



## **Kansas Bioscience & Innovation Roadmap**

# **Biomass, Biofuels, Biomaterials and other Environmental Hot Team Business Plan**

### **1-Apr-2005**

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### **The initiative**

The major objective of the **Kansas Bioproduct Initiative** is to develop a prudent timeline and course of action for the sustainable utilization and commercialization of the state's biomass resources. Commercialization of new technologies is the focus. These could include: lipid-based materials and chemicals in applications for polyols and polyurethanes, biobased adhesives, plastics and composite products, bioconversion systems, extraction of nutraceuticals from collected biomass, such as distillers grain, wheat bran, and other grain processing co-products. Short-term projects are focused on demonstrating progress towards a commercial product within 18 months; intermediate-term projects have a 2-5 year time line; long term programs extend beyond 5 years.

### **Long-term goal(s)**

The ultimate goal is to create a Center of Excellence for Bioproducts. The Center would work to enhance the Kansas economic base and provide development opportunities in rural Kansas. Bioproducts, as defined here, are those created from animal- and plant-based resources such as agricultural crops and crop residues, forestry, pastures, and rangelands. Animal by-products (from Kansas packing plants, for example) are also included. Many petroleum products could be made from renewable bio-based products. Bioproducts includes biomaterials, biochemicals and biofuels.

Much of the discussion regarding *biomaterials* will be covered by the Advanced Materials Cross-Cutting Hot Team.

This initiative will build on existing scientific and technological strengths in the State to:

- Attract additional federal research dollars
- Create high-paying research jobs
- Develop and expand markets for value-added agricultural products of the State
- Create new tax revenues from developing bio-based product businesses

Additionally, a special effort will be made on Biofuels. Kansas has significant existing resources and companies working in ethanol and its co-products, for example. Kansas can be, and increasingly is, a player in alternative fuel production. Companies are also working closer towards a commercially-viable cellulosic-based fuel product.

### **The Need**

There is a clear need for products that can compete with, and ultimately replace, petroleum products. With outrageous forecasts of what the price of oil could do over the summer months, there are clear

opportunities to develop viable products that can compete on price. Kansas can help meet this nation's alternative transportation fuel needs and increase research, capital, and labor investment into Kansas that will enhance the state's economic base.

## **The Resource Base**

Biomass is defined as organic material produced from plant and animal growth. Kansas has been shown to be a leader in the quantitative supply of a variety of biomass resources such as agricultural crop residues, herbaceous energy crops, oilseeds, and agribusiness processing residues. Each of these, and their constituent components (cellulose, hemicellulose, and lignin), can be utilized as feedstocks for a wide variety of end uses (liquid fuel and electricity production, biomaterials, biochemicals, etc.) each providing tremendous societal benefits such as energy security and environmental and economic enhancement. Animal fat and used cooking oil is another underutilized biobased resource that can be converted to fuel.

The Kansas resource base, as it currently exists, could be utilized immediately to produce each of these end products, as long as a practical, prudent, and sustainable approach is employed with respect to energy use, environmental sustainability, and economic feasibility. Examples of potential future areas of commercialization of biomass resources would potentially involve utilizing new crops with increased overall photosynthetic efficiency thereby making plants/crops more energy efficient throughout their total life-cycle, and more adaptable to the need for less use of natural resources (water tolerance) as well as to extreme climate conditions (drought resistant).

## **Current Assets**

AMI, a current KTEC center of excellence, combined with the new BIVAP facility will provide capabilities to evaluate technology enhancements. Several ethanol production facilities exist in the state, as well as potential "bio-park" concepts. Technology for conversion of lipids to biodiesel is known and available.

## **The Approach**

The engine to develop new technologies and demonstrate their efficacy results from the formation of a vibrant **Consortium and Center** built upon the existing research base at Kansas State University and Pittsburg State University. A team would apply an interdisciplinary strategic approach to promote widespread use of biobased products utilizing Kansas agriculture commodities to meet future national and environmental needs, including:

- Several products, such as biobased, protein adhesives, will be commercialized within the short term time frame.
- Several additional composite products from biobased lipids will be targeted within the intermediate term and mobile manufacturing units will be deployed to support the conversion needs of various biobased raw materials sourced throughout the state.
- "By 2025, a well-established, economically viable, bioenergy and biobased products industry will create new economic opportunities for Kansas, protect and enhance our environment, strengthen U.S. energy independence, provide economic security, and deliver improved products to consumers."

Growth of existing businesses, such as ICM and Pinnacle Technologies, for example, should be first priority, followed by recruitment of outside companies (like Iogen) to locate a facility in Kansas.

## **Impact on innovation lifecycle/attributes**

The center will attract talented scientists to work in the bioconversion area; attract new capital and improve the State's financial position; generate new products and technologies; increase employment, support agriculture and utilize the natural resources of Kansas. It would also help to attract, educate and retain our brightest students in the State.

A considerable need definitely exists to “increase our supply” in several attribute areas. Significant investment in all areas, especially the financial capital area (“resolving a gap”) will be needed if the Initiative is to succeed. Currently, sufficient intellectual and human capital does exist in Kansas to launch a large-scale biofuels initiative, but certainly not to sustain it. Utilizing these two resources for the purpose of maximizing efforts guided at the development of this Initiative provides an excellent “springboard” for impacting how we attain the “increase in supply” in the others.

## **Implementation strategy**

### **Champions and organizational “home”**

This center would be built on the existing strong research foundations at Kansas State University with engineering, ag materials processing, and grain science capabilities; and Pittsburg State University, including KPRC, a world leader in the field of oil-based chemicals and materials. The champions will be researchers at PSU and KSU who are already deeply involved in the effort. The organizational home would be a cooperative effort including both universities, but housed at BIVAP.

The state has significant leadership for implementation and commercialization of new knowledge in biofuels including existing Kansas companies, the state’s commodity groups, academia and elsewhere. General knowledge of current state of the art technology resides at state universities along with assessment capability for implementation at specific sites. The Ag Innovation Center, for example, is also available to provide assistance in developing business plans for communities that are considering bioproducts. BIVAP is a resource available to help in technology development and technology optimization that interfaces with industry.

## **Resource requirements**

Capable, dedicated, and sustained leadership will need to be linked from the technology developer (industry/academic), to capital development (entrepreneur/industry/ economists), to technology implementer (industry/agriculture). All need to be well informed of the others’ needs and engaged in a partnership that recognizes everyone’s need to profit in the value chain (hence the Consortium concept). The state has capable leadership in this area, including state agencies, universities and proponents in the legislature.

Existing infrastructure at KSU and PSU would provide the physical facilities, while the leadership partnerships would form a virtual organizational structure activated by the cooperative initiative.

Transition from a total reliance on petroleum-based liquid fuels to partial reliance on ethanol and biodiesel will require a significant expansion of the infrastructure for distribution of the renewable fuels. Increased usage of biofuels requires increased availability to interested consumers. A variety of incentive programs need to be established to expand and nurture a widening distribution system.

- Capital will be needed to for new equipment to expand the capability of BIVAP to serve the comprehensive needs for this initiative. Also, operating capital will be necessary to sustain this support.
- Public capital will be in the form of recurring federal and state funding for the federal center of excellence.
- Investor capital will be in the form of industrial and commercial joint development agreements funding research with commercialization possibilities.
- Entrepreneurs and angel investors will be attracted to the exciting new ideas developing in the national center.

## **Sustaining the initiative**

The Initiative will be sustained through two separate, but equally important routes. On the business side, a Consortium between and among the state's universities and agencies, led by Kansas State University's BIVAP, will be formed. Representation from all biobased industry segments will be included as vehicles for commercialization of developing technologies. This collaborative partnership between academia, government, and industry will financially support research for continuous improvement for economic competitiveness of the newly developed biobased products. Additionally, support for a federal center of research excellence will be sought to continue to expand the number of opportunities available in the state.

Industry leadership and partnerships are critical to the success of a statewide Initiative. Existing Kansas companies working in bioproducts (which will be indexed by Commerce) will help ensure product commercialization makes sense and existing companies are part of the future. Kansas has existing capabilities in this arena that need to be harnessed and learned from.

The biomaterials research programs at KSU and PSU currently are successful at securing external funds from federal and industrial sources. This Initiative will add momentum to current successes and expand this funding base.

A Kansas-based Initiative will need to be sustained through an integrated combination of in-state "start-up" funds and human capital at the state universities, state government, as well as involvement of the private sector. In addition, an effort such as this will need the aggressive pursuit of multiple collaborations with many other public and private sectors persons, organizations, and entities. Because Kansas has an abundance of biomass that can be utilized for the production of not only fuels, but chemicals and materials as well, one medium-term goal would be to investigate the possibility of a federal center of excellence in sustainable biomass production and associated product development.

## **Next Steps**

- Develop an inventory of interested companies and their requirements for internships.
- Commercialization partners
- Stable program funding
- Expansion of laboratories and pilot plants with new equipment
- Develop the conversion enzymes and processes to more fully and economically utilize cellulose, renewable materials

## **Performance metrics**

To be determined by the Consortium, Commerce and KTEC.