Laura Bybee
Email: LMBYBEE@coe.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1
Contribution to the Project: Collection of field samples and processing of data from sondes
Funding Support: NA
International Collaboration: No
International Travel: No

Brooks Campbell
Email: bcampbell@iastate.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 2
Contribution to the Project: Data collection, processing of biomass samples, ISU BAER site
Funding Support: NA
International Collaboration: No
International Travel: No

James Cayer
Email: jwc115@iastate.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 2

Contribution to the Project: Provides assistance to project

Funding Support: NA

International Collaboration: No
International Travel: No

Andrew Christ
Email: andrew-christ@uiowa.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 3

Contribution to the Project: laser composites repair, summer research intern

Funding Support: NA

International Collaboration: No
International Travel: No

Alex DaSilva
Email: dasilva@iastate.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 2

Contribution to the Project: data collection

Funding Support: NA

International Collaboration: No
International Travel: No

Christopher Demings
Email: cdemings@iastate.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 3

Contribution to the Project: Summer Research Intern, LSAMP scholar

Funding Support: NA

International Collaboration: No
International Travel: No

Nolan Dickson
Email: ndickson@iastate.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1
Contribution to the Project: Worked under the supervision of Dr. Vela and Ms. Reichert on new catalysts for lignin and biooil transformations - earned academic credit as part of ISU's First Years Honors Research Mentoring Program

Funding Support: NA
International Collaboration: No
International Travel: No

Brittnie Dotson
Email: simpsjad@uni.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 3

Contribution to the Project: Summer research intern and LSAMP scholar

Funding Support: NA
International Collaboration: No
International Travel: No

Kyle Dvorak
Email: dvorakk@uni.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: physiology of bioenergy feedstocks

Funding Support: NA
International Collaboration: No
International Travel: No

Tyler Elliott
Email: elliotad@uni.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: Student worker, Energy Utilization Plank (Green Communities Project)

Funding Support: NA
International Collaboration: No
International Travel: No

Ryan Everly
Email: rpeverly@iastate.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 2
Contribution to the Project: URA, conducted the desiccant systems testing lab work and the MiDAS installation and tests

Funding Support: NA

International Collaboration: No
International Travel: No

Kyle Fink
Email: finkk@uni.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: Student worker, Energy Utilization Plank (Green Communities Project)

Funding Support: NA

International Collaboration: No
International Travel: No

Letetsia Fox
Email: letetsia_fox@yahoo.com
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 3

Contribution to the Project: Summer intern for the Green Community Campaign

Funding Support: NA

International Collaboration: No
International Travel: No

Jacob Fuentes
Email: jcfuentes@coe.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: Collection of field samples and processing of data from sondes

Funding Support: NA

International Collaboration: No
International Travel: No

Kevin Gallagher
Email: kevinpgd@iastate.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 2

Contribution to the Project: Architectural design proposition for community lab at Lakeside laboratory
Funding Support: NA
International Collaboration: No
International Travel: No

Jiyang Gao
Email: jiaying-gao@uiowa.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 3
Contribution to the Project: Summer Research Intern
Funding Support: NA
International Collaboration: No
International Travel: No

David Gardner
Email: dwg@iastate.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 4
Contribution to the Project: Synthesis & Characterization
Funding Support: NA
International Collaboration: No
International Travel: No

Katelin Ginapp
Email: ginappk@uni.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1
Contribution to the Project: Student worker, Energy Utilization Plank (Green Communities Project)
Funding Support: NA
International Collaboration: No
International Travel: No

Josh Grindeland
Email: jgrinde@iastate.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 2
Contribution to the Project: data collection, processing of biomass samples, ISU BAER site
Funding Support: NA
International Collaboration: No
International Travel: No

Shianne Gruss
Email: shianne-gruss@uiowa.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 3

Contribution to the Project: Summer Communications Intern
Funding Support: NA

International Collaboration: No
International Travel: No

Joseph Hall
Email: joseph-hall@uiowa.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 2

Contribution to the Project: developed demand response algorithms for the smart grid and represented our group at the Iowa Academy of Science meeting
Funding Support: NA

International Collaboration: No
International Travel: No

Emily Hansen
Email: emhansen@iastate.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 9

Contribution to the Project: Research
Funding Support: NA

International Collaboration: No
International Travel: No

Eric Hessing
Email: ehessing@iastate.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: research
Funding Support: NA

International Collaboration: No
International Travel: No
Toni Hoffmann
Email: tonihoff@uni.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 2

Contribution to the Project: Outreach and summer camps
Funding Support: NA
International Collaboration: No
International Travel: No

Maxwell Holtz
Email: holtzm@uni.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: physiology of bioenergy feedstocks
Funding Support: NA
International Collaboration: No
International Travel: No

Peter Ickes
Email: ickesp@uni.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 3

Contribution to the Project: Field experimentation
Funding Support: NA
International Collaboration: No
International Travel: No

Diane Ihimbazwe
Email: ihimbazd@uni.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: Laboratory analysis- Student worker, Energy Utilization Plank (Green Communities Project)
Funding Support: NA
International Collaboration: No
International Travel: No
Matthew Janechek  
Email: matthew-janechek@uiowa.edu  
Most Senior Project Role: Undergraduate Student  
Nearest Person Month Worked: 2  
Contribution to the Project: wind blade plank research  
Funding Support: NA  
International Collaboration: No  
International Travel: No  

Suncica Jasarovic  
Email: suncicaj@iastate.edu  
Most Senior Project Role: Undergraduate Student  
Nearest Person Month Worked: 1  
Contribution to the Project: Science communication, graphic displays, this year mainly involved with production of visuals  
Funding Support: NA  
International Collaboration: No  
International Travel: No  

Mizani Johnson  
Email: mizani.johnson@hotmail.com  
Most Senior Project Role: Undergraduate Student  
Nearest Person Month Worked: 3  
Contribution to the Project: Summer intern for the Green Community Campaign  
Funding Support: NA  
International Collaboration: No  
International Travel: No  

Ekoue Kangni  
Email: edkangni@iastate.edu  
Most Senior Project Role: Undergraduate Student  
Nearest Person Month Worked: 1  
Contribution to the Project: research assistance  
Funding Support: NA  
International Collaboration: No  
International Travel: No  

Benjamin Karkow  
Email: Benjamin-karkow@uiowa.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: Researching Biomass Gasification

Funding Support: NA

International Collaboration: No
International Travel: No

Jacob Kintner
Email: jacob-kintner@uiowa.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: Summer Research Intern

Funding Support: NA

International Collaboration: No
International Travel: No

Parker Koch
Email: parker-koch@uiowa.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: wind green grids research

Funding Support: NA

International Collaboration: No
International Travel: No

Amanda Kohn
Email: alkohn@coe.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: Collection of field samples and processing of data from sondes

Funding Support: NA

International Collaboration: No
International Travel: No

Kirstin Kramer
Email: kramekram@uni.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1
Contribution to the Project: Student worker, Energy Utilization Plank (Green Communities Project)

Funding Support: NA

International Collaboration: No
International Travel: No

Austin Krebill
Email: austin-krebill@uiowa.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: Testing of model wind turbine

Funding Support: NA

International Collaboration: No
International Travel: No

Hallie Kuchera
Email: kucherah@uni.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 3

Contribution to the Project: Lab experimentation

Funding Support: NA

International Collaboration: No
International Travel: No

Tiffany Lam
Email: tsyl303@iastate.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 3

Contribution to the Project: performs research on sugar utilization

Funding Support: NA

International Collaboration: No
International Travel: No

Kameron LeFebvre
Email: lefebvre@uni.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 3

Contribution to the Project: Outreach and summer camps

Funding Support: NA
International Collaboration: No
International Travel: No

Isabelle Leysens
Email: ileysens@iastate.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 2

Contribution to the Project: conducted the post occupancy daylight and thermal comfort research
Funding Support: NA

International Collaboration: No
International Travel: No

Samantha Lodge
Email: sjlodge@iastate.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 3

Contribution to the Project: Summer senior thesis participant
Funding Support: NA

International Collaboration: No
International Travel: No

Jan Lopez
Email: jlopez93@iastate.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 3

Contribution to the Project: Summer Research Intern, LSAMP scholar
Funding Support: NA

International Collaboration: No
International Travel: No

Diana Loutsch
Email: cbircoa@iastate.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: Assist with the workforce development programs Iowa State Uni
Funding Support: NA

International Collaboration: No
International Travel: No
Jeffrey Makinster
Email: jemak3@iastate.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 2

Contribution to the Project: Aerosol imaging for pyrolysis
Funding Support: NA
International Collaboration: No
International Travel: No

Joseph Malicki
Email: jmalicki@iastate.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: performs research on sugar utilization
Funding Support: NA
International Collaboration: No
International Travel: No

Robert Manatt
Email: rkmanatt@iastate.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 2

Contribution to the Project: economic analysis, ISU BAER site
Funding Support: NA
International Collaboration: No
International Travel: No

Deanna Marguglio
Email: dmmarguglio@coe.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: Collection of field samples and processing of data from sondes
Funding Support: NA
International Collaboration: No
International Travel: No

Adrian Martin
Email: martiaat@uni.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: Student worker, Energy Utilization Plank (Green Communities Project)
Funding Support: NA
International Collaboration: No
International Travel: No

Kelsey McKillip
Email: klmckillip@coe.edu

Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: Collection of field samples and processing of data from sondes
Funding Support: NA
International Collaboration: No
International Travel: No

Chloe McPherson
Email: cmcphe9@iastate.edu

Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: Using SCADA data for analysis
Funding Support: NA
International Collaboration: No
International Travel: No

Steven Miller
Email: sdmiller@iastate.edu

Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 2

Contribution to the Project: performs research on sugar utilization
Funding Support: NA
International Collaboration: No
International Travel: No

Esdras Murillo
Email: emurillo@iastate.edu

Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 4
Contribution to the Project: conducted the desiccant systems testing lab work and the MiDAS installation and tests and energy baseline evaluation

Funding Support: NA
International Collaboration: No
International Travel: No

Andrea Myles
Email: andrea-myles@uiowa.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 3

Contribution to the Project: Summer Research Intern

Funding Support: NA
International Collaboration: No
International Travel: No

Barbara Newhall
Email: barbara-newhall@uiowa.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 3

Contribution to the Project: Summer K-12 Outreach Intern, LSAMP scholar

Funding Support: NA
International Collaboration: No
International Travel: No

Kyle Owen
Email: kyle-owen@uiowa.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 2

Contribution to the Project: K-12 Outreach

Funding Support: NA
International Collaboration: No
International Travel: No

Eric Pahl
Email: eric-pahl@uiowa.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 3

Contribution to the Project: Summer Research Intern
Funding Support: NA
International Collaboration: No
International Travel: No

Kanchana Perera
Email: vishadi@iastate.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 4

Contribution to the Project: Synthesis & Characterization

Funding Support: NA
International Collaboration: No
International Travel: No

Abigail Peterson
Email: arepete@iastate.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 3

Contribution to the Project: EPSCoR summer communication intern

Funding Support: NA
International Collaboration: No
International Travel: No

Zane Phillips
Email: philzaa@uni.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: Student worker, Energy Utilization Plank (Green Communities Project)

Funding Support: NA
International Collaboration: No
International Travel: No

Kayla Racinowski
Email: Kayla-racinowski@uiowa.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 3

Contribution to the Project: Summer Research Intern, Researching Biomass Gasification

Funding Support: NA
International Collaboration: No
International Travel: No

Erin Richmond
Email: erin-richmond@uiowa.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 3

Contribution to the Project: Summer Research Intern
Funding Support: NA

Andrew Ridgway
Email: ridgwaya@uni.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: Field research assistant; writing Honor's thesis using data from project.
Funding Support: NA

Christopher Robasse
Email: robassec@uni.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: Student worker, Energy Utilization Plank (Green Communities Project)
Funding Support: NA

Colton Rogers
Email: colton-rogers@uiowa.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: Building the Mobile Energy Innovation Station
Funding Support: NA

International Collaboration: No
International Travel: No
Shane Schmit  
Email: schmit@uni.edu  
**Most Senior Project Role:** Undergraduate Student  
**Nearest Person Month Worked:** 1  

**Contribution to the Project:** Student worker, Energy Utilization Plank (Green Communities Project)  
**Funding Support:** NA  
**International Collaboration:** No  
**International Travel:** No

Kim Schorn  
Email: knschorn@coe.edu  
**Most Senior Project Role:** Undergraduate Student  
**Nearest Person Month Worked:** 1  

**Contribution to the Project:** Collection of field samples and processing of data from sondes  
**Funding Support:** NA  
**International Collaboration:** No  
**International Travel:** No

Jade Simpson  
Email: dotsobaa@uni.edu  
**Most Senior Project Role:** Undergraduate Student  
**Nearest Person Month Worked:** 3  

**Contribution to the Project:** Summer research intern and LSAMP scholar  
**Funding Support:** NA  
**International Collaboration:** No  
**International Travel:** No

Ben Sissel  
Email: bhsissel@iastate.edu  
**Most Senior Project Role:** Undergraduate Student  
**Nearest Person Month Worked:** 2  

**Contribution to the Project:** data collection, survey programming  
**Funding Support:** NA  
**International Collaboration:** No  
**International Travel:** No

Sophia Smarandescu  
Email: sophias@iastate.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 2

Contribution to the Project: data collection, survey programming
Funding Support: NA
International Collaboration: No
International Travel: No

Nadarra Stokes
Email: nlstokes@iastate.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 3

Contribution to the Project: data visualization
Funding Support: NA
International Collaboration: No
International Travel: No

Connor Stumberg
Email: stumberc@uni.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: Student worker, Energy Utilization Plank (Green Communities Project)
Funding Support: NA
International Collaboration: No
International Travel: No

Brennan Wears
Email: brennen-wears@uiowa.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 3

Contribution to the Project: Summer Research Intern
Funding Support: NA
International Collaboration: No
International Travel: No

Seth White
Email: stwhite@iastate.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1
Contribution to the Project: Worked under the supervision of Dr. Vela and Mr. Lin on new catalysts for lignin and biooil transformations - earned academic credit as part of ISU's First Years Honors Research Mentoring Program

Funding Support: NA

International Collaboration: No
International Travel: No

Nicholas Wong
Email: nickwong@iastate.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 2

Contribution to the Project: Gas-phase spectroscopy

Funding Support: NA

International Collaboration: No
International Travel: No

Jianing Wu
Email: jianingw@iastate.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 1

Contribution to the Project: performs research on sugar utilization

Funding Support: NA

International Collaboration: No
International Travel: No

Tracy Wulfekuhle
Email: wulfekut@uni.edu
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 2

Contribution to the Project: Outreach and summer camps

Funding Support: NA

International Collaboration: No
International Travel: No

Andrea Ytzen
Email: andrea.ytzen@gmail.com
Most Senior Project Role: Undergraduate Student
Nearest Person Month Worked: 2

Contribution to the Project: Architectural design proposition for community lab at Lakeside laboratory
**Funding Support:** NA  
**International Collaboration:** No  
**International Travel:** No

**What other organizations have been involved as partners?**

<table>
<thead>
<tr>
<th>Name</th>
<th>Type of Partner Organization</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argonne National Laboratory</td>
<td>Other Organizations (foreign or domestic)</td>
<td>Lemont, IL</td>
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<tr>
<td>Australian National University</td>
<td>Academic Institution</td>
<td>Canberra, Australia</td>
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<td>Dillard University</td>
<td>Academic Institution</td>
<td>New Orleans, LA</td>
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<td>Dordt College</td>
<td>Academic Institution</td>
<td>Sioux Center, IA</td>
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<td>DuPont-Pioneer</td>
<td>Industrial or Commercial Firms</td>
<td>Johnston, IA</td>
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<td>Duke University</td>
<td>Academic Institution</td>
<td>Durham, NC</td>
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<td>Eastern IA Community College</td>
<td>Academic Institution</td>
<td>Cedar Rapids, IA</td>
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<td>EcoEngineers</td>
<td>Industrial or Commercial Firms</td>
<td>Des Moines, IA</td>
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<td>Eglin Air Force Research Lab</td>
<td>Other Organizations (foreign or domestic)</td>
<td>Eglin AFB, FL</td>
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<td>ExxonMobil</td>
<td>Industrial or Commercial Firms</td>
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<td>Farmers</td>
<td>Other Organizations (foreign or domestic)</td>
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<td>Florida International University</td>
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<td>Bath University</td>
<td>Academic Institution</td>
<td>Bath, United Kingdom</td>
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<td>Great Plains Institute</td>
<td>Other Nonprofits</td>
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<td>Harran University</td>
<td>Academic Institution</td>
<td>Sanliurfa, Turkey</td>
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<td>Hawkeye Community College</td>
<td>Academic Institution</td>
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<td>IA Central Community College</td>
<td>Academic Institution</td>
<td>Fort Dodge, IA</td>
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<td>IA Department of Education</td>
<td>State or Local Government</td>
<td>Des Moines, IA</td>
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<td>Name</td>
<td>Type of Partner Organization</td>
<td>Location</td>
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<td>Marshalltown, IA</td>
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<td>IA Western Community College</td>
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<td>Council Bluffs, IA</td>
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<td>Indian Hills Community College</td>
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<td>Ottumwa, IA</td>
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<td>Iowa Energy Center</td>
<td>Other Nonprofits</td>
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<td>Beuth University Berlin</td>
<td>Academic Institution</td>
<td>Berlin, Germany</td>
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<td>Iowa Library Association</td>
<td>Other Nonprofits</td>
<td>Des Moines, IA</td>
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<td>Iowa State University</td>
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<td>Kirkwood Community College</td>
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<td>Cedar Rapids, IA</td>
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<td>LSAMP IINspire</td>
<td>Other Nonprofits</td>
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<td>Lancaster University</td>
<td>Academic Institution</td>
<td>Lancaster, United Kingdom</td>
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<td>Los Alamos National Laboratory</td>
<td>Other Organizations (foreign or domestic)</td>
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<td>Michigan State University</td>
<td>Academic Institution</td>
<td>East Lansing, MI</td>
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<td>MidAmerican Energy</td>
<td>Industrial or Commercial Firms</td>
<td>des Moines, IA</td>
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<td>NExTera Energy Resources</td>
<td>Industrial or Commercial Firms</td>
<td>St. Paul, MN</td>
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<td>CenUSA Bioenergy (USDA NIFA Bioenergy Program)</td>
<td>Other Nonprofits</td>
<td>Ames, IA</td>
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<td>NREL National Renewable Energy Laboratory</td>
<td>Other Organizations (foreign or domestic)</td>
<td>Golden, CO</td>
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<td>National Center for Agricultural Utilization Research</td>
<td>Other Organizations (foreign or domestic)</td>
<td>Peoria, IL</td>
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<tr>
<td>National Center for Atmospheric Research</td>
<td>Other Organizations (foreign or domestic)</td>
<td>Boulder, CO</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Name</th>
<th>Type of Partner Organization</th>
<th>Location</th>
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<tbody>
<tr>
<td>National Laboratory for Agriculture and the Environment</td>
<td>Other Organizations (foreign or domestic)</td>
<td>Ames, IA</td>
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<tr>
<td>North Carolina A&amp;T</td>
<td>Academic Institution</td>
<td>Greensboro, NC</td>
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<tr>
<td>North Dakota State University</td>
<td>Academic Institution</td>
<td>Fargo, ND</td>
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<td>North IA Area Community College</td>
<td>Academic Institution</td>
<td>Mason City, IA</td>
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<td>Northeast IA Community College</td>
<td>Academic Institution</td>
<td>Calmar, IA</td>
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<td>Northern Illinois University</td>
<td>Academic Institution</td>
<td>DeKalb, IL</td>
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<td>Northwest IA Community College</td>
<td>Academic Institution</td>
<td>Sheldon, IA</td>
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<td>Center for Biorenewable Chemicals (NSF ERC Center)</td>
<td>Other Nonprofits</td>
<td>Ames, IA</td>
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<td>Northwestern University</td>
<td>Academic Institution</td>
<td>Chicago, IL</td>
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<td>Our Lady of the Lake University</td>
<td>Academic Institution</td>
<td>San Antonio, TX</td>
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<td>POET-DSM</td>
<td>Industrial or Commercial Firms</td>
<td>Sioux Falls, SD</td>
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<td>Pacific Northwest National Laboratory</td>
<td>Other Organizations (foreign or domestic)</td>
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<td>Phillips 66</td>
<td>Industrial or Commercial Firms</td>
<td>Tulsa, OK</td>
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<td>Prairie View A&amp;M University</td>
<td>Academic Institution</td>
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<td>Project Lead the Way</td>
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<td>Purdue University</td>
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<td>West Lafayette, IN</td>
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<td>Shanghai Jiaotong University</td>
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<td>Central College</td>
<td>Academic Institution</td>
<td>Pella, IA</td>
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<td>Society of Women Engineers</td>
<td>Other Nonprofits</td>
<td>Cedar Falls, IA</td>
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<td>Soil and Water Conservation Service</td>
<td>Other Nonprofits</td>
<td>Ankeny, IA</td>
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<tr>
<td>Name</td>
<td>Type of Partner Organization</td>
<td>Location</td>
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<td>West Burlington, IA</td>
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<td>Southwestern IA Community College</td>
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<td>St. Ambrose University</td>
<td>Academic Institution</td>
<td>Davenport, IA</td>
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<td>Tallgrass Prairie Center</td>
<td>Other Nonprofits</td>
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<td>Third Wave Systems</td>
<td>Industrial or Commercial Firms</td>
<td>Minneapolis, MN</td>
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<td>UC Davis</td>
<td>Academic Institution</td>
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<td>Coe College</td>
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<td>Cedar Rapids, IA</td>
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<td>US Fish &amp; Wildlife Service</td>
<td>Other Organizations (foreign or domestic)</td>
<td>Wapello, IA</td>
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<td>Other Nonprofits</td>
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<td>Union of Concerned Scientists,</td>
<td>Other Nonprofits</td>
<td>Cambridge, MA</td>
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<td>Universidade Federal de Itajubá - UNIFEI</td>
<td>Academic Institution</td>
<td>Itajuba, Minas Gries, Brazil</td>
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<td>Academic Institution</td>
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<td>Academic Institution</td>
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<td>Des Moines Area Community College</td>
<td>Academic Institution</td>
<td>Ankeny, IA</td>
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<tr>
<td>University of Maryland, College Park</td>
<td>Academic Institution</td>
<td>College Park, MD</td>
</tr>
<tr>
<td>Name</td>
<td>Type of Partner Organization</td>
<td>Location</td>
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<tr>
<td>University of Michigan</td>
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<td>University of Tennessee</td>
<td>Academic Institution</td>
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<td>Academic Institution</td>
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<td>University of Wisconsin</td>
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<td>Academic Institution</td>
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<td>Virginia Polytech Institute and State University</td>
<td>Academic Institution</td>
<td>Blacksburg, VA</td>
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<td>Wageningan University and Research Centre</td>
<td>Academic Institution</td>
<td>Wageningen, The Netherlands</td>
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<tr>
<td>Des Moines Public Schools</td>
<td>School or School Systems</td>
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</tr>
<tr>
<td>Western IA Tech Community College</td>
<td>Academic Institution</td>
<td>Sioux City, IA</td>
</tr>
</tbody>
</table>

**Full details of organizations that have been involved as partners:**

**Argonne National Laboratory**

**Organization Type:** Other Organizations (foreign or domestic)

**Organization Location:** Lemont, IL

**Partner's Contribution to the Project:**

Collaborative Research

**More Detail on Partner and Contribution:**

**Australian National University**

**Organization Type:** Academic Institution

**Organization Location:** Canberra, Australia

**Partner's Contribution to the Project:**

Facilities

Collaborative Research

Personnel Exchanges

**More Detail on Partner and Contribution:**
Bath University

**Organization Type:** Academic Institution  
**Organization Location:** Bath, United Kingdom

**Partner's Contribution to the Project:**  
Personnel Exchanges

**More Detail on Partner and Contribution:**

Beuth University Berlin

**Organization Type:** Academic Institution  
**Organization Location:** Berlin, Germany

**Partner's Contribution to the Project:**  
Other: Teaching partnership for summer study abroad workshop 2013 and 2014

**More Detail on Partner and Contribution:**

CenUSA Bioenergy (USDA NIFA Bioenergy Program)

**Organization Type:** Other Nonprofits  
**Organization Location:** Ames, IA

**Partner's Contribution to the Project:**  
Other: Collaboration to develop C6 youth materials

**More Detail on Partner and Contribution:**

Center for Biorenewable Chemicals (NSF ERC Center)

**Organization Type:** Other Nonprofits  
**Organization Location:** Ames, IA

**Partner's Contribution to the Project:**  
Other: Collaborate to provide research experiences for K12 teachers

**More Detail on Partner and Contribution:**

Central College

**Organization Type:** Academic Institution  
**Organization Location:** Pella, IA

**Partner's Contribution to the Project:**  
Personnel Exchanges  
Other: Summer research at IA State, contribute equipment for ecosystem studies

**More Detail on Partner and Contribution:**
Coe College

Organization Type: Academic Institution
Organization Location: Cedar Rapids, IA

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution:

Des Moines Area Community College

Organization Type: Academic Institution
Organization Location: Ankeny, IA

Partner's Contribution to the Project:
Personnel Exchanges

More Detail on Partner and Contribution:

Des Moines Public Schools

Organization Type: School or School Systems
Organization Location: Des Moines, IA

Partner's Contribution to the Project:
Other: engage in discussion regarding education and outreach programs

More Detail on Partner and Contribution:

Dillard University

Organization Type: Academic Institution
Organization Location: New Orleans, LA

Partner's Contribution to the Project:
Personnel Exchanges

More Detail on Partner and Contribution:

Dordt College

Organization Type: Academic Institution
Organization Location: Sioux Center, IA

Partner's Contribution to the Project:
Other: Provided equipment for gasifier system

More Detail on Partner and Contribution:

DuPont-Pioneer
Organization Type: Industrial or Commercial Firms  
Organization Location: Johnston, IA

Partner's Contribution to the Project:
Other: collaborate on workshops on biorenewable energy and engineered crops

More Detail on Partner and Contribution:

Duke University
Organization Type: Academic Institution  
Organization Location: Durham, NC

Partner's Contribution to the Project:
Other: scientific committee for EPSCoR-sponsored workshop on engineered crops.

More Detail on Partner and Contribution:

Eastern IA Community College
Organization Type: Academic Institution  
Organization Location: Cedar Rapids, IA

Partner's Contribution to the Project:
Collaborative Research  
Personnel Exchanges

More Detail on Partner and Contribution:

EcoEngineers
Organization Type: Industrial or Commercial Firms  
Organization Location: Des Moines, IA

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution:

Eglin Air Force Research Lab
Organization Type: Other Organizations (foreign or domestic)  
Organization Location: Eglin AFB, FL

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution:

ExxonMobil
**Organization Type:** Industrial or Commercial Firms  
**Organization Location:** Pennsylvania, PA  

**Partner’s Contribution to the Project:**  
Collaborative Research  

**More Detail on Partner and Contribution:**  
Farmers

**Organization Type:** Other Organizations (foreign or domestic)  
**Organization Location:** Iowa  

**Partner’s Contribution to the Project:**  
Collaborative Research  

**More Detail on Partner and Contribution:**  
ISU BAER farmer advisory board members

---

**Florida International University**

**Organization Type:** Academic Institution  
**Organization Location:** Miami, FL  

**Partner’s Contribution to the Project:**  
Collaborative Research  
Personnel Exchanges  

**More Detail on Partner and Contribution:**

---

**Great Plains Institute**

**Organization Type:** Other Nonprofits  
**Organization Location:** Minneapolis, MN  

**Partner’s Contribution to the Project:**  
Other: Collaborating on a biorenewable energy workshop summer 14  

**More Detail on Partner and Contribution:**

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**Harran University**

**Organization Type:** Academic Institution  
**Organization Location:** Sanliurfa, Turkey  

**Partner’s Contribution to the Project:**  
In-Kind Support  
Facilities  
Collaborative Research  

**More Detail on Partner and Contribution:**
Hawkeye Community College

Organization Type: Academic Institution
Organization Location: Waterloo, IA

Partner's Contribution to the Project:
Facilities
Personnel Exchanges
Other: Mobile Power Tower erected at HCC

More Detail on Partner and Contribution:

IA Central Community College

Organization Type: Academic Institution
Organization Location: Fort Dodge, IA

Partner's Contribution to the Project:
Personnel Exchanges

More Detail on Partner and Contribution:

IA Department of Education

Organization Type: State or Local Government
Organization Location: Des Moines, IA

Partner's Contribution to the Project:
Personnel Exchanges

More Detail on Partner and Contribution:

IA Lakes Community College

Organization Type: Academic Institution
Organization Location: Spencer, IA

Partner's Contribution to the Project:
Personnel Exchanges

More Detail on Partner and Contribution:

IA Valley Community College

Organization Type: Academic Institution
Organization Location: Marshalltown, IA

Partner's Contribution to the Project:
Facilities
Personnel Exchanges

More Detail on Partner and Contribution:
IA Western Community College

Organization Type: Academic Institution
Organization Location: Council Bluffs, IA

Partner's Contribution to the Project:
Personnel Exchanges

More Detail on Partner and Contribution:

Indian Hills Community College

Organization Type: Academic Institution
Organization Location: Ottumwa, IA

Partner's Contribution to the Project:
In-Kind Support
Facilities
Collaborative Research
Personnel Exchanges

More Detail on Partner and Contribution:

Iowa Energy Center

Organization Type: Other Nonprofits
Organization Location: Ames, IA

Partner's Contribution to the Project:
Other: collaborate to provide research experiences for undergraduates and cc students

More Detail on Partner and Contribution:

Iowa Library Association

Organization Type: Other Nonprofits
Organization Location: Des Moines, IA

Partner's Contribution to the Project:
Facilities
Other: Distribution of descriptions of "Science of Energy" summer programs

More Detail on Partner and Contribution:

Iowa State University

Organization Type: Academic Institution
Organization Location: Ames, IA

Partner's Contribution to the Project:
In-Kind Support
Facilities
Collaborative Research

More Detail on Partner and Contribution: Research collaborations, equipment sharing, proposal collaborations,

Kirkwood Community College

Organization Type: Academic Institution
Organization Location: Cedar Rapids, IA

Partner's Contribution to the Project:
In-Kind Support
Facilities
Collaborative Research
Personnel Exchanges

More Detail on Partner and Contribution:

LSAMP IINspire

Organization Type: Other Nonprofits
Organization Location: Ames, IA

Partner's Contribution to the Project:
Other: collaborate to provide research experiences for undergraduates and cc students

More Detail on Partner and Contribution:

Lancaster University

Organization Type: Academic Institution
Organization Location: Lancaster, United Kingdom

Partner's Contribution to the Project:
Personnel Exchanges

More Detail on Partner and Contribution:

Lawrence Livermore National Laboratory

Organization Type: Other Organizations (foreign or domestic)
Organization Location: Livermore, CA

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution:

Los Alamos National Laboratory
Organization Type: Other Organizations (foreign or domestic)
Organization Location: Los Alamos, NM

Partner's Contribution to the Project: Collaborative Research

More Detail on Partner and Contribution:

Michigan State University

Organization Type: Academic Institution
Organization Location: East Lansing, MI

Partner's Contribution to the Project: Collaborative Research

More Detail on Partner and Contribution:

MidAmerican Energy

Organization Type: Industrial or Commercial Firms
Organization Location: des Moines, IA

Partner's Contribution to the Project: In-Kind Support
Collaborative Research

More Detail on Partner and Contribution:

NExtEra Energy Resources

Organization Type: Industrial or Commercial Firms
Organization Location: St. Paul, MN

Partner's Contribution to the Project: Collaborative Research

More Detail on Partner and Contribution:

NREL National Renewable Energy Laboratory

Organization Type: Other Organizations (foreign or domestic)
Organization Location: Golden, CO

Partner's Contribution to the Project: Collaborative Research

More Detail on Partner and Contribution:

National Center for Agricultural Utilization Research
<table>
<thead>
<tr>
<th>Organization Type:</th>
<th>Other Organizations (foreign or domestic)</th>
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<tbody>
<tr>
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<td>Collaborative Research</td>
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<tr>
<td>More Detail on Partner and Contribution:</td>
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</tr>
<tr>
<td><strong>National Center for Atmospheric Research</strong></td>
<td></td>
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<tr>
<td>Organization Type:</td>
<td>Other Organizations (foreign or domestic)</td>
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<td>Organization Location:</td>
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<tr>
<td>More Detail on Partner and Contribution:</td>
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<tr>
<td><strong>National Laboratory for Agriculture and the Environment</strong></td>
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<tr>
<td>Organization Type:</td>
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<td><strong>North Dakota State University</strong></td>
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<td><strong>North IA Area Community College</strong></td>
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</table>
Organization Type: Academic Institution
Organization Location: Mason City, IA

Partner's Contribution to the Project:
Facilities
Personnel Exchanges

More Detail on Partner and Contribution:

Northeast IA Community College

Organization Type: Academic Institution
Organization Location: Calmar, IA

Partner's Contribution to the Project:
Facilities
Personnel Exchanges

More Detail on Partner and Contribution:

Northern Illinois University

Organization Type: Academic Institution
Organization Location: DeKalb, IL

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution:

Northwest IA Community College

Organization Type: Academic Institution
Organization Location: Sheldon, IA

Partner's Contribution to the Project:
Facilities
Personnel Exchanges

More Detail on Partner and Contribution:

Northwestern University

Organization Type: Academic Institution
Organization Location: Chicago, IL

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution:
Our Lady of the Lake University

Organization Type: Academic Institution
Organization Location: San Antonio, TX

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution:

POET-DSM

Organization Type: Industrial or Commercial Firms
Organization Location: Sioux Falls, SD

Partner's Contribution to the Project:
Other: Collaborating on a biorenewable energy workshop summer 14

More Detail on Partner and Contribution:

Pacific Northwest National Laboratory

Organization Type: Other Organizations (foreign or domestic)
Organization Location: Richland, WA

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution:

Phillips 66

Organization Type: Industrial or Commercial Firms
Organization Location: Tulsa, OK

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution:

Prairie View A&M University

Organization Type: Academic Institution
Organization Location: Prairie View, TX

Partner's Contribution to the Project:
Collaborative Research
Personnel Exchanges

More Detail on Partner and Contribution:
Project Lead the Way

**Organization Type:** Other Nonprofits  
**Organization Location:** Indianapolis, IN

**Partner's Contribution to the Project:**  
Personnel Exchanges

**More Detail on Partner and Contribution:**

---

Purdue University

**Organization Type:** Academic Institution  
**Organization Location:** West Lafayette, IN

**Partner's Contribution to the Project:**  
Collaborative Research

**More Detail on Partner and Contribution:**

---

Repreve Renewables

**Organization Type:** Industrial or Commercial Firms  
**Organization Location:** Greensboro, NC

**Partner's Contribution to the Project:**  
Collaborative Research

**More Detail on Partner and Contribution:**

---

Shanghai Jiaotong University

**Organization Type:** Academic Institution  
**Organization Location:** Shanghai, China

**Partner's Contribution to the Project:**  
Collaborative Research

**More Detail on Partner and Contribution:**

---

Society of Women Engineers

**Organization Type:** Other Nonprofits  
**Organization Location:** Cedar Falls, IA

**Partner's Contribution to the Project:**  
Other: Organized Expanding your Horizons event

**More Detail on Partner and Contribution:**

---

Soil and Water Conservation Service
Organization Type: Other Nonprofits
Organization Location: Ankeny, IA

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution:

Soil and Water Conservation Service

Organization Type: Other Nonprofits
Organization Location: Ankeny, IA

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution:

South Dakota State University

Organization Type: Academic Institution
Organization Location: Brookings, SD

Partner's Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution:

Southeast IA Community College

Organization Type: Academic Institution
Organization Location: West Burlington, IA

Partner's Contribution to the Project:
Personnel Exchanges

More Detail on Partner and Contribution:

Southwestern IA Community College

Organization Type: Academic Institution
Organization Location: Creston, IA

Partner's Contribution to the Project:
Personnel Exchanges
Other: Mobile Power Tower erected at SCC

More Detail on Partner and Contribution:

St. Ambrose University
Organization Type: Academic Institution  
Organization Location: Davenport, IA

Partner's Contribution to the Project:  
Personnel Exchanges

More Detail on Partner and Contribution:

Tallgrass Prairie Center

Organization Type: Other Nonprofits  
Organization Location: Cedar Falls, IA

Partner's Contribution to the Project:  
Financial support  
In-Kind Support  
Facilities  
Collaborative Research

More Detail on Partner and Contribution:

Third Wave Systems

Organization Type: Industrial or Commercial Firms  
Organization Location: Minneapolis, MN

Partner's Contribution to the Project:  
Personnel Exchanges

More Detail on Partner and Contribution:

UC Davis

Organization Type: Academic Institution  
Organization Location: Davis, CA

Partner's Contribution to the Project:  
Other: Collaborating on workshops on biorenewable energy and engineered plants

More Detail on Partner and Contribution:

US Fish & Wildlife Service

Organization Type: Other Organizations (foreign or domestic)  
Organization Location: Wapello, IA

Partner's Contribution to the Project:  
Collaborative Research

More Detail on Partner and Contribution:
US Forest Service

**Organization Type:** Other Organizations (foreign or domestic)
**Organization Location:** Ames, IA

**Partner's Contribution to the Project:**
Collaborative Research

**More Detail on Partner and Contribution:**

USDA Natural Resource Conservation Service

**Organization Type:** Other Nonprofits
**Organization Location:** Bedford, IA

**Partner's Contribution to the Project:**
Collaborative Research

**More Detail on Partner and Contribution:**

Union of Concerned Scientists,

**Organization Type:** Other Nonprofits
**Organization Location:** Cambridge, MA

**Partner's Contribution to the Project:**
Other: Collaborating on a biorenewable energy workshop summer 14

**More Detail on Partner and Contribution:**

Universidade Federal de Itajubá - UNIFEI

**Organization Type:** Academic Institution
**Organization Location:** Itajuba, Minas Gries, Brazil

**Partner's Contribution to the Project:**
Collaborative Research
Personnel Exchanges

**More Detail on Partner and Contribution:**

University of Bologna

**Organization Type:** Academic Institution
**Organization Location:** Bologna, Italy

**Partner's Contribution to the Project:**
Collaborative Research

**More Detail on Partner and Contribution:**
University of Colorado

Organization Type: Academic Institution
Organization Location: Boulder, CO

Partner’s Contribution to the Project:
In-Kind Support
Facilities
Collaborative Research
Personnel Exchanges

More Detail on Partner and Contribution:

University of Florida

Organization Type: Academic Institution
Organization Location: Gainesville, FL

Partner’s Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution:

University of Illinois - Urbana-Champaign

Organization Type: Academic Institution
Organization Location: Champaign, IL

Partner’s Contribution to the Project:
Collaborative Research

More Detail on Partner and Contribution:

University of Iowa

Organization Type: Academic Institution
Organization Location: Iowa City, IA

Partner’s Contribution to the Project:
In-Kind Support
Facilities
Collaborative Research
Personnel Exchanges
Other: environmental monitoring of campus energy usage

More Detail on Partner and Contribution: research/proposal collaborations

University of Maryland, College Park

Organization Type: Academic Institution
Organization Location: College Park, MD
<table>
<thead>
<tr>
<th>Partner</th>
<th>Contribution to the Project:</th>
<th>More Detail on Partner and Contribution:</th>
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<tbody>
<tr>
<td>University of Michigan</td>
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<tr>
<td>Organization Type:</td>
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<td>Organization Location:</td>
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<td>University of Nebraska - Lincoln</td>
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<td>Organization Location:</td>
<td>Lincoln, NE</td>
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<tr>
<td>University of Northern Iowa</td>
<td>Collaborative Research</td>
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<td>Organization Type:</td>
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<td>Organization Location:</td>
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<td>Partner's Contribution to the Project:</td>
<td><strong>In-Kind Support</strong>&lt;br&gt;Facilities&lt;br&gt;Collaborative Research&lt;br&gt;Personnel Exchanges&lt;br&gt;Other: collaborate on education and outreach activities</td>
<td><strong>More Detail on Partner and Contribution:</strong> research/ proposal writing collaborations</td>
</tr>
<tr>
<td>University of Tennessee</td>
<td>Collaborative Research</td>
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<td>Organization Type:</td>
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<td>Organization Location:</td>
<td>Knoxville, TN</td>
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<td>University of Waterloo</td>
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</table>
**Organization Type:** Academic Institution  
**Organization Location:** Waterloo, ON, Canada

**Partner's Contribution to the Project:**  
Collaborative Research

**More Detail on Partner and Contribution:**

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**University of Wisconsin**

**Organization Type:** Academic Institution  
**Organization Location:** Madison, WI

**Partner's Contribution to the Project:**  
Collaborative Research  
Other: Scientific committee for EPSCoR-sponsored workshop on engineered crops

**More Detail on Partner and Contribution:**

---

**Utah State University**

**Organization Type:** Academic Institution  
**Organization Location:** Logan, UT

**Partner's Contribution to the Project:**  
Collaborative Research

**More Detail on Partner and Contribution:**

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**Virginia Polytech Institute and State University**

**Organization Type:** Academic Institution  
**Organization Location:** Blacksburg, VA

**Partner's Contribution to the Project:**  
Other: co-author on book manuscript w Passe

**More Detail on Partner and Contribution:**

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**Wageningan University and Research Centre**

**Organization Type:** Academic Institution  
**Organization Location:** Wageningen, The Netherlands

**Partner's Contribution to the Project:**  
Collaborative Research

**More Detail on Partner and Contribution:**

---

**Western IA Tech Community College**
Organization Type: Academic Institution
Organization Location: Sioux City, IA

Partner's Contribution to the Project:
Facilities
Personnel Exchanges

More Detail on Partner and Contribution:

Have other collaborators or contacts been involved? Yes

Impacts

What is the impact on the development of the principal discipline(s) of the project?

In Year 3, The Iowa NSF EPSCoR project has had a significant impact in the research areas of bioenergy, wind energy, energy utilization, and energy policy, as well as in the broader impacts related to the research areas.

BioEnergy (BE)

Research results have demonstrated both the potential of perennial biomass production systems and soil biochar amendments to deliver environmental services and enhance the sustainability of bioenergy production, but have also demonstrated the economic challenge perennial biomass has competing with continuous corn and corn-soybean cropping systems. Based on the computational framework developed in this project for thermochemical biomass processing, researchers can explore the fundamental details of various biomass reactors, and design and optimize efficient and clean biomass reactors to promote the utilization of biorenewable energy. The partnerships and relationships created across disciplines are changing the assumptions in how work is done, and changing the way questions are asked to have more direct relationship to a broader audience.

Wind Energy (WE)

While the WE program emphasizes interdisciplinary research, the foundation is based on individual disciplines. Success of this effort is evidenced by numerous papers published and presentations given at scientific meetings. An ongoing impact is noted by mentors who cite results of Research Experience for Undergraduate (REU) research in research papers and scientific proposals.

The stochastic nature of wind presents unique challenges for the yaw dynamics of wind turbines. Simulation of the spatially and temporally varying turbulent three-dimensional wake of a wind turbine is essential for an accurate representation of the aerodynamic and dynamic processes involved in wind turbine operation. The ability to perform such simulations will provide insight into the effect of random changes in wind speed and direction and their impact on wind farm performance.

Designing against failure with composites is still a challenging task since there are multiple failure mechanisms occurring at multiple length scales that span from microscopic failure in a polymer matrix and fibers to structural failure of the entire blade. The analysis of the structural failure is both theoretically and computationally challenging. As far as composite blades are concerned,
manufacturing defects, impact damage due to transportation and maintenance, high cycle fatigue during operation, wind turbulence, etc., all contribute to the damage accumulation that eventually can result in failure. It is expected that the damage modeling results obtained in the course of this project will strengthen the scientific base and enhance understanding of damage initiation and propagation in composite wind turbine rotor blades, and will provide guidance to damage tolerant designs, thus contributing to the overall wind turbine reliability analysis.

The simulation tool developed in Year 3 has an impact on the design and performance evaluation of wind turbine drivetrains. In particular, this simulation tool facilitates the optimum design process of drivetrain systems for achieving the high product reliability and long product life. The developed reliability analysis of wind turbine structural systems considers realistic wind load variability, which could lead to a reliable optimum design of wind turbine components and reduce wind energy cost.

A risk-averse approach to strategic planning of energy grid operation was proposed. Currently, the overwhelming majority of literature on energy grid optimization and operations assume a risk-neutral framework, where risks of very rare but catastrophic events (such as massive “blackouts”) are not properly taken into account. Moreover, a new, nonlinear measure of risk specifically designed for quantifying risk exposure to catastrophic events was developed.

Energy Utilization (EU)

The project has provided an opportunity to apply basic behavioral theory and practice to a field setting. It is yielding knowledge regarding basic challenges to adoption of new technologies along with the potential problems and benefits of targeting small, rural communities. The project’s work with energy audit process has also provided information on how to better engage community partners in research.

The post occupancy evaluation conducted with the Interlock House led to the proposed existence of a dynamic visual comfort zone, which was presented to the peer community at the Windsor Conference, a leading international conference for human comfort and sustainable architecture in the UK. The proposed metric will potentially have significant impact on the design of passive heated and daylight buildings.

Energy Policy (EP)

The oil industry’s chief lobbying body is the American Petroleum Institute (API). They mounted an extensive campaign against ethanol in 2013 that was largely based on an economic study conducted in the fall of 2012 by NERA consulting. This study concluded that ethanol biofuel mandates were economically impossible to meet and oil companies would have no choice but to export gasoline and diesel to reduce the quantity of Renewable Identification Numbers (RINs) they needed for compliance with the Renewable Fuels Standard. Limited objective analysis of ethanol policy and ethanol markets was being conducted by economists. To fill this void, Pouliot and Babcock conducted a series of studies that showed why NERA’s conclusions and the API claims had little economic foundation. The results of these studies were widely cited in the comments of both ethanol opponents and proponents on EPA’s proposed rule to reduce ethanol mandates. Thus, the objective of these studies to better inform the policy process was met and had the impact of neutralizing the one-sided campaign against biofuels mounted by the oil industry. The results of these studies were also directly communicated to EPA and others in DC.
Broader Impacts (BI)

At this year’s annual meeting (July 21-22, 2014), the BI platform will host a half-day panel discussion on how to integrate broader impacts into faculty scholarship while leveraging existing resources to address the BI goals of a faculty member’s institution. A jurisdiction-wide collaboration session will also be facilitated so faculty can develop new collaborations and compete for seed grants to solidify the collaboration.

The data provided by the CI team can be used to extend knowledge of wind resources and aid those seeking to develop resources in Iowa; and can also be used for education, training, and knowledge creation, for example by students to understand wind resources and the sensor network platforms used to provide those data.

What is the impact on other disciplines?

Renewable energy and energy utilization studies impact many disciplines beyond the traditional physics- and chemistry-based disciplines. Selected impacts in other disciplines are highlighted below.

BioEnergy (BE)

The techno-economic analysis of thermochemical processing helps guide experimental research in the broad field of biorenewables by identifying innovations of high economic or environmental impact. The laser diagnostic instrumentation developed in this research is applicable in a variety of chemically reacting flows in which transient in situ chemistry is not well understood. Instrumentation improvements will result in sensitivity, chemical speciation, temporal resolution, and spatial resolution that are currently unavailable.

Wind Energy (WE)

Many of the students involved in the wind energy activities have been conducting research outside their principal areas. For example, meteorology students are learning about the engineering side of wind energy by conducting power calculations in wind farms and learning the importance of forecasting winds at hub-heights of wind turbines (typically 80 m) as opposed to standard surface wind forecasts which target the 10 m level. Engineering students who are analyzing wind power data and developing numerical models of wind farms are learning more about meteorological characteristics of wind speed and turbulence in the real atmosphere and how idealized the wind tunnel environment really is for simulating real-world wind farms.

The computational tools developed for wind farm simulation are relevant not just to wind turbine applications, but rather to any computational fluid dynamics simulations involving complex flows such as rotorcraft or building or terrain interference.

Modeling wind turbine blade damage is relevant to a number of industries that extensively use composite materials, including aerospace, automotive, defense, infrastructure, etc.
The Reliability Analysis and Multidisciplinary Design Optimization (RAMDO) software that is being developed can be used by researchers in other disciplines to carry out optimizations.

The efficient methods for solving nonlinear mixed-integer optimization problems that are being developed can be used in a variety of problems that arise from the risk-averse stochastic programming formulations.

**Energy Utilization (EU)**

The Green Community Campaign could impact public policy and marketing related to challenges of communicating information about new technologies. Managing the logistics of working to recruit participants indirectly through industry partners can also be applied to many other disciplines.

The research and infrastructure developed with the architects in the Building Science plank have already had a significant impact on projects developed within Mechanical Engineering and Electrical and Computer Engineering, which lead to a joint NSF CyberSEES proposal. The data analysis from this project can also be used by “big data” researchers.

**Broader Impacts (BI)**

The expansion of CI resources through the Iowa NSF EPSCoR project has helped support and enable programs in other disciplines. For example, the CI team helped construct data-driven wind models to enable increased utilization of meteorological data for wind energy applications by creating an easy-to-use, on-line (server based) software framework that enables practitioners to utilize this data. In addition, CI has helped advance and develop the new and emerging field of Materials Informatics and Big Data as applied to all facets of materials science research, ranging from materials modeling to materials characterization. New research in developing informatics methods has been applied to a diverse array of topics including the design of new multifunctional materials for advanced sensors and bio-polymers for drug delivery and energy applications. A recent 2012 news article in Science on the White House Office of Science and Technology Policy’s report on the “Materials Genome Initiative” stated that CI platform leader K. Rajan’s work in materials informatics has made an impact on those “challenging materials problems” that still remain outside other traditional computational methods.

All BI projects aim to increase exposure of women, URM, and community college students to educational and research opportunities in STEM areas, which fits well with the goal of Iowa’s Next Generation Science Standards, where energy concepts can be used as a common thread in various STEM disciplines.

Those outside traditional STEM disciplines are also being impacted by the Iowa NSF EPSCoR project. A graduate student assistant from the English Department, working with External Engagement, has developed her PhD research topic in English Rhetoric and Professional Communication in the area of NSF reporting for large projects, and two student journalist interns will get experience with science communication reporting this summer.

**What is the impact on the development of human resources?**
The Iowa NSF EPSCoR project has had a direct impact on the development of the state’s human resources. Several faculty, staff, and students were directly involved in the project during Year 3. By the numbers, this includes:

- 93 faculty (30 female and 7 URM), including 63 junior faculty (assistant and associate professors; 23 female and 5 URM);
- 67 staff (34 female and 2 URM);
- 15 post-docs (7 female);
- 121 graduate students (39 female and 7 URM);
- 123 undergraduate students (58 female and 13 URM).

Additionally, 5 community college students (1 female) were involved with the project (three will be interns this summer).

Highlights from human resource development during Year 3 include the following.

Three students from ISU attending the EPSCoR National Meeting in Nashville and won the Science Idol contest. These students included Suncica Jasarovic (an undergraduate from the UE platform) and Chloe Dedic and Bernardo Del Campo (both graduate students in the BE platform). They did not know each other before traveling to the conference. They learned effective communication skills and team building while they participated in the competition.

The training and mentoring provided by Passe to Murillo during last summer’s EPSCoR internship inspired him to transfer to ISU’s Electrical and Computer Engineering program from Des Moines Area Community College (DMACC). Murillo was accepted into the prestigious McNair Scholarship program to prepare URM students for graduate research careers. He continues to work with Passe in the Building Science Plank and has presented his research in a variety of venues, receiving several awards for his efforts.

Specific and dedicated staff and numerous postdoctoral scholars, graduate students, undergraduate hourly workers, and interns have been trained in the use of Iowa NSF EPSCoR funded equipment that is used at the two BAER sites. Scientists and students have access to data generated for their agro-economic research, which will enhance their competitiveness for NSF and USDA grants. Additionally, to date 9 graduate students and 22 undergraduate students have gained experience in thermal conversion research at the ISU pilot plant.

Wind Energy Resource Characterization at ISU has developed an intentional and monitored bi-directional mentoring hierarchy to provide a structure for facilitating vertical movement and success of members of underrepresented groups. A positive outcome of this effort is their engagement of women into the program and the intentional positioning of women as mentors to women below them in the hierarchy.

Several undergraduate Architecture, Mechanical Engineering, and Electrical and Computer Engineering students were involved in energy utilization research, including (1) working with baseline data collection and survey analysis, (2) installing instrumentation at the Interlock House, (3) designing and constructing the energy system display trailers for outreach activities, and (4) investigating and analyzing energy systems. Gaining experience in performance based design, considered a key hiring
demand in the Architecture profession for green sustainable buildings, has made these students highly desired in the profession.

The facilities manager at Columbus Junction Community Schools has been given new tools and knowledge to improve energy efficiency of the school building.

The BI Platform has focused efforts on impacting the development of human resources. In the area of faculty development, professional development programs and seed grants are expected to have a positive impact on faculty's ability to build and enhance their research portfolio.

Diversity and outreach efforts have had a major impact on the Regent institutions in galvanizing engagement of diverse graduate and undergraduate students, as well as in giving change agents opportunities to highlight research on best practices for recruitment of diverse faculty. For example, best practices identified by ISU-ADVANCE have been shared and adopted by faculty search committees for all open lines in engineering at ISU and UI, as well as campus wide at UNI. In addition, outreach events aimed at engaging women and URM children enables the strengthening of diversity in STEM pipelines across the State of Iowa. The past year, over 600 female and URM K-12 students were engaged in STEM related outreach activities.

Workforce develop opportunities have targeted elementary and middle school teachers. As a result of teacher involvement in the professional development programs targeted to middle and high school teachers through the Energy Institute (UNI) and Summer Academy (ISU) supported by the Iowa NSF EPSCoR project, at least 7,500 students have been exposed to the subject of finite energy sources. They have also learned how the State of Iowa is addressing the energy shortfall by creating and implementing an extensive bio-based industry. Students are more informed about the Iowa bio-economy, the job market in this area, and the academic requirements to obtaining green-collar jobs.

A longitudinal study to determine the impact of PLTW courses on the students’ long-term performance and college choices is ongoing. The results to date from this study have shown that participation in PLTW courses increases the math and science ITED scores of students by 5.2 points (this is about half a grade level improvement in math, less in science), compared to a control group of students who had comparable scores in 8th grade. Furthermore, students taking PLTW courses show a 60% increase in the odds that they will go to a community college rather than not continuing in post-secondary education. Moreover, students who have taken PLTW courses are more likely to pursue STEM majors in college. Even students who do not select STEM careers will be better informed about how STEM fields relate to their daily lives. The PLTW Diversity/Implementation Coach has been instrumental in allowing for more successful interaction with new schools, leading to the addition of 25 new PLTW schools in Iowa in Year 3 alone. There are now more than 22,000 Iowa students per year taking PLTW high school courses.

Through strengthening of research infrastructure at Indian Hills Community College and Dordt and Central Colleges, more than 80 students and 20 faculty members have engaged in activities related to Iowa NSF EPSCoR equipment funded research projects and have gained increased exposure to RE/EU related research and education.

At Dordt College, 6 students (2 were first generation college students) have completed undergraduate research using Iowa NSF EPSCoR equipment, and 3 of these students have started their engineering careers or further engineering education in the agricultural or bioenergy sector. Two female students are the top candidates for bioenergy research this summer. Dordt College hosts two Engineering Visit Day events for high school students each year, where showcasing their new equipment and its capabilities has had a positive impact on the college’s ability to attract more students into STEM
disciplines. At Central College, to date, 22 students (12 females) have worked as research assistants on the Prairies for Agriculture Project and an additional 65 students (30 females, 5 URMs) have volunteered hours to days at the site. Four faculty use the research project for educational purposes in their classroom.

The communication internship experiences for journalism students through the external engagement team have proven to be very valuable. Both interns from last summer plan to seek a career in science communication; one graduated this spring and the other received an internship in ISU’s College of Engineering. Both students indicated that the experiences with the Iowa NSF EPSCoR project allowed them to further develop their passion for science communication, especially STEM related materials.

**What is the impact on physical resources that form infrastructure?**

One of the goals of the Iowa NSF EPSCoR project is to develop the infrastructure to better perform renewable energy and energy utilization research. Activities in this area during Year 3 are summarized here.

The equipment purchased and installed in the two BAER sites has enabled the BAER teams to make previously impossible measurements, which has been leveraged to conduct research otherwise not possible, and to secure external research funding on related topics.

Significant new instrumentation at ISU for understanding the in situ physical and chemical processes taking place during biomass conversion have been installed, including FTIR, CARS, and high-speed micro-imaging techniques; these new abilities will be available for use in other projects and by other researchers. The physical infrastructure has been significantly enhanced at UI (including both chemical analytics equipment and sample heaters), enabling broader-based and more impactful biomass processing studies.

A marine-based balloon-borne wind resource characterization system was developed using expertise from the WE platform. The system is mounted on an ocean buoy anchored to the sea floor and operates continuously and unattended while delivering data to a shore-based receiver. This system will allow researchers to acquire off-shore wind data in a more economical fashion and lower the cost of bringing off-shore wind power to users.

A new wind tunnel facility and model turbine have been developed at UI for fundamental and applied studies of wind turbine aerodynamics, increasing the research capabilities at UI.

The Interlock House, which serves as the activity center at Honey Creek State Park, and the Columbus Community High School in Columbus Junction will continue to serve as building energy utilization community laboratories for decades to come. They continue to inform Iowans of a buildings role in the energy use profile of the state, as well as inform visitors of their own impact on the environment through the buildings they occupy and how they occupy them.

A high resolution infrared camera was instrumental in evaluating the Lakeside Lab community laboratory.

Seed grant and other equipment funding during Year 3 has allowed for the acquisition of new instrumentation in several laboratories at the Regent institutions, community colleges, and 4 year colleges across the state. This helps with the institutions’ mission to provide hands-on, in depth opportunities for scholarship to students. For example, the purchase of a Li-Cor Carbon Monitoring System and other field equipment at UNI was critical to the involvement of two new UNI researchers in the BE platform.
To date, Indian Hills Community College (IHCC) and Dordt College (DC) have enhanced their bioenergy research and education infrastructure through procurement and usage of a gas chromatograph (IHCC) and a pilot scale fluidized bed biomass reaction system and a gas chromatograph (DC) to provide hands-on experiences for students in their programs. Central College procured a tractor to enable effective faculty and student learning experiences in their prairie restoration project. Additional equipment purchases to strengthen their programs are planned.

With respect to cyberinfrastructure, the storage server at UI is the most tangible physical resource that has been developed. The storage offered by this machine is significant, robust and redundant, and serves as the backbone to many of the other services offered by the UI CI group.

**What is the impact on institutional resources that form infrastructure?**

The collaborations formed through the Iowa NSF EPSCoR project have had an impact on the institutional resources at all three Regent institutions, and provide new ways to do research. For example, the studies at the various field sites provides a framework for collaboration with other disciplines, where a trans-disciplinary team has been formed to investigate integration of biochar into cropping systems models.

New collaborations have also formed that may not have occurred without the Iowa NSF EPSCoR foundation. For example, Heaton (from ISU agronomy) now collaborates with multiple engineering departments at ISU and with engineering, hydrology, and facilities personnel at UI on her bioenergy project. Additionally, Ratner is helping UI power plant boiler operators learn about biomass gasification as they plan to incorporate biomass gasification into standard power generation protocols.

Iowa NSF EPSCoR Wind Energy staff and students at ISU, along with Wind Energy Science, Engineering, and Policy (WESEP) program IGERT participants, WESEP REU students and mentors, and NSF MRI project equipment, form an essential component that has laid the institutional infrastructure for mentoring that bridges the gap between new learners (entry level STEM students) and graduate students. This often is a critical period where students are lost from STEM disciplines, commonly associated with mastering of foundational courses in math, physics, and chemistry. By inserting undergraduates in the mentoring process, there is an additional level of peer support to bridge across this gap. Mentors and mentees are intentionally matched within at-risk groups. For instance, female junior faculty members mentored female REU students, and female “REU alums” mentor new female REU students. While the sample size is small, early successes are encouraging.

The Iowa NSF EPSCoR Building Science plank continues to have a significant impact on the work conducted at the ISU Center for Building Energy Research (CBER). CBER, directed by Building Science plank leader Passe will continue much of the building science work at the Interlock House after the Iowa NSF EPSCoR project is completed.

**What is the impact on information resources that form infrastructure?**

Many of the activities in the Iowa NSF EPSCoR project produce large quantities of data and information; impacts during Year 3 in this area are summarized here.

In the BE platform, high-performance computing resources were purchased and utilized to complete the development of an open-source code to model thermochemical processing of biomass. In the techno-economic analysis area, the models developed as part of this project are producing a large library of chemical process models for a variety of biomass conversation technologies, and these models can be used by other researchers. The data produced by the detailed biofuel chemical
composition and combustion studies will inform technology development in biomass conversion processes, as well as those conducting research on new biomass sources.

The databases acquired through the Crop/Wind Energy eXperiments (CWEX-10, CWEX-11, CWEX-12, and CWEX-13) are now providing a resource for creating new knowledge through better understanding of the wind farm environment and improving models to better simulate wind farms in the future.

The wind data platform using the data from the Kirkwood Community College tower provides a good opportunity for education and a source of high-frequency wind data. The workflows of the system are open to the public and can be extended through the interfaces provided. New interfaces will be installed as requests for functionality arise. The database behind the system will be moved to the storage service soon for added risk mitigation; however, the current database is dumped daily to minimize the risk of data loss.

The building energy performance data from the Interlock House and Columbus Community High School are now available for multiple research projects (e.g., NSF CyberSEES proposal submitted by Ganapathysubramanian, et al.) and are accessible over the internet.

In the area of broader impacts, there is more information on recruitment and diversity opportunities through the new diversity page for the College of Engineering at UI (http://www.engineering.uiowa.edu/ess/future-students/diversity-ui-college-engineering) and through the SP@ISU resource page at ISU (http://www.spisu.iastate.edu).

The UI cyberinfrastructure storage server project was enabled through collaboration with the UI Research Services group, allowing the potential for oversight and collaborations beyond the scope of the original project.

The portals for dissemination via online and social media are having a significant impact on their ability to reach a broad audience. This is evidenced by the following data between September 2013-March 2014: 1876 total views of the four Living with the Sun videos posted on TeacherTube; 293 plays and 3137 loadings of the 11 videos posted on Vimeo; and 1959 views of the 10 videos posted on YouTube. Per Google analytics, in a two month period from January through March of this year (September to January there is no data due to technical problems with Google analytics), the Iowa NSF EPSCOR website had 1913 unique visitors who made 2720 visits for 8,005 pages viewed. Since joining Twitter in January 2013, 1392 tweets have been made, 860 of which were made from April 1, 2013 – March 28, 2014, and the Iowa NSF EPSCoR Twitter account has 289 followers.

**What is the impact on technology transfer?**

The Iowa NSF EPSCoR project is having an impact on technology transfer.

Big Creek instrumentation is being used as part of a collaborative project with an operational forecaster in the National Weather Service (NWS). The data and equipment are directly supporting research that is intended to advance forecasting methodologies. The collaboration with the NWS supports rapid research to operations transfers.

Several companies have visited ISU this past year to understand the technology under development. Research contracts are currently being negotiated with some of them. The open-source thermochemical conversion computational tools are being used by the National Renewable Energy Laboratory, Oak Ridge National Lab, University of Rome Tor Vergata, Italy, University of Limerick,
Ireland, and the National Research Council of Italy. Data from the UI gasifier have been shared publicly, and are being used to make both design and operational procedure changes at Ag Bio-Power in Tama, IA. The development of the Integrated Biomass Assessment Model (IBAM) provides entrepreneurs and policy makers with a tool to assess biogas generation opportunities in the State of Iowa.

The marine-based balloon-borne wind resource characterization system for offshore wind characterization was a joint university-industry-state government partnership that created new intellectual property and expanded the scope of resource characterization tools available to the wind industry.

Through her association with the Center for Building Energy Research and Iowa NSF EPSCoR, Building Science plank leader Passe signed a third nondisclosure agreement with Calmar Research (Syracuse, New York), who holds a patent on an innovative insulated construction element; they are interested in developing research collaborations with ISU.

Weather Analytics develops software applications for weather data, which are crucial in understanding building energy performance; they provided a letter of support for the NSF CyberSEES grant proposal.

Industry contact has been developed with Schneider Electric out of Cedar Rapids, IA; they are interested in whole building energy management systems. Discussions with Schneider Electric, and how to involve them in EPSCoR community laboratories, are on-going.

**What is the impact on society beyond science and technology?**

As in years past, the Iowa NSF EPSCoR project has impacted society beyond science and technology in both personal and broad ways. Selected examples of these impacts are provided below.

**BioEnergy (BE)**

The activities at the BAER research sites include all three Regent institutions and have been critical in the support of the UI power plant biomass partnership. Through this activity, by 2020, $10 million that would have been spent on out-of-state fossil fuels will now be spent on biomass energy grown and used in Iowa.

The biochar industry has made significant advances in the last few years. Globally, there are now ~150 companies or organizations working with biochar, most of which are operating on a small scale (although two industrial scale biochar facilities are under construction). The Iowa NSF EPSCoR support has helped provide critical science based information about biochar, which is needed by this new industry to develop.

**Wind Energy (WE)**

The WE platform has made several public presentations in increase public awareness of the role wind energy has in meeting US energy needs. When possible, wind farm tours are organized and hosted by WE participants for campus visitors (e.g., teachers participating in the Summer Academy and Energy Institute) to provide them with first-hand knowledge on how wind turbines work and how they influence the environment.
It may be problematic to integrate intermittent wind energy production into the electrical grid. To minimize this risk, methods and models are being developed for strategic risk-averse decision making in the presence of uncertainty. This will lead to a more robust and safer electrical infrastructure, thus increasing the efficiency of the government and industrial sectors.

**Energy Utilization (EU)**

The Green Community Campaign is designed to increase public awareness of and use of energy efficient products with the goal of reducing residential energy use. Preliminary indications are that awareness was increased through the community-wide interventions. Additional analyses are needed to determine whether any behavior change can be measured (and if so, sustained).

**Energy Policy (EP)**

The biofuel policy analysis studies that have been released inform the policy process with objective, accurate analysis. Presumably, provision of such analysis will lead to an improved decision-making process.

**Broader Impacts (BI)**

Faculty development activities supported by the Iowa NSF EPSCoR project have provided faculty/staff with more opportunities for developing their skill sets and build research capacity; this allows the institutions in providing a transformative experience for students as well as providing faculty the resources needed to carry out their scholarship.

Through various engagement activities, an increased awareness of STEM related areas (especially in RE/EU topics) is anticipated, enhancing the impact and importance of STEM research and education among parents, students, and teachers across Iowa. As students, especially women and URM students, have more opportunities for developing their skill sets in STEM, it allows Iowa NSF EPSCoR to meet its mission of broadening the STEM pipeline.

CI plank leader K. Rajan has supported the development of the “Materials Genome” work at ISU. Materials Genomics is a new paradigm for materials discovery and design that can provide solutions that are effective, robust, and rapidly deployable. ISU has been a leader in advancing the paradigm of high throughput discovery in the field of materials science, being the first to formally link the “genomics” strategy in biosciences to engineering and materials sciences. Accelerating this process of materials discovery in a technologically robust manner, particularly in the area of energy-related materials, could significantly improve U.S. global competitiveness and ensure that the Nation remains at the forefront of the advanced materials marketplace for energy applications.

**Changes/Problems**

Changes in approach and reason for change
Personnel changes

Dr. Sriram Sundararajan assumed the Broader Impacts platform leadership in January 2014, taking over from Dr. Chitra Rajan, who remains engaged as the ISU member of the Faculty Development Plank. Sundararajan also replaced Rajan as Co-PI of the Iowa NSF EPSCoR project. Sundararajan brings considerable assessment experience to the leadership team. The Iowa NSF EPSCoR leadership team changed with new ISU VPR Dr. Sarah Nusser taking over from outgoing VPR Dr. David Oliver and new UI VPRED Dr. Daniel Reed replaced Dr. Jordan Cohen. The FLARE coordinator left the Iowa NSF EPSCoR project in July 2013.

State Committee

The Iowa EPSCoR State Committee continued to evolve. Christy Twait, UNI Assistant Provost and State Committee Chair, had initiated discussions with the Iowa Innovation Council (IIC) to participate in the State Committee. However, when Iowa became ineligible to receive NSF EPSCoR funding last year and is now in the second year of ineligibility, it was decided that the Committee stay small and include representatives from each university. Reed and Nusser serve as the other two members with PI Heindel serving as a non-voting member.

Strategic Plan Review

The Strategic Plan underwent revisions in Year 3, with input from all five platforms, with the final version approved by NSF on March 5, 2014. While the strategic priorities remained the same and most of the revisions were minor, there were significant changes in approach for faculty development and diversity.

The original strategic plan involved the establishment of the FLARE institute that would serve as a centralized leadership in coordinating faculty development resources across the state. While the institute was established, the differences in culture and operations across the Regents’ institutions resulted in a more decentralized mode of planning and activities. Recognizing this, the FLARE institute was transformed to a formal decentralized leadership wherein the BI Faculty Development leaders at the Regent institutions oversee faculty development efforts independently and focused on the needs of their institution. It is planned to share best practices on an annual basis.

The Diversity team has struggled to evaluate the impact of Iowa NSF EPSCoR programs on diverse constituents within the State of Iowa due to several factors including: challenges in finding common emphasis with the research platforms on participant data collection, and in developing consistent assessment tools across programs. For these reasons, the team took time to revisit outcomes and metrics based on information to which the team has access and programs to which EPSCoR has control – these outcomes are reflected in the updated strategic plan. The strategic priorities of increasing the numbers of diverse participants and in increasing the support systems that enable all participants to persist and thrive in STEM are maintained. The Diversity team has identified research platform stakeholders with whom to strategize for bringing Iowa NSF EPSCoR researchers more into the work of
broadening participation and integrating broader impacts with scholarship in more visible and impactful ways.

With Iowa currently EPSCoR ineligible, the Governance section was modified. Plans for a state office with small staff were abandoned. The original EPSCoR advisory group was retired at the end of Year 2. The Science Expert Board continues to provide annual reviews.

Response to 2013 Annual Report Query

Subsequent to submitting the Year 2 report, the Iowa NSF EPSCoR Program Officer had one question regarding diversity that required follow up: “What plans are in place to improve the number and percentage of women and URM faculty in the remaining three years of the project?” A response from PI Heindel, dated July 29, 2013, outlined two focused activities to address this shortcoming:

1. Target seed funding programs to recruit women and underrepresented minorities (URMs) to be active Iowa NSF EPSCoR faculty participants.
2. Share recruiting and hiring best practices developed at ISU through the ISU NSF ADVANCE program with UI and UNI.

ISU and UNI were able to use carry-over funds from Year 2 to provide seed funding in Year 3 to faculty new to the Iowa NSF EPSCoR project. They also provided additional resources to female and URM faculty currently involved in the project. Of the 24 faculty who received seed grant funds, there were 12 female and 5 URM faculty.

Iowa State University developed faculty training for faculty recruiting and hiring through the NSF ISU ADVANCE program. The focus of the training is to develop a diverse pool of faculty applicants when faculty searches begin, and then ensure a fair and equitable interview/evaluation/hiring process. Dr. Bonnie Bowen, former ISU ADVANCE Executive Director and Iowa NSF EPSCoR Diversity team member, and Dr. Lisa Larson, College of Liberal Arts and Sciences Equity Advisor, both from ISU, provided the following training to UI and UNI:

- September 30, 2013: 3-hour training workshop at UI for eleven administrators.
- October 30, 2013: 1.5 hour training workshop at UNI for the College of Humanities, Arts, and Sciences department heads. Approximately 32 department heads/administrators and search committee chairs attended.

Both training sessions were well received and both institutions indicated they would start using the best practices presented in the workshop in their current hiring cycles. UI has subsequently invested in training materials to provide training across their entire campus. UNI is planning to hold a campus wide workshop in June 2014 that is available to all department heads across UNI. Thus, efforts are in place to institutionalize the best practices identified by ISU NSF ADVANCE at all three institutions and will have a positive long term impact on hiring a diverse faculty.

Lastly, it was determined that some faculty involved in the Iowa NSF EPSCoR project were not included in the Year 1 and Year 2 annual report, and other participants were not categorized correctly due to different individuals compiling the information that did not use consistent definitions. Demographic tables for Years 1 and 2 were subsequently revised and sent to NSF. Demographic data for Year 3 shows that the percentage of female and URM faculty went up from 31% to 33% and from 3% to 8% respectively.
**Science Expert Reviews**

Reviews were held by individual platforms between July and November 2013 and the final report submitted to NSF. Overall, the reviews were positive and suggestions for improvement were minor and are being considered by platform leaders.

**Actual or Anticipated problems or delays and actions or plans to resolve them**

One of the goals of the Wind Energy research effort is to install two tall (120 m) meteorological towers within an operating wind farm. The towers would be instrumented at several vertical locations to capture high frequency aerodynamic data through the atmospheric boundary layer within the wind farm. This would be a one-of-a-kind instrument that, to our knowledge, would not be available anywhere else. Preparations for installing the two towers took longer than expected. Additionally, review of investing in LIDARs rather than the two wind towers was investigated due to the desire for securing tall tower operational funding after the Iowa NSF EPSCoR grant is completed. After discussing the situation with senior leadership at all three Regent institutions, ISU decided to commit to providing operational funding for at least three years after the Iowa NSF EPSCoR project ends. With funding in place to operate and decommission the tall towers after the end date of the Iowa NSF EPSCoR project, it is now expected that the first tower will be constructed this summer.

**Changes that have a significant impact on expenditures**

Expenditures and cost share are on track to meet NSF terms and conditions. As of April 30, 2014, 86% of the current year’s budget and 85% of the cumulative budget have been obligated. The spending plans through the summer of 2014 show that at least 95% of the cumulative budget will be obligated by August 31, 2014. The resulting carry-over funds are expected to be less than 15% of the current year’s budget.

ISU and UNI were able to use Year 2 carry-over funds to provide seed funding to junior faculty, targeting female and/or URM faculty, both new to the Iowa NSF EPSCoR project as well as those currently involved in the project. The financial expenditure data in the template only reflects seed funds provided to ISU faculty. Energy policy funds provided to UNI and UI were not reported by those institutions as seed grants.

As of April 30, 2014, $1,740,394 in cumulative cost share has been reported from the three Regent universities. Between May and August 2014, an additional $261,428 is estimated to be documented. The Iowa Economic Development Authority (IEDA) is providing $2M in cost-share through the life of the project, and it is specifically identified for equipment purchases. To date, $569,560 of these funds have been expended. It is expected that by the end of August 2014, another $139,980 of IEDA funds will be expended. The expected cumulative cost share through year three (all sources) is expected to be $2,711,631.

**Significant changes in use or care of human subjects**

Nothing to report.

**Significant changes in use or care of vertebrate animals**

Nothing to report.

**Significant changes in use or care of biohazards**

Nothing to report.
Special Requirements

Responses to any special reporting requirements specified in the award terms and conditions, as well as any award specific reporting requirements.
Appendix A – Accomplishments

This appendix provides supplemental information to complement the text-based report for the Iowa NSF EPSCoR project and focuses on additional material for “Section 1 – Accomplishments”. Each section provides additional information and is organized by platform (BioEnergy, Wind Energy, Energy Utilization, Energy Policy, and Broader Impacts). A platform will not be included in a section if additional information is not needed. Note that many Broader Impact (BI) activities were completed with and for research faculty through the research platforms. Examples described below include summer undergraduate research internships and faculty development workshops, respectively. Other BI activities were held for a larger audience or targeted groups that may or may not be directly aligned with a specific research platform. In all cases, the BI accomplishments in specific sections are highlighted in a separate “Broader Impacts” sub-section; their integration with research platforms will be emphasized when possible.

A note on the numbering convention:
The section numbers below correspond to the section and question number found on Research.gov for which additional information is provided and may appear to miss a consecutive number. For example, section 1.1 would correspond to section 1 “Accomplishments,” question 1 “What are the major goals of the project?” of the annual report. Additional information is not provided for this question so there is no section 1.1 in this document. Figure and table numbers follow the same convention. For example, Table 1.2c.4 would be the fourth table that provides additional information to section 1, question 2c (Accomplishments: Significant Results).

1.2a Accomplishments: Major Activities
This section provides additional information related to major activities that were completed to address the goals of this project.

The BioEnergy Agriculture plank continues to utilize the two Bioenergy Agro-Ecosystem Research (BAER) sites as outdoor laboratories. The sites have several instruments installed including (i) the capacity to monitor hydrologic process at the watershed scale for both the Clear Creek (near the University of Iowa -UI) and Big Creek (near Iowa State University - ISU) BAER sites, (ii) the capability to monitor changes in agro-ecosystems using hyperspectral imaging, and (iii) the ability to quantify carbon, nutrient, energy, and water fluxes associated with biomass production. The data from these sites are being used to evaluate compounds in fresh water streams found in the sites to assess energy outputs and leaching from farm fields, as well as evaluating the nitrogen content of bioenergy crops at different times in the growing season. Information from these two sites is being used to develop methods and models for scaling agro-ecosystem impact assessment to broader regional scales.

Biochar test plots were established in the Big Creek BAER site to evaluate the impact of biochar on crop productivity, greenhouse gas emissions, and soil quality.
A new Iowa NSF EPSCoR supported faculty member at University of Northern Iowa (UNI), Dr. Kenneth Elgersma, joined the Bioenergy Agriculture plank in Year 3. Elgersma will focus on comparing carbon and nutrient cycling in corn ethanol, switchgrass, and low-input high-diversity grassland biofuel production systems, as well as modeling carbon and nitrogen cycling in invaded wetland habitats managed for biofuel production. Additionally, UNI faculty members, Drs. Mark Sherrard (with interests in biotic and abiotic causes of plant physiological adaptation) and Mark Myers (with interests in ecology, evolution and conservation of north temperate and neotropical vertebrates) joined the plank.

Leveraging Iowa NSF EPSCoR resources and the addition of three new UNI faculty to the plank, monitoring of 48 separate experimental research plots was initiated at the UNI Cedar River Natural Resource Area Biomass Research Site, in the interest of long-term population studies of plant, butterfly, and bird communities to assess biodiversity in biomass cropping systems.


The BioEnergy Logistics and Conversion plank was able to use some carry-over funds designated for this plank to allocate seed grants to faculty new to the Iowa NSF EPSCoR project. Dr. Javier Vela was able to expand bioenergy conversion studies to explore catalysts that enhance conversion technologies. Dr. Dennis Vigil, collaborating with Dr. Zhiyou Wen, began investigating algal photobioreactors as reactors for biomass feedstock production, and is developing mass transport models for a novel Taylor vortex algal photobioreactor. Dr. Malika Jeffries-El enhanced her understanding of biomass-derived furan-2-carbonitrile, which is a precursor to a number of high efficiency conjugated polymers. Dr. Xianglan Bai began investigating production of sugar and platform chemicals via pyrolysis and solvolysis, and Dr. Young Jin Lee received funding for pyrolysis kinetics. Dr. Jacqulyn Baughman is developing a new instrumentation course for the Biorenewable Resources and Technology program. The plank also provided additional resources to current junior faculty in the plank. Dr. Laura Jarboe was able to leverage new Iowa NSF EPSCoR support with funds from other sources to expand her work on fermentation of pyrolytic sugars. Dr. Mark Mba-Wright was able to increase his efforts in the techno-economic analysis of various biofuel conversion technologies.

Work also continued from previous activities that included (i) expanding biomass pyrolysis modeling, (ii) developing tools to study fundamental phenomena of thermochemical processes found in biofuel production, (iii) characterizing biomass pilot plant outputs using chemical analysis tools, and (iv) synthesizing and characterizing zeolites for biocatalysts.

**Wind Energy (WE) Platform: Wind Energy Resource Characterization Plank**

During the current reporting period the five surface flux stations and sonic anemometers purchased for eventual mounting on tall towers in an operating utility scale wind farm were deployed throughout the Story County I & II wind farm for measuring surface fluxes. The 2013 Crop/Wind Energy eXperiments (CWEX-13) field campaign attracted collaborating measurements of wind farm mean and turbulent winds by use of two vertically pointing laser radars provided by J. Lundquist of University of Colorado and the National Renewable Energy
Laboratory (NREL), one scanning LIDAR (Light Detection and Ranging) supplied by NOAA, and one LIDAR provided by the National Center for Atmospheric Research (NCAR).

The logistics of the tall tower installation, commissioning, and decommissioning have been more challenging than originally proposed. After working on different scenarios through the year, it was decided to move forward with construction during Summer 2014. Since the towers will be in operation for only about 2 years of this project, ISU has agreed to support their operation beyond the Iowa NSF EPSCoR project.

A new faculty member, Dr. Andrew Vanloocke joined the plank in January, initially focusing on interactions of large scale wind energy operations with surrounding agricultural fields. Successful searches were also conducted for a field technician and postdoctoral research associate for the project.

Samantha Irvin was the successful candidate for the field technician position. Irvin has an MS in agricultural meteorology from ISU and has field experience measuring moisture fluxes in crop canopies. Holding this position, she will provide a good role model for young female STEM students in a position rarely held by females. Irvin will also be overseeing data archives from the CWEX measurements as well as Supervisory Control And Data Acquisition (SCADA) data secured under a non-disclosure agreement with two Iowa wind farm owners.

The postdoctoral research associate position has been filled by Dr. Dan Rajewski, a December 2013 PhD recipient in Atmospheric Science from ISU. Rajewski has several years of micrometeorological field experience at both University of Nebraska and ISU (including experience as an Iowa NSF EPSCoR project graduate student). He will be the chief scientist on the CWEX experiments.

Data from previous field experiments in this wind farm are being analyzed. An unexpected success in obtaining highly confidential SCADA data from multiple utility-scale wind farm operators in Iowa has created the need to establish a secure Wind Farm Data Analysis Laboratory. This lab has been created with two new high-speed Dell computers, two dedicated hard drive storage units and two designated single-purpose flash drive units for sole use in this secure facility. All units are isolated from the Internet for sole use on data for which there are non-disclosure agreements in place. All major analyses will be done within this room, and only data that have been stripped of key identity will be allowed out of the room for analysis on other computers. The attraction of faculty and student researchers to the CWEX and SCADA data archives has created a need to establish this lab and develop protocols for use of the data.

Field technician Irvin is tasked with ensuring the security of data archived in this facility. Currently, there are researchers using these data from the ISU Departments of Statistics, Mechanical Engineering, Aerospace Engineering, and Geological and Atmospheric Science.

Another success of the project has been the interest in using field data generated under this project for wind farm numerical model validation. Rajewski and WE plank leader Dr. Gene Takle are working with wind farm modelers from NREL, PNNL, and Lawrence Livermore Laboratory.
Another outcome was use of CWEX data by other Iowa researchers. As a result of multiple exchange visits with junior faculty plank member Dr. Andrey Petrov of UNI, a UNI MS project has been defined that will use CWEX data. Furthermore, Rajewski has been approved by the UNI faculty to serve as an external member of the program-of-study committee for the UNI MS student.

An additional development not envisioned in the original proposal was the willingness of two major utilities to share their highly confidential SCADA data with the research team. An exploratory study of these data reveals a rich opportunity to better understand wind farm performance, barriers to improving efficiency, and opportunities for improving wind farm power projections for selling energy on the day-ahead market. Multiple proposals are being prepared to develop methods for lowering the cost of wind energy.

Another major accomplishment was the establishment of the Bi-directional Mentoring Hierarchy for engaging learners and professionals at all levels to enhance academic and professional advancement in wind energy science for all participants, but especially members of at-risk and under-represented groups. The concept is focused on developing and implementing mentoring skills at all levels through intentional and intensive application of near-peer mentors. More details are provided below.

**Wind Energy (WE) Platform: Blade Performance and Reliability Plank**

A computational tool for simulating unsteady dynamic yawing of wind turbines has been developed and tested. Full rotor and nacelle motion can be simulated while accounting for multiple turbine interferences.

A numerical method for simulating flows over complex terrain has been developed and tested. Modeling of wind turbines on a complex terrain is under investigation and is scheduled to be implemented later this year.

A numerical solution acceleration technique utilizing a Runge-Kutta (RK) time integration scheme to reduce simulation turnaround time has been developed. The current acceleration technique under investigation is the use of different time integration schemes that will optimize the runtime by improving stability for larger time steps and/or by reducing the computations within each time step.

Studies on the assessment of the structural performance of composite rotor blades are underway. A fatigue damage model for composite wind turbine blades has been developed and refined. The model accounts for realistic aerodynamic wind load and detailed 3D stress analysis of the laminated composite blades. Optimization of the composite wind turbine blade for the extended fatigue life is underway.

Lightning is one of the main sources of wind turbine insurance claims and downtime. Thus, improving lightning strike resistance of a composite wind turbine blade will lead to better wind
energy economics. A Physics-based model for thermal damage due to lightning strike in a composite wind turbine blade has been developed. The model describes surface interaction between the lightning arc and the composite structure. Computational studies have been performed to assess thermal damage with respect to the lightning current characteristics, material properties, and composite layup of the blade. Experimental electrical and impact characterization of carbon fiber textile composites has been performed. Accurate assessment of the electrical properties is key for lightning strike modeling and development of damage assessment methods based on the electrical resistance measurements.

Detailed design of the recirculating wind tunnel was complete at the beginning of Year 3 and construction began. Construction of the recirculating wind tunnel is now substantially complete and is projected to be complete by Summer 2014. Remaining activities include installation of the turning vanes upstream of the test section, configuration of the test section for planned EPSCoR-related experiments, and testing.

The precision scaled wind turbine to be studied in the recirculating wind tunnel has been constructed and is currently undergoing testing. Primary activities during the present reporting period to date include refinement of the nacelle design to minimize impact on rotor aerodynamics, testing and debugging of wind turbine instrumentation for aerodynamic load measurements, and preliminary wind turbine performance characterization. This summer the plan is to complete a detailed performance characterization of the precision wind turbine, and develop a set of simpler wind turbine models to form a multi wind turbine array within which to test the precision wind turbine.

**Wind Energy (WE) Platform: Drivetrain Design Optimization Plank**
The drivetrain dynamics simulation capability in GearDyn was augmented by integration with the Iowa Reliability-Based Design Optimization (I-RBDO) code. The developed numerical procedures allow for the consideration in the drivetrain dynamics simulation of aerodynamic load variations on rotor blades subjected to pitch controls under wind field uncertainty. Furthermore, the modeling procedures developed and implemented in GearDyn were validated to ensure the simulation accuracy. This work is being extended to include reliability analysis of turbine blades and hubs considering wind load uncertainty, and deterministic design optimization (DDO) of the blade is being carried out.

**Wind Energy (WE) Platform: Green Energy Grids Plank**
The following models, algorithms and methods have been developed: (i) risk-based stochastic optimization models and algorithms that properly quantify the effects of uncertainties on the performance of the energy supply chain; (ii) distributed algorithms for voltage and frequency regulation with piecewise linear cost functions and inter-generator communications; and (iii) algorithms that permit limited inter-generator communications. Currently, methods for demand shaping are being developed.
Energy Utilization (EU) Platform: Green Community Campaign Plank
The intervention campaign was completed in the two test communities. A final posttest survey was completed and energy use data were acquired from MidAmerican Energy. Minority internship applicants were sought from across the country through contacts at Historically Black Colleges and Universities.

Energy Utilization (EU) Platform: Building Science Plank
The community laboratories in the Columbus Community High School in Columbus Junction, IA, and the Interlock House at Honey Creek Resort State Park, are fully established and operational. Both community labs have installed touch screen technology to engage the public in energy utilization measurements.

The Interlock House is also being used as a platform to study passive heating and cooling strategies. To measure air flow and temperature within the Interlock House under passive heating and cooling situations, a Mobile Data Acquisition System (MiDAS) was developed (Figure 1.2a.1); it is a portable armature that holds a series of environmental measurement devices and an accompanying data recording system. MiDAS was developed for the purpose of measuring dynamic flows of the indoor environments using a series of vertical sensors that can be located at any location within the testing space. The data will be used for the validation of Computational Fluid Dynamic (CFD) codes.

Figure 1.2a.1: Mobile Data Acquisition System (MiDAS) that was developed to obtain environmental measurements at various vertical locations inside a residential structure. The vertical measurement array is mounted on an adjustable vertical “stick” that can be moved throughout a structure to obtain data at several locations.
A test facility was completed and calibrated to evaluate desiccant dehumidification systems, with the goal of installing such a system in the Interlock House.

Occupancy thermal comfort and daylighting research in the Interlock House was conducted with Post Occupancy Evaluation (POE) questionnaires, surveys, and measured data in order to study the relationship of human behavior and energy performance in energy efficient passive solar home designs.

To further engage the public in energy utilization understanding at the Interlock House, a one-to-one wall assembly mock-up of the Interlock House and a refined cost estimate of the house (often requested from visitors) for the implementation of similar design strategies was completed.

To expand energy utilization outreach activities and engage others beyond Columbus Junction and Honey Creek State Park, an “energy engagement trailer” or Mobile Energy Innovation Station (MEIS) has been initiated in collaboration with the University of Iowa (UI) and Kirkwood Community College students and their instructor, Joe Greathouse. Design discussions with other potential collaborators are ongoing.

A seed grant was provided to a new faculty member in ISU’s College of Design, Dr. Andrea Wheeler. Her focus is on sustainable school design, and she is surveying Iowa schools to understand their energy utilization requirements and possible areas where different designs will improve energy utilization.

A third community laboratory at Iowa Lakeside Laboratory (http://www.continuetolearn.uiowa.edu/lakesidelab/index.html) was identified. Iowa Lakeside Laboratory is a field station for Iowa’s state universities. Today, the Lab’s mission is to provide facilities and programming as a field station and community resource to support scientific education, research, and outreach programs of the Regents universities and other institutions. Meeting this mission will require increased housing that can be used during the time when academic classes are not in session. These facilities need heating for 9-10 months/year and kitchen facilities for small groups when the main kitchen is closed. Unfortunately such housing is lacking at Lakeside. The proposed transformation of the Faculty Cottage (Figure 1.2a.2) will help alleviate this housing shortage and will do it in a way that reflects the Laboratory’s values of sustainability, preservation, and conservation. The challenge for the project is to develop highly efficient and attractive transformation proposals for the Faculty Cottage to prepare it for an annual 10-12 month occupancy period. This goal will entail analysis of the current location and its climatic potential, iterative energy modeling proposals for an energy efficient upgrade and full scale sectional envelope models/mock-ups to discuss proposals with the stakeholders at Lakeside Laboratory.
A new faculty member at UNI, Dr. Junyong Ahn, joined the Building Science plank. He will focus on energy loss of residential buildings in Iowa small towns utilizing thermal imaging, and incorporate his research into curricular and academic activities such as a sustainable construction course, an undergraduate research course, and extracurricular activities that are conducted by the construction management club at UNI.

**Energy Policy (EP) Platform**

The EP platform held several seminars and workshops for faculty, postdocs, and graduate students working at the interface between economics and engineering within the jurisdiction. Stipends were provided to faculty to (i) travel and participate in interdisciplinary engineering/economic/policy workshops and conferences, and/or (ii) develop energy engineering/economics research teams to develop joint grant proposals. The EP Platform also provided seed grant funding to hold a workshop in energy policy and enhance the research of four current EP platform faculty (three at ISU and one at UNI) and three new faculty not previously affiliated with the Iowa NSF EPSCoR project. Dr. Georgeanne Artz is focusing on integrating bioenergy decision making into Economics undergraduate courses. Dr. Keri Jacobs is investigating how Iowa Co-ops can improve market development of bioenergy feedstocks. Dr. Laura Smarandescu is conducting a study of consumer’s willingness to pay for ethanol. Additionally, seed funding was provided to UI faculty Dr. Peter Damiano, director of the UI Public Policy Center, to host two energy-related symposia.

Biofuel policy research was expanded to build a modeling framework that integrates novel scientific findings into models of biofuel markets, with regulatory options in agricultural and energy policy. Methods were also developed for quantification and communication of uncertainty in the context of integrated engineering/economic/policy modeling of biofuel markets. The research was published in outlook reports for regional, national, and international markets for biofuel feedstocks, energy, and other products, and distributed to the public, industry stakeholders, national and international sources for policy research, lobbying, and decision-making, local governments, the Iowa legislature, U.S. Congress, and relevant federal agencies.
Broader Impacts (BI) Platform: Faculty Development Plank

The majority of faculty development activities conducted over the past year can be broadly grouped into the following two categories:

- **Professional development programs.** A variety of programs for faculty, postdoctoral fellows, and graduate students were provided to meet needs identified through discussions with leaders at colleges, centers, and institutes, as well as research staff and graduate student leaders. Faculty-focused programs addressed research planning for new faculty, successful grant writing, identification of resources on campus for collaborative research, and invited talks to increase awareness of the needs of funding agencies. New programs aimed at developing the next generation of research leaders were also developed that typically engaged graduate students and postdoctoral fellows on developing research programs, funding opportunities, and planning for careers in academia, government, and industry. All programs were typically open to faculty, staff, and students at all three Regent Institutions through the BI leaders at the campuses. Several of the programs offered were leveraged to enhance the impact of existing programs at the institutions. A listing of specific programs is found in Table 1.2a.3.

- **Seed grant program.** In addition to the research platform seed grants referenced above, the UNI BI Faculty Development plank continued its small seed grant award program from Years 1 and 2. Fewer but larger grants were awarded in Year 3 to continue to build and increase research capacity and engagement of external funding agencies. A listing of all Year 3 seed grantees is found in Table 1.2a.4. Furthermore, to encourage cross institutional and cross platform collaborations amongst Iowa NSF EPSCoR faculty, the annual meeting will facilitate a networking session intended to spark ideas for new collaborative projects, with seed grants of $20,000 each (total cost) to be awarded to the three most innovative proposals. An update on activities of Year 2 UNI seed grantees is provided in Table 1.2a.5.

In addition, community colleges and 4 year institutions across the state of Iowa have been engaged to enhance their faculty’s portfolio in research and education.
Table 1.2a.3: Faculty development programs during AY 2013-2014 that were supported or partially supported by the Iowa NSF EPSCoR project.

<table>
<thead>
<tr>
<th>Institution</th>
<th>Program</th>
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</thead>
<tbody>
<tr>
<td>ISU</td>
<td>Basic Grant Writing Workshop</td>
</tr>
<tr>
<td>ISU</td>
<td>New Faculty Program</td>
</tr>
<tr>
<td>ISU</td>
<td>Building and Sustaining Community Collaborations and Partnerships</td>
</tr>
<tr>
<td>ISU</td>
<td>Brown Bag/Workshop: Data Management</td>
</tr>
<tr>
<td>ISU</td>
<td>Grant Writing Workshop- NSF Career Grants</td>
</tr>
<tr>
<td>ISU</td>
<td>Building an Interdisciplinary Research Team</td>
</tr>
<tr>
<td>ISU</td>
<td>NSF Proposal Writing, Tips and Tricks</td>
</tr>
<tr>
<td>ISU</td>
<td>REU Mentor Training Workshop</td>
</tr>
<tr>
<td>ISU</td>
<td>Integrating Broader Impacts in your Proposal</td>
</tr>
<tr>
<td>UNI</td>
<td>Write Winning Grant Proposals, Dr. John Robertson - Grant Writers Workshop</td>
</tr>
<tr>
<td>University</td>
<td>Event Title</td>
</tr>
<tr>
<td>------------</td>
<td>-------------</td>
</tr>
<tr>
<td>UI</td>
<td>Federal Research Funding in a Challenging Fiscal Environment (One Session for Science, Engineering, Education, Arts and Humanities, and one session for Health Research)</td>
</tr>
<tr>
<td>UI</td>
<td>Research@Iowa Orientation</td>
</tr>
<tr>
<td>UI</td>
<td>Ideation Summits</td>
</tr>
<tr>
<td>UI</td>
<td>6th annual UI Health Sciences and Engineering Women Faculty Development Conference: Leading in Academia</td>
</tr>
<tr>
<td>UI</td>
<td>NSF Career Awards Workshop and Faculty Panels</td>
</tr>
<tr>
<td>UI</td>
<td>Workshop: The Craft of Scientific Presentations</td>
</tr>
<tr>
<td>UI</td>
<td>Grants Session: National Endowment for the Humanities Office of Digital Humanities</td>
</tr>
</tbody>
</table>
Table 1.2a.4: Year 3 awarded seed grants.

<table>
<thead>
<tr>
<th>University</th>
<th>Faculty Seed Grant Recipient</th>
<th>Activity</th>
<th>Platform</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISU</td>
<td>J. Baughman</td>
<td>Development of new instrumentation course for Biorenewable Resources and Technology program.</td>
<td>Bioenergy</td>
</tr>
<tr>
<td>ISU</td>
<td>X. Bai</td>
<td>Identification and quantification of volatile compounds produced during biomass pyrolysis; production of sugars and platform chemicals via pyrolysis.</td>
<td>Bioenergy</td>
</tr>
<tr>
<td>ISU</td>
<td>L. Jarboe</td>
<td>Fermentative production of a variety of biorenewable fuels</td>
<td>Bioenergy</td>
</tr>
<tr>
<td>ISU</td>
<td>M. Jeffries-El</td>
<td>Adapting “steam distillation” to recover phenolic monomers from pyrolysis stream.</td>
<td>Bioenergy</td>
</tr>
<tr>
<td>ISU</td>
<td>Y.-J. Lee</td>
<td>Pyrolysis kinetics research.</td>
<td>Bioenergy</td>
</tr>
<tr>
<td>ISU</td>
<td>J. Vela</td>
<td>Catalyst synthesis and characterization.</td>
<td>Bioenergy</td>
</tr>
<tr>
<td>ISU</td>
<td>R.D. Vigil</td>
<td>Equipment grant.</td>
<td>Bioenergy</td>
</tr>
<tr>
<td>ISU</td>
<td>M. Wright</td>
<td>Life cycle assessment of biomass conversion processes.</td>
<td>Bioenergy</td>
</tr>
<tr>
<td>ISU</td>
<td>A. Wheeler</td>
<td>Improved energy utilization and sustainability in Iowa schools.</td>
<td>Energy Utilization</td>
</tr>
<tr>
<td>ISU</td>
<td>G. Artz</td>
<td>Integrating bioenergy decision making into Economics undergraduate courses.</td>
<td>Energy Policy</td>
</tr>
<tr>
<td>ISU</td>
<td>K. Jacobs</td>
<td>How Iowa coops can improve market development of bioenergy feedstocks.</td>
<td>Energy Policy</td>
</tr>
<tr>
<td>ISU</td>
<td>E. MacDonald, R. Morrow</td>
<td>Fall 2014 Workshop in Energy Policy</td>
<td>Energy Policy</td>
</tr>
<tr>
<td>ISU</td>
<td>L. Smarandescu</td>
<td>Explaining differences in consumer’s willingness to pay for ethanol</td>
<td>Energy Policy</td>
</tr>
<tr>
<td>ISU</td>
<td>M. Wright</td>
<td>How variability in feedstock supplies and prices affect the shut-down decisions of biorefineries</td>
<td>Energy Policy</td>
</tr>
<tr>
<td>UI</td>
<td>P. Damiano</td>
<td>Energy policy symposia hosting through the Iowa Public Policy Center</td>
<td>Energy Policy</td>
</tr>
<tr>
<td>UNI</td>
<td>A. Rosburg</td>
<td>Energy policy travel and research grant</td>
<td>Energy Policy</td>
</tr>
<tr>
<td>UNI</td>
<td>P. Berendzen, T. Abebe</td>
<td>Evolutionary Significance of whole-genome duplication in the Catostomidea, a group of tetraploid fishes.</td>
<td>Broader Impacts</td>
</tr>
<tr>
<td>UNI</td>
<td>N. Goonesekere, K. Dhanwada</td>
<td>Pancreatic cancer genes research.</td>
<td>Broader Impacts</td>
</tr>
<tr>
<td>UNI</td>
<td>L. Jackson</td>
<td>Developing a multi-state research partnership for economic use of prairies on farms.</td>
<td>Broader Impacts</td>
</tr>
<tr>
<td>UNI</td>
<td>J. Yates, C. Yates</td>
<td>Determine energy change behavior persistence after competitions end.</td>
<td>Broader Impacts</td>
</tr>
</tbody>
</table>
Table 1.2a.5: Update on Year 2 UNI seed grant activities.

<table>
<thead>
<tr>
<th>Faculty Seed Grant Recipient</th>
<th>Activities and Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>R. He</td>
<td>Submitted NSF Career grant proposal July 2013, not awarded, Submitted NSF MRI proposal, awarded. Gave research presentations at 5 universities in China to increase visibility of UNI Physics department. Established several new collaborations with faculty at Renmin University of China, the Institute of Physics of the Chinese Academy of Sciences and Peking University.</td>
</tr>
<tr>
<td>P. Berendzen</td>
<td>Data generated from seed grant was used as preliminary data for a NSF preproposal submitted 1/ 2014, status pending. Mentored/hired female graduate student. Established new collaboration with UNI and U of M faculty.</td>
</tr>
<tr>
<td>A. Petrov</td>
<td>Traveled to Taimyr, Russia to participate in the pilot study on satellite collaring of wild reindeer - in preparation for planned NSF submission. Established collaborations with the scientists from the Extreme North Agriculture Research Institute, Joint Directorate of Taimyr Nature Reserves, and the Institute of Information and Automatization of the Russian Academy of Sciences. Met with CoPIs to work on newly awarded NSF RCN grant.</td>
</tr>
<tr>
<td>L. Zeitz/P. Gao</td>
<td>Both presented research AERA ’13 in San Francisco, California. Gao gave research presentation in Central China Normal University (CCNU).</td>
</tr>
<tr>
<td>J. DeGroote</td>
<td>Strengthened existing collaborations with Iowa State University Medical Entomology Laboratory, Iowa DNR and Iowa DPH. Developed database on Lyme disease incidence, deer populations, landscape characteristics, climatic, and historical tick presence/abundance compiled from Iowa Department of Public Health (DPH), Iowa Department of Natural Resources (DNR), Oregon State University PRISM Climate Group, and Iowa State University Medical Entomology Laboratory. Mentored 2 undergraduate (one female) students and 1 graduate student.</td>
</tr>
<tr>
<td>J. Kang</td>
<td>Travelled to Botanical Society of America conference as an invited speaker in the Vitaceae symposium. Worked with former colleague to develop protocols for data generation and performed experiments to generate data for future potential submission.</td>
</tr>
<tr>
<td>B. Zan/M. Donegan-Ritter</td>
<td>Submitted NSF proposal, 12/2013, status pending. Five preschool teachers from Waterloo Community Schools (WCS), five teachers from Rockwell Collins Child Development Center, six teachers from Five Seasons Learning Center in Cedar Rapids, and the WCS STEM Coordinator participated in a 3-day CAMP STEM Summer Workshop.</td>
</tr>
</tbody>
</table>

Broader Impacts (BI) Platform: Diversity Plank

During this reporting period, the major diversity effort has been to include more diverse participants in undergraduate research and K-12 engagement as well as initiate cultural change in faculty search practices to positively impact diversity of future faculty search pools. New to the EPSCoR Diversity team this year is Tracy Peterson, UI Director of Diversity Programs and K-12 Outreach. Numerous Diversity events and programs were facilitated in Year 3; they are summarized in Table 1.2a.6. These efforts were achieved through collaboration with key programs that serve women and URM communities and through securing funding for broadening participation. Key activities included:

- Established a research stakeholder group in the various research platforms who will act as an advocate and liaison between BI leaders and faculty.
- Provided broader impacts matching support for women and URM interns as well as staff support to facilitate engagement with outreach programs.
• Conducted programs to improve retention and success of URM students in undergraduate programs (e.g. RISE program at ISU and mentoring workshops).
• Provided a range of K-12 activities focused on engaging girls and URM students in STEM topics through directly funded programs (e.g., camps such as WindSTEP, Girls Scout day and others), and through expanded collaboration with other programs such as Upward Bound, LSAMP, and others.
• Initiated faculty search training at UI and UNI by ISU Advance leaders and Equity Advisors for a “train the trainers” session with participation from UI and UNI faculty, staff, and administrators.
• Continued “Leadership in Equity and Inclusion” training and certification using the National Coalition Building Institute (NCBI) at UNI and UI).
• Presented several diversity seminars and presentations (see Table 1.2a.7 for details).
• EPSCoR Diversity leaders participated in regional and national events (Broader Impacts Infrastructure Summit, National Academy of Engineering/American Society of Engineering Education workshop).
• Recognized and rewarded faculty who have made outstanding contributions to diversity mentoring through the second round of EPSCoR diversity awards.
### Table 1.2a.6: BI-facilitated diversity events and programs.

<table>
<thead>
<tr>
<th>Event</th>
<th>Date(s)</th>
<th>Location</th>
<th>Facilitators</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reigniting the Sophomore Experience (RISE) Lunch Series</td>
<td>9/1/2013-4/30/2014</td>
<td>ISU, Ames, IA</td>
<td>A. Lozano, ISU</td>
<td>Bi-monthly lunch workshops designed to promote success of second year URM students, by focusing on topics including academic achievement, career preparation, leadership development and achieving academic/work/life balance. 20 students attended.</td>
</tr>
<tr>
<td>Upward Bound Tutoring</td>
<td>9/1/2013-6/1/2014</td>
<td>UI, Iowa City, IA</td>
<td>M. Anson &amp; T. Peterson, UI</td>
<td>Tutoring at the high schools in Hispanic serving community.</td>
</tr>
<tr>
<td>Search Committee Diversity Training</td>
<td>9/30/2014</td>
<td>UI, Iowa City, IA</td>
<td>B. Bowen &amp; L. Larson, ISU</td>
<td>Best practices for diversity faculty recruiting, held for search committee members, 11 participants.</td>
</tr>
<tr>
<td>MESA Tutoring</td>
<td>10/8/2013-5/6/2014</td>
<td>UI, Iowa City, IA</td>
<td>T. Peeples, T. Peterson &amp; R. Wilburn, UI</td>
<td>Tuesday Night Tutoring (5th-12th graders) in Iowa City Community.</td>
</tr>
<tr>
<td>Program for Women in Science and Engineering (PWSE) “Road Less Traveled”</td>
<td>10/17/2013, 10/24/2013</td>
<td>ISU, Ames, IA</td>
<td>PWSE &amp; L. Jarboe, ISU</td>
<td>L. Jarboe provided hands-on biofuels activity for middle school and high school attendees.</td>
</tr>
<tr>
<td>Workplace Learning Connection</td>
<td>10/17/2013, 10/24/2013</td>
<td>UI, Iowa City, IA</td>
<td>N. Young &amp; A. Ratner, UI</td>
<td>STEM presentations to 160 seventh graders for STEM Institute program.</td>
</tr>
<tr>
<td>Noche de Ciencias</td>
<td>10/22/2013</td>
<td>UI, Iowa City, IA</td>
<td>T. Peeples, UI; Society of Hispanic Professional Engineers</td>
<td>Evening of STEM activities for K12 Hispanic Children and Parents.</td>
</tr>
<tr>
<td>Search Committee Diversity Training</td>
<td>10/30/2014</td>
<td>UNI, Cedar Rapids, IA</td>
<td>B. Bowen &amp; L. Larson, ISU</td>
<td>Best practices for diversity faculty recruiting presentation to the College of Humanities, Arts and Science; 32 participants.</td>
</tr>
<tr>
<td>Quad Cities Minority Science Partnership</td>
<td>10/31/2013</td>
<td>UI, Iowa City, IA</td>
<td>V. Garr &amp; T. Peeples, UI</td>
<td>17 high school students visit UI for Wind competition/pharmacy visit.</td>
</tr>
<tr>
<td>Exhibit at LSAMP IINSPIRE Annual Conference Internship Fair</td>
<td>11/8/2013</td>
<td>Hawkeye Community College, Waterloo, IA</td>
<td>S. Parks, ISU</td>
<td>EPSCoR participated in the opportunities fair to promote its internship program and connect with underrepresented minority undergraduate STEM students from across the LSAMP-IINSPIRE alliance, in particular community college students, and faculty. Several BI team members from UNI, UI, and ISU participated in the annual meeting. 64 faculty and 60 students attended.</td>
</tr>
<tr>
<td>Journey the World: Innovate and Create</td>
<td>3/8/2014</td>
<td>River Center, Davenport, IA</td>
<td>P. Higby, UNI; Girl Scouts of E IA &amp; W IL</td>
<td>Girl scout STEM and cultural event. Higby provided energy education activities, 500 girls attended.</td>
</tr>
<tr>
<td>Expanding your Horizons</td>
<td>3/29/2014</td>
<td>UNI, Cedar Falls, IA</td>
<td>Cedar Valley Society of Women Engineers; K. Dhanwada, UNI</td>
<td>STEM workshop for 5th-8th grade girls, 73 girls from across Cedar Valley attended.</td>
</tr>
<tr>
<td>Generation STEM!</td>
<td>3/29/2014</td>
<td>UI, Iowa City, IA</td>
<td>T. Peterson &amp; C. Alft, UI</td>
<td>72 Girl Scouts from Eastern IA and western IL participated in a day of STEM activities.</td>
</tr>
<tr>
<td>Event Description</td>
<td>Dates</td>
<td>Location</td>
<td>Facilitators</td>
<td>Description</td>
</tr>
<tr>
<td>-----------------------------------------------------------------------------------</td>
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<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>First Tech Challenge (FTC) Super Regional - Diversity Breakfast</td>
<td>4/4/2014</td>
<td>UI, Iowa City, IA</td>
<td>T. Peterson &amp; R. Whitaker, UI</td>
<td>STEM Breakfast for FTC teams and coaches from URM groups.</td>
</tr>
<tr>
<td>Upward Bound Saturday Academy</td>
<td>4/5/2014</td>
<td>UI, Iowa City, IA</td>
<td>M. Anson &amp; T. Peeples, UI</td>
<td>STEM career day for UB high school students. 3 teachers and 20 students participated.</td>
</tr>
<tr>
<td>Black Girls Do Science</td>
<td>4/12/2014</td>
<td>UI, Iowa City, IA</td>
<td>T. Peterson &amp; B. Berry, UI</td>
<td>STEM activities for 4th-8th grade children, 73 girls and 2 boys participated.</td>
</tr>
<tr>
<td>Program for Women in Science and Engineering (PWSE) “Road Less Traveled”</td>
<td>4/10/2014, 4/17/2014, 4/24/2014</td>
<td>ISU, Ames, IA</td>
<td>PWSE: J. Euker, ISU</td>
<td>C6 Energy educational activities were provided to middle and high school girls, 61 students and 5 teachers participated.</td>
</tr>
<tr>
<td>Investigate Your Future</td>
<td>5/16/2014</td>
<td>West Burlington, IA</td>
<td>P. Higby, UNI; P. Bensmiller</td>
<td>Energy education activities for 8th grade girls, 30 participants.</td>
</tr>
<tr>
<td>Research Experience for CC and College Undergraduate Students</td>
<td>5/2014–8/2014</td>
<td>ISU, UNI, UI campuses, IA</td>
<td>S. Sundararajan, ISU</td>
<td>23 students, (including 13 female, 7 URM and 3 CC students) are participating in research experiences this summer at the three regent institutions.</td>
</tr>
<tr>
<td>Girl Scout Camps</td>
<td>6/2014–8/2014</td>
<td>Camps Little Cloud, Dubuque &amp; Tahigwa, Dorchester, IA</td>
<td>P. Higby, UNI; Girl Scouts of E IA &amp; W IL</td>
<td>Provide energy education activities to about 400 girl scout campers.</td>
</tr>
<tr>
<td>UNI-CUE (Center for Urban Education) Enrichment Camp</td>
<td>6/19/2014 – 7/11/2014</td>
<td>Waterloo, IA</td>
<td>P. Higby &amp; UNI-CUE</td>
<td>Energy education activities provided to a minority targeted summer camps, one for 4-5th grade students and one for 6th grade students. 64 students expected to participate, about 50% URM.</td>
</tr>
<tr>
<td>Upward Bound Summer Program</td>
<td>6/20/2014 – 7/31/2014</td>
<td>UI, Iowa City, IA</td>
<td>M. Anson &amp; T. Peeples, UI</td>
<td>STEM instruction for UB Summer Program high school students. 113 students expected to participate.</td>
</tr>
<tr>
<td>UNI Education Department Meskwaki Nation Summer Camp</td>
<td>6/22/2014 – 6/28/2014</td>
<td>UNI, Cedar Falls, IA</td>
<td>D. Watson &amp; M. Ward, UNI</td>
<td>Camp for 5-7th grade Meskwaki Nation students, with STEM, literacy and leadership curriculum, 25 students expected to participate.</td>
</tr>
<tr>
<td>Day Camp with Minority Students</td>
<td>7/2014</td>
<td>Waterloo, IA</td>
<td>J. Euker &amp; J. Staker, ISU</td>
<td>C6 Energy educational activities will be used at full day session with minority students, estimate 15 attendees.</td>
</tr>
<tr>
<td>Girl Scout Day Camps at UNI</td>
<td>7/7/2014 – 7/28/2014</td>
<td>UNI, Cedar Falls, IA</td>
<td>P. Higby, UNI; Girl Scouts of IA &amp; W IL</td>
<td>Energy education activities provided to an estimated 50 girl scouts.</td>
</tr>
<tr>
<td>EPSCoR WindSTEP Program</td>
<td>7/14/2014 – 7/18/2014</td>
<td>UI, Iowa City, IA</td>
<td>T. Peterson, D. Bennett &amp; K. Alvarez, UI</td>
<td>Wind Mapping summer course for Meskwaki Nation 8th graders, 20 students expected to participate.</td>
</tr>
<tr>
<td>YWCA Activities at UNI</td>
<td>7/18/2014 – 8/1/2014</td>
<td>UNI, Cedar Falls, IA</td>
<td>P. Higby, UNI; Black Hawk Co. YWCA</td>
<td>Energy education activities provided to girls attending YWCA Summer program for girls, 50 participants expected.</td>
</tr>
</tbody>
</table>
Table 1.2a.7: Year 3 Diversity presentations.

<table>
<thead>
<tr>
<th>Presentation</th>
<th>Date(s)</th>
<th>Location</th>
<th>Facilitator(s)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Presentation by ISU Advance Leaders on Diversity in Faculty Hiring</td>
<td>9/30/2013</td>
<td>UI, Iowa City, IA</td>
<td>T. Peeples, UI; B. Bowen &amp; L. Larson, ISU</td>
<td>Diversity in hiring practices workshop for ISU, UNI, and UI administrators, faculty and staff.</td>
</tr>
<tr>
<td>Faculty Search Committee Training</td>
<td>10/15/2013</td>
<td>UI, Iowa City, IA</td>
<td>T. Peeples, UI</td>
<td>Diversity training for UI Chemical and Biochemical Engineering Search Committee.</td>
</tr>
<tr>
<td>Faculty Search Committee training</td>
<td>10/28/2013</td>
<td>UI, Iowa City, IA</td>
<td>T. Peeples, UI</td>
<td>Diversity training for UI Civil &amp; Environmental Engineering Search Committee.</td>
</tr>
<tr>
<td>Presentation by ISU Advance Leaders on Diversity in Faculty Hiring</td>
<td>10/30/2013</td>
<td>UNI, Cedar Falls, IA</td>
<td>D. Mupasiri, UNI; B. Bowen and L. Larson, ISU</td>
<td>32 attendees were present – primarily from the College of Humanities, Arts and Sciences.</td>
</tr>
<tr>
<td>Faculty Search Committee Training</td>
<td>11/12/2013</td>
<td>UI, Iowa City, IA</td>
<td>T. Peeples, UI</td>
<td>Diversity training for Mechanical and Industrial Engineering Search Committee.</td>
</tr>
<tr>
<td>Martin Luther King Seminar</td>
<td>1/24/2014</td>
<td>UI, Iowa City, IA</td>
<td>T. Peeples, UI</td>
<td>Public lecture: Coalitions of Conscience: Dreaming down barriers to STEM education, Math, Liberal Arts.</td>
</tr>
<tr>
<td>Sloan Faculty Mentor Workshop Preparation</td>
<td>1/28/2014</td>
<td>UI, Iowa City, IA</td>
<td>T. Peeples, UI</td>
<td>Resulted in $1.2M Sloan Foundation grant.</td>
</tr>
<tr>
<td>Women's Leadership in Academia</td>
<td>3/24/2014</td>
<td>Washington State University, Pullman WA</td>
<td>N. Magnuson</td>
<td>Public presentation by T. Peeples on Success Strategies for Women Leaders in Academia.</td>
</tr>
<tr>
<td>Broader Impacts Infrastructure Summit: Sustainability, Return on Investment, and Community Impact</td>
<td>4/16/2014-4/18/2014</td>
<td>Arlington, VA</td>
<td>S. Rencoe, Chair, MO EPSCoR and D. Rover, ISU</td>
<td>D. Rover was co PI on EPSCoR workshop grant that co-sponsored Broader Impacts summit held to facilitate a dialogue between NSF and the national Broader Impacts Community. Over 120 professionals, including 29 from EPSCoR jurisdictions.</td>
</tr>
<tr>
<td>Sloan Faculty Mentor Workshop</td>
<td>7/31/2014-8/2/2014</td>
<td>UI, Iowa City, IA</td>
<td>C. Mitchell &amp; T. Peeples, UI</td>
<td>Faculty conference to bring together exemplary minority students mentors to share best practices.</td>
</tr>
</tbody>
</table>

Broader Impacts (BI) Platform: Workforce Development Plank

Workforce development events and programs for this reporting period are summarized in Table 1.2a.8. Key activities in Year 3 include:

- Continued and expanded efforts to provide elementary and middle school teachers with immersive hands-on experiences in STEM areas, specifically in RE/EU topics.
- Engaged community college instructors in efforts to improve STEM awareness in students as well as faculty at 4 year colleges in efforts to increase infrastructure to enable STEM activities.
- Significant increase in the scope of Project Lead the Way (PLTW) activities to provide training to K-12 and community college instructors on STEM and diversity related topics to strengthen STEM pipelines.
- Faculty at ISU received Iowa Board of Regent approval to offer a coursework-only Masters of Engineering degree in Energy Systems. This degree requires 30-credit hours of coursework in a variety of energy-related areas, and is targeted at the working professional because it can be completed through on-line learning offerings.
- Provide STEM-related summer camps to middle and high school students. A complete list of these camps is provided in Table 1.2a.9.
Table 1.2a.8: BI-facilitated workforce development events and programs.

<table>
<thead>
<tr>
<th>Event</th>
<th>Date(s)</th>
<th>Location</th>
<th>Facilitators</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLTW New school implementation advising visits</td>
<td>9/2013-5/2014</td>
<td>Waukon, Cresco, N. Fayette, Oelwein, Manchester, Muscatine, South Winn, IA</td>
<td>L. Digman, UI</td>
<td>11 trips; much advising over phone/email to many teachers and administrators and counselors.</td>
</tr>
<tr>
<td>Community College Visits</td>
<td>9/2013-5/2014</td>
<td>Calmar, Waukon, Peosta, Cedar Rapids, Hiawatha, Manchester, Oelwein, IA</td>
<td>L. Digman, UI</td>
<td>28 visits made throughout the year; worked with 34 CC faculty/staff.</td>
</tr>
<tr>
<td>Wind Day at the Clay County Fair</td>
<td>9/8/2013</td>
<td>Clay Co. Fairgrounds, Clay County, IA</td>
<td>P. Higby, UNI</td>
<td>125 participants in wind education activities.</td>
</tr>
<tr>
<td>Community College Biology Teacher Outreach</td>
<td>9/28/2014</td>
<td>Iowa Falls, IA</td>
<td>L. Jarboe, ISU</td>
<td>Presentation on Metabolic Engineering of Microbes for the Production of Biorenewable Fuels and Chemicals, 12 teachers attended.</td>
</tr>
<tr>
<td>PLTW STEM Conference for Iowa Teachers</td>
<td>9/30/2013</td>
<td>Altoona, IA</td>
<td>L. Digman, K. Munson &amp; A. Fitzwater, UI</td>
<td>349 teachers attended. PLTW teachers were provided the opportunity to attend breakout sessions at the PLTW STEM Connection Conference regarding diversity in Iowa.</td>
</tr>
<tr>
<td>PLTW STEM Conference for Counselors and Administrators</td>
<td>10/7/2013</td>
<td>Ames, IA</td>
<td>C. Schroeder, ISU</td>
<td></td>
</tr>
<tr>
<td>Cutting Edge Biorenewables for All Workshop, IA Science Teachers Section Fall Conference</td>
<td>10/23/2013</td>
<td>Scheman Bldg, Ames, IA</td>
<td>M. VanDeWall, C. Rinehardt, D. Colsch &amp; C. Reichert (SALI graduates)</td>
<td>Participants include 10 MS teachers.</td>
</tr>
<tr>
<td>ICTM IAS-ISTS Joint Conference</td>
<td>10/22/2013-10/24/2013</td>
<td>Scheman Building, Ames, IA</td>
<td>S. Parks, P. Higby, A. Leshem, J. Staker &amp; S. He, ISU</td>
<td>Iowa Council of Teachers of Mathematics, Iowa Science Teaching Section of the Iowa Academy of Science. EPSCoR was exhibitor at conference, showcasing C6 educational materials and Living with the Sun Video curriculum for High School Physics.</td>
</tr>
<tr>
<td>Twain Elementary Outreach</td>
<td>12/13/2013</td>
<td>UI, Iowa City, IA</td>
<td>T. Peterson, UI</td>
<td>Second grade classes introduced to STEM.</td>
</tr>
<tr>
<td>Event Description</td>
<td>Date</td>
<td>Location</td>
<td>Presenters</td>
<td>Description</td>
</tr>
<tr>
<td>----------------------------------------------------------------------------------</td>
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</tr>
<tr>
<td>Cub Scout Den Presentation (3rd Grade Students)</td>
<td>12/16/2013</td>
<td>Horn Elementary School, Iowa City, IA</td>
<td>J. Buchholz, UI</td>
<td>Cub Scouts Pack 206: Discussion of energy, construction and testing of wind turbines, 6 students.</td>
</tr>
<tr>
<td>Introducing Biorenewables in the Classroom Workshop, Hayes Middle School, New Mexico</td>
<td>2/18/2014</td>
<td>Albuquerque, NM</td>
<td>J. Wickert (SALI graduate)</td>
<td>Participants include 12 MS teachers.</td>
</tr>
<tr>
<td>STEM Day at the Capitol</td>
<td>2/13/2014</td>
<td>Des Moines, IA</td>
<td>L. Digman &amp; T. Peeples, UI; A. Leshem, ISU</td>
<td>Presented EPSCoR STEM opportunities.</td>
</tr>
<tr>
<td>Biomass Crop Production Workshop</td>
<td>3/7/2014</td>
<td>Iowa City, IA</td>
<td>E. Heaton, ISU</td>
<td>Biomass Crop Production Workshop, for Iowa farmers, energy producers, land managers and other interested parties, 27 participants.</td>
</tr>
<tr>
<td>Iowa City West HS Visit Day</td>
<td>3/7/2014</td>
<td>UI, Iowa City, IA</td>
<td>T. Peterson, UI; D. Audia</td>
<td>STEM Visit Day for PLTW students, 70 students participated.</td>
</tr>
<tr>
<td>Office of Precollegiate Programs for Talented and Gifted (OPPTAG)</td>
<td>3/13/2014</td>
<td>ISU, Ames, IA</td>
<td>OPPTAG; L. Jarboe, ISU</td>
<td>L. Jarboe provided hands-on biofuels activity for middle school students.</td>
</tr>
<tr>
<td>Community College Career Fair</td>
<td>3/26/2014</td>
<td>Upper Iowa University with NE Iowa Community College, Fayette, IA</td>
<td>L. Digman</td>
<td>L. Digman participated in a career fair for an estimated 600 students in eight to tenth grade.</td>
</tr>
<tr>
<td>Dubuque Area Family STEM festival</td>
<td>4/12/2014</td>
<td>Dubuque, IA</td>
<td>L. Digman, K. Munson</td>
<td>Participated in High School STEM event in Dubuque, 1200 HS students attended the STEM event.</td>
</tr>
<tr>
<td>Science of Energy Library Program</td>
<td>6/2014-8/2014</td>
<td>Various cities in IA</td>
<td>P. Higby</td>
<td>Energy education activities provided to elementary, middle and high school students in libraries across IA. Expect 240 participants.</td>
</tr>
<tr>
<td>Lego Robotics Training</td>
<td>6/2/14-6/6/14</td>
<td>UI, Iowa City, IA</td>
<td>T. Peterson/J. Richardson</td>
<td>Training on new EV3 robotics Platform. 12 teachers and 60 students expected to attend.</td>
</tr>
<tr>
<td>Ames Summer Enrichment Program</td>
<td>6/11/2014-7/23/2014</td>
<td>Ames, IA</td>
<td>S. He &amp; Z. Shao, ISU, D. Schmitt, Ames School Systems</td>
<td>He and Shao will provide biorenewable energy related education lessons and activities to elementary to middle school students, 90 students are expected to participate.</td>
</tr>
</tbody>
</table>
Appendix A – Accomplishments
Iowa NSF EPSCoR

<table>
<thead>
<tr>
<th>Iowa 4-H Youth Conference</th>
<th>6/24/2014-6/26, 2014</th>
<th>Ames, IA</th>
<th>ISU Extension, Jill Euken</th>
<th>C6 Energy educational activities will be used at a half-day session with 4H campers, estimate 20 attendees.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biorenewables Summer Academy Leadership Institute (SALI) for MS teachers</td>
<td>6/24/2014-6/28/2014</td>
<td>ISU, Ames, IA</td>
<td>E. Hall; Hoover High School</td>
<td>Participants include 4 Middle School teachers.</td>
</tr>
<tr>
<td>Summer Academy for Middle School Teachers</td>
<td>7/7/2014-7/28/2014</td>
<td>ISU, Ames, IA</td>
<td>E. Hall; Hoover High School</td>
<td>Participants include 12 Middle School teachers.</td>
</tr>
<tr>
<td>Biorenewables Workshop</td>
<td>7/7/2014-7/11/2014</td>
<td>Ankeny, IA and ISU, Ames, IA</td>
<td>L. Bleeker; Parkview Middle School</td>
<td>Participants include 20 Elementary teachers.</td>
</tr>
</tbody>
</table>

Table 1.2a.9: UNI-sponsored STEM summer camps for middle and high school students.

<table>
<thead>
<tr>
<th>Camp Theme</th>
<th>Date</th>
<th>Location</th>
<th>Instructor(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Camp Multimedia</td>
<td>6/23/2014-6/27/2014</td>
<td>UNI Campus</td>
<td>D. Shaw, E. Wallingford (UNI faculty); J. Mitchell (UNI staff)</td>
</tr>
<tr>
<td>Cookies, Games and Websites</td>
<td>6/17/2014-6/20/2014</td>
<td>UNI Campus, for 11-18 yrs (6th-12th grade)</td>
<td>P. Gray (UNI faculty)</td>
</tr>
<tr>
<td>Creative Quest: Art Games for the Brain</td>
<td>7/21/2014-7/25/2014</td>
<td>UNI Campus, for 13-18 yrs (8th-12th grade)</td>
<td>A. Pippert (UNI staff)</td>
</tr>
<tr>
<td>Digital Storytelling: Using Technology to Create Narrative Art</td>
<td>7/7/2014-7/11/2014</td>
<td>UNI Campus, for 14-18 yrs (9th-12th grade)</td>
<td>A. McCormick (UNI staff)</td>
</tr>
<tr>
<td>Exploring the Tall Grass Prairie through Art and Science</td>
<td>6/16/2014-6/20/2014</td>
<td>UNI Campus, for 8-12 yrs (2nd-6th grade)</td>
<td>W. Miller (UNI faculty)</td>
</tr>
<tr>
<td>Introduction to Robotics</td>
<td>7/14/2014-7/18/2014</td>
<td>UNI Campus, for 10-14 yrs (5th-8th grade)</td>
<td>M. Fienup &amp; B. Schafner (UNI faculty)</td>
</tr>
<tr>
<td>Introduction to Robotics for Girls</td>
<td>7/7/2014-7/11/2014</td>
<td>UNI Campus, for 10-14 yrs (5th-8th grade)</td>
<td>M. Fienup &amp; Ben Schafer (UNI faculty)</td>
</tr>
<tr>
<td>MiniSumo Robotics Camp</td>
<td>6/23/2014-6/27/2014</td>
<td>UNI Campus, for 14-17 yrs (8th-12th grade)</td>
<td>D. Olson (UNI faculty)</td>
</tr>
<tr>
<td>Scientific Thought in Motion</td>
<td>6/17/2014-6/18/2014</td>
<td>UNI Campus, for 9-12 yrs (4th-6th grade)</td>
<td>A. Hunzelman (UNI staff)</td>
</tr>
<tr>
<td>Why Not? Vertex-Edge Graph Theory and Improvisational Comedy</td>
<td>6/16/2014-6/20/2014</td>
<td>UNI Campus, for 16-18 yrs (10-12th grade)</td>
<td>M. Balong (UNI staff)</td>
</tr>
</tbody>
</table>

Broader Impacts (Bl) Platform: Cyberinfrastructure (CI) Plank

Key CI activities in Year 3 include:

- Developed web portals to provide the EPSCoR community and partnering institutions, including industry, with remote access to state-of-the-art facilities and distributed infrastructure for research and education. Examples include the EPSCoR CI portal [http://isuepscorci.engineering.iastate.edu/EPSCoR_Prototype/] and portals to collect and analyze wind turbine (SCADA) data at Kirkwood community college [http://epscor2.cgrer.uiowa.edu/html/kirkwood.html]. The Iowa EPSCoR CI portal can now
assist the research platforms gather and analyze data and develop large scale computational models.

- Collaborated with faculty on the Wind and Energy Utilization platforms to develop CI capabilities that enhance their research activities. Examples include construction of data-driven wind models to enable increased utilization of meteorological data for wind energy applications (with Dr. Baskar Ganapathysubramanian and WE Plank leader Takle) and assisting EU plank leader Dr, Ulrike Passe’s team to collect, store, and analyze data for energy utilization calculations in the Interlock House.
- Provided training and outreach activities through course development and deployment (UI – Information systems for environmental resources), educational workshops for students, and a webinar series on a range of research as well as teaching and pedagogy for high schools.

**Broader Impacts (BI) Platform: External Engagement and Communications (EE) Plank**

External engagement contacts and events for Year 3 are listed in Table 1.2a.10. Key activities include:
- Maintained the EPSCoR website and used it to gather and disseminate information about the project.
- Prepared and distributed an Iowa NSF EPSCoR tri-annual newsletter.
- Engaged student journalists to write stories and describe broader impacts and discoveries of Iowa NSF EPSCoR faculty and students.
- Hosted Iowa NSF EPSCoR workshops and “legislators in the lab” experiences for state and federal elected officials.
- Planning to host the state-wide Iowa NSF EPSCoR annual meeting.
### Table 1.2a.10: Contacts made by the External Engagement and Communications Team.

<table>
<thead>
<tr>
<th>Event</th>
<th>Location</th>
<th>Facilitators</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Host Legislators in the Lab</td>
<td>BRL, ISU, Ames, IA</td>
<td>J. Euken, D. Laird, L. Jarboe</td>
<td>9/5/2013</td>
</tr>
<tr>
<td>Co-host Mississippi River/Gulf of Mexico Watershed Nutrient (Hypoxia) Task Force Conference</td>
<td>Minneapolis, MN</td>
<td>J. Euken; ISU; J. Hill, UM;</td>
<td>9/23/2013-9/24/2013</td>
</tr>
<tr>
<td>Co-host ISU Bioeconomy Showcase Seminar and Progressive Dinner</td>
<td>Iowa State University BEI, ISU BioCentury Research Farm, Iowa Energy Center/BECON</td>
<td>R. Brown, J. Euken, R. Mills, S. Parks; L. Johnson, D. Jarboe, ISU CCUR; M. Petri, Iowa Energy Center</td>
<td>9/30/2013</td>
</tr>
<tr>
<td>C6 at Order of the Knoll, ISU Foundation</td>
<td>Hilton Concourse, ISU</td>
<td>J. Staker, B. Del Campo, E. Debner, S. Parks</td>
<td>10/4/2013</td>
</tr>
<tr>
<td>Host ExxonMobil</td>
<td>Ames, IA</td>
<td>J. Euken, R. Brown</td>
<td>10/15/2013</td>
</tr>
<tr>
<td>Host EcoEngineers</td>
<td>Ames, IA</td>
<td>J. Euken</td>
<td>10/29/2013</td>
</tr>
<tr>
<td>Host Gen 2 Energy Company</td>
<td>Ames, IA</td>
<td>J. Euken</td>
<td>11/7/2013</td>
</tr>
<tr>
<td>Host Biorenewables Bash</td>
<td>BRL, BCRF, ISU, Ames, IA</td>
<td>J. Euken, BEI</td>
<td>11/14/2013</td>
</tr>
<tr>
<td>Host Iowa Rep. Isenhart visit</td>
<td>BRL, ISU, Ames, IA</td>
<td>J. Euken</td>
<td>11/18/2013</td>
</tr>
<tr>
<td>Host University Corporation for Atmospheric Research (UCAR)</td>
<td>BRL, ISU, Ames, IA</td>
<td>J. Euken</td>
<td>11/20/2013-11/22/2013</td>
</tr>
<tr>
<td>Co-sponsor Extreme Weather Symposium</td>
<td>Hy-Vee Hall, Des Moines, IA</td>
<td>P. Damiano, L. Gannon</td>
<td>12/11/2013</td>
</tr>
<tr>
<td>Lunch and Learn event at Capitol</td>
<td>Capitol building, Des Moines, IA</td>
<td>J. Euken, R. Mills</td>
<td>1/22/2014</td>
</tr>
<tr>
<td>Host BRL opportunities for Art</td>
<td>BRL, ISU, Ames, IA</td>
<td>R. Mills</td>
<td>1/24/2014</td>
</tr>
<tr>
<td>Science Communication class tour of EPSCoR communications</td>
<td>BRL, ISU, Ames, IA</td>
<td>J. Euken</td>
<td>1/28/2014</td>
</tr>
<tr>
<td>Biorenewables Experience Tour with Leadership through Engineering Academic Diversity (LEAD)</td>
<td>BRL, ISU, Ames, IA</td>
<td>J. Baughman, L. Ancar</td>
<td>4/4/2014</td>
</tr>
<tr>
<td>Congressional Staffers Biofuel Tour of Iowa</td>
<td>Ames, IA</td>
<td>J. Euken</td>
<td>8/11/2014-8/14/2014</td>
</tr>
</tbody>
</table>

The BI Internal Evaluation team continued working with the management team and Iowa NSF EPSCoR participants throughout the year to provide technical assistance for evaluation activities.
1.2b **Accomplishments: Specific Objectives**

This section provides additional information related to specific objectives that were accomplished this past year related to the milestones in the strategic plan.

**BioEnergy (BE) Platform: BioEnergy Agriculture Plank**

A technician for support of the Big Creek BAER site has been hired with 50% EPSCoR funds and 50% ISU Agronomy Department funds. The technician has been trained and is providing day-to-day logistics support for management and sample collection at the Big Creek BAER site. EPSCoR funds to support a technician at the Clear Creak BAER site were used to partially support three technicians working in the Clear Creak BAER site during Year 1 and for support of graduate students in Years 2 and 3. A hyper-spectral camera has been purchased and is being used to develop remote sensing platforms for analysis of land use and agro-ecological impacts. Instrumentation for monitoring stream flow have been purchased and installed in the BAER sites. Automated equipment for measuring greenhouse gas (GHG) emissions from soils was designed and built and is being used to quantify GHG emission. Soil moisture and water quality monitoring equipment was purchased in 2013. Data from both Big Creek and Clear Creek stream gauges, rain gauges, etc. are available on the Iowa Flood Center web site: [http://ifis.iowafloodcenter.org/ifis/en/](http://ifis.iowafloodcenter.org/ifis/en/).

Using BAER site data, Sherrard tested whether selection on plant physiology differs in three species with contrasting flowering times and drought tolerance: (i) *Tradescantia bracteata* (early, low), (ii) *Heliopsis helianthoides* (intermediate, intermediate), and (iii) *Panicum virgatum* (late, high). Biomass, seed number, chlorophyll content, leaf florescence, photosynthetic rate, and specific leaf area on 125 individuals per species were measured. Preliminary results suggest that selection for increased capacity for photosynthesis is strongest in the earliest flowering species (*T. bracteata*) and weakest in the latest flowering species (*P. virgatum*). This may suggest that high metabolism and rapid development have more adaptive value in early flowering tall grass prairie species.

Myers used the UNI Cedar River Natural Resource Area Biomass Research Site to assess the effects of vegetation diversity (1, 5, 16, or 32 species) and soil type (sandy loam, loam, and clay loam) on bird and butterfly abundance, diversity, and community composition in experimental plots managed as agroenergy crops. Preliminary results demonstrated that plant communities established with identical management practices developed variable habitat characteristics due to underlying edaphic (e.g., soil related) variations, and that bird and butterfly communities were structured in response to this heterogeneity. Further, he showed that birds readily used and nested in habitats provided by recently established perennial agroenergy crops, and bird abundance and richness were positively correlated with crop plant diversity.


Dr. Song-Charng Kong has developed an open-source computer code for simulating biomass thermochemical conversion. This code has been released to the research community and is being continuously improved by researchers at ISU for its accuracy. Dr. Albert Ratner is exploring biomass thermochemical conversion at UI’s pilot plant and he determined that there
is insight into gasification products resulting from a chunk-based char-producing gasifier, which is different from powdered char production.

Dr. J.P. Tessionner used Iowa NSF EPSCoR funds to purchase equipment for zeolite synthesis and characterization. His starting hypothesis for this research was that diffusion and mass transfer limitations represent a major bottleneck to further improve the catalyst’s performance. To address this issue, he developed synthetic strategies to create molecular highways in the microporous catalyst. However, only very minor changes in selectivity and yield were observed. The thorough characterization of the samples indicated that the mesopores are ink-bottle shaped. Consequently, the mesopores improve the intra-crystalline diffusion but the narrow pore mouth limits the reactants’ access to the active sites. Further investigations are on-going to decrease the zeolite crystal size, thus decreasing the diffusion path of reactants and products. The obtained results also revealed a higher contribution from sites on the external surface to undesired reactions. His preliminary results were instrumental in obtain funding for additional work from the Iowa Energy Center.

Dr. Terry Meyer constructed a combustion rig for torrefied or slurried biomass. Initial testing was conducted and showed difficulties in entraining the torrefied biomass; improvements are underway. Meyer also oversaw the development of a laser laboratory to complete fundamental studies of biofuel combustion. Instrumentation that was purchased and installed in this laboratory include: (i) an optically accessible biomass conversion test cell (Figure 1.2b.1); (ii) a transient in situ Fourier Transform Infrared (FTIR) spectrometer (Figure 1.2b.2); (iii) a Gas Chromatograph Flame Ionization Detector (GC-FID) (Figure 1.2b.3); (iv) a Coherent Anti-Stokes Raman Scattering (CARS) device (Figure 1.2b.4); and (v) a droplet-on-demand generator for bio-derived fuels (Figure 1.2b.5).

Figure 1.2b.1: Sample cell design for in situ analysis of near-field pyrolysis product evolution using FTIR and nonlinear optical techniques. The test cell has been modified to allow for experiments using Coherent Anti-Stokes Raman Scattering (CARS). Additional improvement for a Generation 2 test cell is ongoing to improve heating rates and mimic conditions of pyrolysis pilot plants.
Figure 1.2b.2: Schematic and photograph of set-up for transient in situ FTIR during pyrolysis reactions. The infrared beam was extracted from the instrument, focused through the cell for ~2 mm resolution using parabolic mirrors, and detected with a new mercury cadmium telluride (MCT) detector exhibiting high sensitivity.

Figure 1.2b.3: A Gas Chromatograph Flame Ionization Detector (GC-FID) has been installed to characterize the equilibrium products of biomass conversion processes. Preliminary tests show promising results but require improvements in transfer lines to avoid condensation of relevant products prior to analysis.
Appendix A – Accomplishments
Iowa NSF EPSCoR

Figure 1.2b.4: Coherent Anti-Stokes Raman Scattering (CARS) configuration used for probing phenolic compounds within optically accessible biomass conversion cell.

Figure 1.2b.5: Schematic and set-up for droplet-on-demand for characterizing multiphase physics of bio-derived fuels and model compounds for biomass decomposition.

Jeffries-El has determined that furan-2-carbonitrile, which is a precursor to a number of high efficiency conjugated polymers, can be synthesized in a single step from furfural. For the purposes of this study, she started with furfural from a commercial source. Currently her team is getting isolated yields of around 50%. She has selected the 3,6-di(furan-2-yl)pyrrolo[3,4-c]pyrrole-1,4(2H,5H)-dione (DFDPP) moieties for her study because they are: (i) easily synthesized from bio-renewable starting materials; (ii) inherently electron-deficient, enabling their use as electron-acceptors in donor/acceptor (D/A) copolymers; and (iii) readily customizable enabling a number of structural modifications. The synthesis of the diethylhexyl derivative of DFDPP is shown in Figure 1.2b.6. The condensation reaction of 2-furonitrile and diethyl succinate yielded the bislactam 8, which was then alkylated using potassium carbonate to obtain the DPP derivative 9. Ethylhexyl chains were used to increase the solubility of the target polymers. The bromination of compound 9 afforded the desired monomer 10. This method is a slight modification from the literature procedures, and the overall yield for this approach is higher. Her team then copolymerized monomer 10 with 2,2'-bistrimethylstannyl-4,4'-bis-(2-ethylhexyl)-dithieno[3,2-b:2',3'-d]silole 11 to obtain polymer P1. This polymer is dark green-black with a weight-averaged molecular weight of 41,000 and a polydispersity index of 2.8.
The substitution of furan in place of thiophene in the popular diketopyrrolopyrrole (DPP) moiety has shown to greatly improve the solubility and optical properties of the polymers. P1 has an absorbance maximum of 700 nm in solution and 721 nm in film (Figure 1.2b.7), and an onset at 872 nm, corresponding to an optical band gap of 1.4 eV. Cyclic voltammetry indicates an electrochemical band gap of 1.7 eV, with a highest occupied molecular orbital (HOMO) level at -5.19 eV and a lowest occupied molecular orbital (LUMO) level of -3.49 eV. The performance of this material in bulk heterojunction photovoltaic cells (BHJ-PVCs) will be evaluated as discussed in section 4.1. These results demonstrate the promise of this building block, however the design of new materials with similar band gaps and lower HOMO and LUMO levels would be even more favorable. One way to accomplish this goal would be to use a different electron-donating monomer.
Figure 1.2b.7: Solution and film absorption profile of a furan containing DPP polymer.

Supplemental funding from a successful proposal to the Iowa Alliance for Wind Innovation and Novel Development (IAWIND) has supported an industry-university partnership involving Iowa State University, Anemometry Specialists, Inc. (ASI, an Iowa company), WindLogics (a private wind industry meteorological firm), and NextEra (owner of the central Iowa 200-turbine wind farm). A brief winter field campaign discussed in the last reporting period enabled simultaneous wind measurements to be made from tower based anemometers and an anemometer on a flight model being tested for deployment on a tethered balloon. Preliminary progress on this project caught the eye of the Wind and Water Technologies Program of DOE that has granted funds for a pilot project in the Gulf of Mexico. A consortium consisting of a private company, Baryonyx, and a university partnership (four Texas universities) has collaborated (under DOE funding) to complete the development and fly the balloon based system from a buoy located about 5 miles offshore near South Padre Island, TX.

During this reporting period, the expertise of the Iowa NSF EPSCoR team was leveraged to develop a marine-based balloon-borne wind resource characterization system. The system is mounted on an ocean buoy anchored to the sea floor and operating continuously and unattended while delivering data to a shore-based receiver (conceptual model in Figure 1.2b.8). The completed buoy system is shown in Figures 1.2b.9, and Figure 1.2b.10 shows the maiden deployment of the system. Careful scrutiny reveals four flight modules with sensors for wind speed, wind direction, pressure, and temperature suspended from the balloon. Figure 1.2b.11a provides a close-up of an individual flight module, and Figure 1.2b.11b shows two flight modules attached to the tether beneath the balloon.
Figure 1.2b.8: Schematic of the marine-based balloon-borne wind resource characterization system mounted on an ocean buoy anchored to the sea floor and operating continuously and unattended while delivering data to a shore-based receiver.

Figure 1.2b.9: Towing the buoy system with solar power array and data acquisition system to the candidate wind power location in the Gulf of Mexico 5 miles offshore of South Padre Island, TX.
Figure 1.2b.10: Maiden flight of the prototype marine-based, balloon-borne wind resource characterization system mounted on an ocean buoy anchored to the sea floor in the Gulf of Mexico five miles offshore of South Padre Island, TX and operating continuously and unattended while delivering data to a shore-based receiver (see insert for first wind speed data received).

Figure 1.2b.11: (a) Flight module with wind speed, wind direction, pressure, humidity and temperature sensors. (b) Balloon and tether with two modules attached.

**Wind Energy (WE) Platform: Blade Performance and Reliability Plank**

An overset grid method was developed and implemented within an existing finite volume solver framework. Local body-attached grids are allowed to move freely within a larger global grid to simulate the motion of the body. In this way, motion of both bodies and rotors during a simulation can be accounted for, such as in the case of wind turbine blades and nacelle yawing about the tower.
A novel finite volume Computational Fluid Dynamics (CFD) solver capable of handling complex terrains has been developed and tested. In order to model complex terrain, the solver has to be capable of handling non-orthogonal curvilinear body fitted coordinates. This introduces additional complications in the solution method. In the present research, a solution process for body fitted non-orthogonal grids has been developed which retains the form and structure similar to orthogonal grids.

The investigation of different time integration schemes has focused on Runge-Kutta (RK) methods. Explicit vs. implicit RK time integration is being evaluated for its relative performance and benefits. Explicit RK methods can be used effectively to remove any matrix inversion from time integration by allowing the solution to be updated at each cell explicitly. However, explicit RK methods have strict time step restrictions and are prone to diverge for large time steps. Implicit RK methods can be used to improve the time step restrictions compared to explicit RK; these methods require matrix inversion for each time step but have greater stability, allowing for larger time steps to be taken.

A fatigue analysis procedure has been developed for large horizontal axis wind turbine blades and include (i) random wind field simulations, (ii) aerodynamic analysis, (iii) stress analysis by finite element analysis, and (iv) fatigue damage evaluation based on tested fatigue data. A deterministic design optimization code has been completed. Optimization studies of the composite wind turbine blade for the extended fatigue life are underway. The proposed fatigue analysis procedure could facilitate the reliability analysis and reliability-based design optimization (RBDO) of wind turbine blades considering wind load uncertainty.

A model of thermal damage in glass fiber polymer-matrix composites in wind turbine blades subjected to a lightning strike has been developed. The model describes surface interaction between the lightning arc and the composite structure. The model provides time- and electric-current-dependent variation of the lightning arc radius and lightning current-induced heat flux generated at the composite surface. The formulated nonlinear transient heat transfer problem with a moving boundary is solved using a finite element method. The solution procedure accounts for phase transitions in the materials. The obtained results include temperature field profiles and evolution of the thermal damage. The model was implemented into commercial finite element analysis software. Computational studies of thermal damage are underway.

Experimental electrical and impact characterization of carbon fiber textile composites has been performed. A fully instrumented experimental setup for characterization of electrical properties has been developed. The setup allows for real time measurements of the electrical resistance of the composites during low velocity impact tests.

Finally, a new wind tunnel and precision model wind turbine at the University of Iowa has been completed, and constitute completion of the milestone of enhancing blade performance laboratory at UI.
Wind Energy (WE) Platform: Drivetrain Design Optimization Plank

The accomplishments made in Year 3 in the Drivetrain Design Optimization plank are aligned with the milestones of Strategic Priority 1.4. The GearDyn drivetrain simulation code developed in this project was integrated with NREL’s FAST and TurboSim codes to account for the variation of aerodynamic loads of rotor blades in the time-domain drivetrain dynamic analysis under random wind fields. By further integrating it into the Iowa Reliability-Based Design Optimization (I-RBDO) code, it was demonstrated that the variability characteristics of the transmission error of wind turbines can be systematically predicted under the wind field and gear geometry imperfection uncertainties.

A 2D multi-physics hydrodynamic numerical analysis for the laser peening process was developed to enhance the surface of the drivetrain components. Also developed was a multi-step numerical analysis to investigate mechanisms involved in surface microstructure alterations during the drilling process of hardened steels. The modeling efforts were enhanced by the completion of a literature review addressing meshfree particle methods, elastohydrodynamic lubrication, and bearing failure. This allowed for studies of the smooth particle hydrodynamics method and developed conceptual models for bearing failure.

To model wind load uncertainty, 249 wind speed datasets were collected. Because of the increased number of wind speed datasets, the parametric distributions, which determine the specific Weibull and log-logistic distribution, were identified by maximum likelihood estimate methods. The wind load uncertainty model allowed plank members to (i) develop a parametric composite blade model for reliability analysis, deterministic design optimization (DDO) and RBDO of the blade; (ii) develop a new fatigue analysis procedure for composite wind turbine blades; (iii) develop modified web hub designs for reliability analysis of hub; and (iv) carry out parameterization of the hub web for DDO and RBDO of hub.

Wind Energy (WE) Platform: Green Energy Grids Plank

A strategic-level stochastic programming model for the design of a High-Voltage DC (HVDC) renewable energy grid was developed. This model takes into account the weather and power demand uncertainties. Both historical and simulated data have been used to take into account the possibility of very rare, but extremely costly adverse events, such as massive “blackouts”. In addition, general solution methods for mixed-integer risk-averse optimization problems have been developed that were also used to solve the grid optimization problem.

Earlier decentralized algorithm for optimal dispatch to the case where the generator cost functions are piecewise linear was extended. The previous cost functions plank members worked with were differentiable. Piecewise linearity precludes differentiability. Algorithms have also been developed that exploit limited amounts of inter-generator communications. Another extension in in the works. Hitherto it was assumed that frequency deviations that were measured and used to effect optimization, bore a linear relationship to load imbalance. In practice that is an approximation. A method is being developed that assumes that the precise relationship is unknown except that the frequency deviation is an increasing function of the
load imbalance. These results are being extended to demand shaping problems by treating the latter as a dual optimization problem.

**Energy Utilization (EU) Platform: Green Community Campaign Plank**
The posttest survey was completed while the audit interviews continue. Sales data from the two intervention communities and the reference community were acquired from some retailers. Residential energy use was acquired from MidAmerican Energy. Datasets have been cleaned and analyses have begun. Recruiting for summer minority interns to work on this effort was completed with anticipation of two interns for the summer.

**Energy Utilization (EU) Platform: Building Science Plank**
The Columbus Junction Community Laboratory is fully operational. This includes window shading that was installed in the high school library to reduce glare and increase energy efficiency; the shades are fully programmable so shading can be a function of time of year and time of day. The lighting in the high school library has also been upgraded and the library has been fitted with occupancy sensors and a daylight harvesting option. The energy utilization data for the high school is also available to all students (and the community) through a school energy dashboard ([http://buildingdashboard.com/clients/columbus/cchs/](http://buildingdashboard.com/clients/columbus/cchs/)). Anyone who accesses the site can see current energy usage, as well as past usage for selectable time periods. The front page of the dashboard is shown in Figure 1.2b.12

![Figure 1.2b.12: Front page of the Columbus Community High School building energy dashboard.](image)

The Interlock House Community Laboratory at Honey Creek State Park installed a GreenTouchscreen data display system. Various data can be viewed through the Internet at [http://siemens.honeycreek.greentouchscreen.com/](http://siemens.honeycreek.greentouchscreen.com/). Validation of the correct data transmission is still on-going with the CI team. The site is used to engage the public as they visit the Interlock
House, which is the visitor center at Honey Creek State Park. The front page of the Interlock House site in shown in Figure 1.2b.13.

Figure 1.2b.13: Front page of the GreenTouchscreen data display system for the Interlock House Community Laboratory at Honey Creek State Park.

**Energy Policy (EP) Platform**

No additional information is provided in Section 1.2b for the Energy Policy Plank.

**Broader Impacts (BI) Platform: Faculty Development Plank**

Over 18 faculty development programs (programs listed in Table 1.2a.3) delivered across the three Regent institutions engaged over 700 attendees from the faculty, post-doctoral, and graduate student ranks. Carry-over funds were used to award 23 seed grants in Year 3 across all platforms with an emphasis on increasing research capacity of junior and/or underrepresented faculty members.

**Broader Impacts (BI) Platform: Diversity Plank**

Diversity activities in Year 3 have increased visibility of the Iowa NSF EPSCoR project with institutional collaborators. The activities continue to support the goal to increase participation of female and URM students in EPSCoR supported programs. Diversity and BI leaders have successfully identified existing programs that Iowa NSF EPSCoR can work with to leverage and maximize impact – these include Upward Bound, LSAMP, and other regional entities such as Girl Scouts, Regional STEM hubs, Quad Cities Minority Science Partnership, etc. Iowa NSF EPSCoR funds are also being utilized to promote research experience for female and URM undergraduates and community college students through collaboration with IINSPIRE-LSAMP.

To address the issue of increasing faculty diversity, the Diversity team collaborated to establish search committee best practices training for STEM groups, and has expanded these activities to address implicit bias training in the faculty search process. Specifically, ADVANCE faculty from
ISU provided search committee training at UI and UNI in Fall 2013. This work is based on the research from several NSF Advance programs. Together with training on leadership and collaboration with the National Coalition Building Institute (NCBI) Campus Affiliate, these activities have facilitated the broader dissemination of data and best practices to current faculty. Finally, this year the establishment of a stakeholders group was initiated to better engage research faculty in diversity efforts and to establish appropriate indicators and benchmarking data to best represent and measure progress.

**Broader Impacts (BI) Platform: Workforce Development Plank**

Several outreach programs to engage K-12 students and teachers in STEM related activities have been conducted in collaboration with regional organizations such as Girls Scouts, Library programs and others. A listing of these programs can be found in Table 1.2a.8.

Similar to last year, plans are underway to conduct workshops (a three-week Summer Academy for middle school teachers and a one week workshop for elementary school teachers) on Biorenewables at ISU. A cohort of twelve middle school science teachers and 21 elementary school teachers from across Central Iowa is anticipated. Figure 1.2b.14 shows the 2013 cohort of elementary teachers touring the BioCentury Research Farm at Iowa State University. Participants typically attend faculty led lectures and seminars on related topics and conduct hands-on laboratory activities associated with the production of biorenewable fuels and chemicals. The experience also includes pedagogy training to help teachers create grade appropriate classroom materials that comply with the Iowa Core Curriculum requirements and simultaneously focus on biorenewables.

Figure 1.2b.14: 2013 elementary teachers of the Summer Academy touring the BioCentury Research Farm at Iowa State University.

A Summer Academy Leadership Institute (SALI) will be held again this summer with an expected cohort of 5 K-12 teachers selected from Year 2 Summer Academy participants. These teachers receive more in-depth training (train-the-trainer style) in two of the biorenewable topics covered in the Summer Academy. This increased proficiency will allow these teachers to
facilitate two-day workshops on biorenewables for teachers around the State of Iowa, thus maximizing impact. Graduates from the Year 2 SALI training held 3 workshops on biorenewables for teachers between August and February.

The UNI Energy Institute, a three week program focusing on renewable energy will engage about 15 high school and middle school teachers in hands-on experiences in pedagogy development in STEM topics. As before, during the two weeks of face to face meetings, they learn content from experts in renewable energy and energy efficiency and participate in activities that model best practices in STEM evaluation.

Iowa NSF EPSCoR PLTW Implementation/Diversity Coach Lisa Digman worked with coordinators from the fifteen Iowa PLTW community colleges, including 7 coordinators that were new this year, to encourage program best-practices as they relate to PLTW in Iowa; she also has continued to develop strong relationships with state PLTW secondary school coordinators. She has worked to (i) help increase the number of PLTW schools in their region, (ii) develop successful implementation strategies, (iii) explore successful community partnership teams, (iv) provide teacher professional development, and (v) develop rural regional centers such as the Lynn County regional center and the NICR regional centers. During this reporting period, 25 new PLTW secondary schools were added to the state (see Table 1.2b.1 for a listing of new PLTW schools). In addition, Digman continued to work on increasing the diversity of the students in PLTW classrooms, including developing new classroom materials and recruiting tools, and working on events that promote diversity in STEM education.

Table 1.2b.1: Middle and high schools with whom the PLTW Implementation/Diversity Coach worked to expand PLTW offerings in Y3.

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<th>HLV HS</th>
<th>Linn-Mar HS</th>
<th>Diagonal MS</th>
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<td>St. Albert School District</td>
</tr>
<tr>
<td>Howard-Winn/Cresco HS</td>
<td>Howard-Winn/Cresco MS</td>
<td>West Delaware School District</td>
</tr>
<tr>
<td>North Fayette HS</td>
<td>North Fayette MS</td>
<td>New London School District</td>
</tr>
<tr>
<td>Hampton Dumont HS</td>
<td>Hampton Dumont MS</td>
<td>Muscatine Grade School</td>
</tr>
<tr>
<td>Waterloo School District</td>
<td>Waterloo Central MS</td>
<td>Muscatine MS</td>
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<tr>
<td>Spencer HS</td>
<td>Spencer MS</td>
<td>Muscatine HS</td>
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<tr>
<td>Southwest HS</td>
<td>Southwest MS</td>
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<tr>
<td>Waukon HS</td>
<td>Charles City MS</td>
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Broader Impacts (BI) Platform: Cyberinfrastructure (CI) Plank
During the past year, the CI team has developed an open-source suite for computational and theoretical models, for research platforms. A process has been established to implement training materials for CI resources such as the use of data analytical tools. Specifically, the CI team assisted EU plank leader Passe’s team by creating a database and related CI tools specifically for the project involving the Interlock House. This included the following: (i) a fully loaded DATA BASE, (ii) a DATA repository, (iii) monthly update loading capabilities, (iv) a verifying pipeline query script for the DATA BASE (DB:MySQL), (v) a user interface to query the database, and (vi) an online DATA BASE Report View page (d3js library, PHP, javascripts). The CI
team has also initiated the integration of data driven models with large scale computational modeling to develop a simulation based research environment to predict large scale energy systems behavior through linkages with the new high performance computing capabilities. Additional funding has also sought additional funding for CI related projects in the following areas: educational assessment, virtual classrooms, and research programs in the areas of renewable energy and sustainable materials.

**Broader Impacts (BI) Platform: External Engagement and Communications (EE) Plank**
The EE team has ensured timely updates and content management of the Iowa NSF EPSCoR website. They have reached out to pertinent constituents to expand the Iowa NSF EPSCoR newsletter subscription list and developed and distributed two issues of the Iowa NSF EPSCoR newsletter, with the third scheduled to go out early summer. The team added a webpage featuring EPSCoR diversity programs and shared stories via the web, Twitter, and newsletters. They effectively organized and hosted a congressional briefing in Washington, DC with the EP Platform, and hosted “Legislators in the Lab” to ensure the most effective means of communication regarding the project to the state legislature. Two communications students, one at ISU and one at UI, have been engaged for the summer.
1.2c Accomplishments: Significant Results
This section highlights significant results from the bioenergy, wind energy, energy utilization, and energy policy research activities as well as broader impact activities.


Understanding of the relative invasive potential of Miscanthus species and switchgrass cultivars has increased, and it has been discovered that the current Big Creek BAER site has physical limitations restricting its utility for water use and quality studies. Drs. Emily Heaton and Marc Linderman began a collaboration to conduct aerial mapping of Miscanthus distribution in key Iowa regions. Heaton and Dr. Adam Ward are working to expand relationships with the UI power plant in hopes of moving to on-farm research as farmers begin planting bioenergy crops to meet UI power plant demand.

The effect of nitrogen (N) fertilizer on switchgrass biomass production and Nitrogen Use Efficiency (NUE) was evaluated. Low initial soil N concentration increases biomass yield response to N fertilization, while high initial soil N concentration reduces this response. This study suggests that NUE depends on site-specific N management strategies that are responsive to soil N supply and plant N status. It was also determined that N management and harvest time influence both yield and sustainability of switchgrass production for bioenergy systems. Delaying harvest until after frost reduces the harvested biomass but also reduces the amount of N removed with the harvest, allowing more N to be stored in belowground tissues. Post frost harvest reduces N fertilizer requirements and helps prevent switchgrass yield declines in subsequent years.

In corn systems, it was determined that long-term harvesting of ~90% of above ground stover without compensating organic amendments can have negative impacts on soil quality. After 19 years of residue harvesting, soil organic carbon was 7% lower, cation exchange capacity was 7% lower, and nitrogen mineralization potential was 25% lower than in soil from control plots where residue was not harvested. The study demonstrated the critical need for conservation protocols to compensate for residue harvesting. Annual root production in response to variation in soil properties across a toposequence was quantified for three bioenergy cropping systems (continuous corn, triticale/sorghum, switchgrass). Root production was not influenced by topography or soil properties for the annual cropping systems whereas switchgrass root production was lowest on the floodplain and higher in sandy soils with low soil C and N levels. Understanding soil property influences on root productivity can improve modeling of C cycling in cropping system.

Farm-gate costs and returns of five second generation biofuel cropping systems were analyzed for an ongoing experiment in central Iowa. The continuous corn cropping system was found to be the most profitable under current market conditions. Second generation biofuel cropping systems could be more cost competitive by boosting yields, increasing demand, and compensating farmers for environmental benefits of second generation biofuel systems.
Biochar was explored as a possible soil amendment. The conclusion was that the addition of biochar increased water retention by 23% and decreased soil bulk density by 9% relative to controls. The study indicated that the biochar co-product of bioenergy production is effective for increasing the ability of soil to retain water. Near-infrared reflectance spectroscopy (NIRS) was used to rapidly and reliably quantify the amount of biochar carbon added to soils. Any sale of carbon credits or green payments to farmers for carbon sequestration as a result of biochar amendments will require a rapid and inexpensive audit system; this study demonstrates that NIRS can function effectively for this purpose. Finally, it was shown that the Boehm titration method that is used as a tool for characterizing the surface chemistry of biochars and the original Boehm method do not work with biochars, despite numerous published papers reporting the use of the Boehm method with biochars. A revised Boehm method was developed and it was demonstrated that the revised method can be used with most biochars. This discovery will correct problems in the literature and enhance understanding of biochar surface chemistry.


Dr. Zengyi Shao, encouraged by the recent interest demonstrated by DOE and NSF in exploring unconventional microbial hosts for sustainable bioenergy production, has been working on setting up the basic genetic toolkits for manipulating *I. orientalis* and *S. stipitis*, including (i) establishing stable expression vectors, (ii) identifying constitutive promoters, (iii) generating auxotrophic strains, (iv) improving the current transformation technique, and (v) designing an efficient gene knockout method. Using this base, *I. orientalis* was recently characterized as an attractive non-conventional yeast for the production of dicarboxylic acids on the “DOE Top 12 Chemicals” list, mainly due to its robustness to acid inhibition. Shao identified constitutive promoters, generated auxotrophic strains and set up transformation technique for this host. All these tools are essential for engineering *I. orientalis* for fermenting pyrolytic sugars to produce valuable products. On the other hand, she showed *S. stipitis* has the highest native capacity for xylose fermentation. Despite that *S. stipitis* serves as a resource for isolating genes involved in xylose transporting and utilization, its broad application directly as a host in biomass conversion is deterred mainly due to the lack of various genetic manipulation tools. She has identified a novel centromere sequence that will be used to create expression vectors stable in *S. stipitis*. She has also identified a group of strong promoters that are functional in mixed sugar condition. These tools are required for manipulating *S. stipitis* for efficient mixed sugar fermentation (note *S. stipitis* is considered as an attractive host to utilize biomass hydrolysis products, and its potential for using pyrolytic sugars needs to be evaluated).

Wright assessed the impacts of energy price uncertainty on the financial viability of advanced biorefineries. Volatility in energy markets such as gasoline, diesel, and natural gas contribute to uncertainty in biorefinery finance projections. For example, the historical drop in natural gas prices has led to a significant shift in natural gas prices projections; this is shown in Figure 1.2c.1, where changes in the 2013 Energy Information Administration (EIA) energy price projections have shifted the expected net present value distributions of emerging advanced biofuel technologies.
Wright also used techno-economic analysis to estimate the cost of gasoline and diesel from microalgae remnants via two distinct scenarios: (i) thermal drying and catalytic pyrolysis (TDCP), and (ii) partial mechanical dewatering and catalytic pyrolysis (MDCP). Gasoline and diesel costs via these scenarios were estimated to be $1.80/liter and $1.49/liter, respectively (Figure 1.2c.2). Feedstock and capital costs contribute the most to these estimates. Feedstock costs could be reduced if an algae market develops that lowers the cost of microalgae remnants. Significant technology development would be required to lower capital costs of this technology.
Appendix A – Accomplishments
Iowa NSF EPSCoR

Figure 1.2c.2: Algae biofuel production costs for the thermal drying (TDCP) and mechanical dewatering (MDCP) catalytic pyrolysis scenarios based on 20-year discounted cash flow rate of return analysis with 10% internal rate of return, 2000 MT per day capacity, and feedstock cost of $66/MT of microalgae.

Wright further investigated the impact of learning rates on the scaling behavior of advanced biorefineries. The literature features several formulations to estimate the relationship between facility capacity and production costs. The most common formulation is the Economies of Scale power law, but the S-Curve and Stanford-B curves are also well known. A limitation of these formulations is that they do not account for technological learning – the effect of cost reductions with increasing capacity. As shown in Figure 1.2c.3, it was determined that technological learning in feedstock supply and conversion to fuels could lower biofuel costs and lead to smaller optimal facility capacities.

Figure 1.2c.3: Gasification + Fischer-Tropsch and fast pyrolysis with hydroprocessing scenario costs ($/gal) vs. plant capacity (million gallons per year) based on economies of scale (EOS), Stanford-b, and S-curve models assuming cumulative industry capacity of 16 billion gallons per year.
Wright established that algal biomass dewatering results in significant capital, operating, and energy costs to a catalytic pyrolysis facility. Therefore, an alternative approach was investigated. Hydrothermal liquefaction (HTL) (Figure 1.2c.4) employs an aqueous medium thereby eliminating the need for feedstock drying. Research findings indicate that HTL avoids dewatering costs.

Figure 1.2c.4: Schematic of the microalgae hydrothermal liquefaction process for gasoline and diesel production.

Corn stover is a potential source for advanced biofuel production, but Wright showed that it suffers from high delivery costs to large-scale facilities. These delivery costs also include a wide range of uncertainty factors along each step of the supply chain. The sensitivity of the delivery cost of biomass to variations in costs through multiple steps was therefore explored. Figure 1.2c.5 shows the different steps considered in this study and the range of calculated costs for each step.

Figure 1.2c.5: Windrowing (W), Baling (B), Bale Collection and Stacking (BCS), Nutrient Removal (NR), Transport to Storage (TS), Storage (S), Transport to Distributed Processing Plant (TDPP), Pretreatment (PT), Transport to Centralized Processing Plant (TCPP), and Administrative (A) costs and associated uncertainties.
Bio-oil is a liquid product of processing biomass under fast pyrolysis conditions that could be inserted into existing crude oil refineries. The conventional approach to bio-oil production yields an unstable liquid with undesirable qualities for refining equipment. Bio-oil can be stabilized with additional processing steps shown as the Upgrading section in Figure 1.2c.6, but is incurs additional capital and operating costs. Wright is investigating the requisite stable bio-oil value to compensate for these additional processing costs.

![Diagram of biomass fast pyrolysis and bio-oil stabilization/upgrading](image)

**Figure 1.2c.6:** Biomass fast pyrolysis and bio-oil stabilization/upgrading for insertion into existing crude oil refineries.

Recent environmental regulations mandate significant reductions in emission levels of existing power generation facilities. Coal power plants are one of the major contributors to greenhouse gas emissions in the power sector. Work by Wright (Figure 1.2c.7) indicates that coal/bio-oil blends can be fed into existing boilers to reduce their overall emissions by more than 60%.
Duckweed is a fast growing aquatic species with the potential to become a source of feedstock for advanced biofuel production. However, there is limited information on the performance of processing duckweed via catalytic pyrolysis. Wright optimized the yield of total aromatic hydrocarbons (TAH) from the catalytic pyrolysis of duckweed by varying the temperature and catalyst-to-biomass ratio. As shown in Figure 1.2c.8, yields of almost 10 wt. % of TAH can be obtained, which suggests that this is a viable process for biofuel production from duckweed.
Biogas is another potential biofuels source. Using techno-economic analysis, Wright developed an interactive tool for identifying potential biogas project sites in Iowa that can be used to evaluate the cost of deploying facilities at those sites. The tool is being released as an online resource for public use. Figure 1.2c.9 shows the main map interface with the numerous sources of biogas generation feedstock in Iowa.

Figure 1.2c.9: Iowa Biogas Assessment Model (IBAM) interface. IBAM facilitates economic and biogas resource assessment in the State of Iowa.

Meyer was able to use the Iowa NSF EPSCoR-supported equipment in his laser laboratory to begin fundamental studies of biofuel combustion. Initial imaging experiments were conducted to detect fluorescence and Mie scattering of bio-oil, reactive boiling of model biomass compounds, Coherent Anti-Stokes Raman Scattering (CARS) of model biomass compounds, and transient in situ Fourier Transform Infrared (FTIR) spectroscopy of lignin and cellulose derived from biomass (Figures 1.2c.10 – 1.2c.13). Results indicate that experimental methods will enable in situ investigation of biomass conversion and utilization processes to understand the fundamental physics and chemistry of these processes. This equipment was also leveraged to establish expertise that has been utilized to acquire additional research funding from industry currently totaling $300k for three years in related research areas.
Figure 1.2c.10: Sample spectra from *in situ* FTIR of biomass model compounds. Difference in the C-H and C-C bonds can easily be detected in the two model compounds for possible identification of transient species within an optically accessible reactor.

Figure 1.2c.11: Transient *in situ* spectra during pyrolysis of lignin and cellulose in an optically accessible sample cell, allowing evaluation of reaction time scales and relevant products. Analysis of detailed spectra is ongoing.
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Figure 1.2c.12: Coherent Anti-Stokes Raman Scattering (CARS) data of model biomass compound (left) and light gas (right). Investigation of ability to detect transient species evolution is ongoing, along with the ability to measure temperature in the reacting boundary layer.

Figure 1.2c.13: Sample imaging of model biomass compound undergoing reactive boiling at conditions similar to the pyrolysis processes. Further imaging experiments will be conducted in the reacting boundary layer in the optically accessible pyrolysis sample cell.

The most significant accomplishment during this period is the development of the marine-based balloon-borne wind resource characterization system mounted on an ocean buoy anchored to the sea floor and operating continuously and unattended while delivering data to a shore-based receiver (see, for example, Figure 1.2b.10). This pilot project demonstrated a new and less expensive alternative to the currently used method for characterizing wind resources in offshore environments, especially deep water locations. The only currently available method for in-situ measurements is fixed towers anchored in the sea floor. The balloon-based system developed as part of this project will cut the cost substantially for prospecting for future off-shore (and on-shore) wind power sites.

WE plank leader Takle was able to leverage Iowa NSF EPSCoR support to enhance an innovative training program. This program involves a bi-direction mentoring hierarchy based on a collection of ISU wind energy projects funded by NSF and others. The motivation for addressing
the larger context of mentoring is the assertion that mentoring for success in advancing students in STEM education needs to (i) be multi-level, (ii) be continuous across programs, and (iii) involve “mentoring of mentors”. This mentoring structure is depicted in Figure 1.2c.14.

The blue arrows on the bottom of Figure 1.2c.14 show the path students are encouraged to follow. Of note is the recruitment and retention of students “graduating” from one opportunity into follow-on opportunities. Particularly for under-represented and at-risk groups, it is proposed that preparation for success at the next level helps to prevent drop-out. This is best achieved by intense in-program mentoring on products of achievement at the next level. For example, REU students in 2012 and 2013 were given intense instruction and guidance on writing research papers in the form accepted by scientific journals. Each student was provided weekly one-on-one mentoring by the project PI on writing project report papers in the form of a journal article. This individual project goal was reinforced by graduate student mentors for each student. The outcome is that each REU student was able to produce a product of achievement commonly expected at the next level, which builds confidence and raises aspirations and self-expectations.

The red arrows on the top of Figure 1.2c.14 show the intentional mentoring also has a multi-level structure. REU students are asked to help mentor college entry-level students who are also in STEM programs on campus; the REU students discuss their research and help lead tours of research facilities in their area. IGERT graduate students in the Wind Energy Science, Engineering, and Policy (WESEP) program serve as mentors to the undergraduate WESEP REU
students. Several WESEP IGERT students served as mentors in 2013. The student mentoring concept is built on one of the foundational themes of the Iowa NSF EPSCoR project where senior faculty intentionally recruit and mentor junior faculty. This concept was expanded through the NSF WESEP IGERT and NSF WESEP REU students to form a continuum that provides a clear and continuous pathway for success at each academic level.

Wind Energy (WE) Platform: Blade Performance and Reliability Plank
A method for simulating specified yaw dynamics of a wind turbine has been developed. The use of overset grids allows for the accounting of full body motion, including the rotation of the nacelle about the tower.

A new formulation of the governing conservation equations has been developed for flow in complex geometries. The governing equations are written in a mixed basis. Such an approach maintains a structure similar to an orthogonal solver and thus has many advantages which are not found in the existing non-orthogonal solution procedures.

The development of acceleration techniques for CFD has shown a decrease in simulation runtime. Using explicit RK methods greatly reduces the computations of each time step; however, explicit RK has strict time step restrictions. Implicit RK methods have also proven to decrease runtime by allowing larger time steps, even though more computations must be computed within each time step.

A new comprehensive fatigue analysis procedure for composite wind turbine blades, including a wind load uncertainty model, random wind field simulations, aerodynamic analysis, detailed stress analysis, and fatigue damage evaluation, was proposed and investigated. The wind load uncertainty model realistically captures the wind load variation, which may also be utilized in fatigue analysis and reliability analysis of wind turbine components (e.g., hub and bearings). The wind load calculation is controlled by the mean wind speed and the turbulence intensity factor. Thus, the fatigue analysis could involve the effect of both the mean wind speed and atmospheric turbulence. A new aerodynamic load calculation method, which combines the aerodynamic analysis of an airfoil and a wind turbine blade to efficiently generate varied wind pressures for detailed stress analysis using finite element analysis has been formulated. In the fatigue damage calculation procedure, a method that solves the multi-axial complex stress states of variable amplitude has been developed.

Thermal response of the polymer-matrix composite laminate used in a Sandia 100-meter All-glass Baseline Wind Turbine Blade (SNL 100-00) subjected to a lightning strike has been studied. The tip region composite panel is considered, as it has been reported in the literature that the blade tip is more susceptible to lightning strikes than the remaining blade components. The physical model describing surface interaction between the lightning arc and the composite structure has been developed. The model provides time- and electric-current-dependent variation of the lightning arc radius and lightning current induced heat flux generated at the composite surface. The temperature-dependent thermal properties of the VectorPly E-LT 5500 unidirectional [0]2 E-glass fiber vinyl ester resin matrix fabric and SNL triaxial [±45]2[0]2 E-glass
fiber vinyl ester resin matrix fabric used in the wind blade tip composite panel were derived using available experimental data. The formulated nonlinear transient heat transfer problem with a moving boundary was solved using a finite element method. The solution procedure accounts for phase transitions in the materials. The obtained results include temperature field profiles and evolution of the thermal damage.

The experimental setup, including the precision wind tunnel for wind turbine application, was the focus of this project year to date. During the remaining quarter of Year 3, a detailed experimental campaign using the precision wind turbine model is expected to be complete – of which the rotor is a scale model of the NREL Phase VI rotor – to present a detailed account of the effect of scale on wind turbine performance, using data from the NREL Phase VI experiment as a reference.

**Wind Energy (WE) Platform: Drivetrain Design Optimization Plank**

The stochastic analysis was performed using the integrated multi-physics gear dynamics simulation code developed in Year 3 under wind field uncertainty, which involves two codes developed at the University of Iowa (GearDyn and I-RBDO) and two codes developed at NREL (FAST and TurboSim), as shown in Figure 1.2c.15. The equivalent mesh stiffness model used in GearDyn was validated by comparing plank results with the detailed finite element results as shown in Figure 1.2c.16. The static transmission error predicted by GearDyn code was validated by comparing it with those discussed in the literature.

![Figure 1.2c.15: Numerical procedure for wind turbine drivetrain dynamics.](image)
To account for the axial misalignment of the gear shaft as shown in Figure 1.2c.17, the modified non-conformal contact model for the misaligned gear tooth was proposed, allowing for the consideration of surface-to-line contact arising from the axial misalignment. To predict the location of the gear teeth contact point with surface-geometry imperfections, the hybrid collision detection algorithm was developed and implemented in the contact geometry analysis of GearDyn as shown in Figure 1.2c.18.

(a) Variable mesh stiffness
(b) FE model

Figure 1.2c.16: Comparison of mesh stiffness obtained by equivalent and FE models.

Figure 1.2c.17: Axial misalignment.

(a) Gear tooth contact with surface-geometry imperfections, and (b) hybrid collision detection.
To improve the reliability of wind turbine components, microstructural alterations during the hard drilling process has been studied using a multi-step numerical analysis. As represented in Figure 1.2c.19, three-dimensional (3D) Finite Element (FE) simulations are first performed using a relative coarse mesh with AdvantEdge for hard drilling of AISI 1060 steel to achieve the steady-state solution for thermal and deformation fields. Defining the initial condition of the cutting zone using the previous 3D simulation results, a multi-physics model is then implemented in two-dimensional (2D) coupled Eulerian-Lagrangian (CEL) finite element analysis in ABAQUS to model both phase transformation and grain refinement on a fine mesh to comprehend the surface microstructure alterations. This allows for a simultaneously study of the interaction among surface microstructures, drilling parameters, and the hardness of the work piece material. With the comparison to related experimental results, the capabilities of the multi-physics model to accurately predict critical surface microstructural attributes such as phase compositions, grain size, and microhardness during the drilling of carbon steel are demonstrated in Figure 1.2c.20.

Figure 1.2c.19: Multi-step numerical models for microstructural change during the hard drilling process.
Figure 1.2c.20: Comparison of simulated profiles of shear strain, total dislocation density, grain size along the penetration with the SEM and TEM micrograph near surface of a hole.

The laser peening process induces pressures on the order of 1 GPa at the target surface by way of short, high energy laser pulses. To better understand the laser-matter physics during the process and control the surface quality, a 2D multi-physics hydrodynamic numerical analysis was carried out based on the hydrodynamic governing equations of mass, momentum, and energy transfer. This model produces histories and spatial profiles of pressure, velocity, energy, and temperature, which can be used to further analyze the process. The pressure distribution in terms space is shown in Figure 1.2c.21, where the peak pressure is approximately 1.8 GPa. In addition, the laser peening induces shock wave pressure profiles; the model can simulate these provide, which can be used as inputs to the finite element analysis to find the residual stresses in the target material.
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Figure 1.2c.21: Pressure distribution at \( t = 4 \) ns (8 ns pulse duration, 3.2 GW/cm\(^2\) power density).

After reviewing the literature for meshfree particle methods and bearing failure, it was decided to use a smooth particle hydrodynamics (SPH) method to study the mechanical behavior of elastohydrodynamic lubrication (EHL) and the lubrication-bearing interaction. The model output will be the normal and shear forces on the bearing surface. A schematic representation of this model is shown in Figure 1.2c.22.

Figure 1.2c.22: EHL modeling using meshfree methods.

After getting the normal and shear forces from the model developed in Figure 1.2c.22, finite element analysis will be applied to study fatigue crack initiation life and fatigue crack growth life. The thermo-mechanical coupling shown in Figure 1.2c.23 will be considered since high temperatures were observed in the bearing during cyclic rotation. Hence, the high
temperatures will dramatically change the lubrication viscosity. The effect of debris loading on bearing fatigue life of will be considered via the development of a multiscale model as schematically shown in Figure 1.2c.24.

Figure 1.2c.23: Thermo-mechanical coupling for bearing failure studies.

Figure 1.2c.24: Multiscale modeling of debris in lubrication.

Using the reliability analysis of the blade and hub model with the wind load uncertainty, the probability of failure and cumulative distribution function (CDF) of fatigue life at selected finite element nodes were calculated. The fatigue damage contours and the probability of failure contour of the blade and hub model were obtained, which helps find the hotspots for DDO and
RBDO procedures. Hence, this information will be used with the developed DDO code and the I-RBDO software system for reliability based design optimization of wind turbine blades.

**Wind Energy (WE) Platform: Green Energy Grids Plank**
It was determined that higher-order nonlinear risk measures, which estimate the risk through higher order moments of the tails of loss distributions, allow for better control of uncertainties in renewable energy grids compared to more commonly used linear or lower-order risk functionals. On the algorithmic side, branch-and-bound solution methods based on outer polyhedral approximations of nonlinear constraints demonstrated superiority compared to branch-and-cut methods with nonlinear cuts.

While previous work on optimal dispatch did not require any explicit communication between generating units other than a frequency deviation measurement (which by its nature was easily available locally), research showed that advantage can be taken of even limited communication infrastructure to significantly improve the performance of our dispatch algorithm in terms of convergence speed and robustness to a lack of persistent excitation.

**Energy Utilization (EU) Platform: Green Community Campaign Plank**
Analyses are ongoing. Findings should be available at the end of the year. Pre/post comparisons will be completed in Year 3 and findings will be reported beginning in Year 4.

**Energy Utilization (EU) Platform: Building Science Plank**
Although the community laboratory at Columbus Junction Community High School has been established and is operating, processes for getting the public involved with the lab has been slow to develop.

Mobile Energy Innovation Station (MEIS), i.e., the energy utilization demonstration trailer, has involved Kirkwood Community College students and instructors. Much of the construction work will be completed over the summer. A UI student is leading the construction with supervision by a UI shop engineer. Figure 1.2c.25 shows the trailer with some of the internal demonstrations. Dr. Craig Just is also working with the Iowa Renewable Energy Association (IRENEW) to develop additional demonstrations that can be transported with the trailer to various community events.
Figure 1.2c.25: (a) Mobile Energy Innovation Station (MEIS), and (b) various wall insulations, exterior door construction types, light bulbs, and water heating options, that can be explored inside the MEIS.

Wheeler has begun exploring the role school buildings play in the issue of sustainable design. Accordingly, growing research evidence has documented that the move towards a more sustainable community depends as much on the cooperation of the people who occupy those environments as the built environments that can be created. Without building user communities educated about sustainability, buildings risk being poorly utilized and innovative energy technologies misunderstood. She will be using this information as she develops the book, *New Schools*, which she is authoring.

While the desiccant dehumidification testing is still ongoing, preliminary results show promising success of the tested technology. The liquid desiccant solution was able to dehumidify the created warm and humid air stream. Due to various calibration issues, more exact efficiency data still has to be obtained this summer.

Post occupancy thermal comfort and daylighting research was conducted with Post Occupancy Evaluation (POE) questionnaires and measured data at the Interlock House. Preliminary metrics were developed for a dynamic visual comfort (DVic) zone, which will be a new addition to the existing comfort metrics for evaluation of indoor human behavior based on multiple dynamic environmental data and human behavior research. Energy baseline reporting metrics for the Interlock House had been established in Year 2 and continued into Year 3. Comparisons between both data sets are currently been conducted for Years 2 and 3, and will be ongoing to complete the full year of data. Evaluation of the interaction of human behavior based on POE questionnaires and existing data sets will be ongoing through this summer.

Two demonstration projects for the Interlock House were completed in April 2014. A full scale wall assembly will be available to demonstrate the energy efficient wall assembly to visitors of
the house. A current cost estimate was also completed to demonstrate the actual cost of a comparative solar home based on the State of Iowa 2014 cost index.

Design proposals to improve the energy utilization of the Lakeside Lab Community Laboratory project have been completed by two independent capstone research students in Architecture. The Building Science team collected preliminary energy data during a site visit in February 2014, where they also tested the new high quality infrared camera funded by the Iowa PowerFund. A full scale mock-up of the proposed efficiency retrofit is currently constructed and will be presented to the stakeholders of Iowa Lakeside Lab and the Friends of Lakeside Lab as potential funding body of the retrofit. The final design and a proposal for the related data acquisition system will be drafted in Summer 2014.

The Energy Policy Platform has been active in providing support for faculty to develop interdisciplinary (engineering/economics) teams and grant applications. Three current activities in this area are summarized here:

1. A collective pre-proposal from active participants in the workshop series was drafted and sent to 5 NSF programs (DRMS-SBE, MES, ESD, SYS, and SoO). The focus was on the theme of sustainability and associated risk from a final consumer’s and a firm’s perspectives. Engineers, economists and a statistician were involved in this effort. The group finally received some positive feedback from Mo Wang, the director of NSF-SoO (Science of Organization), who would welcome a full application on the sub-theme of firms and corporation and their perception of risk associated with sustainability and how to mitigate these risks. Given the amounts typically awarded by NSF, the group will have to target a feasible project and select the most promising ideas into a compelling full proposal. This will be fully developed in early Fall 2014 and submitted in January 2015.

2. A second effort focused on bioplastics, where a pre-proposal was submitted by Drs. Erin MacDonald (ME) and John Beghin to the proposed Center of Bioplastics and Biocomposites (CB²) at ISU. CB² is a proposed NSF-funded I/UCRC center to be led by David Grewell, ISU, if funded. The pre-proposal focused on acceptability and willingness to pay for bioplastic packaging by final consumers and for intermediate goods in business-to-business (B2B) exchanges. The pre-proposal was selected by industry groups last fall and by the future industry board of CB². A full proposal was developed and selected and is now one of the 5 “finalist” proposals to be funded if the CB² Center is approved by NSF and the Iowa Board of Regents. The proposal was also presented to several firms (ADM, Ecoproducts, and P&G).

3. The grant application to USDA-NIFA, “A Multi-disciplinary decision-modeling tool to assess food, advanced cellulosic biofuel and water tradeoffs in the Midwest,” was not funded. This proposal was submitted in Spring 2013 and ranked 7th among 44 full proposals with outstanding ratings from reviewers and the panel. USDA received 80+ pre-proposals and invited 65 full proposals; 4 proposals were funded. In sum, this was a valuable effort just falling short of success.
Table 1.2c.1 summarizes the six workshops organized by the EP platform during Year 3. Six ISU faculty presented the workshops. A total of 110 faculty, staff, and students from Iowa State University participated in the workshops.

Table 1.2c.1: NSF EPSCoR Energy Policy Workshops held in the 2013-2014 academic year.

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<th>Speaker</th>
<th>Workshop Title</th>
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<td>S. Pouliot, Economics, ISU</td>
<td>The demand for E85: geographical location and capacity constraints of fuel stations</td>
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<td>11/13/2013</td>
<td>J. Beghin, Economics, ISU</td>
<td>Identify a theme on which interested parties could help write a white paper to submit as a pre-proposal to NSF</td>
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<td>11/20/2013</td>
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<td>A top-down analysis of optimal incentive strategies in an advanced biofuel market</td>
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<td>1/31/2014</td>
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<td>Biofuel supply chain and Bottom-up market equilibrium model for production and policy analysis</td>
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<td>2/14/2014</td>
<td>L. Wang, Industrial Manufacturing and Systems Engineering, ISU</td>
<td>Potential competition for biomass between biopower and biofuel under RPS and RFS2</td>
<td>16</td>
</tr>
<tr>
<td>3/11/2014</td>
<td>A. Elobeid, Economics, ISU</td>
<td>An overview of the CARD/FAPRI biofuel model</td>
<td>13</td>
</tr>
</tbody>
</table>

The EP platform also organized six seminar speakers for the 2013-2014 Energy Policy seminar series, which are listed in Table 1.2c.2. Nearly 150 participants attended the seminars in person. Six participants tuned in via Adobe Connect.

Table 1.2c.2: Listing of the NSF EPSCoR Energy Policy Seminars held in the 2013-2014 academic year.

<table>
<thead>
<tr>
<th>Date</th>
<th>Speaker Name &amp; Affiliation</th>
<th>Seminar Title</th>
<th>Attendance Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>9/10/2013</td>
<td>J. Bushnell, University of California, Davis and National Bureau of Economic Research</td>
<td>Forecasting supply and demand balance in California’s cap and trade market</td>
<td>30</td>
</tr>
<tr>
<td>10/3/2013</td>
<td>A. Faaij, Copernicus Institute of Utrecht University, The Netherlands</td>
<td>Biobased Economy; Quo Vadis?</td>
<td>25</td>
</tr>
<tr>
<td>3/24/2014</td>
<td>J. Dumortier, Indiana University-Purdue University</td>
<td>Co-firing in coal power plants and its impact on biomass feedstock availability</td>
<td>21</td>
</tr>
<tr>
<td>4/10/2014</td>
<td>P. Adler, USDA-ARS, University Park, PA</td>
<td>Life cycle assessment: a tool to inform energy policy</td>
<td>14</td>
</tr>
<tr>
<td>4/24/2014</td>
<td>W. Hogan, Harvard University, Cambridge, MA</td>
<td>Electricity market design and the green agenda</td>
<td>39</td>
</tr>
<tr>
<td>5/5/2014</td>
<td>M. Auffhammer, University of California, Berkeley</td>
<td>Quantifying Intensive and Extensive Margin Adaptation Responses to Climate Change: A Study of California’s Residential Electricity Consumption</td>
<td>18</td>
</tr>
</tbody>
</table>

The new energy policy courses, developed with Iowa NSF EPSCoR support in 2012, were offered this past year. The graduate level domestic energy policy course was offered in Fall 2013 with 14 registered students; student evaluations were extremely positive. The new international energy policy graduate course curriculum was developed with EPSCoR support and moved through the course approval process at ISU. The course was offered in Spring 2014 for the first time with 20 students enrolled. It should also be noted that these energy policy topics, and the two new courses, have been developed and taught by a lecturer who is completing a PhD program at ISU and will be moving on to conduct research and teach similar courses at another institution. ISU administration believed these topics were so important that a new tenure-track position was created in political science to teach the courses and conduct associated research; ISU Central Administration has allocated funds to support the new position. The search process was conducted in Fall 2013; an offer was extended early in 2014, and the offer has been accepted. The new hire will begin employment at ISU in the Fall of 2014.

A major accomplishment this year was the development of a new and innovative model of the markets for Renewable Identification Numbers (RINs) and biofuel feedstock. Existing models capture the interactions between these two markets using a single-year static framework. But because RINs and biofuel feedstocks can be stored from one year to the next, their prices depend on expectations of future market conditions. Dynamic, stochastic optimization models are difficult to formulate and solve because of the curse of dimensionality. New solution procedures were applied to this problem and a unique dynamic, stochastic, multi-market equilibrium model was solved to estimate the impact of the Environmental Policy Agency’s proposed rule to decrease biofuel mandates. The model was used to project the distributions of corn prices and RIN prices in 2014 and beyond under the proposed rule and under the assumption the EPA decides ultimately to keep mandates in place.

Three main conclusions resulted from the effort to understand how obligated parties can comply with Renewable Fuels Standards. The first is that the market for RINs was working as intended in 2013. High RIN prices were signaling obligated parties that it was in their interest to make the needed investments to expand the ability to consume ethanol in high ethanol blends such as E85. The second is the level of investment in E85 infrastructure would be small relative to the savings in compliance costs that would have resulted from the investment. This result demonstrates the incentive to make the investments were large. The third major finding was the high RIN prices that signaled the need to invest would not be passed on to consumers in the form of higher gasoline prices because the increased use of E85 would have decreased the demand for gasoline, thereby offsetting price increasing pressures of higher refinery costs due to RIN prices.
Table 1.2c.3  Energy Policy outlook and policy briefings provided to date (statistics are as of 5/11/2014).

<table>
<thead>
<tr>
<th>Report Title</th>
<th>Date Issued</th>
<th># Pdf downloads</th>
<th># Online Full Text Views</th>
<th># Online Synopsis Views</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impact of increased Ethanol Mandates on Prices at the Pump (S. Pouliot &amp; B. Babcock)</td>
<td>Jan-14</td>
<td>441</td>
<td>110</td>
<td>598</td>
</tr>
<tr>
<td>Feasibility and Cost of Increasing US Ethanol Consumption Beyond E10 (B. Babcock &amp; S. Pouliot)</td>
<td>Jan-14</td>
<td>848</td>
<td>271</td>
<td>864</td>
</tr>
<tr>
<td>RFS Compliance: Death Spiral or Investment in E85? (B. Babcock &amp; S. Pouliot)</td>
<td>Nov-13</td>
<td>431</td>
<td>584</td>
<td>521</td>
</tr>
<tr>
<td>The Economic Role of RIN Prices (B. Babcock &amp; S. Pouliot)</td>
<td>Nov-13</td>
<td>984</td>
<td>685</td>
<td>513</td>
</tr>
<tr>
<td>RFS Compliance Costs and Incentives to Invest in Ethanol Infrastructure (B. Babcock)</td>
<td>Sep-13</td>
<td>423</td>
<td>734</td>
<td>629</td>
</tr>
<tr>
<td>Impact of Sales Constraints and Entry on E85 Demand (B. Babcock &amp; S. Pouliot)</td>
<td>Aug-13</td>
<td>244</td>
<td>345</td>
<td>701</td>
</tr>
<tr>
<td>Price It and They Will Buy: How E85 Can Break the Blend Wall (B. Babcock &amp; S. Pouliot)</td>
<td>Aug-13</td>
<td>829</td>
<td>2194</td>
<td>939</td>
</tr>
</tbody>
</table>

Whether flex fuel technologies are a feasible pathway to expanding ethanol consumption beyond E10 levels was investigated using a unique approach that combined data on the location of flex vehicles with the location of stations that sell E85 in the United States. The results of the series of studies demonstrate that existing infrastructure is sufficient to modestly expand ethanol consumption beyond E10 levels. New investments would be required in E85 stations if EPA were to allow mandates to increase as anticipated in current law. These investments would be incentivized by reduced compliance costs that meet blending mandates on the part of owners of oil refineries.

The new model of RINs and corn markets incorporates uncertainty about future gasoline prices and corn yields in a way that is consistent with how traders in futures markets perceive markets to work and in a way that policy makers can understand and utilize in policy analysis. Current decisions on corn supply and storage depend on current conditions and expectations of future conditions. The newly developed model can be used to project the cost of meeting corn ethanol mandates under different expected market conditions and different future realizations of random corn yields and gasoline prices.
Appendix A – Accomplishments
Iowa NSF EPSCoR

Stipends were provided to four junior faculty members to attend interdisciplinary engineering/economic/policy workshops and conferences. Recipients were:

- Dr. Guiping Hu, Assistant Professor, Industrial and Manufacturing Systems Engineering, Iowa State University
- Dr. Lizhi Wang, Assistant Professor, Industrial and Manufacturing Systems Engineering, Iowa State University
- Dr. Sebastien Pouliot, Assistant Professor, Economics, Iowa State University
- Dr. Alicia Rosburg, Assistant Professor, Economics, University of Northern Iowa

In collaboration with Iowa State University’s Bioeconomy Institute, Iowa NSF EPSCoR researchers held two congressional briefings on Capitol Hill entitled, “Through the Blend Wall or Not: Policy Options and Impacts” in response to debates on Renewable Fuel Standard (RFS) policies. The briefings were originally scheduled for October 3, 2013, but had to be cancelled due to the government shutdown. After rescheduling, a briefing for the House of Representatives was held on November 12, 2014, and a briefing at the Senate was held on the next day. Both briefings were well received, with 80 total congressional staff, reporters, and others in attendance. Iowa NSF EPSCoR economist Dr. Bruce Babcock presented findings from research he and EPSCoR economist Dr. Sebastien Pouliot have conducted regarding renewable identification numbers (RINS), credits that help companies comply with the RFS blending requirements, and E85 fuel station investments. Jeremy Martin, Senior Scientist in the Union of Concerned Scientists’ Clean Vehicles Program was also featured. The briefings were summarized on the Iowa NSF EPSCoR web site (http://iowaepscor.org/research/energy/policy/briefings) and the Governors’ Biofuel Coalition web site (http://www.governorsbiofuelscoalition.org/?p=7581).

In addition to the policy briefings in Washington, DC, Babcock made several presentations to professional audiences to further their training and understanding of important market developments in biofuel and related commodities. He made two presentations at the “RIN Academy” in August 2013; this academy is a program put on by EcoEngineers and Iowa State University. At these presentations, he showed how RIN prices for advanced biofuels are determined when multiple biofuels exist that compete for the market. He then discussed how expanded consumption of ethanol in E85 can be used to comply with biofuel mandates. At the National Ethanol Conference, his plenary talk before 2,000 attendees demonstrated how E85 consumption would increase if RIN prices were allowed to rise and why E10 prices would fall with increased RIN prices. He also made presentations on E85 and fuel markets to the Fuels Institute and to commodity traders at a program put on by Advanced Traders.

In addition, Babcock made presentations on biofuel markets to academic audiences at Oregon State University, the Republic University of Uruguay, and at UC Berkeley.

Finally, Babcock and Pouliot’s Iowa NSF EPSCoR-sponsored publications have been downloaded over 4,600 times in the last year. Babcock also made presentations that reached approximately 2,400 people.
Broader Impacts (BI) Platform: Faculty Development Plank
Over 18 faculty development programs (programs listed in Table 1.2a.3) delivered across the three Regent institutions engaged over 700 attendees from the faculty, post-doctoral and graduate student ranks. Seed grants of $1,000-$3,000 given in Summer 2012 to 12 UNI faculty (with the expectation that they would send in grant submissions within 3 months of the end of the seed grant) resulted in 11 submissions to federal funding agencies during the current year (Sept 2013-Aug 2014). Four of the submissions were awarded to UNI totaling over $1 million – a nearly 30 times increase from the initial total seed grant activity.

Broader Impacts (BI) Platform: Diversity Plank
Internship programs for Summer 2014, with a special emphasis on targeting female, URM, and community college students, are in place, with 23 student interns engaged, including 3 community college students, 13 female students and 5 URM students. IINSPIRE-LSAMP and Iowa NSF EPSCoR have collaborated to recruit, match, and place URM and CC STEM students from the alliance into Iowa NSF EPSCoR research labs. This is a great example of how Iowa NSF EPSCoR resources can be leveraged with existing programs to increase impact.

Based on evidence indicating sophomore level support was lacking for URM students in engineering, the RISE (ReIgniting the Sophomore Experience) program was developed at ISU to provide such students with “lunch and learn” activities on topics to help bolster their academic success. More than 20 students participated in this program and plans are in place to track the impact of this program on their academic success.

A significant result from the Diversity efforts at UI was receiving the 2014 University Center for Exemplary Mentoring (UCEM) Award ($1,200,000). This project boasts 174 faculty mentors from 22 STEM programs. Twelve minority PhD students have been recruited in the first cohort of fellows. The Iowa UCEM is hosting a faculty conference this summer (July 31 – Aug 2) to bring together exemplary mentors of minority students from across the nation to network and share best practices. As part of the team, Iowa NSF EPSCoR faculty will share experiences and best practices in mentorship. Mentor training workshops were also held at ISU to promote effective mentoring of summer interns – these are jointly funded by Iowa NSF EPSCoR and IINSPIRE-LSAMP.

Anticipated engagement of summer programs for K-12 female and URM students across the Regent institutions is summarized in Table 1.2a.6. The Upward Bound – Iowa NSF EPSCoR collaboration now serves 120 students in yearlong programs. Iowa NSF EPSCoR is supporting tutors to help students as well as STEM instructors for the 5-week summer program and engagement visits. Other K-12 activities during this reporting period have engaged more than 500 female and URM students.

Search committee training was conducted for all open lines in the Colleges of Engineering at ISU and UI, as well as campus wide for UNI. Disparities in hiring at the University level are not limited to STEM disciplines and the achievement of diverse pools and hires is a continued challenge. Assessment of the training is in process, as some of the searches have not been
completed at the writing of this report. The impact of the search committee training provided to UI and UNI by ISU ADVANCE faculty has been very immediate in terms of institutional acceptance – in addition to engaging search committees in various colleges at both campuses, UNI is holding a campus wide workshop on diversity training this summer and UI is in the process of institutionalizing the training across campus. The impact of this activity will be felt long after the conclusion of the Iowa NSF EPSCoR project.

**Broader Impacts (BI) Platform: Workforce Development Plank**

The Summer Academy for K-12 teachers has resulted in positive feedback from the participants. All teachers agreed that the overall quality of the program was high and that the professional development in this program was closely related to everyday teaching. Teachers reported their intentions to use information about renewable energy in their classrooms in a variety of ways. Several teachers indicated that they would use labs from the Summer Academy in their classrooms. They also reported that they would share content knowledge that they had learned in the program with their students. The Energy Institute K-12 participants have likewise provided positive feedback on content with plans to share what was learned in their classrooms.

The PLTW training programs are paying rich dividends in engaging female students. Two years ago, Iowa reported a 15.4% female enrollment in HS PLTW courses. Last year’s numbers indicated an increase to 16.1%. This year there was a significant increase to 18.2% female enrollment. Iowa added 32 new PLTW schools in the 2012-13 school year and added an additional 25 schools in the 2013-14 school year.

Through the Bioenergy Platform, agreements are in place with Dordt College, Central College, and Indian Hills Community College to enhance their bioenergy research and education infrastructure. To date, Dordt College has acquired a pilot scale fluidized bed biomass reaction system and a gas chromatograph, and will be acquiring additional related equipment which will be used for the newly introduced Chemical and Energy Systems program option within its multidisciplinary engineering curriculum. As a result of EPSCoR funded research equipment, Dordt will be offering two new courses in its 2014-2015 academic catalog, and additionally, current classes are able to offer hands-on experience with thermodynamics of reacting systems. Central College procured a tractor to enable effective faculty and student learning experiences in their prairie restoration project. Indian Hills Community College acquired a gas chromatograph to provide hands-on experiences for students in the Laboratory Bioprocess Technology and Agriculture/Biofuels Process Technology programs. Overall, over 80 students and 20 faculty members have engaged in activities using this equipment and have gained increased exposure to RE/EU related research and education opportunities.

**Broader Impacts (BI) Platform: Cyberinfrastructure Plank**

The CI Team developed new interactive visualization tools for statistical analysis of data. These have been setup to provide faculty (as well as CC and high school teachers) with data analysis tools for teaching concepts in introductory chemistry. An interactive module has been built that allows on-line inputs of data related to the properties of the elements to be quickly correlated
statistically and visualized so as to easily extract patterns and trends in data that otherwise are difficult to see. It is presently being tested and reviewed by faculty at ISU and UNI, and will be available for classroom use later this summer. The CI team plans to work with UNI to deploy these tools in selected undergraduate courses later this summer.

The CI team has helped researchers by developing an easy-to-use, on-line (server based) software framework that enables researchers to utilize the data generated by their research (e.g., NSF–SOLAR program project). The CI team continues to work with Kirkwood Community College and Eastern Iowa Community College in various research and education related initiatives. These collaborations continue to thrive and grow.

UI CI team members co-taught two information systems classes, including one they helped design, featuring Iowa renewable energy, and which uses Kirkwood Community College wind turbine data.

Engaging research platforms in the use of CI-enabled work remains a challenge. The CI team will continue to reach out to Iowa NSF EPSCoR researchers at all Regent campuses. The CI team currently leverages various resources to help support Iowa NSF EPSCoR goals and related work.

Broader Impacts (BI) Platform: External Engagement and Communications Plank
Various portals and mechanisms of engagement and communication have been used effectively in reaching out to Iowa NSF EPSCoR constituents and a broader audience. Some significant accomplishments include:

- Website and social media: Twitter has been used to drive traffic to the Iowa NSF EPSCoR website. A total of 860 tweets have been crafted between April 1, 2013 and March 28, 2014, including retweets by followers. Tweetreach.com estimates tweets including the Iowa NSF EPSCoR screen name reached approximately 2,039 Twitter accounts. The website had 1,913 visitors who made 2,720 visits for a total of 8,005 pages viewed according to Google analytics. A new page was added to the Iowa NSF EPSCoR web site in 2013 to highlight diversity efforts of the Iowa NSF EPSCoR project.
- Newsletters: The subscriber list for the Iowa NSF EPSCoR email newsletter Energy Innovator increased from 804 to 890 during the last year. About 15% of the recipients used a link within the email to access an Iowa NSF EPSCoR webpage. A survey to evaluate the value of the newsletter and its impact was sent with a response rate of 23% provided positive feedback regarding content, frequency of distribution, and recommendation for additional content.
- Student Interns: Two female summer interns have started work on the project.
- Engaging the legislature: In collaboration with the EP Platform, the Year 3 Congressional briefing included separate events for the Senate and the House of Representatives in November 2013. Over 80 Congressional Aides attended the events. The Year 3 Legislators in the Lab program was held on September 5, 2013 with Representative Bobby Kaufmann and Senator Roby Smith participating. An additional event was added this year for state elected officials; on January 22, the EE team hosted an Iowa NSF
EPSCoR “Lunch and Learn” event at the Iowa State Capitol. Eight senators and representatives attended the event.

- Educational and research videos on TeacherTube (4 videos), Vimeo (11 videos), and Youtube (10 videos) have garnered a large number of views (~7000) over the past year, including 72 views by classrooms for the TeacherTube videos.
1.2d **Accomplishments: Key Outcomes or Other Achievements**

This section outlines key outcomes and achievements that were completed in the past year. Each section below includes a table of project milestones and metrics for those associated with the given platform; these tables are found at the end of each respective subsection.

**BioEnergy (BE) Platform**

The BE platform addresses strategic priorities 1.1 and 1.2; progress on these priorities is highlighted in Tables 1.2d.1 and 1.2d.2. Selected BE key outcomes to highlight this year include:

- Relationships with the UI power plant as it transitions to biomass power are under continued development. To assist with this transition, a stakeholder workshop and other statewide meetings were hosted in collaboration with Ferman Milster of UI to sign up farmers to plant 1000 acres of Miscanthus x giganteus in 2015. The UI plant is the most tangible near-term market for biomass energy in Iowa, and serves as an example project.

- An open-source computer code for simulating biomass thermochemical conversion was developed. Researchers in NREL and Oak Ridge National Lab are exploring the possibilities of adopting this code for their biomass reactor research. The code is being used by researchers at ISU to generate preliminary results for other NSF projects.

- Graduate student Chia-Cheng Lin developed a new deoxysilylation route to transform metal oxide nanoparticles into silica-coated metal sulfide, selenide, or phosphide nanoparticles in a single step (one pot process). The resulting, silica supported materials are known to be active and selective catalysts for hydrogenation and hydro-de-oxygenation of oxygenated and unsaturated substrates. Because the initial metal oxides used are based on cheap, earth abundant first row transition metals such as nickel, this material could serve as excellent replacements for expensive and scarce noble metals such as Pt and Pd in the conversion and upgrading of bio-oils.
Table 1.2d.1: **Strategic Priority 1.1:** Expand research capacity for evaluating ecosystem sustainability of bioenergy agriculture.

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Yr 1</th>
<th>Yr 2</th>
<th>Yr 3</th>
<th>Yr 4</th>
<th>Yr 5</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Establish agreements and collaborations for use of watersheds as BAER sites</td>
<td>On track</td>
<td>Done</td>
<td></td>
<td></td>
<td></td>
<td>Agreements are in place and collaborations established (Landscape Biomass and COBS - Big Creek, NSF CNH - Clear Creek.)</td>
</tr>
<tr>
<td>Train two technicians for monitoring/maintaining BAER sites</td>
<td>On track</td>
<td>Done</td>
<td></td>
<td></td>
<td></td>
<td>Big Creek is supported by a technician, Clear Creek is supported by graduate students.</td>
</tr>
<tr>
<td>Establish BAER site databases</td>
<td>Initiated</td>
<td>Done</td>
<td></td>
<td></td>
<td></td>
<td>Data base and website at UI will serve as team site.</td>
</tr>
<tr>
<td>Purchase hyper-spectral camera and develop remote sensing platforms</td>
<td>Done</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Operations and data collection began summer 2013.</td>
</tr>
<tr>
<td>Implement data base of hyperspectral imagery for BAER sites</td>
<td></td>
<td>On track</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Purchase/install stream flow, water quality, soil water, and GHG sensors</td>
<td>On track</td>
<td>On track</td>
<td>On track</td>
<td></td>
<td></td>
<td>Progressing on schedule.</td>
</tr>
<tr>
<td>Implement databases for carbon, water, nutrient, and GHG fluxes</td>
<td>On track</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preliminary data available on carbon, nutrient, water, and GHG fluxes</td>
<td>On track</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Begin remote monitoring of ecosystem changes within the BAER sites</td>
<td>Done</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Begin annual monitoring of ecosystem changes within BAER sites</td>
<td>Done</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AGRO-IBIS models parameterized watersheds</td>
<td>On track</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Involve students in research in the BAER sites</td>
<td>On track</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Students involved in research at both BAER sites.</td>
</tr>
<tr>
<td>Prepare a large-scale, inter-platform grant proposal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prepare a large-scale, grant proposal involving bioenergy faculty</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Host conference or workshop on bioenergy agriculture</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Metrics</th>
<th>Yr 1</th>
<th>Yr 2</th>
<th>Yr 3</th>
<th>Yr 4</th>
<th>Yr 5</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research Publications</td>
<td>1</td>
<td>21</td>
<td>13</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scientific Presentations</td>
<td>0</td>
<td>44</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extramural Grants Submitted</td>
<td>16</td>
<td>24</td>
<td>19</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extramural Grants Awarded</td>
<td>5</td>
<td>4</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cross-Institutional authorship of publications</td>
<td>0</td>
<td>8</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Publications &amp; presentations by junior faculty</td>
<td>1</td>
<td>50</td>
<td>25</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 1.2d.2: **Strategic Priority 1.2:** Expand capacity to perform experimental and computational studies of thermochemical biomass conversion.

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Yr 1</th>
<th>Yr 2</th>
<th>Yr 3</th>
<th>Yr 4</th>
<th>Yr 5</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purchase/install equipment in three thermochemical processing pilot plants</td>
<td>On track</td>
<td>On track</td>
<td>On track</td>
<td>On track</td>
<td>On track</td>
<td>Progressing on schedule.</td>
</tr>
<tr>
<td>Purchase/install instruments in the biomass characterization laboratory</td>
<td>On track</td>
<td>On track</td>
<td>On track</td>
<td>On track</td>
<td>On track</td>
<td>Progressing on schedule.</td>
</tr>
<tr>
<td>Instrumentation purchased/installed in laser lab for fundamental studies</td>
<td>On track</td>
<td>On track</td>
<td>On track</td>
<td>On track</td>
<td>Done</td>
<td>Progressing on schedule.</td>
</tr>
<tr>
<td>Hire post-doc researcher to develop software</td>
<td>On track</td>
<td>On track</td>
<td>On track</td>
<td>On track</td>
<td>Done</td>
<td>Model for simulating biomass thermochemical conversion developed.</td>
</tr>
<tr>
<td>First bioenergy project in cyberinfrastructure launched</td>
<td>On track</td>
<td>Done</td>
<td>Done</td>
<td>Done</td>
<td>Done</td>
<td>Open-source code released to research community, see narrative.</td>
</tr>
<tr>
<td>Second bioenergy project in cyberinfrastructure launched</td>
<td>Initiated</td>
<td>Initiated</td>
<td>Initiated</td>
<td>Initiated</td>
<td>Initiated</td>
<td>Planning and discussion under way.</td>
</tr>
<tr>
<td>Workshop conducted on integrating experimental and computational studies</td>
<td>On track</td>
<td>On track</td>
<td>On track</td>
<td>On track</td>
<td>On track</td>
<td>Planning and discussion under way.</td>
</tr>
<tr>
<td>Host conference/workshop on biomass conversion</td>
<td>On track</td>
<td>On track</td>
<td>On track</td>
<td>On track</td>
<td>On track</td>
<td>Planning and discussion under way.</td>
</tr>
<tr>
<td>At least 50% of plank faculty members engaged in industry collaborations</td>
<td>On track</td>
<td>On track</td>
<td>On track</td>
<td>On track</td>
<td>On track</td>
<td>5 grad students and 13 undergraduate students were involved in pilot plant research in Y3.</td>
</tr>
<tr>
<td>Involve students in expanded pilot plants</td>
<td>On track</td>
<td>On track</td>
<td>On track</td>
<td>On track</td>
<td>On track</td>
<td>Equipment purchased to build up research programs and student training.</td>
</tr>
<tr>
<td>Prepare a large-scale, inter-platform grant proposal</td>
<td>On track</td>
<td>On track</td>
<td>On track</td>
<td>On track</td>
<td>On track</td>
<td>Equipment purchased to build up research programs and student training.</td>
</tr>
<tr>
<td>Enter into research collaborations with PUI/CCs providing equipment to build their research infrastructure</td>
<td>Done</td>
<td>Done</td>
<td>Done</td>
<td>Done</td>
<td>Done</td>
<td>Agreements established with Indian Hills Community College, and Dordt and Central Colleges.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Metric</th>
<th>Yr 1</th>
<th>Yr 2</th>
<th>Yr 3</th>
<th>Yr 4</th>
<th>Yr 5</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research Publications</td>
<td>3</td>
<td>49</td>
<td>20</td>
<td>19</td>
<td>10</td>
<td>8</td>
</tr>
<tr>
<td>Scientific Presentations</td>
<td>26</td>
<td>40</td>
<td>48</td>
<td>49</td>
<td>54</td>
<td>56</td>
</tr>
<tr>
<td>Extramural Grants Submitted</td>
<td>19</td>
<td>64</td>
<td>69</td>
<td>71</td>
<td>74</td>
<td>76</td>
</tr>
<tr>
<td>Extramural Grants Awarded</td>
<td>5</td>
<td>11</td>
<td>24</td>
<td>26</td>
<td>28</td>
<td>30</td>
</tr>
<tr>
<td>Scientific Pilot Project Awarded</td>
<td>2</td>
<td>0</td>
<td>10</td>
<td>12</td>
<td>15</td>
<td>18</td>
</tr>
<tr>
<td>Cross-Institutional authorship of publications</td>
<td>0</td>
<td>13</td>
<td>5</td>
<td>8</td>
<td>11</td>
<td>14</td>
</tr>
<tr>
<td>Publications and presentations by junior faculty</td>
<td>9</td>
<td>75</td>
<td>58</td>
<td>60</td>
<td>62</td>
<td>64</td>
</tr>
</tbody>
</table>
Wind Energy (WE) Platform
The WE platform is responsible for strategic priorities 1.3 and 1.4. The milestones and current metrics for these strategic priorities are highlighted in Tables 1.2d.3 and 1.2d.4. Additional WE achievements to emphasize this year include:

- A new outcome from the REU class of 2013 was the result of promoting applications for major scholarships and fellowships. As an example, one REU student (Destenie Nock, an African American female student from North Carolina A&T) was encouraged to apply for prestigious interdisciplinary fellowships. Faculty mentors (Takle) supported her applications with letters of recommendation for the Mitchell, Fulbright, Marshall, and Rhodes Scholarships. As of this time, the outcomes are unknown but a process has been established and has provided a new dimension for facilitating professional development of high-achieving REU students.

- Machining-induced surface microstructural changes to wind turbine components were modeled through multi-step finite element-based models. It was shown that the machining surface integrity during hard drilling can be optimized by adjusting the process parameters.

- The process physics during laser peening were modeled using the 2D multi-physics hydrodynamic numerical model to help design the laser peening process for wind turbine components.
Table 1.2d.3: **Strategic Priority 1.3**: Advance the science of wind energy resource characterization, optimal multi-turbine performance and effective energy delivery.

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Yr 1</th>
<th>Yr 2</th>
<th>Yr 3</th>
<th>Yr 4</th>
<th>Yr 5</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Install instrumented tall towers</td>
<td>On Track</td>
<td>On Track</td>
<td></td>
<td></td>
<td></td>
<td>Consultant engaged Y1, sites identified, land contracts under negotiation.</td>
</tr>
<tr>
<td>Complete construction of first tower, acquire lease for second, complete construction of second tower by end of Y3</td>
<td></td>
<td>On track</td>
<td></td>
<td></td>
<td></td>
<td>The first tower will be constructed this summer. Lease acquisition for second tower ongoing, with construction of the second tower likely starting this fall.</td>
</tr>
<tr>
<td>One multi-month dataset on characteristics of the low-level jet</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>This will be achieved once wind towers are installed and operating.</td>
</tr>
<tr>
<td>Multiple test cases available for model validation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acquire Windcube</td>
<td>Delayed</td>
<td>Not needed</td>
<td></td>
<td></td>
<td></td>
<td>Not needed in Y1 because a unit was brought to CWEX by CU/NREL. With the anticipated installation of the two wind towers, the unit will not be needed.</td>
</tr>
<tr>
<td>Archive one month of data from tower and Windcube</td>
<td>On track</td>
<td>Done</td>
<td></td>
<td></td>
<td></td>
<td>Data from CU/NREL unit archived.</td>
</tr>
<tr>
<td>One complete year of wind climate data publicly available in the archive by Y4</td>
<td></td>
<td></td>
<td>On track</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Archive and disseminate multiple years of data</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conduct annual multi-institutional field campaign</td>
<td>Delayed to 2013</td>
<td>Done</td>
<td>On track</td>
<td></td>
<td></td>
<td>Planning for field campaign in progress.</td>
</tr>
<tr>
<td>One test case available in IEA WAKEBENCH for model validation</td>
<td></td>
<td></td>
<td>On track</td>
<td></td>
<td></td>
<td>Dataset is being used by NREL, PNNL and LLNL, IEA has not adopted yet, discussions will take place this summer.</td>
</tr>
<tr>
<td>Establish wind data archive and have inaugural data sets publicly available</td>
<td>On track</td>
<td>Done</td>
<td></td>
<td></td>
<td></td>
<td>Data available from NCAR used by junior faculty. Additional data archived and available from IA Env Mesonet.</td>
</tr>
<tr>
<td>Expand archive with CWEX 13 data, facilitate access to data</td>
<td></td>
<td>On track</td>
<td></td>
<td></td>
<td></td>
<td>CWEX-13 data is being archived, with some data now being used for publications.</td>
</tr>
<tr>
<td>Multiple modeling groups providing CWEX data</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CWEX data provided for classes, theses</td>
<td>Ongoing</td>
<td>Ongoing</td>
<td></td>
<td></td>
<td></td>
<td>See narrative.</td>
</tr>
<tr>
<td>Hold international conference on windfarm model simulation and validation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Metric</th>
<th>Yr 1</th>
<th>Yr 2</th>
<th>Yr 3</th>
<th>Yr 4</th>
<th>Yr 5</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research Publications</td>
<td>0</td>
<td>6</td>
<td>9</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Scientific Presentations</td>
<td>5</td>
<td>7</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extramural Grants Submitted</td>
<td>13</td>
<td>12</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extramural Grants Awarded</td>
<td>0</td>
<td>3</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cross-Institutional authorship of publications</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Publications and presentations by junior faculty</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 1.2d.4: **Strategic Priority 1.4**: Optimize wind energy economics to compete with fossil fuels through engineering advancements in turbine reliability, manufacturability, and maintainability, and delivery of energy to grid.

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Yr 1</th>
<th>Yr 2</th>
<th>Yr 3</th>
<th>Yr 4</th>
<th>Yr 5</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assess state of the art models for management of generation and</td>
<td>Done</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>distribution of wind energy and renewable energy.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Develop risk-based stochastic optimization models to quantify effects</td>
<td></td>
<td></td>
<td></td>
<td>Done</td>
<td></td>
<td></td>
</tr>
<tr>
<td>of uncertainties on performance of energy supply chain.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Design optimal curtailment curves for wind generators.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Develop a multistate flow network model for renewable energy supply</td>
<td>On Track</td>
<td>Done</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>chain.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Develop distributed algorithms for voltage and frequency regulation</td>
<td></td>
<td></td>
<td>Piecewise linear</td>
<td>Piecewise linear</td>
<td>Distributed algorithms</td>
<td></td>
</tr>
<tr>
<td>with piecewise linear cost functions and inter-generator</td>
<td></td>
<td></td>
<td>cost and</td>
<td>cost and</td>
<td>for voltage and</td>
<td></td>
</tr>
<tr>
<td>communications.</td>
<td></td>
<td></td>
<td>intergenera-</td>
<td>intergenera-</td>
<td>frequency regulation</td>
<td></td>
</tr>
<tr>
<td>Develop methods for demand shaping</td>
<td></td>
<td></td>
<td>tion</td>
<td>tion</td>
<td>completed in Y2.</td>
<td></td>
</tr>
<tr>
<td>Generalize loss-of-load-probability metrics to account for generation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>variability.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Design distributed algorithms for voltage and frequency regulation and</td>
<td>Done</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>control with no inter-generator communication.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Develop and code discrete-event simulation models for wind</td>
<td></td>
<td></td>
<td>On track</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>energy supply chain.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Study the effects of storage and load management techniques on reserve</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>requirements.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Develop wind load uncertainty model and wind turbine blade model for</td>
<td></td>
<td></td>
<td></td>
<td>Done</td>
<td></td>
<td></td>
</tr>
<tr>
<td>fatigue analysis.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Demonstrate RBDO methodology on blade and hub.</td>
<td></td>
<td></td>
<td>On track</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Develop optimization algorithm based on surrogate model.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Design and construct recirculating wind tunnel and precision scale wind</td>
<td>On Track</td>
<td>On track</td>
<td>On track</td>
<td></td>
<td></td>
<td>Design finished; construction underway, expected to be completed by this</td>
</tr>
<tr>
<td>turbine for experimental studies.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>July.</td>
</tr>
<tr>
<td>Enhance blade performance laboratory at UI. Performed flow</td>
<td></td>
<td></td>
<td>On track</td>
<td></td>
<td></td>
<td>Blade performance laboratory enhancement completed; measurements and</td>
</tr>
<tr>
<td>measurements and simulations on isolated wind turbine models and tandem</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>simulations ongoing.</td>
</tr>
<tr>
<td>configurations.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dynamic simulations of wind turbines informed by experimental results.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Develop multiscale blade damage model.</td>
<td>On track</td>
<td>On track</td>
<td>Done</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Develop computational code blade damage initiation and propagation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Validate models developed in previous years.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Task</td>
<td>Year 1</td>
<td>Year 2</td>
<td>Year 3</td>
<td>Year 4</td>
<td>Year 5</td>
<td>Comments</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Develop multiscale model of gear teeth failure.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Done</td>
</tr>
<tr>
<td>Conduct RBDO of gear box bearing and teeth under aerodynamic loads</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Done</td>
</tr>
<tr>
<td>New: Develop material processes to improve manufacturability and maintainability</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Done</td>
</tr>
<tr>
<td>New: Conduct pilot tests and develop models for finished part integrity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>On track</td>
</tr>
<tr>
<td>New: Improve the processes with models</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Develop wind energy drivetrain modeling and simulation code</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Done</td>
</tr>
<tr>
<td>Integrate the drivetrain simulation code with RBDO with wind load and geometry uncertainties. Demonstrate RBDO methodology on turbine drivetrain</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>On track</td>
</tr>
<tr>
<td>Conduct RBDO of wind turbine drivetrain</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At least 50% of plank faculty members engaged in industry collaborations</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>On track</td>
</tr>
<tr>
<td>Continued industrial engagement by plank faculty</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Metric</th>
<th>Yr 1</th>
<th>Yr 2</th>
<th>Yr 3</th>
<th>Yr 4</th>
<th>Yr 5</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research Publications</td>
<td>15</td>
<td>14</td>
<td>32</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scientific Presentations</td>
<td>6</td>
<td>20</td>
<td>22</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extramural Grants Submitted</td>
<td>17</td>
<td>15</td>
<td>16</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extramural Grants Awarded</td>
<td>3</td>
<td>3</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Publications and presentations by junior faculty</td>
<td>7</td>
<td>26</td>
<td>37</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Energy Utilization (EU) Platform

The EU platform is focused on strategic priorities 1.5 and 1.6; Tables 1.2d.5 and 1.2d.6 summarize progress on these priorities during Year 3. Selected highlights include:

- A large number of national and international research presentations were presented by ISU undergraduate research assistants working with Passe.
- Based on knowledge gained through the Iowa NSF EPSCoR project, Passe was awarded an interdisciplinary NSF EFRI EAGER grant and is collaborating with colleagues at Harran University in Turkey.

Table 1.2d.5: **Strategic Priority 1.5**: Utilize community-level laboratories to determine whether or not social marketing interventions can change energy conservation knowledge, attitudes and behaviors.

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Yr 1</th>
<th>Yr 2</th>
<th>Yr 3</th>
<th>Yr 4</th>
<th>Yr 5</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Three communities and partnering community colleges/four-year colleges selected</td>
<td>Done</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Communities: Charles City, LeMars, and Oskaloosa; Colleges: Hawkeye CC, Western Iowa Technical CC, Wartburg College and Buena Vista University.</td>
</tr>
<tr>
<td>CSBR Summer Minority Internship Developed</td>
<td>Done</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Focus groups, interviews and pretest surveys completed</td>
<td>On Track</td>
<td>Done</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intervention Materials Developed</td>
<td>On Track</td>
<td>Done</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Materials and media buys in place in communities</td>
<td>On Track</td>
<td>Done</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intervention events completed</td>
<td>Done</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Completed August, 2013.</td>
</tr>
<tr>
<td>Energy Audit follow-up completed</td>
<td>Done</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Completed August, 2013.</td>
</tr>
<tr>
<td>Posttest Interviews Completed</td>
<td>Done</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Survey and audit interviews completed</td>
<td></td>
<td>On track</td>
<td></td>
<td></td>
<td></td>
<td>Audit interviews ongoing.</td>
</tr>
<tr>
<td>Sales and energy data collected and analyzed</td>
<td></td>
<td>On track</td>
<td></td>
<td></td>
<td></td>
<td>Data collected, analysis ongoing.</td>
</tr>
<tr>
<td>Grant Proposal Developed with Junior Faculty</td>
<td></td>
<td>On track</td>
<td></td>
<td></td>
<td></td>
<td>Proposal development plans initiated.</td>
</tr>
</tbody>
</table>

Table 1.2d.6: Metric

<table>
<thead>
<tr>
<th>Metric</th>
<th>Yr 1</th>
<th>Yr 2</th>
<th>Yr 3</th>
<th>Yr 4</th>
<th>Yr 5</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collaborative Agreements with 4-Year Colleges &amp; Community Colleges Established</td>
<td>3</td>
<td>0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Scientific Presentations</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extramural Grants Submitted</td>
<td>1</td>
<td>4</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extramural Grants Awarded</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Female and URM Students Participating in Plank</td>
<td>2</td>
<td>6</td>
<td>2</td>
<td></td>
<td></td>
<td>2 Female, URM students participating as summer interns.</td>
</tr>
<tr>
<td>Publications and presentations by junior faculty</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 1.2d.6: **Strategic Priority 1.6**: Study the relationship between building science, design, and human behavior in existing structures in Iowa.

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Yr 1</th>
<th>Yr 2</th>
<th>Yr 3</th>
<th>Yr 4</th>
<th>Yr 5</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Establish data acquisition system and performance evaluation baseline of</td>
<td>On track</td>
<td>Done</td>
<td></td>
<td></td>
<td></td>
<td>Interlock House established as working community laboratory August 2013.</td>
</tr>
<tr>
<td>Interlock House as community lab</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evaluate Interlock House data</td>
<td></td>
<td></td>
<td>On track</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Establish field laboratory with one middle school/high school</td>
<td>On Track</td>
<td>Done</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Establish two field laboratories to study energy efficiency in building</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>structures and construction processes with outreach to K-12 STEM education</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>projects</td>
<td></td>
<td></td>
<td>On track</td>
<td></td>
<td></td>
<td>Projects: Energy Efficient Transformation of Faculty Cottage at IA Lakeside Laboratory; Field based small town IA residential building energy loss study.</td>
</tr>
<tr>
<td>Establish Baseline reporting parameters</td>
<td>On Track</td>
<td>On track</td>
<td>Done</td>
<td></td>
<td></td>
<td>Baseline data collected and reported for Y2 and Y3 for interlock house.</td>
</tr>
<tr>
<td>Multiple calibrated design models and simulations completed</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evaluation strategies developed</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Detailed in narrative.</td>
</tr>
<tr>
<td>Metric</td>
<td>Yr 1</td>
<td>Yr 2</td>
<td>Yr 3</td>
<td>Yr 4</td>
<td>Yr 5</td>
<td>Comments</td>
</tr>
<tr>
<td>Research Publications</td>
<td>0</td>
<td>2</td>
<td>11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scientific Presentations</td>
<td>7</td>
<td>6</td>
<td>23</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extramural Grants Submitted</td>
<td>5</td>
<td>10</td>
<td>17</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extramural Grants Awarded</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cross-Institutional authorship of publications</td>
<td>0</td>
<td>3</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of undergraduate students involved in building science research</td>
<td>24</td>
<td>29</td>
<td>38</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>and/or independent study projects</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of graduate students involved in building science research and/or</td>
<td>6</td>
<td>6</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>independent study projects</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Publications and Presentations by Junior Faculty</td>
<td>7</td>
<td>8</td>
<td>22</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The milestones and current metrics for the EP platform address strategic priorities 1.7 and 1.8; they are summarized in Tables 1.2d.7 and 1.2d.8. Highlights from Year 3 include:

- Several new faculty became involved in energy policy research through seed grants.
- The six biofuel policy briefs released this reporting period have been downloaded as PDF files over 4,600 times.
- Iowa NSF EPSCoR began collaborating with the UI Public Policy Center and provided support for a symposium on Iowa Extreme Weather that was held December 11, 2013. A renewable energy symposium will be co-sponsored in Fall 2014.
Table 1.2d.7: **Strategic Priority 1.7**: Advance integrated engineering/economic modeling to project the impact of federal, state, and local policies on renewable energy markets, technology design and deployment.

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Yr 1</th>
<th>Yr 2</th>
<th>Yr 3</th>
<th>Yr 4</th>
<th>Yr 5</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post-doc from engineering hired to support platform</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Establish and run a regular seminar series</td>
<td>On track</td>
<td>Established</td>
<td></td>
<td></td>
<td></td>
<td>Seminar series offered F12-S13, available as webinars.</td>
</tr>
<tr>
<td>Run a regular seminar series where research results are presented and discussed</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Most seminars offered for viewing online <a href="http://iowaepscor.org/research/energy/policy/seminars">http://iowaepscor.org/research/energy/policy/seminars</a></td>
</tr>
<tr>
<td>Establish and deliver energy policy graduate course</td>
<td>On track</td>
<td>Done</td>
<td></td>
<td></td>
<td></td>
<td>Courses developed: BRT515x - Energy Policy; BRT516x - International Energy Policy.</td>
</tr>
<tr>
<td>Offer energy policy course</td>
<td></td>
<td>Ongoing</td>
<td></td>
<td></td>
<td></td>
<td>BRT515x was offered in F13; BRT516x was offered in S14.</td>
</tr>
<tr>
<td>Develop a market modeling framework integrating economic and engineering analyses</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Develop new methods to solve stochastic models and communicate results within the modeling framework</td>
<td></td>
<td>Ongoing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evaluate the economic and technical feasibility of new renewable energy technologies</td>
<td>On going</td>
<td>On going</td>
<td>Ongoing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Provide stipends for faculty to travel/participate in interdisciplinary workshops and conferences</td>
<td>Done</td>
<td>Done</td>
<td></td>
<td></td>
<td></td>
<td>Described in narrative.</td>
</tr>
<tr>
<td>Provide stipends for faculty to develop interdisciplinary (engineering/economics) teams and grant applications</td>
<td>Done</td>
<td>Done</td>
<td></td>
<td></td>
<td></td>
<td>In addition to travel support, 7 seed grants were awarded, see narrative.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Metric</th>
<th>Yr 1</th>
<th>Yr 2</th>
<th>Yr 3</th>
<th>Yr 4</th>
<th>Yr 5</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research Publications</td>
<td>2</td>
<td>11</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scientific Presentations</td>
<td>1</td>
<td>21</td>
<td>18</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extramural Grants Submitted</td>
<td>3</td>
<td>27</td>
<td>18</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extramural Grants Awarded</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of students taking policy classes</td>
<td>0</td>
<td>39</td>
<td>34</td>
<td></td>
<td></td>
<td>14 students in BRT 515X; 20 students in BRT 516X.</td>
</tr>
<tr>
<td>Number of faculty participating in workshops/seminars</td>
<td>2</td>
<td>32</td>
<td>40</td>
<td></td>
<td></td>
<td>83 total non-EPSCoR faculty, staff, graduate students and postdocs attended through the year.</td>
</tr>
<tr>
<td>On-campus seminars held</td>
<td>0</td>
<td>6</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cross-disciplinary authorship of publications</td>
<td>0</td>
<td>9</td>
<td>2</td>
<td></td>
<td></td>
<td>Joint publications by BE and EP.</td>
</tr>
<tr>
<td>Presentations by junior faculty at scientific conferences</td>
<td>3</td>
<td>9</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conferences held</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 1.2d.8: **Strategic Priority 1.8**: Analyze market and technology deployment impacts of policies designed to promote RE and communicate results to the public, federal and state legislators and regulators.

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Yr 1</th>
<th>Yr 2</th>
<th>Yr 3</th>
<th>Yr 4</th>
<th>Yr 5</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use the newly-developed integrated modeling framework to conduct analysis of proposed policies and new technologies and publish web-based reports on findings</td>
<td>Done</td>
<td>Done</td>
<td>Done</td>
<td></td>
<td></td>
<td>Described in narrative.</td>
</tr>
<tr>
<td>Brief legislators and regulators as requested as to the technical and economic feasibility of new renewable energy technologies</td>
<td>Done</td>
<td>Delayed</td>
<td>Done</td>
<td></td>
<td></td>
<td>US Congressional briefings in Washington DC for the House November 12, 2013 and the Senate Nov 14, 2013 – details in narrative.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Metric</th>
<th>Yr 1</th>
<th>Yr 2</th>
<th>Yr 3</th>
<th>Yr 4</th>
<th>Yr 5</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Legislative/Congressional Public Briefings</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td></td>
<td></td>
<td>See narrative</td>
</tr>
<tr>
<td>Updates of web-based outlook information</td>
<td>2</td>
<td>4*</td>
<td>6</td>
<td></td>
<td></td>
<td>*Updated # of Y2 outlooks</td>
</tr>
</tbody>
</table>
Broader Impacts (BI) Platform
The strategic priorities of the BI platform focus on 1.9, 2.1, 2.2, 3.1, 3.2, 4.1, and 5.1. Tables 1.2d.9 – 1.2d.14, found at the end of this subsection, summarize the milestones and current metrics for the BI platform. Additional outcomes and achievements to highlight for Year 3 are summarized below.

• Faculty development programs became decentralized to enable better development and delivery of programs at each Regent institution to allow facilitators to focus on the needs of a given location.
• Best practices for recruitment of diverse faculty were shared among the Regent institutions.
• Over 600 female and URM students were engaged in more than 20 STEM related outreach activities this past year.
• Leveraging Iowa NSF EPSCoR BI activities at UI, a SLOAN UCEM has been established to facilitate development of graduate students and faculty mentors to increase diversity presently in STEM graduate departments and ultimately in the professoriate.
• Over the last year, more than seventy-five K-12 instructors received professional development training in the areas of bio-renewables via the ISU Summer Academy and in energy utilization and efficiency via UNI’s Energy Institute. As a result of these training opportunities, over 7,500 K-12 students have been exposed to the subject of finite energy sources to support the U.S. standard of living and how the State of Iowa is addressing the shortfall by creating and implementing an extensive bio-based industry. These activities continue to provide STEM focus to K-12 students and will help strengthen workforce in these areas for the future.
• The Energy Systems minor at ISU added 15 students to the program for a total of 29 students enrolled. Of these 29 students, 9 graduated with the minor in Year 3.
• A coursework-only Masters of Engineering degree in Energy Systems at ISU was approved by the Iowa Board of Regents in Spring 2014. A graduate certificate in Energy Systems was approved by ISU in Fall 2013; 2 distance students are currently enrolled in the new certificate program.
• The student team of Suncica Jasarovic (UE platform), Chloe Dedic (BE platform), and Bernardo Del Campo (BE platform) won the NSF EPSCoR Science Idol competition at the National NSF EPSCoR conference in Nashville, TN, in November 2013.
Table 1.2d.9: **Strategic Priority 1.9:** Implement coordinated multi-institutional human resource development activities for assisting with the recruitment and mentoring of early career tenure-track faculty for RE/EE research and education capacity.

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Yr 1</th>
<th>Yr 2</th>
<th>Yr 3</th>
<th>Yr 4</th>
<th>Yr 5</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Establish the FLARE Institute: hire staff; establish Advisory Board. New in Y3: Review concept, move to Decentralize leadership</td>
<td>Done</td>
<td>Done</td>
<td>Transformed</td>
<td></td>
<td></td>
<td>Decision was made that each University would build on their individual strengths in faculty development; this change was approved in our revised strategic plan.</td>
</tr>
<tr>
<td>Diversity taskforce provides resources to help search committees reach women and URM candidates.</td>
<td>Being developed</td>
<td>On track</td>
<td>On track</td>
<td></td>
<td></td>
<td>ISU Diversity team members presented to UI and UNI faculty search committees on best practices for diversity hiring.</td>
</tr>
<tr>
<td>Coordinate plans across the Regent Institutions and hire new faculty members</td>
<td>Done</td>
<td>Done</td>
<td></td>
<td></td>
<td></td>
<td>Plans for RE/EU faculty completed as part of the final negotiation for the grant - 3 faculty hired in Y1 started work in Y2; 3 new faculty hires in Y2 started work in Y3.</td>
</tr>
<tr>
<td>Engage additional faculty through seed grants</td>
<td></td>
<td></td>
<td>On track</td>
<td></td>
<td></td>
<td>Several seed grants made to faculty at the three regent universities- see narrative.</td>
</tr>
<tr>
<td>BI leaders provide appropriate mentoring and professional development programs for new faculty</td>
<td>On track</td>
<td>On track</td>
<td></td>
<td></td>
<td></td>
<td>Various professional development programs offered during Year #3.</td>
</tr>
<tr>
<td>Plan and implement professional development programs for researchers, post-docs, and graduate students</td>
<td>Done</td>
<td>Done</td>
<td>On track</td>
<td></td>
<td></td>
<td>Various professional development programs offered during Year #3.</td>
</tr>
<tr>
<td>Catalog existing BI related programs at Regent institutions</td>
<td>Done</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collect and analyze data on BI programs; modify programs as needed</td>
<td></td>
<td></td>
<td>On track</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gather information/data on the successes and the challenges faced by existing BI programs to identify strategies appropriate for Iowa</td>
<td>Ongoing</td>
<td>Ongoing</td>
<td></td>
<td></td>
<td></td>
<td>Started collaborating with a subset of BI programs at all 3 campuses in Y2, will continue to gather data.</td>
</tr>
<tr>
<td>Disseminate lessons learned at Iowa and best practices across the state and EPSCoR jurisdictions</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collaborate with the NSF I-3, ADVANCE programs and other BI related programs at Regent institutions</td>
<td>On track</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Best Practices from SP@ISU (NSF I-3 program) and ADVANCE documented, available Fall 2013.</td>
</tr>
<tr>
<td>Disseminate best practices nationally.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metric</td>
<td>Yr 1</td>
<td>Yr 2</td>
<td>Yr 3</td>
<td>Yr 4</td>
<td>Yr 5</td>
<td>Comments</td>
</tr>
<tr>
<td>-----------------------------------------------------------------------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>--------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Number of new faculty hired in RE/EU platforms.</td>
<td>5</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>Updated Y2 number: New hire in WE Platform (ISU) started Jan 2014. New BE and EU hires at UNI started Fall 2013.</td>
</tr>
<tr>
<td>Women faculty in RE/EE platforms.</td>
<td>14</td>
<td>13</td>
<td>24</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>URM faculty in RE/EE platforms.</td>
<td>2</td>
<td>3</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number faculty development programs offered</td>
<td>10</td>
<td>18</td>
<td>18</td>
<td></td>
<td></td>
<td>See narrative.</td>
</tr>
<tr>
<td>Number of non-Regent Institutions in Iowa that connect with Iowa NSF EPSCoR.</td>
<td>3</td>
<td>13</td>
<td>19</td>
<td></td>
<td></td>
<td>Includes Iowa’s 15 CCs, Dordt, Central, Coe and Grinnell Colleges.</td>
</tr>
<tr>
<td>Number of non-Iowa institutions that connect with or communicate with Iowa NSF EPSCoR for purposes of dissemination</td>
<td>0</td>
<td>1</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percentage of EPSCoR faculty, post-docs, graduate students who attend development programs</td>
<td>50%</td>
<td>65%</td>
<td>70%</td>
<td></td>
<td></td>
<td>At least one attendance at a development program, including the annual meeting.</td>
</tr>
</tbody>
</table>
Table 1.2d.10: **Strategic Priority 2.1** (maps to outcomes A, C and D): Increase participation of women and underrepresented minorities (URMs) in STEM, especially in RE/EU fields through the coordination of statewide, multi-institutional efforts.

**Strategic Priority 2.2** (maps to outcomes B, C and D): Coordinate resources to help faculty, staff, and students create a more welcoming environment with sustainable support systems for success of women and URMs in affected programs.

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>Yr 1</th>
<th>Yr 2</th>
<th>Yr 3</th>
<th>Yr 4</th>
<th>Yr 5</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A Catalog existing Diversity related programs at the Regent universities (including education and outreach)</td>
<td>On track</td>
<td>Done</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A Identify a subset of the cataloged programs that EPSCoR can work with to leverage and maximize impact</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A Continue collaborating with other BI related programs at related institutions</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A Increase participation of female and URM students in EPSCoR supported programs.</td>
<td>In progress</td>
<td>In progress</td>
<td>In progress</td>
<td></td>
<td>Recruitment efforts ongoing.</td>
<td></td>
</tr>
<tr>
<td>A Disburse/award matching support for CC and UG STEM research interns</td>
<td>Done</td>
<td>Done</td>
<td></td>
<td></td>
<td>On track</td>
<td></td>
</tr>
<tr>
<td>A Expand RE/EU research internship programs for community college and undergraduate students.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>On track</td>
<td></td>
</tr>
<tr>
<td>A Establish appropriate indicators and benchmarking data to represent information about participation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Initiated</td>
<td></td>
</tr>
<tr>
<td>A Refine and utilize indicators and benchmarking data to inform progress in participation of women and URMs in EPSCoR programs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A Catalog resources to help search committees in reaching qualified female and URM applicants via ISU ADVANCE and other related initiatives</td>
<td>On track</td>
<td>Done</td>
<td></td>
<td></td>
<td></td>
<td>Diversity team collaborated with ISU ADVANCE to provide training to UI and UNI in F2013, see narrative.</td>
</tr>
<tr>
<td>A Provide search committee training to positively impact efforts to recruit highly qualified women and URM applicants</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>On track</td>
<td></td>
</tr>
<tr>
<td>A Search committees across the state use the resources developed by the Diversity team in their hiring practices and processes to reach qualified women and URM applicants</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B Catalog existing STEM education and outreach programs (diversity and WFD) across the jurisdiction</td>
<td>On Track</td>
<td>Done</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B Inform programs of evidence-based practices to promote effectiveness and success. Establish appropriate indicators and benchmarking data for to represent information about participation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Initiated</td>
<td></td>
</tr>
<tr>
<td>B Programs utilize evidence-based practices and measure progress</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>Network with a subset of existing diversity related program leaders to learn about their needs and ways to engage them</td>
<td>Done</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>Leverage existing programs to increase quantity of participants or extent to which change is achieved</td>
<td>Initiated</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>Provide NCBI and/or other training workshops for interested project faculty, staff, and students.</td>
<td>Done Done Done</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>Implementation of review processes for Iowa NSF EPSCoR programs and expected program specific diversity goals</td>
<td>Initiated</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>Programs show evidence of sustainable practices in moving towards attainment of diversity goals.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>Establish appropriate indicators and benchmarking data for various stakeholder programs</td>
<td>Initiated</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>Refine and utilize indicators and benchmarking data to inform progress in programs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B, D</td>
<td>Implementation of a process that compiles and reviews results from existing climate/attitude surveys conducted by constituents and from new assessments</td>
<td>Initiated</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B, D</td>
<td>Use of process to measure change in overall climate/attitudes across jurisdiction to the best extent possible</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 1.2d.11: **Strategic Priority 3.1**: Create innovative and transformative approaches to educate the future workforce necessary to strengthen the state’s leadership in renewable energy and energy utilization.

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Yr 1</th>
<th>Yr 2</th>
<th>Yr 3</th>
<th>Yr 4</th>
<th>Yr 5</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Develop K-12 Professional Development (PD) training materials</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Annual summer academies and workshops offered by ISU and UNI, see narrative.</td>
</tr>
<tr>
<td>Provide PD training for K-12 educators</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Engagement by PLTW D/I Implementation Coach, see narrative.</td>
</tr>
<tr>
<td>Develop and provide appropriate PD programs for CC instructors</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Engagement by PLTW D/I Implementation Coach, see narrative.</td>
</tr>
<tr>
<td>Provide student summer and academic year research experiences, directly and/or by leverage of other programs.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>23 summer interns participating across all three regent institutions.</td>
</tr>
<tr>
<td>Provide opportunities for interested community college instructors to have summer research experiences at Regent Institutions</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Several opportunities provided in Y2. Feedback indicated that this was not viable/feasible as support goal transformed in Y3.</td>
</tr>
<tr>
<td>Provide assistance to Community Colleges for pedagogy and curriculum development as needed. Provide partnership support in pursuing external grants</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Feedback from community colleges indicated that they preferred this kind of engagement. See narrative.</td>
</tr>
<tr>
<td>Students enroll in Energy Systems undergraduate minor at ISU. First students complete minor in Y3-4</td>
<td>On track</td>
<td>Ongoing</td>
<td>Ongoing</td>
<td></td>
<td></td>
<td>9 students graduated with minor in Spring 2014 (Y3).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Metric</th>
<th>Yr 1</th>
<th>Yr 2</th>
<th>Yr 3</th>
<th>Yr 4</th>
<th>Yr 5</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of K-12 teachers participating in RE/EU PD training</td>
<td>160</td>
<td>231</td>
<td>421</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of students impacted each year by K-12 teachers receiving RE/EU PD training</td>
<td>14,560</td>
<td>28,875</td>
<td>40,580</td>
<td></td>
<td></td>
<td>Estimate 20 students reached by Elem. Teachers, 100 by MS/HS teacher.</td>
</tr>
<tr>
<td>Schools audited by RE/EU PD training teachers</td>
<td>15</td>
<td>12</td>
<td>12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RE/EU lesson plans by RE/EU PD training teachers</td>
<td>--</td>
<td>31</td>
<td>46</td>
<td></td>
<td></td>
<td>Lesson plans developed by Summer Academy and Energy Institute participants.</td>
</tr>
<tr>
<td>Students Participating in RE undergraduate minor at ISU</td>
<td>0</td>
<td>14</td>
<td>29</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 1.2d.12: **Strategic Priority 3.2**: Expand the Iowa workforce that is technically qualified to support the growing renewable energy and energy efficiency sectors.

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Yr 1</th>
<th>Yr 2</th>
<th>Yr 3</th>
<th>Yr 4</th>
<th>Yr 5</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hire PLTW Implementation/Diversity Coach.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complete d Summer 2012</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PLTW coach visits high-need PLTW secondary schools and community college PLTW directors</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Worked with 69+ schools for program improvement and future implementation.</td>
</tr>
<tr>
<td>Ongoing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increase in the number of PLTW affiliated schools.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>25 new secondary schools added in Y3.</td>
</tr>
<tr>
<td>On track</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increase diversity of PLTW course participants</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>See narrative.</td>
</tr>
<tr>
<td>On track</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Metric</th>
<th>Yr 1</th>
<th>Yr 2</th>
<th>Yr 3</th>
<th>Yr 4</th>
<th>Yr 5</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLTW secondary schools visited by D/I Coach</td>
<td>5</td>
<td>52</td>
<td>8</td>
<td></td>
<td></td>
<td>Reflection of establishment of STEM hubs by state, which help with physical visits. D/I Coach additionally helped 22 principals and 43 teachers via phone/email.</td>
</tr>
<tr>
<td>New PLTW secondary schools added to state network</td>
<td>14</td>
<td>32</td>
<td>26</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percentage females in PLTW courses</td>
<td>15.4%</td>
<td>16.1%</td>
<td>18.2%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of community college teachers participating in PLTW</td>
<td>3</td>
<td>21</td>
<td>44</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 1.2d.13: **Strategic Priority 4.1:** Facilitate communication between various constituencies within the Iowa jurisdiction, outside the Iowa jurisdiction, and at the state and federal government level.

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Yr 1</th>
<th>Yr 2</th>
<th>Yr 3</th>
<th>Yr 4</th>
<th>Yr 5</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>NSF EPSCoR Renewable Energy web hub established with initial content;</td>
<td>Done</td>
<td>Done</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extend web outreach and involvement</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monthly additions to web site on platforms; Increased traffic on website</td>
<td>Done</td>
<td>Done</td>
<td>On track</td>
<td></td>
<td></td>
<td>Diversity tab added to website.</td>
</tr>
<tr>
<td>from previous year; Y3: Add new diversity tab</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Create/subscribe users to Iowa EPSCoR newsletter</td>
<td>Done</td>
<td>Ongoing</td>
<td>Ongoing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hire, train, and utilize student journalists</td>
<td>Done</td>
<td>Done</td>
<td>On track</td>
<td></td>
<td></td>
<td>Graduate student involved year round, summer interns engaged starting 5/2014.</td>
</tr>
<tr>
<td>Core “talking points” developed and shared with Iowa EPSCoR faculty</td>
<td>Done</td>
<td>Done</td>
<td>On track</td>
<td></td>
<td></td>
<td>Will be shared at the Annual meeting 7/2014.</td>
</tr>
<tr>
<td>Conduct one workshop for federal congressional staff in Years 1, 3, 5</td>
<td>Done</td>
<td>Done</td>
<td></td>
<td></td>
<td></td>
<td>Separate workshops for House and Senate held 11/12 and 11/13, 2014.</td>
</tr>
<tr>
<td>Two state legislators/year participate in “legislators in the lab”</td>
<td>Done</td>
<td>Delayed</td>
<td>Done</td>
<td></td>
<td></td>
<td>Legislators in lab held 9/5/2013; EPSCoR presentation to State legislators at Lunch and Learn in the Capitol on 1/22/2014.</td>
</tr>
<tr>
<td>Conduct annual meeting</td>
<td>Done</td>
<td>Done</td>
<td>On track</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Metric</th>
<th>Yr 1</th>
<th>Yr 2</th>
<th>Yr 3</th>
<th>Yr 4</th>
<th>Yr 5</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iowa NSF EPSCoR web site hits</td>
<td>1,124</td>
<td>6,000</td>
<td>2720</td>
<td></td>
<td></td>
<td>(January-March 2014)-see narrative.</td>
</tr>
<tr>
<td>Iowa NSF EPSCoR newsletters developed</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td></td>
<td>3rd</td>
<td>newsletter to come out this summer.</td>
</tr>
<tr>
<td>Iowa NSF EPSCoR newsletter subscriptions</td>
<td>0</td>
<td>632</td>
<td>864*</td>
<td></td>
<td></td>
<td>*as of April, 2014</td>
</tr>
<tr>
<td>Embedded journalists (# students)</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Embedded journalists (# articles)</td>
<td>6</td>
<td>9</td>
<td>12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Talking points</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elected officials and State Legislators in the lab</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Workshops for federal congressional aides</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Workshop attendees (federal congressional aides)</td>
<td>34</td>
<td>0</td>
<td>80</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Annual meeting (internal participants- faculty and staff)</td>
<td>73</td>
<td>78</td>
<td>75**</td>
<td></td>
<td></td>
<td>**Estimate</td>
</tr>
<tr>
<td>Annual meeting (student participants)</td>
<td>60</td>
<td>59</td>
<td>60**</td>
<td></td>
<td></td>
<td>**Estimate</td>
</tr>
<tr>
<td>Annual meeting (external participants)</td>
<td>37</td>
<td>21</td>
<td>25**</td>
<td></td>
<td></td>
<td>**Estimate</td>
</tr>
</tbody>
</table>
Table 1.2d.14: **Strategic Priority 5.1:** Support overall project goals by providing connectivity, access, and CI-related training for EPSCoR members, educators, and industry partners.

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Yr 1</th>
<th>Yr 2</th>
<th>Yr 3</th>
<th>Yr 4</th>
<th>Yr 5</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hire two CI technical staff (one at ISU and one at UI).</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Done</td>
</tr>
<tr>
<td>Develop comprehensive Iowa EPSCoR website.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Develop an open-source suite for computational and theoretical models, for research platforms</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Establish connections among Regent institutions using existing facilities</td>
<td>On Track</td>
<td>Done</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Identify and establish a community of CI users (researchers, staff and students) in RE/EU</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>On Track</td>
</tr>
<tr>
<td>Grow the community of CI users (researchers, staff, and students) in RE/EU</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Implement training programs to interface HPC with the scientific community</td>
<td>In progress</td>
<td>Done</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Develop and implement training materials for CI resources as needed</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>On Track</td>
</tr>
<tr>
<td>Link sensors from across the state that measure climatic, environmental, and ecological data</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Done</td>
</tr>
<tr>
<td>Integrate data driven models with large scale computational modeling to develop a simulation based research environment to predict large scale energy systems behavior</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>On Track</td>
</tr>
<tr>
<td>Create a virtual engineering tool to assist the bioenergy platform develop efficient systems for collecting, analyzing, and modeling data</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Establish guidelines for developing and designing energy systems for state wide use</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>On Track</td>
</tr>
<tr>
<td>Energy consumption data disseminated to promote efficient use of energy for commercial and residential consumers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Develop educational portals.</td>
<td>On Track</td>
<td>Done</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seek additional funding for CI related projects</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ongoing</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Metric</th>
<th>Yr 1</th>
<th>Yr 2</th>
<th>Yr 3</th>
<th>Yr 4</th>
<th>Yr 5</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>CI Technical hires are made</td>
<td>2.5</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Two full time hires each at UI and UNI, half time post doc.</td>
</tr>
<tr>
<td>Number of research projects that have CI-enabled data/resources</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Project Participants Using High Performance Computing Resources</td>
<td>10</td>
<td>15</td>
<td>15</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of educational programs connected via CI</td>
<td>2</td>
<td>4</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of training programs for HPC related skills</td>
<td>0</td>
<td>1</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of open-source materials available</td>
<td>0</td>
<td>5</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of CI related grant proposals submitted.</td>
<td>2</td>
<td>0</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of CI related grant proposals funded</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Project Management and Sustainability

Three additional strategic priorities address project evaluation and overall project sustainability and management. Tables 1.2d.15 – 1.2d.17 provide updated milestones and metrics for these priorities. Sustainability highlights during the past year include:

- Seed grants are increasing the number of faculty who are impacted by Iowa NSF EPSCoR resources and are providing them opportunities to obtain preliminary data to be used in proposal applications.
- Energy-related educational opportunities have been expanded at ISU to now include an undergraduate minor in energy systems, a graduate certificate in energy systems, and a coursework-only masters of engineering degree in energy systems.
- New energy related graduate courses have been developed at ISU and include: ME531 - Advanced Energy Systems and Analysis, BRT515x - Energy Policy, and BRT516x - International Energy Policy.
- New information systems course developed at UI: GEOG:3560-0001 – Spatial Analyses of Wind Energy, utilizes Kirkwood CC Wind turbine data.
- Dordt College is offering two new courses EGR 344 – Fluidized Engineering, and EGR 345 – Biorenewable Systems Engineering.
- Best practices in faculty search processes to ensure a diverse faculty pool have been shared among the three Regent institutions; these processes are being operationalized for all future faculty searches.

Table 1.2d.15: **Strategic Priority 6.1**: Implement an integrated, multi-year evaluation plan to measure progress toward the goals and objectives of the IA EPSCoR Project.

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Yr 1</th>
<th>Yr 2</th>
<th>Yr 3</th>
<th>Yr 4</th>
<th>Yr 5</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evaluation processes are developed.</td>
<td>Done</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>A logic model and a data implementation plan has been developed.</td>
</tr>
<tr>
<td>Engage an external evaluator and appoint an evaluation advisory team.</td>
<td>On track</td>
<td>Done</td>
<td></td>
<td></td>
<td></td>
<td>External Evaluator confirmed, Scientific Advisory Board established.</td>
</tr>
<tr>
<td>Identify project outcomes, metrics, and baseline data</td>
<td>On track</td>
<td>Done</td>
<td></td>
<td></td>
<td></td>
<td>Project outcomes and metrics are in the evaluation plan; baseline data was collected summer 2012.</td>
</tr>
<tr>
<td>Research and BI outcomes are identified and assessed with respect to established goals</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>On going</td>
<td></td>
</tr>
</tbody>
</table>
Table 1.2d.16: **Strategic Priority 7.1:** Build a statewide RE/EU research and education enterprise that continues beyond the five-year project period.

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Yr 1</th>
<th>Yr 2</th>
<th>Yr 3</th>
<th>Yr 4</th>
<th>Yr 5</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Statewide Science and Technology Plan completed and adopted.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Done</td>
</tr>
<tr>
<td>Grant proposals submitted.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ongoing Ongoing</td>
</tr>
<tr>
<td>Growth in sponsored funding in RE/EU at the three Regent Institutions</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Faculty hired into tenure-track positions</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Metric</th>
<th>Yr 1</th>
<th>Yr 2</th>
<th>Yr 3</th>
<th>Yr 4</th>
<th>Yr 5</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extramural Grants Submitted</td>
<td>74</td>
<td>129</td>
<td>142</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extramural Grants Awarded</td>
<td>14</td>
<td>24</td>
<td>48</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Faculty in RE/EU fields</td>
<td>60</td>
<td>66</td>
<td>77</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1.2d.17: **Strategic Priority 8.1:** Maintain an effective, transparent and multi-level management structure to provide oversight and coordinate the research, BI, and sustainability plans of the project.

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Yr 1</th>
<th>Yr 2</th>
<th>Yr 3</th>
<th>Yr 4</th>
<th>Yr 5</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Develop project strategic plan</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Review and revise project strategic plan using evaluation data</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Strategic plan revised, approved 3/5/14.</td>
</tr>
<tr>
<td>Project strategic plan updated for post-award activities</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hire Budget Analyst and Project Administrator</td>
<td>Done</td>
<td>Done</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Establish an external Advisory Board</td>
<td>On track</td>
<td>Done</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conduct annual review by the Science Expert Board</td>
<td>Done</td>
<td>Done</td>
<td>On track</td>
<td></td>
<td></td>
<td>Science Expert Board finalized in Y1.</td>
</tr>
</tbody>
</table>

| Governance                                                                 |      |      |      |      |      |                                                    |
| Establish the State Governing Committee’s charter and by-laws.             | Done |      |      |      |      |                                                    |
| Develop and approve state S&T plan.                                       | Done |      |      |      |      | Signed S&T Plan sent to NSF 8/2012.                |
| State Governing Committee assists researchers in pursuing funding opportunities. |      | NA   | NA   |      |      | Iowa is currently not eligible for additional EPSCoR-type awards. |
1.3 **Training and Professional Development Opportunities**

Training and professional development opportunities were provided through all four research platforms and the BI platform, and many of the efforts focused on student training and development. During Year 3 of this project, 15 post-docs (7 female and 1 URM), 121 graduate students (39 female and 7 URM), and 123 undergraduate students (58 female and 13 URM) were provided training opportunities through the Iowa NSF EPSCoR project. Note that the URM students were self-identified. Many of these students were able to attend workshops and conferences, domestically and internationally, for professional development and to present their research. Several of the Iowa NSF EPSCoR-supported students also received presentation awards at these events, including:

- Yeqing Wang was awarded the second prize for his poster “Modeling of Thermal Damage of Composite Wind Turbine Blades Subjected to Lightening Strike” in the Wind Turbine Blade Performance and Maintenance category, IWEA (Iowa Wind Energy Association) Conference Research Poster Competition, 2014.
- Christopher Hill and Yeqing Wang (with Dr. Olesya Zhupanska) received the American Society for Composites Best Paper Award, 2013.
- Bryne Berry received a NASA Fellowship from Iowa Space Grant Consortium, 2013-2014.
- Esdras Murillo attended the Louis Stoke Midwest Center of Excellence (LSMCE) Conference in Indianapolis, IN, and his Interlock House poster titled “Annual Energy Consumption in a Community Lab and Analysis of the Electricity Flow” was one of the top three presented. Esdras also attended the IINSPIRE LSAMP Conference in Waterloo, IA and received awards for “Student’s Favorite Poster” and “Outstanding Student Mentor Award”.
- Mary Nyaema attended the IINSPIRE LSAMP conference and won a third place award for her poster, “Impact of University of Iowa STEM Seminars 2013 in Enriching Upward Bound’s Science Curriculum” in the Experiential Category.
- Suncica Jasarovíc, Chloe Dedic and Bernie Del Campo won the Student Science Idol Competition during the National NSF EPSCoR Conference in Nashville, TN in 2013.
- Yeqing Wang, Daniel Lee and Soroush Aramidéh won first, second, and third place, respectively, for their posters at the Iowa NSF EPSCoR all hands summer meeting.

Sustainable student training in energy systems has been spearheaded by PI Heindel. He led the effort to develop a minor in energy systems at ISU that focuses on renewable energy and energy utilization ([http://www.me.iastate.edu/energy-systems-minor/](http://www.me.iastate.edu/energy-systems-minor/)). The minor began accepting students in Fall 2012. Currently, 29 students have officially registered for the minor (and 9 have graduated) and represent all engineering departments at ISU. Heindel also developed a new graduate course at ISU entitled “ME 531: Advanced Energy Systems and Analysis” which was offered for the first time in Fall 2013, and enrolled 8 on-campus students and 13 off-campus (distance) students. The ME 531 course is one of two required courses for the graduate certificate in energy systems, which was approved by the ISU Faculty Senate in Fall
2013; this course is also required for the Iowa Board of Regent-approved Masters of Engineering in Energy Systems Program, which was formally approved Spring 2014. Heindel is involved in all of these student-focused training programs in energy systems.

The graduate level courses in energy policy and international energy policy that were developed and offered through the Energy Policy platform have been well received. ISU believed these topics to be important enough to create a new tenure track position to teach these topics; a new faculty in political science has been hired and will start in Fall 2014.

Collaborating with Ellsworth Community College, the Green Community Campaign plank of the EU Platform sponsored an international lecture in October at UNI. The speaker was Dr. Peter Jahr from Germany who spoke on “Renewable Energies – What we should (not) learn from the European Union”.

Initially involved last summer in the Building Science plank as an EPSCoR intern from Des Moines Area Community College, Murillo credits the training and mentoring provided by plank leader Passe with inspiring him to transfer to ISU’s Electrical and Computer Engineering program. He was accepted into the prestigious McNair Scholarship program to prepare URM students for graduate research careers. He continues to work with Passe in the Building Science plank as an ISU student.

Faculty were also provided many training and professional development opportunities. Selected highlights from the past year include:

- The seed grant provided to Wheeler provided the foundation for her to apply for a prestigious 2 month long summer fellowship at Bath University, UK to explore Passivhaus standard schools.
- Just participated in the faculty “Boot Camp” in Fall 2013, sponsored by the National Center for Faculty Development and Diversity. This 16 week boot camp focused on faculty success and work-life balance. A particular focus was given to scholarly writing on a daily basis. The program improved skills for proposal and manuscript preparation.
- Ratner received Iowa NSF EPSCoR Leadership in Mentoring and Outreach Award at the All Hands Meeting.

The Broader Impacts platform also offered several training and professional development opportunities for members of the research platforms as well as targeted programs to broaden participation, address workforce development, and enhance human resource development; these opportunities are also detailed below.
Faculty Development: 18 faculty development programs (programs listed in Table 1.2a.3) delivered across the three Regent institutions engaged over 700 attendees from the faculty, post-doctoral and graduate student ranks. For faculty, these programs focused on research planning for new faculty, successful grant writing, identification of resources on campus for collaborative research, and invited talks to increase awareness of the needs of funding agencies. New programs aimed at developing the next generation of research leaders were also developed that typically engaged graduate students and postdoctoral fellows on developing research programs, funding opportunities, and planning for careers in academia, government and industry. All programs were typically open to faculty, staff and students at all three Regent Institutions through the BI leaders at the campuses. Several of the programs offered were through leveraging Iowa NSF EPSCoR support by cost sharing with existing programs to enhance the impact of the training. Some of these events also catalyzed discussions with community colleges on future collaborative efforts.

Diversity: Diversity was the focus of several training and professional development programs within the Iowa jurisdiction. Mentoring people from diverse backgrounds was the topic of several mentoring workshops for faculty and graduate students/post-doctoral researchers where best practices in student recruitment, engagement, and retention were shared in order to maximize student success. One key accomplishment of diversity efforts is the establishment of a University Center for Exemplary Mentoring (UCEM) through a $1.2M grant to UI from the SLOAN foundation. This will facilitate development of graduate students and faculty mentors to increase diversity presently in STEM graduate departments and ultimately in the professoriate. A conference is scheduled for July 31-Aug 2 and will include faculty from institutions that serve minority students from across the United States. These “Exemplary Mentors” will meet with the 174-member SLOAN faculty cohort. As part of the team, Iowa NSF EPSCoR faculty will share experiences and best practices in mentorship. Break out sessions will be held for engineering, the sciences, medicine, and public health to facilitate networking.

STEM outreach and engagement training in youth policy compliance has been provided to engineering administrators and departmental executive officers as well as to student organization leaders. Specific training developed through the ISU NSF ADVANCE program was shared with leadership at UI and UNI by ISU ADVANCE faculty. The training provided information on best practices and recognition of how factors such as implicit bias can affect diversity in recruitment of faculty. In addition to the training being provided at ISU for all search committees through institutionalization of practices through the NSF ADVANCE grant, sharing of the training with UI and UNI has resulted in their adopting it across their campuses as well.

Workforce Development: The summer programs for K-12 teachers offer extensive training on biorenewables (both fuels and chemicals) and Iowa’s bio-economy (ISU), and wind energy and energy efficiency (UNI). Participants at these training programs are also introduced to the concept of a green-collar workforce and the increased demand for skilled labor to meet the needs of Iowa’s extensive and growing bio-based industry. All PLTW training programs are design to engage instructors in effective delivery of the program to students. Specific examples include (i) PLTW Core Training Institutes were held on both the UI and ISU campuses, serving a
total of 174 PLTW teachers for targeted curricular training in PLTW coursework; (ii) PLTW Iowa Conferences for teachers (349) and a separate conference for counselors and administrators and; (iii) engineering week event at Kirkwood Community College for 486 PLTW students.

The bioenergy infrastructure provided by Iowa NSF EPSCoR has enabled Dordt College to offer two new courses in project-based exploration of thermo-chemical reactors and bioenergy systems. These new courses are EGR 344 – Fluidization Engineering (on theory and applications of fluidized bed reaction and conversion systems), and EGR 345 – Biorenewable Systems Engineering (on theory and applications of biorenewable technology, products, and processes).

At Dordt College, 6 students (2 were first generation college students) have completed undergraduate research using Iowa NSF EPSCoR equipment; 3 of these students have started their engineering careers or further engineering education in the agricultural or bioenergy sector. Two female students are the top candidates for bioenergy research this summer. Dordt College hosts two Engineering Visit Day events for high school students each year, where showcasing the Iowa NSF EPSCoR funded equipment and its capabilities has had a positive impact on the college’s ability to attract more students into engineering and STEM disciplines. At Central College, to date, 22 students (12 females) have worked as research assistants on the Prairies for Agriculture Project and an additional 65 students (30 females, 5 URMs) have volunteered hours to days at the site. Four faculty use the research project for educational purposes in their classroom.

**Cyberinfrastructure:** Workshops offered at UI, as well as previously archived webinars, provide opportunities for education, training and professional development. The CI team at UI has organized and hosted a series of hands-on workshops with the XSEDE program (https://www.xsede.org/). This is a virtual computing system used to share access to computing resources and world-class expertise in computing. The UI CI group has hosted 4 workshops as satellite feeds for the Pittsburg Supercomputing Center (https://www.psc.edu/). Each workshop covers a variety of topics including MPI (http://www.open-mpi.org/), high-performance computing, Big Data (Hadoop), RDF and Sparql (http://www.w3.org/TR/rdf-sparql-query/), and OpenACC (http://www.openacc-standard.org/). All of these classes are related to high-performance or large-scale computing. Students get the opportunity to use world-class supercomputing resources such as the Stampede Supercomputer (https://www.tacc.utexas.edu/stampede/) at the Texas Advanced Computing Center.

As a part of training and outreach efforts, the CI team at UI co-taught CEE:5129 – Information Systems for Resource Management in Fall 2013, in which 18 students attended. Additionally, the team assisted with the course design of and taught sections of an information system class that exposes students to new concepts about renewable energy options available in Iowa. The class, GEOG: 3560:0001 – Spatial Analyses of Wind Energy, uses the wind turbine data collected by Iowa NSF EPSCoR projects at Kirkwood Community College; 18 students attended the class.

**External Engagement and Communications:** Selected members of the Iowa NSF EPSCoR team will be participating in the pilot NSF communications program Becoming EPSCoR Champions
(BEC) on July 23-24, 2014. Follow-on activities will include putting the concepts into practice in the Iowa NSF EPSCoR project, and highlighting “best communications practices” on the Iowa NSF EPSCoR web site and in the newsletter.

1.4 **Dissemination of Results to Communities of Interest**
No additional material presented in this appendix.

1.5 **Plans and Activities for Year 4**
This section provides details to the plans and activities that will be accomplished during year 4 of this project (September 1, 2014 – August 31, 2015). In all cases, mentorship and support of the development of Iowa NSF EPSCoR students and junior faculty members will continue. External proposals will also be submitted by each platform. Selected activity highlights are summarized below for each platform.

**BioEnergy (BE) Platform**
Long-term monitoring of the Clear Creek (near UI) and Big Creek (near ISU) BAER sites, and UNI Cedar River Natural Resource Area Biomass Research Site will continue to improve understanding of flow, energy, and nutrient transport, as well as plant and wildlife community dynamics. Specific activity at the Big Creek river monitoring network will be used to study quantitative precipitation forecasts and distributed hydrologic modeling. Results will be shared with National Weather Service forecasters in Johnston, IA. Rating curves, data, and study results will also be available to other researchers working in this basin.

Collaborations between the UI power plant and area farmers for energy crop production in on-farm research sites will build from previous experiences with the BAER sites. Miscanthus demonstration planting will begin with UI in May. Farmer signup for the 2015 season will begin in June.

Research plots established in UNI’s Biomass Research Site will be used to measure percent nitrogen, chlorophyll content, photosynthetic rate, and total biomass of populations of *P. virgatum* grown in four prairie communities with contrasting diversity (1, 5, 16, or 32 species). Plant nitrogen content influences on aboveground biomass will be tested. This research will provide new insight into the utility of mixed perennial prairie vegetation as a low-input bioenergy feedstock.

Biochar impact on soil water retention under field conditions will be quantified. Impacts of bioenergy cropping systems and biochar amendments on soil nutrient levels, biomass yields, and greenhouse gas emissions will be quantified.
Water quality monitoring and data analysis in the Clear Creek BAER site will continue. A coupled hyperspectral data collection campaign with data validation from on-the-ground samples will be conducted. A collaboration with funded Critical Zone Observatory researchers will be used to leverage existing infrastructure and data. Several numerical experiments focused on nutrient exports, hydrology, and crop yields as a function of land management and climate dynamics will be conducted.

A series of genetic tools for manipulating *I. orientalis* and *S. stipitis* have been developed and will be used to investigate their potential as hosts to convert pyrolysis products with inhibitors present. Considering that glucose, xylose and galactose are the three major monosaccharides in the hydrolysates of pyrolysis sugars, *I. orientalis* and *S. stipitis* will be engineered to co-ferment these three sugars initially through incorporating the corresponding sugar transport and utilization genes. Synthetic biology-based strategies will be implemented for future strain optimization. Producing two representative compounds, isobutanol and 2,3-butanediol, directly from pyrolysis product mixture by the engineered hosts will be evaluated in the next reporting period.

The catalysts developed during Year 3 will be tested in Year 4 in both *in situ* and *ex situ* fast pyrolysis conditions to determine their effectiveness. Work will also continue to improve the instrumentation and testing procedures under relevant biomass conversion conditions (pyrolysis and gasification) for different biomass feedstocks, with the goal of understanding the basic physics and chemistry of these processes.

Novel techno-economic analysis frameworks will be developed to incorporate uncertainty parameters in the analysis; this will be used to evaluate innovative approaches to economic and environmental biofuel and biopower production, including duckweed as a potential biomass fuel source.

Work to increase the yield of furan-2-carbonitrile will continue with a focus on using biomass-derived materials as the feedstock. Additional conjugated polymers are currently being prepared to evaluate the performance of these materials in organic solar cells.

**Wind Energy (WE) Platform**

One of the major goals of Year 4 is to construct a 120-m tall measurement tower in a Central Iowa wind farm for measurement of mean and turbulent wind characteristics, as well as temperature and humidity, within the lowest 120 m of the wind farm. This will enable the documentation of wind farm characteristics of turbine wakes and interactions of turbines. Hence, it will be possible to study the wakes of upwind turbines that may reduce the power production of downwind turbines. It may also be possible to determine if the upstream wakes create wind shear and high turbulence conditions, potentially leading to premature component failure in downwind turbines.

Wind tunnel experiments and numerical modeling will be conducted with a multiple wind turbine array to explore the physics of wake interactions on model wind farm performance.
To consider the full yaw dynamics of a wind turbine, the aerodynamic loads must be considered. A method governing the yaw dynamics of the turbine based on the integrated aerodynamic loads will be developed. In this way the turbine will be allowed to freely rotate about the tower based on a force and moment balance of the blades. The complex terrain flow solver shall be extended to include wind turbine modeling capabilities. Further research into convergence acceleration techniques shall be pursued.

The developed fatigue analysis procedure will be integrated into the reliability analysis and reliability-based design optimization (RBDO) procedures. The work on lightning strike progressive damage model will be continued.

The RBDO approach will also be used in the design optimization of the wind turbine drivetrain using the approach developed in Year 3. To this end, the tip relief of the gear surface will be selected as design variables to be optimized such that the transmission error, which is the main cause of gear noise and vibration, can be minimized under the wind load uncertainty. A high dimensional surrogate model will also be developed to calculate the fatigue damage; it will also be incorporated into the RBDO procedure.

Laser-assisted machining, hardening, and peening experiments on wind turbine materials will be completed. A laser composite repairing (LCR) process will also be developed to enable a cost efficient repair of composite materials on wind turbine blades.

A semi-definite programming (SDP) relaxation of alternating current model will be developed for renewable energy grids. Solution techniques will also be developed for mixed-integer SDP models. A distributed control approach to dispatch will be extended to the problem of demand response, i.e., including loads in the process of dispatch to better accommodate variable generation.

**Energy Utilization (EU) Platform**
Student and teacher energy knowledge evaluation surveys will be developed and administered at the Columbus Junction Community High School. Baseline building energy data acquired at the Columbus Junction Community Laboratory will be incorporated into learning activities for target audiences.

The post occupancy evaluation at the Interlock House and the visitor survey will continue, as well as the Cyberinfrastructure data visualization and interface.

Air flow and temperature data will be acquired at the Interlock House using the Mobile Data Acquisition System (MiDAS) to calibrate CFD models and simulations. A large NSF Cyber SEES proposal has just been submitted that will utilize the Interlock House data to validate high performance computing CFD models and control strategies for high performance passive heated, ventilated and cooled green buildings.
The liquid desiccant dehumidification system will be integrated into the Interlock House building system and tested in real world conditions over a full year. The exact date for implementation has to be decided with Iowa Department of Natural Resources (DNR) as the owner of the building.

The ISU Building Science team plans to develop the Faculty Cottage retrofit at Iowa Lakeside Laboratory as the third community laboratory. The stakeholders at this Regents resource center anticipate the retrofit to occur in Fall 2014 based on the design proposals developed at ISU in Spring 2014. In parallel, the Building Science team will develop the data acquisition system and survey instruments for the post occupancy evaluation planned to start in Spring 2015 (assuming the retrofit is completed by then).

The MiDAS hardware will be used to examine the newly develop Dynamic Visual Comfort Zone inside the Columbus Junction community laboratory and for natural ventilation comfort and energy efficiency research in the ASHRAE project with Wheeler, if successful. The MiDAS hardware will also be utilized at the Lakeside Laboratory.

Residential towns for building energy efficiency performance research as the fourth community lab will be selected, based on the cooperation of the pertinent Rural Electric Cooperative. Once the residential town(s) for the building energy efficiency performance research is(are) selected, the required data will be collected from both street level and overhead (aerial). Then, the collected data will be analyzed for energy efficiency by various variables such as building orientation, location of openings, overhang length, etc. While taking thermal imaging pictures from selected residential buildings, the visual images of heat energy loss will be shared to educate residents.

**Energy Policy (EP) Platform**

As in previous years, there are plans to offer 6 workshops and 6 seminars in 2014-15. A similar mix of policy-relevant topics will be covered with potential interest to engineers and economists. Next year, graduate students will be encouraged to directly present their research at the workshop rather than having professors presenting on behalf of their groups. This experience will contribute to students’ marketability. A full proposal will be submitted to NSF-SoO by January 2015.

A policy workshop in September 2014 will be organized in which economists and others will be invited to share their current forward-thinking ideas and research about the key policy issues that need to be addressed regarding renewable fuels. This workshop will guide the outreach and publication effort for next year.

In collaboration with the Public Policy Center at UI, a renewable energy symposium will be co-sponsored, tentatively scheduled for October 16, 2014 in Iowa City, IA.
Broader Impacts (BI) Platform
The Faculty Development team will continue to collaborate with existing programs on the Regent campuses to enhance faculty development and focus on what is needed on the respective campuses. Seed grants will also continue to build research capacity. Specifically, an activity at the Year 3 Annual Meeting will be used to encourage collaborations, and then three (3) seed grants of $20,000 (total costs) will be awarded to new collaborations, with a focus across institutions.

The Diversity team will provide activities that support STEM faculty who are writing NSF and other federal grants, and provide BI programming for junior faculty through cost and effort sharing. Additionally, current campus programs (e.g., Programs for Women in Science and Engineering, IINSPIRE-LSAMP, etc.) will be leveraged to recruit diverse students in research activities. Faculty will also be mentored to enable effective engagement of women and URM students in their research efforts. Mentoring support will also be provided for the first cohort of SLOAN graduate fellows (12 STEM PhD students who are URMs). There will be emphasis on recruiting and maintaining diverse faculty collaborators through national SLOAN community building efforts. Benchmarks and metrics for diversity efforts and tools for effective assessment and evaluation of the diversity efforts will be further developed. The leadership at the Regent institutions will be reminded of the best practices used in the faculty search process to ensure a diverse pool of faculty candidates.

The Workforce Development team will continue to offer the Summer Academy and Energy Institute again, similar to this year. The BI resources used for the Summer Academy will continue to be leveraged with other projects, e.g., the NSF Engineering Research Center for Bio-renewable Chemicals, to increase the number of participants in the Summer Academy.

Current Project Lead The Way activities will be expanded to strengthen this STEM pipeline, including (i) provide a dedicated area on the PLTW Iowa website for diversity guidance including STEM marketing materials for parents of girls (i.e., Making Connections: Helping Your Daughter Create a Brighter Future with STEM), (ii) provide recruiting “in a box” tools for teachers and counselors, and (iii) provide profession development opportunities for PLTW teachers via community colleges.

The CI team will continue to work with Iowa NSF EPSCoR researchers to better support their activities. It is expected that the educational and training workshops will continue to increase in frequency and have a positive impact on CI engagement with the research platforms.

The EE team will focus on diversity components of the Iowa NSF EPSCoR project during Year 4 to communicate successes and challenges in this area.