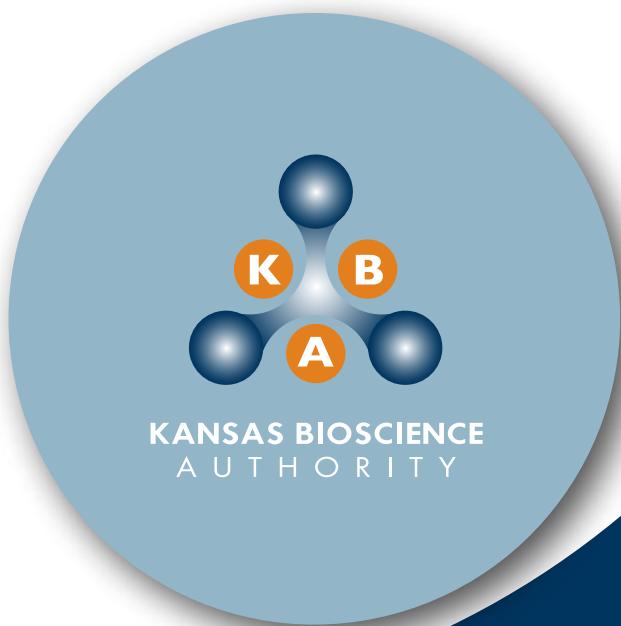


Protecting the American Food Supply and Agricultural Economy

Our expertise has created a magnetic effect



The Kansas Bioscience Authority has made food safety a top priority, and this focus is having a magnetic impact. Bioscientists, researchers, and veterinarians in Kansas are leading the way in the development of safeguards that ensure the safety of the American food supply and agricultural economy.

With the world population set to reach 9.5 billion in 2050, livestock producers must add another 10 billion animals to their herds to satisfy the needs of an additional 3 billion people.

While the agriculture industry in Kansas and elsewhere is well positioned to meet this demand, public health officials face a tougher test. This dramatic increase of both people and animals opens the door for the rapid spread of diseases that could harm the food supply — particularly since biological threats pose an even more imminent threat than nuclear ones.

About 75 percent of major new infectious diseases are zoonotic (illnesses transmitted from animals to humans), according to the Centers for Disease Control and Prevention (CDC). There are more than 250 known food-borne diseases, and the CDC investigates some 1,200 food-borne outbreaks annually. On top of that, there is the looming threat of bio- or agro-terrorism.

With this backdrop, the Kansas Bioscience Authority has made food safety a top priority, and this focus is having a magnetic impact. Bioscientists, researchers, and veterinarians in Kansas are leading the way in the development of safeguards that ensure the safety of the American food supply and agricultural economy. Collaborative research initiatives in animal and human medicine have resulted

in effective detection, prevention and treatment of disease. And researchers and companies are moving scientific and technical breakthroughs from the lab into the commercial marketplace.

Business, government face the challenge together

International agricultural products giant **Cargill**, with 130,000 employees in 66 countries, is the kind of company that could build a new research and development facility anywhere in the world.

But when it made its decision in 2010 about where to move forward with a \$15 million state-of-the-art technology and innovation center focused on food safety and the development of new food products, Cargill chose Wichita.

Work done at the Wichita R&D center will boost the animal health, meat, and poultry industries in North America. Specifically, the center will focus on food safety, conducting research on new technology to control, minimize and eliminate pathogenic bacteria at their origins.

"There is a tremendous amount of pride knowing this facility will be located in the heart of downtown Wichita," said Jody Horner, president of Cargill Meat Solutions.

Similary, **Ceva Biomune** expanded in Kansas with its food animal and poultry vaccine manufacturing facility. Ceva spokesman Gary Baxter said the new 20,000 square foot facility will enable his company to meet the production demands of its growing share in the global food animal vaccine market.



This rendering shows Cargill Meat Solutions' plans for a new, state-of-the-art technology and innovation center focused on food safety.

The facility is also designed to produce large animal vaccines and custom vaccines and to continue the advances Ceva has achieved in the development of vector vaccines.

"We've already hired more than 25 new scientists and Ph.D. level researchers," Baxter said.

The federal government also is partnering with Kansas to ensure new innovations for food safety make their way into the private sector. In July, the

protect the agricultural economy and bring bioenergy solutions to the marketplace.

Addressing national challenges

To defend the U.S. food supply against agroterrorism and to protect it against emerging animal pathogens, the Department of Homeland Security (DHS) has awarded \$12 million to the **Center of Excellence for Emerging and Zoonotic Animal Diseases (CEEZAD)** at Kansas State University.



U.S. Department of Agriculture's Agricultural Research Service selected the KBA as one of nine organizations it is working with nationally to spin technologies out of federal labs into businesses that can commercialize them.

As part of the Agricultural Technology Innovation Partnership network, the KBA will serve as an important portal, connecting Kansas' entrepreneurial community and higher-education institutions with world-class outcomes from more than 100 federal research locations nationwide. Strong economic impact is expected as the KBA and USDA work to

In February 2010, DHS selected K-State based on the strength of its expertise in vaccine development and ongoing research in zoonotic and animal disease detection. Center director **Dr. Juergen Richt** is a KBA eminent scholar and Regents distinguished professor in the College of Veterinary Medicine.

"Because of Dr. Richt's work," said Karrine Cortes, grant manager for the center, "we already had much of what DHS was looking for."

"The whole idea of these DHS centers of excellence," said Dr. Igor Morozov, science manager of the CEEZAD, "is to address the difficult issues of emerging threats and biological catastrophes whether they are natural epidemics or incidents caused accidentally or purposely by terrorists."

CEEZAD will develop pre-harvest agricultural defense systems and train a work force to implement the measures. It will partner with Texas A&M's Foreign Animal and Zoonotic Disease Defense Center.

"The KBA has supported our start-up efforts, getting us funds to set up the lab, put an administration in place and draft our work plan," Morozov said.

Preventing outbreaks

Once called the mystery swine disease, Porcine Reproductive and Respiratory Syndrome (PRRS) is a double edged sword. Not only can it decimate a pig population, it can also destroy a regional or national pork economy. Three years ago, a mutant strain of PRRS forced Chinese producers to slaughter 100 million hogs.

"Even though the Chinese still had 500 million surviving hogs, the economic damage was widespread," said **Dr. Jishu Shi**, lead investigator for a PRRS vaccine adjuvant project at **Kansas State University's Biosecurity Research Institute**. "Within three months, pork prices had doubled."

Shi hinted at the devastation such an outbreak would cause in the U.S. with a total hog count of 100 million. If a strain of PRRS capable of killing 100 million animals took hold here, the entire U.S. industry could be wiped out.

"Even if the highly pathogenic strain of PRRS only afflicts 15 or 20 percent of the hog population, it still would be tough to rebuild the industry," Shi said.

With a \$500,000 grant from the KBA, Shi and his team are developing new biological adjuvants for PRRS vaccine to ensure the mutant strain that attacked the Chinese hog industry doesn't get a foothold in the U.S. The testing is conducted at K-State's National Agricultural Biosecurity Center.

"The KBA grant has been key to our research," said Shi.

Keeping livestock healthy

Megastarter is in business to put weight on beef cattle and to help dairy cattle produce more milk. The company was formed last year when the May family, long-time Colorado ranchers, acquired a patent from a South African company to cultivate anaerobic microbes that prevent the accumulation of lactic acid — causing acidosis — in the rumen.

"We're developing products to accelerate beef cattle weaning from pasture and grasses to feed-lot grains," said Megastarter CEO Michael Lipfield of the process that can involve several costly stages. "If producers can skip some of these stages, they can get their cattle bigger faster, and their dairy cattle can produce more milk more quickly."

Since the new owners of Megastarter were based in Colorado, the company might have been located there as well. But the KBA worked to attract Megastarter to Kansas, close to the animal health resources available at K-State.

"In addition to awarding a grant that allowed us to relocate six people," Lipfield said, "the KBA facilitated a loan so we could purchase a building and set up facilities in nearby Wamego."

Stopping the ecological gymnasts

Microbes have been described as "ecological gymnasts" with an uncanny ability to adapt to evolving or devolving conditions. They can change directions and move across species lines. When transmitted as arboviruses (disease carried by blood-sucking arthropods like ticks, fleas and mosquitoes), they are difficult to control. The rapid global spread of West Nile virus 10 years ago is a good example.

The Arthropod-Borne Animal Diseases Research Unit (ABADRU), part of the USDA's Agricultural Research Service, is on the front lines of detecting and controlling arthropod diseases in U.S. livestock, including "wild type" and vaccine strains of Rift Valley Fever virus (RVFV).

In 2010, ABADRU selected Manhattan, Kan., as its new home, relocating from Laramie, Wyo., to develop novel disease diagnostic systems for the early detection of viruses such as RVFV.

Dr. William Wilson, the unit's lead investigator, described RVFV as similar to West Nile. Based on its research of that virus, ABADRU is advancing biosensor technology to assay antibodies and protein/nucleic acid. Wilson and his team expect to develop patentable virus detection systems that can produce results in less than an hour versus the current two-hour standard.

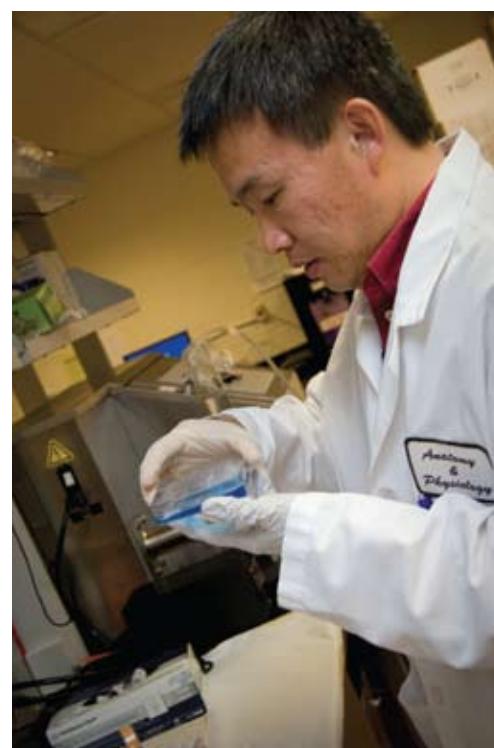
ABADRU's work to design this technology has been hastened with the unit's move to Manhattan, where it is taking advantage of the Kansas State University biocontainment research facilities.

"With this laboratory, we can conduct actual sample research," said research microbiologist Dr. Barbara Drolet, "and benefit from the collaboration with K-State scientists."

The KBA provided assistance in moving the operation from an outdated structure in Wyoming. Wilson said five years of work might have been lost without the KBA's assistance.

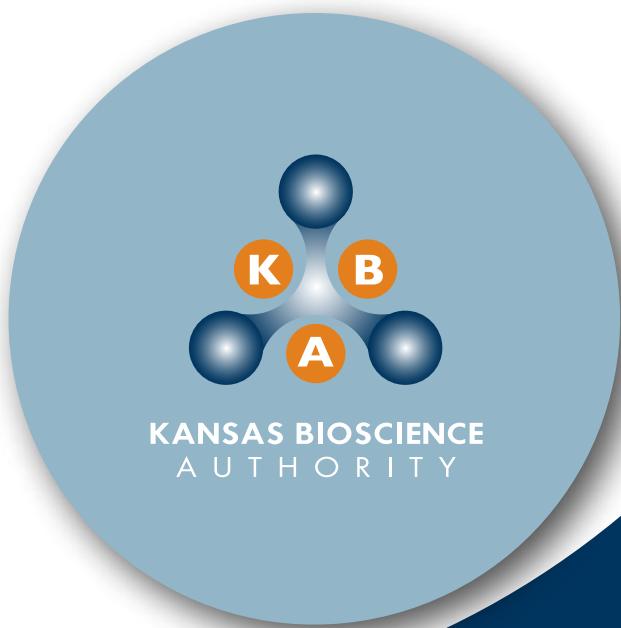
"With the help of the KBA, the move went amazingly well," he said. "It was a heroic effort from everyone involved."

Below: Dr. Jishu Shi uses a microfluidizer in his lab at K-State's College of Veterinary Medicine to make vaccine adjuvant.



Improving Human Health

Success is attracting top scholars, big investments



Kansas ranked #1 in the nation for its increase in funding from the National Institutes of Health, jumping 37 percent at a time when overall NIH funding declined by 4.7 percent.

The Kansas Bioscience Authority is investing in research, fostering the growth of companies, and bringing industry and academia together to address important bioscience challenges in the human health sector.

Thanks to this comprehensive approach, Kansas' national leadership in the biosciences is growing — attracting more investment capital, earning more government and philanthropic grants, and developing more technology aimed at improving human health. The potential economic benefit to the state could be enormous as new technology is transferred to commercial enterprises and licensees.

In the last three years, for example, the **University of Kansas Cancer Center** has received more than 100 patents for its work in cancer research, with 51 patents registered in the first half of 2010 alone.

Achievements like these have catapulted KU to the frontline in the battle against cancer and bolstered Kansas' image as a destination for cutting edge research and good investment opportunities.

Another area of great promise is orthopedic medicine. Wichita is transforming itself into a powerhouse in this sector, leveraging its heritage in aerospace engineering. In fact, the National Institute for Aviation Research (NIAR) has

designated Wichita as one of three corporate clusters in the U.S. where engineers, doctors, and scientists are studying the potential for using advanced aerospace composite materials in orthopedic surgery.

KBA eminent scholar **Dr. Paul Wooley** is the research director of the **Center of Innovation for Biomaterials in Orthopaedic Research** (CIBOR), which was launched by the KBA in 2009 with a \$4 million founding investment. Wooley described the aviation industry as cyclical, whereas orthopedic medicine is more constant, especially with an aging population.

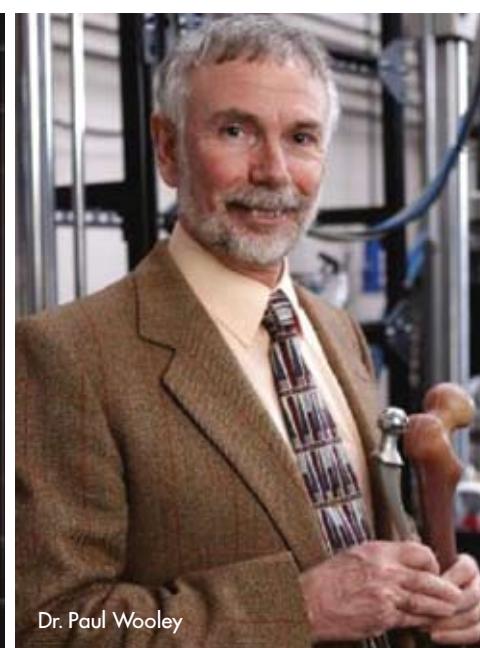
"Hip and knee replacement procedures alone represent a \$32 billion business," said Wooley. "You wouldn't have to have a significant share of that to provide

an economic advantage for the region and the state."

Wooley and his team expect to create a new field within orthopedic medicine with the introduction of composite materials developed by the aerospace industry to replace plastic and metal implants.

"We're developing the next generation of materials," said Wooley. And because of the composite expertise found in Wichita, he said, "We have instant access to the technology."

CIBOR's work also has attracted \$2.1 million from the Miami-based Knight Foundation, in addition to other funding from the U.S. Department of Defense to develop sophisticated battlefield bandages to reduce amputations and stabilize limbs during medevac.



Dr. Paul Wooley

Eminent scholars choosing Kansas

Successful research propels human health advancements and the growth of the life sciences sector. With that understanding, the KBA is helping Kansas attract eminent scholars whose work will bring significant research funding and future industrial growth.

This approach recognizes that an incremental approach is not sufficient in today's highly competitive bioscience field — game-changing investments are required.

Another top recruit, **Dr. David Volkin**, came to KU from Centocor R&D, a subsidiary of Johnson & Johnson. Volkin is using a \$2.49 million grant from the KBA over five years to direct and expand KU's Laboratory for Macromolecule and Vaccine Stabilization.

Then in October, with \$9.17 million in new commitments to attract five more top scholars to Kansas, the KBA exceeded the \$50 million mark in its investments in cancer fighting cures.



Kapil Bhalla, MD, and his team at the University of Kansas Cancer Center

In its recruitment efforts, the KU Cancer Center focuses on candidates who are recipients of National Cancer Institute (NCI) research funding and who have a track record of commercialization.

"The KBA has been absolutely vital in helping us recruit senior level researchers," said center director **Dr. Roy Jensen**.

In 2010, the KBA approved \$1.8 million over five years to support the work of **Dr. Rakesh Srivastava**, who joined KU from the University of Texas Health Center at Tyler. He arrived at his new post with NCI funding for his research on the molecular mechanics of cancer cell growth and his work to develop drugs to prevent and treat cancers.

Dr. Kapil Bhalla is a professor of internal medicine and deputy director of the KU Cancer Center. Bhalla came from the Medical College of Georgia and is an expert in novel targeted therapeutics of breast cancer, lymphoma, and leukemia.

Dr. Shrikant Anant is the center's associate director for prevention and a professor of molecular and integrative physiology. Anant, formerly with the University of Oklahoma, focuses on gastrointestinal cancer research.

Other scholars filled key leadership positions as associate directors of translational research; basic science; and Phase I trials.

The five scholars announced in October brought \$1.7 million in annual research funding from the National Cancer Institute.

"The KBA has been essential to our efforts to move forward," Jensen said. "With its support, we can leverage our ability to acquire one-to-one matching grants from various sources."

Success breeds success

Rex Wiggins of **TVAX Biomedical** reiterated Jensen's point about leveraging KBA funds to attract other funding.

"One of the biggest benefits we got from the KBA," he said, "was the validation of our company as an important entity in the biotech community."

Wiggins explained that backing from the KBA tends to put an enterprise in a favorable light with private equity companies. Early in 2010, TVAX received a \$600,000 convertible note from the KBA to go forward with a Phase I clinical trial of a patented brain cancer immunotherapy utilizing a patient's own immune cells. That grant primed the influx of an additional \$2 million in private capital and matching funds.

In October, the FDA authorized TVAX to commence a Phase II trial testing the safety and efficacy of its immunotherapy for grade III and IV astrocytomas.

In addition to funding, Wiggins said the KBA lent TVAX valuable expertise in managing and protecting its intellectual property. He envisions enormous potential for TVAX that could translate into upwards of \$5 billion in revenue and a work force of 300 Kansans.



Doctors and researchers at TVAX are developing vaccines that induce the immune system to recognize cancerous cells and fight the disease through immunotherapy rather than chemotherapy.

Partners in cancer fight across the state

KU Cancer Center is not the only front from which the war on cancer is being waged in the state. At Kansas State University, Dr. Masaaki Tamura is two and a half years into a research project to create a new type of cancer-attacking cell from umbilical cord tissue. Tamura's work, which includes collaboration with researchers at the MD Anderson Cancer Center, has been supported by a \$500,000 investment from the KBA.

"What we are making are powerful therapeutic cells that target only the cancer cells, killing them all without damaging or destroying normal cells," said Tamura.

Using induced pluripotent stem cell (iPSC) technology, Tamura expects the therapeutic cells to eradicate the cancer without any recurrence, adverse side effects or the need for additional therapy. Noting the progress of his team's work, he pointed to cells they have created that are surviving more than three weeks in the cancerous tissue and delivering maximum therapeutic efficacy.

In the course of his research, Tamura has received a patent for umbilical cord matrix stem cell banking, the technology for collecting and storing these cells. When he completes the study, Tamura will patent the procedure and make the technology available for licensing.

"We have the expertise here at K-State, and the KBA has been supportive," he said.

Deciphera Pharmaceuticals is attacking cancer with a proprietary drug discovery technology platform, and it is also committed



Dr. Masaaki Tamura and his assistant study cell growth patterns in cultured cells from umbilical cords.

to working with Kansas companies to capitalize on the region's life sciences expertise and expanding common economic opportunities for regional enterprises.

"We are concentrating our attention on cancer and looking for ways to cooperate with the KU Cancer Center and other Kansas companies," said Dr. Daniel Flynn, president and CEO.

Using a patented process, Deciphera custom designs switch inhibitors — small molecular systems capable of stopping or retarding the chemical reactions that create cancerous tumors — that pharmaceutical manufacturers use in their human clinical trials.

In 2010, Deciphera received a \$390,000 voucher from the KBA and has established research partnerships with **Xenometrics** of Stilwell and **XenoTech** of Lenexa to study drugs that will treat gastrointestinal tumors, mast cell leukemias, metastatic cancers and autoimmune disorders.

Deciphera has licensed several of its programs, most notably

to Eli Lilly. Flynn described Deciphera as a privately held company that is firmly rooted in the area and dedicated to growing in Kansas. He said Deciphera is "a true drug R&D company."

With a grant of \$150,000 from the National Science Foundation and match funding of \$50,000 from the KBA, **NanoScale** of Manhattan is studying the potential to use nanoparticles in the early detection of cancer.

"We are looking at the use of nanoparticles in imaging technology," said Dr. Olga Koper, vice president of technology and technical services. She said her team is also investigating the potential for nanoparticles to attack tumors without damaging the surrounding healthy tissue.

"Funding from the KBA helps us attract additional support from other sources. However, it is not just their financial help; we really appreciate the KBA's general business advice, feedback and introduction to a network of contacts," Koper said.



Connecting human and animal health

Kansas' strengths in human health and animal health are complementary and have positioned the state for global leadership in the field known as "one health." A fascinating research project led by renowned researcher **Dr. Carol Fabian** at the KU Cancer Center is illustrative.

Fabian and her collaborators are studying the use of Omega-3 fatty acids for breast cancer prevention. **Dr. Wayne Carter** of **Hill's Pet Nutrition** in Topeka is part of the research team based on Hill's success in creating an anti-cancer diet for dogs that used the same acids.

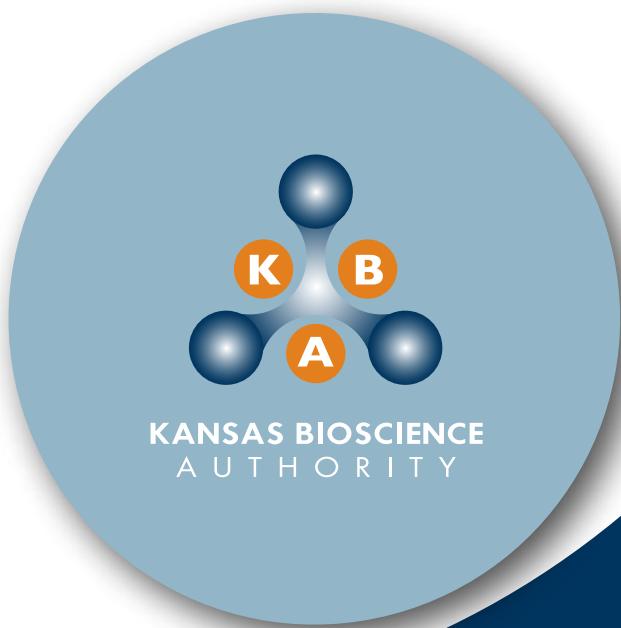
If a high dose of Omega-3 fatty acids favorably modulates risk factors for breast cancer in humans, Fabian will apply for a multi-principal investigator grant from the National Cancer Institute. Down the road, Fabian plans to pair Omega-3 with other promising vitamins and natural products for breast cancer prevention.



Dr. Carol Fabian

Increasing America's Energy Independence

Kansas brings unique strengths to renewable fuels



“That combination of experience in agriculture and oil and gas production uniquely positions Kansas to guide the country toward energy independence.”

— Black & Veatch manager of engineering Jon Erickson

When the federal Energy Independence and Security Act became law in 2007, Kansas was already poised to spearhead the further development of renewable fuels that will move the U.S. toward greater energy self-sufficiency. The state sits on vast natural gas resources, operates an advanced wind turbine power generating infrastructure, and grows a variety of grasses and other crops essential to biofuel production. Additionally, Kansas has been selected as the future home of the nation's first commercial-scale hybrid cellulosic ethanol production plant when Abengoa's Hugoton plant comes on stream in the next couple of years.

Perhaps most importantly, though, Kansas is well known both for its agriculture heritage and a rich history of oil and gas extraction, said Jon Erickson, manger of engineering, industrial products at Black & Veatch.

“That combination of experience in agriculture and oil and gas production uniquely positions Kansas to guide the country toward energy independence,” said Erickson.

He pointed out another special trait Kansans bring to the national effort: A willingness and ability to get people in various industries to use their unique skills to help the state move forward.

That's where the KBA has led the way, making a \$4.1 million funding

investment in the **Kansas Alliance for Bioenergy and Biorefining** (KABB), a center of innovation that has united key industry players with the academic research and development expertise found in the state.

“It is critical to understand the whole process,” said David Disberger, vice president of engineering at agricultural equipment manufacturer AGCO in Hesston. “Somebody has to know how to prepare the fields, plant the seed, harvest the crop and move it to the plants.”

KABB relies on research conducted at Kansas State University and the University of Kansas to advance enzymatic and thermal chemical technologies, which convert biomass

to fuel. Construction engineering firms involved with KABB bring their expertise in designing and building facilities to enhance commercialization opportunities.

Disberger predicts these partnerships will provide tremendous value for the state.

In 2010, KABB established a board of directors and hired bioenergy industry veteran Jeff Roskam as CEO. The KABB board identified major barriers and solutions and set priorities for the development of the bioenergy business in Kansas.

Below: A KBA investment is helping AGCO develop technology and equipment that will provide feedstock economically and reliably to cellulosic biorefineries.



"We have two areas where we are focusing our efforts," said Roskam, who brings several decades of experience to the position. "The first we call the 900 pound gorilla — the cost of growing biomass, harvesting it, compensating the farmers and transporting it for processing."

The second priority, Roskam explained, is to further advance the technologies involved in the conversion of biomass to biofuel, whether the process involves thermal chemical catalysts or enzymes to break down the sugars.

Roskam said there are intangible concerns KABB considers equally important.

"We need to communicate to the people of Kansas, as well as to the country as a whole, the benefits of biomass as a feedstock for bioenergy," he said. "Bioenergy can play a significant role in the nation's move toward energy independence."

KBA investments in Kansas bioenergy projects are supporting research and development and driving technology commercialization:

- AGCO (Hesston, Kan.) is demonstrating the effectiveness of the large-square bale for providing biomass feedstocks to cellulosic ethanol producers.
- Archer Daniels Midland (multiple locations in Kansas) and the University of Kansas' Center for Environmentally Beneficial Catalysis are researching new technologies and processes to convert biomass and vegetable oils into biobased fuels and chemicals.
- ICM (Colwich, Kan.) is testing and commercializing groundbreaking biomass gasification technology to produce energy or Syngas, which can be further refined to fuels and chemicals. It is also collaboratively developing cellulosic ethanol technology using non-food sources.
- Edenspace Systems (Manhattan, Kan.) is developing innovative applications of plants (corn, sorghum and others) for renewable fuels and chemical production in an environmentally sustainable manner.

Bioenergy Solutions from Field to Fuel: Kansas' Competitive Advantage

- Multiple high value energy crops
- Energy crop technology providers
- World-class research expertise
- Industry-led center of innovation
- Harvesting technology companies
- Process technology providers
- Processing facilities
- Fuel distribution
- Refineries