TRANSLATING NEW AGRICULTURAL PRODUCTS AND USES INTO RURAL ECONOMIC VIABILITY

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New nonfood, nonfeed industrial products (biobased products) derived from agricultural and forestry raw materials and wastes offer tremendous opportunities to expand agricultural markets. Commodity crops such as soybeans and corn are being used in an increasing number of industrial applications such as inks, plastics, paints, adhesives, textiles, lubricants, solvents, fuels and fuel additives. However, farmers and local rural communities have not been fully benefitted in these new value-added markets as they continue to emerge. The two projects described in this presentation promote rural development through demonstration projects that focus on local small scale value-added processing of soybeans into industrial products.

INTRODUCTION

The definition of biobased products is broad: a commercial or industrial product, other than food or feed, which utilizes biological products or renewable domestic agricultural (plant, animal, and marine) or forestry materials. However, the purpose of promoting biobased products is to stimulate new uses, new crops, and new technologies. There are a number of advantages to biobased products.

From a customer perspective:

- Products perform as well as or better than conventional counterparts, which are petroleum-based in many instances.
- The customer base for these products is being expanded due to legislation and a series of executive orders directing Federal agencies to take a pro-active role in a wide range of activities promoting environmental stewardship, thus creating market pull that will also stimulate procurement by State and local agencies and the private sector.

From a USDA perspective, the processing and use of biobased industrial products can result in:

- new business opportunities beyond traditional food, feed and fiber markets
- economic development in rural areas through new farming and processing opportunities
- value-added products from new uses and utilization of agricultural residues and wastes
- diversification in agriculture through development of specialty crops and new industrial crops
- fostering sustainable development because products are from renewable resources grown and processed in an environmentally preferable way
- stimulation of R&D to meet a growing demand for new products and technologies that are environmentally preferable

From a national perspective, the U.S. can have a reliable supply of industrial products for defense, industry and the consumer based on renewable, critical raw materials supplied by the American farmer.

New products entering the marketplace encounter numerous obstacles such as high prices, unvalidated

performance to existing industry standards, lack of standards, and lack of marketing networks. Two research/development/demonstration projects described in this presentation address these obstacles by demonstrating product performance and engaging all stakeholders. And the small scale processing activities to produce the biobased products will allow farming communities to benefit from the value-added processing activities.

The funding authority for these projects is Section 401 of the Agricultural Research, Extension and Education Reform Act of 1998 (AREERA)(7 U.S.C. 7621) which established the Initiative for Future Agriculture and Food Systems. This initiative provided a new opportunity to address critical and emerging issues related to future food production and safety, environmental quality, natural resource management and farm income. Six priority program areas were established including "New and alternative uses and production of agricultural commodities and products." The program area focused on development of crop varieties for biobased industrial products and biofuels, processing biomass, product development, test/evaluation/certification for commercial use, demonstration of products, consideration of environmental impacts, life cycle cost evaluation, and establishing marketing networks. This initiative offered a unique grant opportunity for conducting a comprehensive program to move new products and technologies from the research stage into demonstration, ultimately to result in successful commercialization.

SOYBEANS TO INDUSTRIAL GREASES

The first project entitled "Demonstration and Implementation of a Modular Crop-Based Grease Production System," is led by the University of Northern Iowa's Ag-Based Industrial Lubricants Research Program (ABIL). ABIL has been developing and testing vegetable oil-based lubricants since 1991, and has product line that is commercially available. Crop-based lubricants have been proven to add value through excellent lubricity, and positive environmental properties. However, a major obstacle to broader market adoption of these lubricants is a lack of commercial infrastructure focused on advancing the availability of these products, which is essential to demonstrating performance and building consumer confidence. And ultimately, relationships between supply and demand through production capacity that can be quickly adapted to a broadly diversified crop oil supply base needs to be established. The objective of this project is to demonstrate the feasibility of a replicable, low risk soybean processing and manufacturing operation for on-farm production of industrial greases of consistent quality, among affiliated sites with production can be adapted to localized demand as conditions warrant.

Benefits of local processing

As opposed to petroleum which is sourced from centralized refineries, vegetable oils are grown in rural areas across the country. Because the acreage is widespread and variation in the raw materials is inherent, use of disbursed small volume processing is attractive. This strategy enhances the opportunity for producers to benefit directly by providing feedstock for niche markets.

The current higher input cost of vegetable oils compared to petroleum used in lubricant formulations needs to be overcome by higher value to end-users and processors in order to be commercially successful. In order to accomplish this objective, the activities of all stakeholders have been integrated into a "closed cooperative" that includes seed producers, farmers, equipment manufacturers, additives suppliers, marketers and end users. Project success will result in a franchise model where farmers develop added value through manufacturing operations. Established marketing entities will focus on the design, testing, warranting and sale of specific formulations. An intermediary organization will serve as a clearinghouse, capitalize equipment financing and support elevators/farmers with manufacturing

specifications and pre-mixed additive formulations.

The equipment for the on-farm operation includes a hammermill for soybean size reduction, extruder that produces a meal/oil mixture, expeller that presses the oil out of the mixture, which then goes to a separator. The meal is delivered to a cooler and the oil into a kettle which is the first step in the grease manufacturing process. The grease is milled to a final texture through shearing and pre-packaged chemicals are added resulting in grease formulations for use in the trucking and railroad industries. Three demonstration sites are fully equipped, each with different grease kettle sizes including a small 220 gallon capacity, a mid-sized 300 gallon capacity and large size with 300and 850 gallon capacities. Quality control of the grease is conducted on-site and at the ABIL facility.

Results to Date

All three farms are producing commercial grade industrial grease. Over the course of the project, 2.5 millions pounds of grease could be produced if the three farms operate at full capacity over the course of a year. One example of production and cost is the mid-sized farm operation which has produced 30,000 pounds of grease at $.80 per pound, exceeding $1.00 after distribution costs are added. The petroleum-based counterpart is ranges from $1.00 to $1.50 per pound, so the soybean product is competitive. It is currently being tested and evaluated as a rail grease by Norfolk-Southern Railroad and as a "fifth wheel" grease for tractor trailer hitches by Acklie Transportation's Indiana terminal .

SOYBEANS TO HEATING FUEL, AVIATION DEICER, URETHANE FOAM, SOLVENTS

The second demonstration project is entitled "Technology Development, Transfer, and Marketing of Industrial Products for Rural Communities." The multidisciplinary team conducting this work is led by Purdue University's Department of Agricultural and Biological Engineering. The major objective is to develop value-added industrial products from soybeans at the local rural community level by combining existing small scale expeller processing equipment capacity with known soybean utilization technologies. Ultimately, the scaled processing and production will be compatible with local rural community infrastructures. Key components also include identification of social and economic impacts at the local level and the use of life cycle costing of the industrial products to identify and resolve deficiencies early in the project. This approach includes an analysis of competing products to focus on performance, economic, environmental and health advantages that will allow consideration of alternative steps, as necessary, to ensure sustainability and environmental preferability of the products.

Small scale processing exists today at approximately 100 facilities throughout the U.S. for production of food products with nutritional advantages over products from large scaled technologies. These facilities are seeking new value-added opportunities to develop processing capacity for future high value agricultural crops.

Products to be manufactured and tested at selected sites include a blended heating fuel, protein-based polyurethane foam component, biodegradable aviation deicer, solvents and glycerol, technical processing data to support scaled processing facilities vs soybean varieties, and a feasibility/marketing business plan will be developed that incorporates economic and community infrastructures.

Each product will have different technical challenges and will be at different stages of commercialization at the end of this grant.

- The fuels project is anticipated to be the most rapidly commercialized because biodiesel is already proven to be easily produced and utilized on a relatively small scale. Funding will be

sought to continue the fuels project as an agricultural extension program to enable local rural communities to effectively utilize this information as appropriate.

- The deicer project will provide technical and economic feasibility information which must then be followed by an extended certification process needed prior to commercial production.

- The urethane foam project will focus on the use of a finely milled protein to be used as a stabilizer and enhancer for a urethane product that has been recently commercialized.

- The soybean oil esterification process to produce solvents will focus on catalyst optimization and the glycerol produced from the process will be used for the deicer formulation.

- The scaled processing study will match crop properties and process operations parameters for consistent product quality.

- The economic, marketing and rural community analysis will address market potential and economics of products and will also analyze local community infrastructure and concerns. A business plan for commercial implementation will then be developed, tailored to the needs of the community. Specific considerations will include regional supply and demand, transportation, labor, environmental and regulatory requirements and other market factors.

Results to date

This project is new and the research team is just getting started. At its conclusion, this project could serve as a model for integrating biological and engineering sciences with the social sciences to optimize the chances of success for new local processing activities.

SUMMARY

Both of the projects described will have measurable outcomes:

- New knowledge and new biobased products will result from technology transfer
- Marketing networks will be established
- Data for life cycle cost evaluation will illustrate environmental preferability
- By virtue of the authority under which these projects were funded, graduate students will be educated for the next generation of agribusiness

Small scale processing has a number of advantages in addition to adding value to a commodity crop. Processing can be readily tailored to accommodate the inherent variations of crop-based raw materials, and can be responsive to local supply and demand. Interest in identity preserved soybean processing might be stimulated because the parameters are suitable for processing specialty crops. Although not yet a factor in either project, small scale processing could have a positive impact on the public discussion of genetically modified crops for nonfood uses. All of these factors translate into new opportunities for enhancing rural economic viability.

TRANSLATING NEW AGRICULTURAL PRODUCTS AND USES INTO RURAL ECONOMIC VIABILITY

Overview

- Significance of biobased industrial products
- Funding authority
- “Demonstration and Implementation of a Modular Crop-Based Grease Production System”
- “Technology Development, Transfer, and Marketing of Industrial Products for Rural Communities”
- Summary

SIGNIFICANCE OF BIOBASED INDUSTRIAL PRODUCTS

Definition *- nonfood, nonfeed industrial products derived from domestic agricultural and forestry raw materials and wastes*

From a Customer Perspective:

- **performance**
- **Federal agencies promoting environmental stewardship through procurements**

SIGNIFICANCE OF BIOBASED INDUSTRIAL PRODUCTS

From a USDA Perspective

- new business opportunities
- economic development in rural areas through new farming and processing opportunities
- value-added products from new uses and utilization of wastes
- diversification in agriculture with specialty crops and new crops
- sustainable development
- stimulation of R&D to meet the growing demand for new products and technologies

From a national perspective

- reliable supply of industrial products for defense, industry and the consumer based on renewable, critical raw materials supplied by the American farmer.

LEGISLATIVE AUTHORITY

Section 401 of the Agricultural Research, Extension and Education Reform Act of 1998 (AREERA)(7 U.S.C. 7621)

Initiative for Future Agriculture and Food Systems

- **integration of research, education and extension**
- **multidisciplinary, multi-institutional, multi-state**
- **education**
- **international collaboration**

LEGISLATIVE AUTHORITY

Program area 13.0 New and alternative uses and production of agricultural commodities and products

- new crop varieties
- processing biomass
- product development
- test and evaluation/certification for commercial use
- demonstration of processing and/or product use
- life cycle costing
- environmental attributes
- marketing

DEMONSTRATION AND IMPLEMENTATION OF A MODULAR CROP-BASED GREASE PRODUCTION SYSTEM

University of Northern Iowa, Ag-Based Industrial Lubricants Research Program

Objective: to develop a replicable, low risk grease production module tailored to the features of vegetable-based lubricants, and to establish relationships between local supply and demand through small scale, specialized production

DEMONSTRATION AND IMPLEMENTATION OF A MODULAR CROP-BASED GREASE PRODUCTION SYSTEM

Products are superior to petroleum-based products

- better lubricity
- less toxic
- longer performance life

DEMONSTRATION AND IMPLEMENTATION OF A MODULAR CROP-BASED GREASE PRODUCTION SYSTEM

Integrated Activities of All Stakeholders

- seed producers
- farmers
- equipment manufacturers
- elevators
- additives suppliers
- marketers
- end users

DEMONSTRATION AND IMPLEMENTATION OF A MODULAR CROP-BASED GREASE PRODUCTION SYSTEM

The Process

- hammermill; extruder/expeller; separator
- kettle; shearing; additive packages

Products

- fifth wheel grease for hitches on tractor trailers
- rail road track grease/rail curve grease

DEMONSTRATION AND IMPLEMENTATION OF A MODULAR CROP-BASED GREASE PRODUCTION SYSTEM

Results to Date

- Three participating farms
- small: 220 gallon kettle
- mid-sized: 300 gallon kettle
- large: 300 gallon and 850 gallon kettles
- Total grease production: 2.5 million pounds operating at full capacity for one year

On-going testing with railroad industry and trucking industries

TECHNOLOGY DEVELOPMENT, TRANSFER, AND MARKETING OF INDUSTRIAL PRODUCTS FOR RURAL COMMUNITIES

Purdue, Department of Agricultural and Biological Engineering

Objective: to develop value-added industrial products from soybeans by combining existing small scale expeller processing equipment capacity with known soybean utilization technologies

TECHNOLOGY DEVELOPMENT, TRANSFER, AND MARKETING OF INDUSTRIAL PRODUCTS FOR RURAL COMMUNITIES

Partnerships

- industrial equipment manufacturers
- communities
- marketers
- consumers

Process

- builds on existing small scale expeller processing facilities for niche food markets

TECHNOLOGY DEVELOPMENT, TRANSFER, AND MARKETING OF INDUSTRIAL PRODUCTS FOR RURAL COMMUNITIES

Products

- blended heating oil
- aviation deicer
- urethane foam
- solvents and glycerol
- scalable low cost esterification process
- processing study to match crop properties and process operations
- economic, marketing and rural community analysis

Results

- new project but if successful, could potentially serve as a model for integrating biological and engineering sciences with the social sciences for optimal community benefits

SUMMARY

- TECHNOLOGY TRANSFER
- NEW MARKETING NETWORKS
- EDUCATION
- ? PUBLIC ACCEPTANCE OF GM CROPS FOR NONFOOD USES
- INCREASED PROFITABILITY FOR FARM AND RURAL BUSINESS SECTORS