

# IOWA ENERGY CENTER

FY 2015 ANNUAL REPORT

*July 1, 2014–June 30, 2015*

# TABLE OF CONTENTS



03	DIRECTOR'S MESSAGE
04	ENERGY EFFICIENCY PROGRAM
06	BIOENERGY PROGRAM
08	RENEWABLE ENERGY PROGRAM
10	EDUCATION AND OUTREACH PROGRAM
12	GRANT PROGRAM TABLES
13	LEGACY GRANT PROGRAM TABLE
14	FINANCIAL REPORT
15	STAFF AND ADVISORY COUNCIL

## ABOUT THE IOWA ENERGY CENTER

The Iowa Energy Center was created by the Iowa Energy Efficiency Act of 1990 with a mission to:

- Strive to increase energy efficiency in all areas of Iowa energy use;
- Conduct and sponsor research on energy efficiency and conservation that will improve the environmental, social, and economic well-being of Iowans, minimize the environmental impact of existing energy production and consumption, and reduce the need to add new power plants;
- Serve as a model for state efforts to decrease reliance on imported fuels and to decrease reliance on energy production from nonrenewable, resource-depleting fuels;
- Conduct and sponsor research to develop alternative energy systems that are based upon renewable sources and that will reduce the negative environmental and economic impact of energy production systems;
- Assist Iowans in assessing technology related to energy efficiency and alternative energy production systems and support educational and demonstration programs that encourage implementation of energy efficiency and alternative energy production systems;
- Develop a program to provide assistance to rural residents for energy efficiency efforts;
- Cooperate with the state board of education in developing a curriculum which promotes energy efficiency and conservation; and
- Sponsor research grants and projects submitted on a competitive basis by Iowa colleges and universities and private nonprofit agencies and foundations.

## VISION STATEMENT

The Iowa Energy Center supports economic development, environmental sustainability, and social well-being in Iowa through energy innovation, education, and entrepreneurship. We provide Iowans with reliable, objective information on energy and efficiency options.



# DIRECTOR'S MESSAGE

Welcome to the Iowa Energy Center's annual report for fiscal year 2015, which covers the period from July 1, 2014, to June 30, 2015.

In last year's report I wrote about new grant programs implemented at the Energy Center to make Iowa colleges, universities, and nonprofit organizations more competitive in bringing investment dollars to the state. These programs provide funding to help groups build partnerships, prepare proposals, do upfront work to make proposals more credible, and provide necessary matching funds that may otherwise be hard to come by. Energy Center grants support many activity areas, including energy research, technology development, demonstration, deployment, education, workforce development, and community development.

The success of those core programs continued through fiscal year 2015. For every dollar awarded by the center since the start of the programs in July 2013, Iowa groups have captured \$4.11 in national nonprofit foundation and federal agency competitions. In fiscal year 2015, the Energy Center helped Iowa organizations secure nearly \$2.4 million. Importantly, through these grant programs the Iowa Energy Center is benefiting a wider range of organizations and covering a broader range of energy topics than ever before.

Now that the core grant programs have been established, the Center has turned its attention to three other priorities: entrepreneurship and commercialization, energy workforce development, and K-12 energy education. In 2015 the center

made upgrades to its facilities for testing commercial building energy efficiency technologies in order to bring them closer to market. The Energy Center has partnered with state agencies to bring Iowa energy startup companies to the attention of venture capitalists. Moreover, the Center has launched pilot projects to test ways to disseminate energy education content throughout the state at both the K-12 and community college level.

As you can see, with these and the broader range of our initiatives, the Iowa Energy Center is supporting Iowa's interest in a robust, yet environmentally sound, economic future through:

- Innovation,
- Entrepreneurship and commercialization,
- Workforce development, and
- Educated citizenry.

The Iowa Energy Center will continue to work with stakeholders and citizens to find innovative ways to adapt to the state's changing needs and to add value for those interested in a more secure energy future for Iowa.

Sincerely,



Mark C. Petri, Ph.D.  
Director, Iowa Energy Center



## IN FY 2015 IOWA ENERGY CENTER GRANT PROJECTS CONTRIBUTED TO:

- 40 PROFESSIONAL JOURNAL PUBLICATIONS
- 2 ISSUED PATENTS WITH 2 PENDING
- 4 ISSUED PH.D. DEGREES WITH 14 PENDING
- 15 ISSUED M.S. DEGREES WITH 4 PENDING
- 1 ISSUED B.S. DEGREE WITH 5 PENDING
- 9 FUNDED EXTERNAL AWARDS IN THE AMOUNT OF \$2,389,906

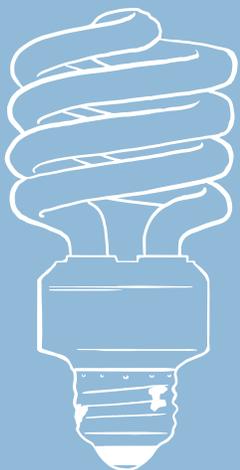
# ENERGY EFFICIENCY

## ENERGY EFFICIENCY PROGRAM MANAGER

Xiaohui (Joe) Zhou,  
Ph.D., P.E.



## GRANT PROGRAM HIGHLIGHTS



## PROGRAM OVERVIEW

The Iowa Energy Center's Energy Efficiency Program includes areas such as building, industrial, agricultural, and transportation efficiency. The center's internal research and training focus on the commercial building sector, given the availability and unique features of the Energy Resource Station (ERS) in Ankeny, Iowa.

In FY 2015, the Iowa Energy Center completed the Iowa Public Building Energy Benchmarking Phase II Project, which was supported by the Department of Energy (DOE). As part of this project, 902 additional Iowa public buildings were enrolled in the benchmarking program. Overall, 2,176 Iowa public buildings and 78,718,895 sq. ft. of gross building area have been benchmarked. These buildings represent a potential annual cost savings of approximately \$14 million. A final project report and a user case study report are posted on the Iowa Energy Center website. The Iowa Energy Center also helped the Iowa Economic Development Authority (IEDA) by working with key Iowa utility companies to establish a new partnership to support the program over the next three years.

The Iowa Energy Center staff, paired with the Iowa Army National Guard, started a U.S. Department of Defense (DOD) supported energy demonstration project at five Iowa

Army National Guard demonstration sites as highlighted on page five.

The ASHRAE (American Society of Heating, Refrigerating and Air Conditioning Engineers) "Low Energy LED Lighting Heat Gain Distribution in Buildings" project is also underway. An experimental system was set up at the ERS and preliminary tests have been successfully conducted. Three research proposals have been submitted seeking external funding for future research in the area of building energy efficiency.

This year, the ERS went through a major building control system upgrade. The upgrade project replaced the old-generation Direct Digital Control (DDC) building control system with a new web-based, BACNet system. The new system allows the facility to keep up with the latest technology in the field and greatly increases the research capability of the ERS. The facility has been used to conduct a two-week research experiment for the University of Texas at Dallas on an advanced control algorithm.

External funding opportunities in the area of energy efficiency are closely monitored and relayed to Iowa Energy Center eligible grantees. The Center staff also answered various questions related to energy efficiency from the general public through phone calls or the "Ask an Expert" section of the IEC website.

In fiscal year 2015, the Iowa Energy Center funded seven projects related to energy efficiency through its grant programs. Here are a few highlights.

### **DR. MUFIT AKINC** NEXT GENERATION INSULATION MATERIAL FOR APPLIANCES, IOWA STATE UNIVERSITY

Dr. Akinc led a team of researchers to explore various materials to reduce the cost of the core materials of Vacuum Insulation Panels (VIP) for applications in appliances, transportation and buildings. The results have shown that up to 40-50% of the fused silica may be substituted with Diatomaceous Earth – a much cheaper material – with little compromise in thermal resistance. Building simulation results suggested whole building thermal energy consumption can be reduced by 25%-38% by using VIPs.

### **DR. CHRIS WILLIAMS** DISTILLATION BOTTOMS AS A WARM MIX ASPHALT TECHNOLOGY IOWA STATE UNIVERSITY

The utilization of isosorbide distillation bottoms as a warm mix asphalt additive has been demonstrated to be a viable bio-derived alternative to other technologies.

The research demonstrated the IDB performs well in permanent deformation, low temperature cracking, fatigue resistance, and moisture susceptibility and would meet and exceed pavement performance expectations of owner/agencies. Owner/agencies, such as the Iowa Department of Transportation, as well as asphalt suppliers and paving contractors have expressed an interest in conducting field trials of an asphalt mixture containing isosorbide distillation bottoms.

### **DR. BASKAR GANAPATHYSUBRAMANIAN** VALIDATING A LARGE SCALE CFD MODELING FRAMEWORK IOWA STATE UNIVERSITY

Dr. Baskar Ganapathysubramanian and Dr. Ulrike Passe applied a Large-Eddy-Simulation (LES) approach to model natural ventilation in buildings with active-passive systems. Demonstration and validation of the framework have been conducted using measurements at the Interlock house comparing with predicted thermal and flow fields using the framework.

## MEET OUR ENERGY EFFICIENCY IMPACT AWARD WINNER

Kimberly Dickey, Energy Manager;  
Iowa Army National Guard

### DEMONSTRATING ENERGY SAVINGS THROUGH OPTIMIZED BUILDING CONTROL

Partnering with the Iowa Energy Center, Kimberly Dickey of the Iowa Army National Guard and their facility engineers are demonstrating an optimized building control strategy at five military sites in Iowa.

The demonstration project is sponsored by the U.S. Department of Defense's Environmental Technology Demonstration and Validation Program (ESTCP) and led by the Energy Center's Dr. Xiaohui Zhou.

The main objective of the project is to verify the predicted 30 percent fan motor energy savings on real buildings for HVAC systems utilizing an optimized building control strategy called the Tiered Trim and Respond (TTR) method.

This method was originally proposed by then Iowa State University (ISU) Professor Dr. Ron Nelson when he was working on an Iowa Energy Center sponsored research project. Compared to traditional control strategies, it has demonstrated significant energy savings, better control stability, and improved comfort at the Energy Resource Station and on ISU's campus.

Five sites have been selected for the Iowa Army National Guard demonstration: one in Boone, one in Waterloo, one in Muscatine, and two at Camp Dodge in Des Moines. These buildings were chosen to represent various building types, functions, and building control systems.

The buildings include, for example, the Joint Force Headquarters, a flight facility with a hangar and the



Military Entrance Processing Station, which is the first point of contact for all people joining the military across the country.

After thorough due diligence was conducted by the project team on each building's mechanical and control system, a fan motor energy and HVAC system performance monitoring plan was designed. The plan was implemented by procuring and installing the necessary energy monitoring instrumentation in order to collect relevant HVAC data points at these sites.

Local control contractors were hired to implement the TTR method and troubleshoot any existing HVAC equipment and control issues. After all the potential issues were resolved and preliminary testing proved the TTR method was implemented correctly, a one-year comparison test began in 2015. The comparison test consists of switching the HVAC

system control strategy every two weeks between their existing control strategy and the TTR method. Selected HVAC and fan motor energy data are currently collected, trended and analyzed weekly.

Dickey plays an important role in this project as she is in charge of collecting building meter data and coordinating activities between the Iowa Energy Center and Iowa Army National Guard facility engineers. "The Energy Center collaboration has been great in so many ways," she said.

Preliminary results show that compared to existing fixed static pressure methods, the TTR method's total fan energy savings for these buildings are 23 percent, 36 percent, 33 percent, 23 percent, and 26 percent. Its control performance was mostly as expected – responsive to sudden load changes while keeping relatively stable control.

## ABOUT THE ENERGY RESOURCE STATION (ERS)

The Iowa Energy Center's Energy Resource Station (ERS) is helping to solve the most critical problems and to enhance technologies in commercial building energy efficiency. No other facility in the nation has capabilities that are as integrated as those at ERS. The facility, in Ankeny, Iowa, is designed to simultaneously test and demonstrate multiple, full-scale commercial building heating, ventilating, and air conditioning (HVAC) systems. The facility allows for real-world demonstrations of HVAC equipment and control systems, as well as training opportunities related to energy efficiency. Research projects conducted at ERS are part of the Energy Center's applied research portfolio and often involve collaborations with national energy laboratories, universities, and industry leaders.

### KEY BENEFITS:

The Energy Resource Station supports the state's economy and environment, as well as Iowa's role as a national leader in implementing energy efficiency technology.

- Cost and energy savings for commercial, industrial, and residential buildings.
- Increased energy efficiency, boosting Iowa's economy and reducing energy dollars leaving the state.
- Establishing unbiased product performance information for businesses and homeowners to make more informed investments.

# BIOENERGY

## BIOENERGY PROGRAM MANAGER

Norm Olson, P.E.



## GRANT PROGRAM HIGHLIGHTS



## PROGRAM OVERVIEW

The bioenergy program continues to receive a significant number of proposals for the Center's Opportunity Grant and Matching Grant programs. One area receiving great emphasis deals with addressing the U.S. Department of Energy (DOE) targets of delivering biomass at \$80 per dry ton and then producing drop-in transportation fuels from this biomass at \$3 per gallon of gasoline equivalent. Several of the Energy Center's Opportunity Grants are research projects working to meet these goals.

Another vital area receiving increased attention is the production of bio-based chemicals that can be used to replace petrochemicals. This is a long-standing area of prominence for the Center and has recently become

a focus at the DOE, increasing the likelihood of outside funding opportunities for these types of projects. One more positive development for the bio-based chemical area is the significant emphasis being placed on the development of this industry by the Iowa Economic Development Authority (IEDA).

An important development at the BECON facility in FY 2015 was the successful production of methanol from biomass by Frontline Bioenergy, LLC. Frontline is developing thermal gasification processes by building on technology originally developed by Iowa Energy Center grantee Robert Brown and several of his graduate students. This is a significant development and opens the door to the production of an enormous variety of chemicals and fuels from biomass.

### SONG CHARNG KONG EXPERIMENTS, TECHNOECONOMICS, AND OPTIMIZATION OF BIOENERGY SYSTEMS BASED ON BIO-OIL GASIFICATION IOWA STATE UNIVERSITY

The conversion of biomass into fuels usable for transportation can be achieved through various methods. Biological and thermochemical are two such approaches. Examples of biological approaches include the production of ethanol from corn and biodiesel from soybeans. On the other hand, thermochemical approaches convert non-food biomass (such as corn stover) into synthesis gas through gasification or into liquid bio-oil through fast pyrolysis. Biomass gasification is a more mature technology and the resulting syngas can be synthesized to liquid fuels.

However, commercialization of biomass gasification has been hampered by its capital and operating costs. This is due to the difficulties of transporting bulky solid biomass over a long distance, processing solid feedstock at high pressure, and having to remove contaminants from the product gas stream. Conversely, fast pyrolysis of biomass can produce bio-oil in small processing plants at distributed locations such that the transportation a long distance can be better avoided.

One possible technology involves gasifying bio-oil to syngas, which in turn is synthesized to liquid transportation fuels. The team has built a first-of-its-kind bio-oil gasifier and will further conduct experiments to characterize and optimize its performance in this project. A high-fidelity processing simulation model will then be used to help optimize gasifier performance and predict the performance of commercial-scale plants.

The resulting simulation tools could be used to determine plant achievement once certain components or subsystems are altered. There are also optimization algorithms within the

simulation tools to help optimize the system layout and performance. For example, imagine that one can "walk" into a \$500 million biorefinery and "see" the layout of the plant as well as extract real-time performance data of reactors by changing operating conditions on the fly. This scenario could become a reality as a result of this study.

The success of this project may help develop technologies that enable the production of transportation fuels from non-food biomass. The state of Iowa has been the leading producer of corn ethanol and soy biodiesel, both produced via biological processes. With the abundance of biomass it produces, Iowa could again lead the nation in the production of renewable fuels through thermochemical conversion processes. As a result, the outcome of this project has the potential to greatly improve the rural economy of Iowa and the broader regions.

### MARK WRIGHT TECHNO-ECONOMIC SCREENING OF BIOFUELS AND BIOCHEMICALS FROM HIGH MOISTURE FEEDSTOCK IOWA STATE UNIVERSITY

This opportunity grant proposal sought Iowa Energy Center funding for developing preliminary data to support the pursuit of future U.S. DOE and USDA funding announcements. The DOE and USDA had issued a joint notice of intent for three topic areas: feedstocks development, biofuels and biobased products development, and development analysis. This project created a techno-economic comparison of biofuel production pathways for wet feedstocks such as algae and sweet sorghum. Findings from this analysis could support the development of several DOE and USDA proposals by providing preliminary economic data. We envision that the economic analysis could be included in: 1) supporting information for feedstock development and biofuels products development proposals, and 2) development analysis proposals.

# MEET OUR BIOENERGY IMPACT AWARD WINNER

Laura Jarboe, Associate Professor of Chemical & Biological Engineering; Iowa State University

## JUST TRYING TO MATTER

For most of us, showing up to work day after day can be a bit monotonous. This is not the case for Dr. Laura Jarboe, professor of Chemical Engineering at Iowa State University. For her, motivation comes easy at the workplace, because she knows that her work is making the world a better place. With support from the Iowa Energy Center, Jarboe is conducting research that focuses on making fuels and chemicals from biomass.

Jarboe uses microbial biocatalysts, such as yeast fermentation, engineers the microbes that change their genetics, and uses them to make ethanol into butanol, a more efficient fuel.

In addition, Jarboe is studying ways of breaking down non-food biomass into valuable materials. Jarboe's preferred method is thermochemical processing, which burns biomass without oxygen. This breaks it down into individual sugars, but doesn't burn it away completely. This method is a cheaper option and uses biomass that would otherwise be wasted.

Thermochemical processing can directly replace petroleum by producing a large variety of chemicals. Thermochemical processes have very broad possibilities, so Jarboe's research has many facets.

These processes are still not perfect, and Jarboe is



working to overcome a number of obstacles. These hurdles include removing trace inhibitors that are harmful to the microorganisms essential to the energy-making process. Jarboe and her team are focusing on ways to filter these inhibitors out as well as finding ways to change the genetic makeup of the microorganisms so that they are immune to the inhibitors. Both options have their benefits, such as lipids that can be made directly into fuel. However, both options also have their own difficulties.

The Iowa Energy Center has helped fund Jarboe's research for three years now. This funding has helped support the use of two graduate students. Additionally, this funding has helped Jarboe's team research the economic viability of each process, which is of paramount importance in her research.

Laura Jarboe is motivated because she believes that every day her work is making the world a better place, by decreasing our dependence on fossil fuels and increasing our security.

## ABOUT THE BIOMASS ENERGY CONVERSION (BECON) FACILITY

The Iowa Energy Center's Biomass Energy Conversion (BECON) facility in Nevada, Iowa, supports the state's most innovative and collaborative biomass projects. Through BECON, the Energy Center has established a platform for researchers to turn promising ideas into commercial-scale biomass conversion units. It is open to researchers from all of Iowa's colleges, universities, and non-profit organizations, and from the private sector. An important objective of BECON is to provide a place where researchers can collaborate and exchange ideas and information.

### KEY BENEFITS:

- Increasing exposure to potential investors, funding agencies, and legislators who can witness pre-commercial technologies being refined firsthand.
- Demonstrating full-scale biomass conversion technologies, increasing adoption and commercialization.
- Strengthening Iowa's economy by actively leading discussions and sharing technologies across Iowa and around the world.

## FACILITY TOURS

Iowa International Center Tour  
Iowa Economic Development Authority Tour  
Iowa State Fair Presentation  
NH3 Fuel Conference Presentation  
NH3 FA Tour  
Indian Hills Community College Presentation  
Missouri University of Science and Technology Tour  
Caterpillar Tour  
Iowa High School Renewable Energy Tour

9  
TOURS

357  
PEOPLE

# RENEWABLE ENERGY

## RENEWABLE ENERGY PROGRAM MANAGER

Bill Haman, P.E.

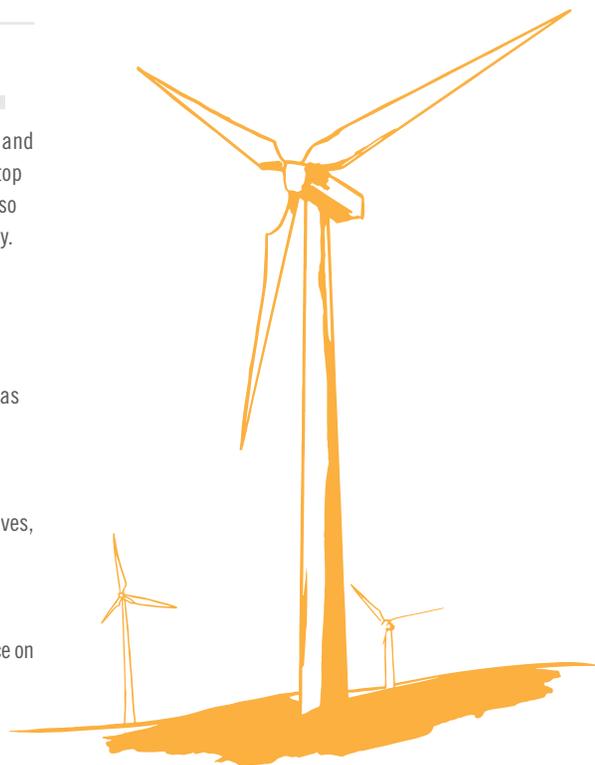


## PROGRAM OVERVIEW

Iowa is one of the nation's leaders in its policymaking and investment in renewable energy. As well as being the top producer of ethanol and biodiesel liquid fuels, Iowa also ranks third nationally in installed wind energy capacity. Extended wind energy investments by Investor Owned Utilities have only furthered Iowa as a leader in the adoption of wind energy.

Solar energy, not previously a broadly adopted source, has benefited from recent price declines and generous tax incentives to become one of the fastest growing energy generation sectors in the state. With the growth of community-based solar fields by rural electric cooperatives, Iowa is poised to maintain its place among national leaders in use of renewable energy sources.

Between the rapid growth of solar and the continued reliance on wind, the Alternate Energy Revolving Loan Program (AERLP) saw its most activity ever in FY 2015.



## ABOUT THE ALTERNATE ENERGY REVOLVING LOAN PROGRAM (AERLP)

The Iowa Energy Center's Alternate Energy Revolving Loan Program (AERLP) was created by the Iowa legislature in 1996 to promote the development of renewable energy production facilities in the state. Through this program successful applicants receive a low-interest loan that consists of a combination of AERLP and lender-provider funds. The AERLP provides up to 50% of the total loan, up to a maximum of \$1 million with a maximum term of 20 years. The lender manages the entire loan and arranges repayment of the AERLP share to the Energy Center, which is then revolved back into the program and made available to new applicants.

By 2010 the Iowa legislature had provided a total of \$15.9 million to the AERLP through a combination of appropriations and a one-time assessment on Iowa's investor-owned utilities. Since these funds continually revolve back into the program as loans are repaid, the AERLP has supported the development of hundreds of alternate energy production facilities throughout the state including wind, solar, biomass, biofuel, and hydroelectric installations.

Over the past 19 years, the AERLP has received 692 loan applications that have led to 354 total projects generating an excess of 2 million megawatt-hours annually. A total of \$38.9 million in AERLP loans through FY 2015 have been leveraged against nearly \$256 million of other capital investment.

This fiscal year the Energy Center funded primarily solar energy projects and a wind energy project, totaling 91 new projects with an estimated annual generation of 5,190 MWh, for a total of \$5,596,362 in AERLP loans made.

### ALTERNATE ENERGY REVOLVING LOAN PROJECTS

Technology	ANNUAL TOTAL FROM FY 2015		TOTAL SINCE 1996	
	Annual Projects	Annual Energy (MWh)	Total Projects	Total Annual Energy (MWh)
<b>SOLAR</b>	90	4,843	164	8,608
<b>LARGE WIND<sup>2</sup></b>	1	347	115	317,735
<b>SMALL WIND<sup>2</sup></b>	-	-	47	1,481
<b>BIOMASS<sup>1</sup></b>	-	-	22	1,748,922
<b>HYBRID<sup>3</sup></b>	-	-	5	108
<b>HYDRO</b>	-	-	1	2,863
<b>TOTAL</b>	<b>91</b>	<b>5,190</b>	<b>354</b>	<b>2,074,717</b>

<sup>1</sup>Includes the electrical equivalent of projects producing fuels such as ethanol, biodiesel and wood.

<sup>2</sup>Small Wind = 20 kW nameplate rating or less; Large Wind = more than 20 kW nameplate rating.

<sup>3</sup>Includes a combination of solar, hydro, small wind, large wind or biomass.

### ALTERNATE ENERGY REVOLVING LOAN PROGRAM EXPENDITURES

	FY 2015	SINCE 1996
<b>AERLP LOANS MADE</b>	\$5,596,362	\$38,896,911
<b>LEVERAGED RESOURCES</b>	\$6,369,936	\$235,917,050
<b>CONSTRUCTED PROJECT COSTS</b>	\$11,966,297	\$274,813,961

## MEET OUR RENEWABLE ENERGY IMPACT AWARD WINNER

Sri Sritharan, Professor of Civil, Construction & Environmental Engineering; Iowa State University

### A DREAM TEAM FOR TALL TOWERS

Sri Sritharan is a structural engineer at Iowa State University working to improve the efficiency of wind turbines by increasing their height. This tall tower project involves many people from around the country, working with wind energy industry leaders and the Department of Energy (DOE). Sritharan works on the design of the towers, putting him at the center of it all. Currently, wind towers are generally eighty meters tall and constructed of steel. However, Sritharan's use of a new concrete structure called "hexcrete" can increase turbine heights to 120 or even up to 140 meters, greatly boosting the efficiency of wind turbines. This technology opens up opportunity for wind power production in all fifty states.

For towers taller than 100 meters, the price of using steel rises exponentially. Also, putting together steel towers in the field, which would solve logistical issues, raises cost precipitously.

Through a Matching Grant, the Iowa Energy Center is funding fatigue behavior research. This covers every possible likelihood of fatigue, and thus ensures that the new towers will have a longer life. Current steel towers are governed by fatigue behavior and can last up to twenty-five years. Sritharan is concerned that no one can be sure how much life is left in some current towers. With concrete towers, fatigue is not as significant of a problem as it is with steel towers. Because of this, Sritharan believes that concrete towers can last up to forty years. It is also easier to measure the life-span of concrete towers.

Concrete is relatively cheap compared to steel. Sritharan uses high strength and ultra-high strength concrete for this project. This is still much cheaper than steel and can reduce the base of the tower in size by fifty percent, which eliminates challenges of blade clearance and logistic issues of transportation and on-site construction. Additionally, it allows Sritharan to easily increase tower height.

"It's a hot project," Sritharan says. The fact that it is so popular creates a lot of energy and enthusiasm in the people he works with. He has fifteen to twenty people working on the project with him, and Sri calls this group a "dream team." They are all excited to fix a national problem, and love the fact that they have the DOE behind them.

Tall towers are not just for use in one specific area of the nation, but will impact all regions of the U.S., including areas that were once thought to be not viable for wind energy production. This technology would also allow the industry to use fewer wind turbines and still produce the same amount of energy. This technology solves multiple issues, and reduces the overall cost of energy.



## GRANT PROGRAM HIGHLIGHTS

The Iowa Energy Center endorsed and supported 11 renewable energy projects in FY 2015. Under the new grant programs the Energy Center endorsed one Planning Grant, five Opportunity Grants, and four Matching Grants. Nine of these projects received funding, representing a commitment of more than \$540,000. Here is one example of what Iowans can accomplish with funding from Energy Center grants.

### DR. WEIYU XU

DATA SECURITY IN SMART GRID: A COMPUTATIONAL APPROACH  
UNIVERSITY OF IOWA

Smart grids modernize existing electrical grids by integrating advanced sensing, communications and control systems into system operations. However, adopting cyber systems in smart grid introduces new data security issues. Damaging events and cyberattacks may cripple system operations by injecting bad data or even deliberate false data. Secure state estimation under cyberattacks and

damaging events is of great interest to grid operators. This project is investigating the fundamental limits on data security and aims to provide computational tools for secure state estimation.

Smart grid technology is particularly important to Iowa because of the high percentage of wind power generation. To lead the country in wind power, Iowa has to be a leader in smart grids, as well. The research will help accelerate Iowa's transition to a secure smart grid while addressing data privacy concerns. Power companies can apply these research results to evaluate the vulnerability of the power grid and optimize protection strategies for smart grid security.

The outcomes of this project will help train graduate students and incorporate research products into undergraduate and graduate courses at the University of Iowa and elsewhere. These efforts will help boost Iowa's leadership in education, research and implementation of smart grid technology.

# EDUCATION AND OUTREACH

DIRECTOR  
Mark Petri



## PROGRAM OVERVIEW

Building on our efforts in fiscal year 2014 to establish new partnerships for our education and outreach activities, the Iowa Energy Center in fiscal year 2015 began new initiatives to achieve greater statewide impact. In April 2015 the center established its new special-project grant program that is providing funding for energy education and outreach activities that have high impact and statewide value. Projects include public education and training activities related to energy production, use, efficiency, and conservation. Two such projects were funded this year, and the program has been extended into fiscal year 2016.

The center has been working with the Department of Education, community college presidents, and community college academic officers to find ways to collaborate on a statewide energy workforce development initiative. Based on those discussions, the center has launched a pilot project with the Iowa Community College Online Consortium and Iowa Lakes Community College to create a series of online alternative energy courses that can be accessed by college students and adult learners throughout the state.

Likewise, the Energy Center is piloting projects to create

high-quality energy education content that can be used by K-12 teachers in every Iowa school by partnering with the Iowa Area Education Agencies to disseminate the material through its AEA Online portal. The first pilot project is a collaboration with the Iowa Agriculture Literacy Foundation to create a set of classroom lessons that will be made available statewide through the AEA K-12 online system. The lessons focus on the connections between energy and agriculture and comply with Iowa STEM education standards.

We are expecting to launch additional pilots soon that will help guide the development of a competitive grant program that will start later in fiscal year 2016 to fund Iowa colleges, universities, and nonprofit organizations to create, test, and qualify energy education programming to improve energy literacy in the state and ensure a pipeline of qualified workers for a growing energy job market. In all, through its grant programs, sponsorships, scholarships, and pilot projects, the Iowa Energy Center made 15 education and outreach awards, totaling more than \$105,000. Moreover, the center held six professional training events at our Energy Resource Station and continued its Iowa Energy Center Speaker Series with two statewide webinars.



## OUTREACH ACTIVITIES

In FY 2015, the Energy Center participated in numerous outreach events including but not limited to:

- 2014 ASERTTI Fall Meeting
- The Iowa State Fair
- ISU Day at the Capitol
- ISU Electrical and Computer Engineering Graduate Seminar

## PROFESSIONAL DEVELOPMENT WORKSHOPS

The Iowa Energy Center hosted or sponsored more than 827 hours of professional and workforce development training sessions as part of our Energy Efficiency program in FY 2015.

## SPEAKER SERIES EVENTS

- Jim Spaeth, "Overcoming Technical and Non-Technical Barriers on the Road to Commercialization"
- Marilyn Brown, "Green Savings: How Policies and Markets Drive Energy Efficiency"

## SPONSORSHIPS

- Clean Energy Trust's Clean Energy Challenge
- Energy Manufacturing Workshop
- Envisioning a Carbon Negative Economy workshop
- Iowa Agriculture Literacy Foundation
- Iowa Energy Summit
- Midwest Wind Energy Center Advisory Board
- Renewable Energy Challenge Symposium
- State Science Fair of Iowa, Youth and Energy Scholarships



## MEET OUR EDUCATION AND OUTREACH IMPACT AWARD WINNER

Jay Staker, State Science and Technology Fair of Iowa

### LOOKING TO THE FUTURE

"Through the kids, you get to see the future," says Jay Staker.

Staker, the State Science and Technology Fair of Iowa (SSTFI) board chair, is also the interim director for Iowa Space Grant Consortium. Staker is receiving a 2015 Impact Award from the Iowa Energy Center for his passion and dedication in helping the next generation of Iowa scientists. He was a science teacher for over twenty years and has been with Iowa State for over a decade.

While conducting his life's work, Staker has always pondered how to help children learn science. He strives to find better methods for teachers, ways to support educators, and most importantly, he tries to find ways for children to actually do science, not just hear about it. In addition, Staker claims that perhaps the most important thing kids learn at the SSTFI is the ability to effectively communicate their ideas to others.

In his role, Staker gives oversight as a board chair for the State Science and Technology Fair of Iowa. He gives direction, provides support for staff, and helps find funding for the fair, as well. This is how he originally came into contact with the Iowa Energy Center.

The Iowa Energy Center gives scholarships to students with the best energy or efficiency projects at the State Science and Technology Fair of Iowa, a



role that Staker is very pleased with.

Staker also loves the fact Iowa Energy Center staff comes to the event to interact with the participants. "The Iowa Energy Center has a huge presence, and it gets everyone excited," said Staker. The connections that the kids make with people like the Energy Center staff are perhaps the most important thing they can take away from the SSTFI, according to Staker. One of the best things about Center's involvement is that kids can make a good connection, not just at the fair, but also all over the state of Iowa.

Not all kids have an equal opportunity to learn about science, and this fair is one way Staker believes that he can give disadvantaged children a chance to work on something important. This is one of the reasons why the two-day event has no entry fee. Staker thinks that this may also be the reason why the number of participants continues to rise each year, while nationally, science fair numbers are constantly falling. "It's fun to see the public come in and try to talk to these kids and just say 'wow'," Staker had to say about the amazing work that SSTFI participants produce.

## ABOUT THE LEARNING INSTITUTE

The Energy Center continues invest in growing and improving its online resources to support public education in energy and energy efficiency options. This includes timely announcements on funding and professional development opportunities.

This past fiscal year, the Learning Institute actively incorporated technology and leveraged social media to build a more robust online presence, bringing more content to Iowans and our partners. With a newly developed video channel and a company profile page on LinkedIn, the Energy Center is providing engaging educational content about our grant programs, recipients, and funding opportunities. You can connect with us on Twitter, Facebook, LinkedIn, Vimeo, and Instagram.

The Energy Center continues to be a repository for professional development and learning opportunities throughout the state through its events calendar. In FY

2015 announcements for numerous courses, workshops, presentations, webinars, and conferences were posted. Educators can continue to find information on the Energy Center's Youth and Energy Scholarship Program, as well as links to educational resources.

### Key Benefits:

- Hands-on educational experiences for schools, nonprofits, and businesses through scheduled tours at our two research facilities.
- Educational resources for homeowners about geothermal energy, energy tips, and financial incentives.
- Professional and workforce development opportunities through courses, workshops, conferences, presentations, and webinars.
- Educational videos on energy innovation throughout Iowa.

# GRANT PROGRAM TABLES

PROGRAM AREA	ORGANIZATION	GRANT TITLE	ENDORSED	FY 2015 AWARD
<b>MATCHING GRANTS</b>				
Bioenergy	Iowa State University	Analysis and Enhancement of CO <sub>2</sub> Mass Transfer for Algal Cultivation via an Integrated Revolving Algal Biofuel	\$120,000	-
Bioenergy	Iowa State University	Targeted Improvement of Biological Carbon Utilization and Biomass Yield for Algal Biofilm Chemicals	\$122,000	-
Bioenergy	Iowa State University	The Algal Crush Spread: Biofuels and Bioproducts	\$200,000	-
Bioenergy	Iowa State University	Delivering a Replicable, Integrated, Landscape Design Template that Simultaneously Improves Bioenergy	\$200,000	-
Bioenergy	Iowa State University	Spatially and Temporally Optimized Landscapes for Bioenergy, Food, and Ecosystem Services	\$200,000	-
Bioenergy	Imagine Grinnell	Watershed Scale Landscape Restoration and Research Initiative for Sustainable Bioenergy Systems	\$200,000	-
Education and Outreach	Iowa State University	Cultivating Awareness of Iowa's Biogas Generation Potential	\$18,200	-
Energy Efficiency	Iowa State University	Validation of RP-1455 Advanced Control Sequences for HVAC Systems	\$30,522	-
Energy Efficiency	Iowa State University	Simulated Network Control Model to Minimize Energy Use through Personalized Signaling	\$50,000	-
Energy Efficiency	Iowa State University	Achieving Energy Efficiency through Connected Vehicles	\$50,000	-
Renewable Energy	Iowa Wind Energy Association	Midwest and Prairie Regional Wind Resource Center	-	\$18,640
Renewable Energy	Iowa State University	Hexcrete Tower for Harvesting Wind Energy at Taller Hub Heights	-	\$83,510
Renewable Energy	Iowa Association of Municipal Utilities	A Public Power Model for Solar Market Pathways	\$200,000	-
Renewable Energy	Iowa State University	Solar Configurations and Operations Enabling System Resilience (SCORE) in a SunShot Future	\$59,173	-
<b>OPPORTUNITY GRANTS</b>				
Bioenergy	Iowa State University	Building a Highly Adaptable Microbial Consortium for Efficiency Biomass Utilization	-	\$75,000
Bioenergy	Iowa State University	Long-term Assessment of Miscanthus Productivity and Sustainability	-	\$99,954
Bioenergy	Iowa State University	Techno-Economic Screening of Biofuels and Biochemicals from High Moisture Feedstock Cultivating Awareness of Iowa's Biogas Generation Potential	-	\$24,228
Bioenergy	Iowa State University	Commercial Scale Biofuel Conversion: Design with Transient Chemistry and Thermal Characterization	-	\$80,000
Energy Efficiency	Iowa State University	Sustainable, Smart Buildings: Integrating Design, Adaptive Controls and Predictive Design	-	\$79,591
Energy Efficiency	Iowa State University	Data-Driven Multi-Agent Systems Approach for Monitoring and Control of Integrated Buildings	-	\$78,071
Renewable Energy	University of Iowa	Realistic Simulation of a Wind Farm Unit for Energy Production Optimization	-	\$88,840
Renewable Energy	Iowa State University	Innovative Dual-Rotor Wind Turbine Designs to Improve Wind Farm Efficiency	-	\$116,143
Renewable Energy	Iowa State University	Improved Electricity Generation Unit Commitment and Dispatch Using Stochastic Optimization	-	\$50,000
Renewable Energy	University of Iowa	Data Security and Privacy in Smart Grid: A Computational Approach	-	\$38,337
Renewable Energy	University of Iowa	Chemical Fuels from CO <sub>2</sub> : Electrochemical Reduction in Task-Specific Solvents	-	\$82,600
Renewable Energy	University of Iowa	Estimating Potential Hydrokinetic Energy and Recovery Fraction in Iowa Waterways	-	\$60,000

# GRANT PROGRAM TABLES, CONT.

PROGRAM AREA	ORGANIZATION	GRANT TITLE	ENDORSED	FY 2015 AWARD
<b>PLANNING GRANTS</b>				
Education and Outreach	Indian Hills Community College	Bioenergy Technology Education Center Partner Summit — NSF Regional Center Proposal Planning	-	\$5,000
Energy Efficiency	Iowa State University	Multi-Agent Based Mixed Centralized and Decentralized Control of Building Energy Systems	-	\$4,922
Renewable Energy	Iowa Association of Municipal Utilities	Collaborative Workshop to Plan Full Application for DOE Solar Market Pathways Grant	-	\$2,533
<b>SPECIAL PROJECT GRANTS</b>				
Education and Outreach	University of Northern Iowa	Northeast Iowa Solar Energy Fair	-	\$5,084
Education and Outreach	University of Northern Iowa	Public Education and Dissemination of Biomass Energy Research	-	\$4,363

# LEGACY GRANT PROGRAM TABLE

PROGRAM AREA	ORGANIZATION	GRANT TITLE	FY 2015 AWARD	CUMULATIVE AWARD
Bioenergy	Iowa State University	Liquid Phase Refinery of Biomass to Fuels by Graphene Derived Nanocatalysts	\$107,496	\$364,863
Bioenergy	Iowa State University	Experiments, Technoeconomics, and Optimization of Bioenergy Systems Based on Bio-Oil Gasification	\$127,528	\$456,357
Bioenergy	Iowa State University	Hybrid Processing for Robust Production of Biorenewable Fuels and Chemicals	\$110,143	\$314,872
Bioenergy	Iowa State University	Catalytic Processing of Whole Algal Biomass into Aromatics and Ammonia	\$106,412	\$226,270
Bioenergy	Iowa State University	Conversion of Biomass into Fuels and Chemicals Using Solvolysis	\$102,000	\$205,006
Bioenergy	Iowa State University	Renewable Diesel Production from Biofuel Co-Products	\$181,072	\$329,952
Education and Outreach	East Sac County Schools	Energy Education, Conservation and Efficiency: Sustainability in Iowa's Rural Schools	-	\$20,000
Education and Outreach	Des Moines Public Schools - Iowa Energy and Sustainability Academy	Enhanced Energy Education for the Iowa Energy and Sustainability Academy	-	\$12,300
Energy Efficiency	Iowa State University	ISU Farm Energy: Applying Energy Efficiency to Farm Enterprises	\$81,839	\$279,734
Energy Efficiency	Iowa State University	Next Generation Insulation Material for Appliance, Transportation and Building Systems	\$19,803	\$96,763
Energy Efficiency	University of Iowa	Riser Sleeve and Mold Ablation Technologies for Improving Energy Efficiency in Steel Casting	\$107,496	\$364,863
Energy Efficiency	Iowa State University	Municipal and Hydrocarbon Waste Streams — an Alternative Source for Fuels	\$118,098	\$248,197
Energy Efficiency	Iowa State University	Distillation Bottoms as a Warm Mix Asphalt Technology	-	\$124,140
Renewable Energy	Iowa State University	Novel Equichromic Organic/Inorganic Solar Cell	\$81,413	\$267,274
Renewable Energy	Iowa State University	Smart Sensory Membrane for Wind Turbine Blades	\$97,311	\$201,234

# FINANCIAL REPORT

The Iowa Energy Center receives primary funding from an assessment on the revenue of utility companies. Assessment funding for the FY 2015 totaled \$4.1 million. These funds are paid by the utilities to the Iowa Utilities Board, which then remits funding to Iowa State University. Iowa State administers the Energy Center, as mandated by statute.

The Energy Center also receives revenue from user fees at the Biomass Energy Conversion (BECON) facility in Nevada, Iowa, and the Energy Resource Station (ERS) in Ankeny, Iowa. These fees are utilized to offset the expenditures incurred in operating the facilities. The Energy Center also receives interest income on unspent funds.

The Alternate Energy Revolving Loan Program (AERLP) is managed by the Energy Center, and the enabling legislation allows for one-half the interest earned on unspent funds to be used to offset marketing and administrative expenditures by the Energy Center on behalf of the program. This spendable interest (\$30,382 for FY 2015) is not sufficient to cover the actual costs of administration of the program, and the Energy Center utilizes assessment funding to pay for costs in excess of the limit.

The financial statement presented here is shown on a modified cash basis and reflects actual outlays of funds, plus encumbrances of funds, for the fiscal year. This methodology is not in accordance with Generally Accepted Accounting Principles (GAAP), and substantially omits all the statements and disclosures required by GAAP. While the statement itself is unaudited, the Energy Center is subject to audit from both the State of Iowa and outside audit firms as part of Iowa State University. For FY 2015, the Energy Center placed 100% of assessment funds received into service.

As the grant programs continue to evolve, the awards will no longer be tied to program award solicitations for a specific fiscal year. The Energy Center targets keeping a cash reserve of approximately one-half the annual assessment amount, to ensure our ability to meet obligations for both operational and grant expenditures. Past statements have referred to this amount as a "carry forward." Due to the changing nature of grant award terms, this amount is considered to be, and referred to as, a reserve to ensure cash flow obligations can be met. Iowa State University is not obligated to fund any cash shortfalls incurred by the Energy Center.

The nature of the Matching Grant program results in timing issues related to expenditures. An endorsement in FY 2015 – a commitment of funds contingent on winning an external funding opportunity – must await the final sponsor award to ensure the matching funds will be required. These funds will likely not be expended in the fiscal year in which the Energy Center's endorsement is made, but will be expended when the requests for payment are made to the final sponsor. For multi-year external projects, then, Energy Center expenditures for a FY 2015 Matching Grant endorsement may be two or more years in the future. As of the end of FY 2015 the Energy Center had made awards under the Matching Grant program totaling \$302,150, and had endorsements, which await final sponsor approval, of an additional \$1,148,473.

Opportunity Grant awards awaiting disbursement as of the end of FY 2015 totaled \$662,701.

## FY 2015 (12 MONTHS ENDED JUNE 30, 2015)

## UNAUDITED

CASH RESERVES, JULY 1, 2014	2,407,102	
Utility Assessment Revenue	4,148,425	
Interest Income on Invested Assessment Funds	60,764	
User Fees - Service Centers	60,764	
Total Funds Available for Use		6,683,919
<b>GRANT EXPENDITURES</b>		
Legacy Grants	1,592,351	
Planning Grants	13,343	
Opportunity Grants	347,719	
Matching Grants	243,250	
Total Grant Expenditures		2,196,662
<b>ENCUMBERED BUT UNEXPENDED GRANT FUNDS</b>		
Legacy Grants	413,657	
Planning Grants	8,773	
Opportunity Grants	662,701	
Matching Grants	56,490	
Total Encumbered Grant Expenditures		1,141,621
Total FY 2015 Grant Spending		3,338,283
<b>OPERATIONAL EXPENDITURES BY TYPE</b>		
Personnel	1,231,875	
Travel	58,724	
Contracted Services and Information Technology Services	305,072	
Supplies	148,856	
Repairs and Maintenance	111,536	
Utilities	49,320	
Tuition	13,815	
Depreciable Equipment	46,463	
Total Funds Available for Use		1,965,662

## OPERATIONAL EXPENDITURES BY FUNCTIONAL BREAKDOWN

Energy Efficiency Program	270,799	
Bioenergy Program	106,065	
Renewable Energy Program	56,557	
Education and Outreach Program	129,038	
Loan Program (Unrecovered Costs)	107,650	
Administration	767,151	
<b>SERVICE CENTER COSTS</b>		
Energy Resource Station (Ankeny)	252,865	
Biomass Energy Conversion Facility (Nevada)	275,537	
Total Service Center Expenditures		528,402
TOTAL EXPENDITURES (BY FUNCTION)		1,965,662
UNENCUMBERED FUNDS REMAINING		1,379,974

## EXPENDITURES CHARGED TO SPONSORED RESEARCH PROJECTS

Personnel	108,409	
Contracted Services and Information Technology Services	72,159	
Travel	2,726	
Maintenance and Repair	6,637	
Supplies	14,568	
Tuition	5,387	
Misc.	26,979	
Total		236,863

# IOWA ENERGY CENTER STAFF

**Mark C. Petri, Ph.D.,** Director

## **ENERGY RESOURCE STATION (ERS), ENERGY EFFICIENCY PROGRAM**

**Xiaohui Zhou, Ph.D., P.E.,** Program and Facility Manager

**Ran Liu, Ph.D.,** Postdoctoral Research Associate

**Scott Lochhead, P.E.,** Mechanical Engineer

**Denise Junod,** Administrative Assistant

## **BIOMASS ENERGY CONVERSION (BECON) FACILITY, BIOENERGY PROGRAM**

**Norm Olson, P.E.,** Program and Facility Manager

**Troy Barker,** Facility Mechanic

## **ALTERNATE ENERGY REVOLVING LOAN PROGRAM (AERLP), RENEWABLE ENERGY PROGRAM**

**Bill Haman, P.E.,** Program Manager and Loan Program Manager

## **MARKETING AND COMMUNICATIONS, EDUCATION AND OUTREACH PROGRAM**

**Leigh Nelson,** Communications Coordinator

**Peter Ampe,** Public Relations Intern

**Taylor Buckley,** Graphic Design Intern

**Tommie Clark,** Public Relations and Photojournalism Intern

**Zach Dahl,** Marketing Intern

## **BUSINESS ADMINISTRATION**

**Julie Charlson,** Administrative Assistant

**Linda Hintch,** Safety and Security Officer

**Patty Prouty,** Grant Specialist

**Britta Sandberg,** Contract Coordinator

**Martin D. Watt,** Office Coordinator/Fiscal Officer



## ADVISORY COUNCIL

*The advisory council assists the Iowa Energy Center director in fulfilling the Iowa Energy Center's mission by providing advice on budgets, planning, and policies.*

### **RESEARCH AND EDUCATION SECTOR**

**Peter Damiano, DDS, MPH,** Director, Iowa Public Policy Center, The University of Iowa

**Kavita Dhanwada, Ph.D.,** Associate Dean and Associate Professor — College of Natural Sciences, University of Northern Iowa (Council Vice Chair)\*

**Valerie Newhouse,** President, Iowa Lakes Community College

**Arun Somani,** Associate Dean — College of Engineering, Iowa State University

**Gary Steinke,** President, Iowa Association of Independent Colleges and Universities

**Catherine Zeman,** Professor — Health, Physical Education and Leisure Services; Recycling and Reuse Technology Transfer Center, University of Northern Iowa

### **PUBLIC SECTOR**

**Jennifer Easler, J.D.,** Office of Consumer Advocate

**Geri D. Huser,** Chair, Iowa Utilities Board

**Brian Selinger,** Team Leader — Energy, Iowa Economic Development Authority

**Sheila Tipton,** Member, Iowa Utilities Board\*

### **UTILITY SECTOR**

**Dean Crist,** Vice President — Regulation,  
MidAmerican Energy Company (Council Chair)\*

**John Euchner,** CEO, Nishnabotna Valley Rural Electric Cooperative

**Michael Fehr,** Vice President — Regulation, MidAmerican Energy Company

**Vern Gebhart,** Vice President — Business Infrastructure and Technology,  
Alliant Energy

**Todd Kielkopf,** General Manager, Indianola Municipal Utilities

*Members are listed by constituency for the July 1, 2014 - June 30, 2015 term.*

*\*Terms ending mid-year*



## CONTACT US

### MAIN OFFICE

2521 University Blvd., Suite 124, Ames, IA 50010-8629  
(515) 294-8819 | [iec@iastate.edu](mailto:iec@iastate.edu)

### BIOMASS ENERGY CONVERSION (BECON) FACILITY

1521 West F Ave., Nevada, IA 50201 | (515) 382-1774

### ENERGY RESOURCE STATION (ERS)

DMACC Bldg. #23, 2006 S. Ankeny Blvd.,  
Ankeny, IA 50023 | (515) 965-7055

## CONNECT WITH US



[www.iowaenergycenter.org](http://www.iowaenergycenter.org)

