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energizing Arkansas

Focusing on sustainable, cutting-edge & renewable energy alternatives

NW Arkansas center dedicated to furthering

"smart grid" technologies

New advanced solar cells

Enzyme research furthers cellulosic ethanol development

Cover: Dr. Elizabeth Hood with transgenic corn in the Arkansas Biosciences Institute's greenhouse.

NW Arkansas Center Dedicated to Furthering "Smart Grid" Technologies

America's electric power industry is the largest among developed countries and serves the biggest economy. Yet, the nation's transmission grid is fragmented among more than 3,100 entities and is in need of modernization as the U.S. economy becomes more dependent on uninterrupted, high quality electric power supplies. The University of Arkansas' National Center for Reliable Electric Power Transmission (NCREPT) is one of the most advanced research facilities in the country dedicated to creating a "Smart Grid" that will carry electricity in a cheaper, more reliable and efficient manner.

According to Dr. Alan Mantooth, NCREPT's executive director, the term "Smart Grid" refers to both the hardware and software added to the power system to achieve "a more autonomous responsiveness to events that impact the electrical power grid, and optimal day-to-day operational efficiency of electrical power delivery."

NCREPT was established in 2005 through a $1 million grant from the U.S. Department of Energy to investigate and develop electronic systems that will modernize the nation's outdated power grid. In 2009, NCREPT moved into a new 7,000-square-foot test facility at the Arkansas Research and Technology Park in Fayetteville, Ark. "The lab can work with experimental distribution systems of up to 6.5 megawatts and can test current generated by wind, solar or other power sources," Mantooth explained.

Each year the nation loses billions of dollars due to power outages. NCREPT staff work with next-generation materials and equipment that will replace electromechanical devices now in use to help localize and improve response time to outages. Currently, NCREPT's researchers are developing a

Dr. Alan Mantooth serves as NCREPT's executive director. He is one of 302 Institute of Electrical and Electronics Engineers (IEEE) members in the nation who have been elevated to the grade of IEEE Fellow for his contributions to the modeling of power electronic devices.

In 2009, NCREPT moved into a 7,000-square-foot world-class power electronics test facility in Fayetteville, Ark. The Center can work with experimental electricity distribution systems of up to 6.5 megawatts.

device that will interrupt a fault current when it exceeds a predetermined threshold, thereby reducing susceptibility to a blackout. "The Fault Current Limiter isolates power failures and prevents surges without interrupting power to the consumer," Mantooth said.

In addition to its internal research projects, NCREPT conducts testing for commercial clients. NCREPT's first customer was an international company, The Switch, which required a series of tests on commercial AC-DC-AC conversion equipment designed to connect an alternative power source to the electric grid. In a joint project with Arkansas Power Electronics International Inc. (APEI), Rohm Co. Ltd. and Sandia National Laboratory, NCREPT assisted with the development and testing of the world's first commercial high-temperature silicon carbide power module. The collaboration earned both APEI and NCREPT R&D Magazine's 2009 R&D 100 Award.

Another NCREPT initiative is the Industry/University Cooperative Research Center on Grid-Connected Advanced Power Electronic Systems (GRAPES), a program funded by the U.S. National Science Foundation that is jointly conducted with the University of South Carolina. GRAPES' mission is to accelerate the adoption and insertion of power electronics into the electric grid in order to improve system stability, flexibility, robustness and economy.

Both NCREPT and GRAPES have industrial partners that fund core research efforts through a membership fee. In return, sponsors receive access to reports, papers and other materials produced as a result of NCREPT projects. Partners may have an opportunity to propose focus areas for research. One of NCREPT's newest members is the city of North Little Rock. "It's vital we understand what resources are available to our citizens today as well as in the future," said North Little Rock Mayor Patrick Hays. "By becoming a member of NCREPT, North Little Rock can be among the first to participate in future power systems."

Another component of NCREPT is developing manpower to operate and maintain power systems. "We're about to face a huge void in the workforce within the electric power field. Men and women who built our electric power grid are now in their 50s and 60s and they're about to retire," Mantooth said. "Utilities are very interested in hiring new graduates to come in and learn the current system from those who work with it every day."

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Enzyme Research

Furthers Cellulosic Ethanol Development

Researchers in Jonesboro, Ark., under the leadership of Dr. Elizabeth Hood, are developing technology to make the production of cellulosic ethanol more affordable. A small part of most plants is starch, the component currently used to make commercial ethanol. However, this ethanol can also be made from cellulosic biomass — plant matter composed primarily of inedible cellulose fibers that form the stems and branches of most plants.

Cellulosic biomass has been a challenge for scientists to economically convert to ethanol, because the cellulose is tightly bound in a matrix that cannot be directly fermented. In the past, scientists have used harsh acids and high temperatures to try and break the cellulose down into its individual sugar components. However, recent advances in the relatively new field of industrial biotechnology are focusing attention on developing enzymes that can break down the cellulose.

A team of researchers, under the leadership of Dr. Elizabeth Hood, is developing a less expensive way to produce enzymes that can break down plant cellulose for the production of ethanol. Dr. Hood is a Distinguished Professor in the College of Agriculture at Arkansas State University in Jonesboro, Ark.

Hood's research team at the Arkansas Biosciences Institute located at Arkansas State University is focused on developing large quantities of inexpensive enzymes by using plants as biofactories. Through genetic modification, a breed of corn with a high concentration of an enzyme in its germ has been developed. This enzyme can break down the cellulose in plants. This means that rather than purchasing expensive enzymes, someone who wants to produce cellulosic ethanol could potentially just grow this corn, which would provide both the feedstock and the enzyme. These new enzyme technologies could allow farmers to utilize waste materials via the production of ethanol, ultimately lowering the cost of biofuels to consumers.

"We work with maize seed to make our enzymes," Hood explained. "But we are happy to use those enzymes on any type of plant material that would come into a manufacturing facility because our enzymes will break down any plant material."

Researchers must continue to work through technical hurdles before cellulosic ethanol can be marketed at competitive prices. "I would love to do the kind of research that will allow the enzymes to be made cheaply enough," Hood said.

"Research" is defined as a systematic study directed toward fuller scientific knowledge or understanding of the subject studied. "Development" is the systematic use of knowledge and understanding gained from research directed toward the production of useful materials, devices, systems or methods, including design and development of prototypes and processes.

— National Science Foundation

PUBLIC POLICY

Energy insecurity, concerns about climate change and global competitiveness have prompted a host of policy changes such as the passage of the Energy Independence and Security Act of 2007. Such emphasis on the development of clean energy technologies has created an environment in which intensive investment in research and development (R&D) is necessary to support the policy mandates set forth by both the federal and state governments.

Arkansas has been making steady progress in the realm of R&D. The Arkansas Science & Technology Authority (ASTA) was created in 1983 with the mission to "bring the benefits of science and advanced technology to the people and state of Arkansas." Last fiscal year, ASTA awarded approximately $8 million dollars in grants and tax credits to foster research activities throughout the state. Most of the projects were administered through ASTA's Research Match Program, the Centers for Applied Technology, the Basic Research Grant Program, the Arkansas Research Alliance and the Research and Development Tax Credit Programs.

EPSCoR – the Experimental Program to Stimulate Competitive Research – was created to enhance national research funding for university scientists and engineers in Arkansas. Its strategic plan includes establishing multi-university partnerships for research clusters and collaboration between universities, assisting researchers in attracting the human and intellectual capital needed to successfully compete for federal and private-sector R&D funding, all while promoting initiatives that support "job-creating" research.

"Arkansas is a very creative state and we have people who are doing mind-blowing research," said Dr. John Ahlen, ASTA president. While government can prime the pump of research, the private sector must support the process by which an innovation is brought to the market and made economically viable – the "D" in R&D. Strategic partnerships can help carry out such activities by leveraging public and private investments. ASTA's programs assist companies through various stages of development from the inception of a technology-based business to the commercialization of new products.

"Arkansas has a long history in technology-based economic development," Ahlen explained. "Over the last two decades, ASTA has increased its research and development activities and applied them to the state's economy," Ahlen explained. Creating companies within the state creates an economic ecosystem. The companies put down deep roots, anchoring them in Arkansas; they hire home-grown university graduates into quality, high-paying jobs, letting them remain in Arkansas. The companies also allow the state to recruit talented students and research faculty.

"As a state, we're doing all the right things, but on a small scale," Ahlen said. Public policy can help address these challenges by providing dedicated funding that encourages the research, development and commercialization of new technologies. "Arkansas must attempt to become more competitive with other states by offering state dollars that can be leveraged with federal funds and by providing other incentives and rebates," Tom Riley, director of the University of Arkansas Division of Agriculture Public Policy Center, explained.

"We can gain strategic advantage by making investments in energy research and development now."

"Arkansas has people who are doing mind-blowing research."

UALR Center Using Nanotechnology to Develop Advanced Solar Cells

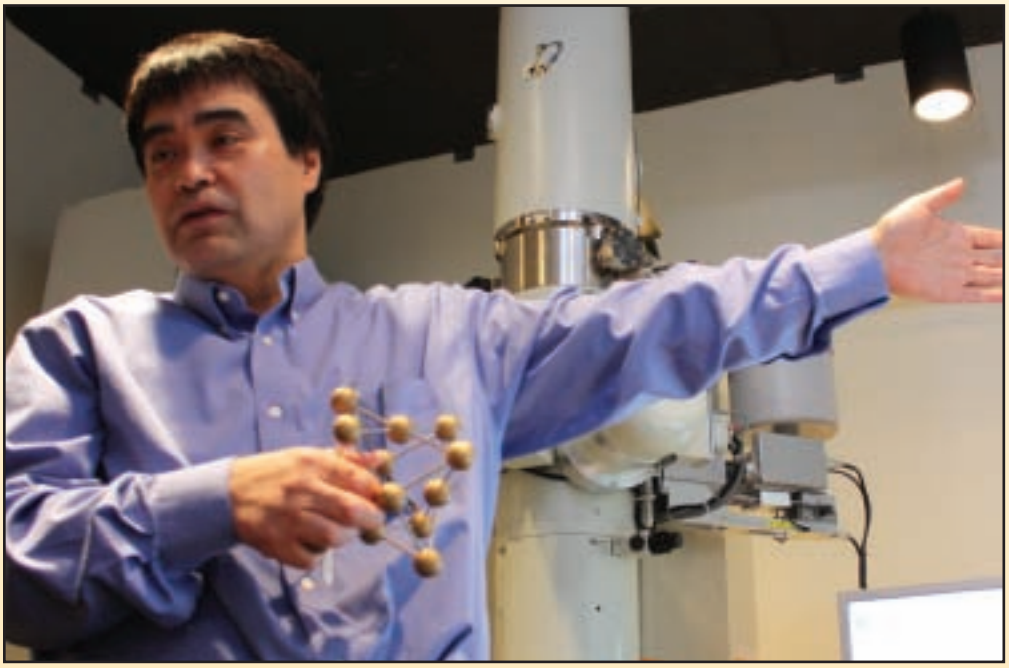
The Arkansas Nanotechnology Center at the University of Arkansas at Little Rock (UALR) is opening new doors in the area of advanced solar cell technology. Dr. Alexandru Biris, director and chief scientist at UALR's Nanotechnology Center, and a team of researchers including physicists, chemists and engineers are developing organic solar panels based on polymers and carbon nanotubes, which they synthesize at the Center.

Nanotechnology involves the control and manipulation of materials at the nanoscale — particle sizes from 1 to 100 nanometers (nm), in which 1 nm equals 1 billionth of a meter — to create new materials and structures that have novel properties due to their small size. While nantotechnology is an established field of research, work with carbon nanotubes is relatively new.

The Center has been awarded two patents for its technique for producing carbon nanotubes and has additional patents pending. "We have developed a unique process for synthesizing and characterizing high quality, well-proportioned carbon nanotubes, which is essential for our research," Biris said. The Center's carbon nanotubes offer new potential to deploy solar cells with improved strength and flexibility.

Traditional solar cells use semiconductors to capture light. Each photon of light that is absorbed raises an electron in the semiconductor material to a high-energy state. The electron then drifts away from the net positive charge left generating a current, which is turned into electricity.

The semiconductor most commonly used in traditional photovoltaic arrays is silicon, which makes efficient solar cells but is not without limitations. For silicon to absorb enough light, relatively thick slabs need to be used. Semiconductor-grade silicon is an expensive material;



Dr. Fumiya Watanabe, director of instrumentation at the Nanotechnology Center, explains how the Transmission Electronic Microscope (in background) can detect a particle as small as 0.1 nanometer. The Center works with other institutions to break down nanoparticles into their component elements.

Organic solar cells have the potential to be significantly thinner, more flexible, cheaper and quicker to produce. There are endless possibilities for practical applications.

Dr. Alex Biris, who earned his Ph.D. at UALR's Donaghey College of Information Science and Systems Engineering, is now the director and chief scientist for the Arkansas Nanotechnology Center based on the University's campus.

too expensive to make consumption of silicon based solar panels economically feasible for the masses.

The energy market would benefit immensely from organic solar cells. Energy producers commonly use conventional silicon cells, but organic solar cells have the potential to be significantly thinner, more flexible, cheaper and quicker to produce. "There are endless possibilities for the practical applications of organic solar panels," Biris explained. "Imagine solar panels so flexible they can mold to a roof or something that is almost like a paint or thin film that can be applied to surfaces." Biris estimates that development and commercialization of such products are just a few years away. "This area of research is growing so rapidly that advances are being made every day."

The Nanotechnology Center was established in 2006 with a $5.9 million appropriation from the Arkansas General Assembly to perform outstanding research and serve the Arkansas scientific community, industry and develop business-ready technologies. The Center's research into organic solar panels began in 2007 with a grant from the Department of Energy. Currently housed in the campus' Engineering Technology and Applied Sciences building, Biris anticipates construction to begin in the spring on a new facility dedicated solely to nanotechnology research.

TREND WATCH

State Launches Industrial Loan Program. Applications for the Arkansas Industrial Energy Technology Loan (IETL) Program are being accepted by the Arkansas Energy Office (AEO) of the Arkansas Economic Development Commission. The loan finances energy efficiency retrofits and green energy implementation for industries in the state. IET loans will be distributed as long as funds are available. As projects are completed, the loan repayments will be used to issue additional loans. The AEO aims to make this loan fund a permanent, or long-term, funding option for Arkansas industries. For more information, go to http://arkansasenergy.org/industry/incentives-and-programs/-industrial-energy-technology-loan-.aspx.

Arkansas Awarded $2.7 Million for Appliance Rebate Program. The U.S. Department of Energy awarded the Arkansas Energy Office (AEO) of the Arkansas Economic Development Commission $2.74 million to launch an ENERGY STAR® Appliance Rebate Program intended to stimulate the economy by encouraging consumers to replace older, less efficient appliances with new, more energy-efficient ENERGY STAR® qualified models. Rebates will be awarded starting March 2010 on a first-come, first-served basis until the allocated program funds are depleted. Rebates are mailed in and the customer receives the rebate check within six to eight weeks. Appliances eligible for the rebate program include refrigerators, clothes washers and hot water heaters with $125, $175, and $200 rebates each, respectively. For more information, go to www.arkansasenergy.org/energy-in-arkansas/energy-policy-and-legislation/recovery-2009/energy-star-appliance-rebate.aspx.

Small Cities and Counties Eligible for Block Grant Program. Arkansas received $5 million in federal stimulus funding for the Energy Efficiency Conservation Block Grant (EECBG) Program. This program provides grants to small cities and counties for energy efficiency and renewable energy projects. The Arkansas EECBG program will assist local governments in implementing strategies to reduce fossil fuel emissions, reduce total energy use, improve energy efficiency and deploy market-ready renewable energy technologies. Small cities and counties can apply for funding through this competitive grant program. The Arkansas Energy Office has partnered with Winrock International, an Arkansas-based nonprofit organization, to administer this program. Grant applications are due April 30, 2010. For more information, go to http://www.arkansasenergy.org/government/energy-grants-for-small-cities-and-counties.aspx.

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MARK YOUR CALENDAR

Green & Sustainable Business 101 — SBNCA Lunch & Learn Series

March 9, 2010, noon – 1:00 p.m. • Arkansas Studies Institute, Little Rock, Arkansas

Learn what it means to be a green and/or sustainable business. Sponsored by the Sustainability Business Network of Central Arkansas, registration is $10/person. Participants should bring their own lunch. Reservations are required. To register or for more information, send an e-mail to info@sbnca.org.

Boiler Operator Training

March 16 – 18, 2010 • Chamber of Commerce, Texarkana, Arkansas

This three-day training covers safe and energy-efficient boiler operation, including maintenance, inspection, codes and trouble shooting. To register or for more information, email JFoster@ArkansasEDC.com or TScott@ArkansasEDC.com.

ACCA HVAC Training: Residential Manual J Load Calculations, Duct System Design, Testing and Sealing

April 6 – 8, 2010 • Arkansas Electric Cooperatives Board Room, Little Rock, Arkansas

This training is designed to improve installation practices for heating, ventilation and air conditioning (HVAC) equipment, including measures designed to reduce leakage in air ducts. To register or for more information, email JFoster@ArkansasEDC.com or TScott@ArkansasEDC.com.

Energizing Arkansas is a joint education project of the Arkansas Energy Office of the Arkansas Economic Development Commission and the University of Arkansas Division of Agriculture Public Policy Center. The goal of this newsletter is to provide timely, informative articles on the development of energy efficiency, renewable energy and energy policy in Arkansas. Each issue of Energizing Arkansas will explore new research and technology in the bioenergy sector, examine the economic, environmental and policy impacts of bioenergy and spotlight people and organizations leading the pack in sustainable, renewable energy.

Electronic versions of the newsletter as well as an accompanying video clip highlighting one of the stories featured in each issue may be accessed at www.arkansasenergy.org or at ppc.uaex.edu. E-mail your questions or comments to energizingarkansas@uaex.edu.

UofA University of Arkansas Division of Agriculture Public Policy Center

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