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In short

■ by E. Douglas Beach and Gregory R. Gajewski

Biobased industrial products: What the federal government is doing

In a recent *CHOICES* (2nd Quarter 1993), Conklin and Gahr and Zulauf and Tweeten argued for increased government, university, and private sector research on "new" industrial uses for biobased products. More may be needed but, as we show here, the U.S. Departments of Agriculture, Energy, and Defense, sometimes in cooperation with universities and the private sector, already have a number of research and development projects in place. Some show promise of commercially viable, "new" industrial uses of agricultural and forestry crops.

USDA biobased activities

New opportunities for biobased products have received increased attention at USDA. Real expenditures to research, develop, and commercialize these products and processes are expected to increase approximately 1.3 percent in 1994. Since 1991, USDA expenditures on biobased activities have grown approximately 8.7 percent per year, in 1987 dollars.

At least seven USDA agencies are involved. USDA's Office of Energy (OE) and the Economic Research Service (ERS), cooperating with the Colorado School of Mines, have started a major study to determine the emission effects of ethanol-blended fuels.

The newly created Alternative Agricultural Research and Commercialization (AARC) Center located in Washington, D.C., assists the private sector in closing the gap between research and commercialization of biobased products. AARC Center funds must be repaid by successful projects (\$10 million initially available). In

its first call for projects, the Center received over 400 preproposals requesting \$175 million.

Funded projects included the following:

- ethanol from grasses and other biomass sources—three projects in California, Florida, and Texas
- paper pulp from straw—Oregon
- newsprint from kenaf and recycled fibers—Texas
- lawn mats from kenaf—California
- structural composites from kenaf—California
- furniture parts molded from flaked low-grade lumber—Michigan
- a granite-like composite board for furniture, tile, and structural use from soybeans and waste newspaper—Minnesota
- on-farm composting utilizing animal manure, animal bedding, yard waste, and starch-based biodegradable polymers—Pennsylvania
- biodegradable films and coatings from wheat starch—Kansas
- cornstarch-encapsulated pesticides—two projects in Kansas and Missouri
- nontoxic ethanol-based windshield washer fluid—Missouri
- three biodiesel projects: production and processing technology in Kansas, production from

E. Douglas Beach
and Gregory R.
Gajewski are
agricultural
economists with the
Economic Research
Service, USDA.

Biobased industrial products are chemicals and materials generally derived from agricultural and forestry resources. Biobased products include such items as biofuels, biodegradable plastics, chemical feedstocks, absorbent polymers, cosmetic ingredients, waxes, lubricants, resins, gums, and pharmaceuticals.

animal byproducts in Florida, and performance standards in Washington, D.C.

- lubricants from crambe and industrial rapeseed oils—Washington
- concrete-release agents from rapeseed oil specialty lubricants and cosmetics—California/Arizona
- insulation material using milkweed floss—Nebraska

USDA's Agricultural Research Service (ARS) encourages its scientists to enter into Cooperative Research and Development Agreements (CRADAs) with private firms to commercialize biobased technology from their research. These agreements provide the cooperator with the right of first refusal to an exclusive license on patented inventions made under the project. ARS is the recognized leader throughout government, with over 300 CRADAs since they were first established in 1986. In addition, ARS accounted for over 60 percent of USDA's 1993 expenditures on new uses.

ARS also helped create the Biotechnology Research and Development Corporation (BRDC). BRDC is a consortium of ARS, the University of Illinois Biotechnology Center, and seven stockholders: Agricultural Research and Development Corp.; American Cyanamid; Amoco Technology; Dow Chemical; Allelix; Hewlett-Packard; and IMCERA. The consortium defines research projects with market potential and enables industry to enter into high-risk ventures that might otherwise be too risky to examine individually.

BRDC has licensed ARS patents to encapsulate pesticides within a starch matrix. The resulting granule not only protects the active ingredient from deterioration due to handling or storage, but also provides controlled release of the pesticide. BRDC and four of its shareholders will invest \$475,000 in the new encapsulation process, and AARC will invest an additional \$500,000.

USDA's Cooperative State Research Service (CSRS), Office of Agricultural Materials, also sponsors biobased activities. They work with and fund university teams to develop processes to manufacture biobased industrial products. Two product-oriented consortia were formed with non-federal entities to leverage federal invest-



A stand of kenaf is inspected by ARS soil scientist L.N. Namken at Rio Farms in Texas' Rio Grande Valley.

ments. One consists of nine states and ARS and develops high erucic acid from crambe and industrial rapeseed. The other will develop technologies to produce natural rubber and other products from guayule.

CSRS also collaborates with the Department of Defense. Projects include the following:

- functional fluids—from rapeseed, crambe, castor, lesquerella, and jojoba oils
- oil-selective adsorbents—many plant materials have a natural affinity for oils and can be used as oil-absorbent pillows and booms, and in food processing equipment
- vegetable oil epoxies—selected naturally occurring fatty acids in many plants can be converted to epoxies for use in paints, coatings,



Dan Kuglar

The front and sports sections of the July 13, 1987, final edition of the Bakersfield Californian being printed on kenaf newsprint.

- polymers, and biodegradable adhesives
- biodegradable polymers from starch—the goal is to give the Navy biodegradable eating utensils and packaging materials for proper disposal at sea.

DOE biobased activities

One of the most ambitious efforts is DOE's Alternative Feedstocks Program (AFP). Worldwide use of biomass for food, feed, and fiber accounts for only 7 percent of total biomass production. Uses of biomass in the United States are also low—representing a tremendous untapped source of energy.

DOE's objectives are to develop bio-processes that enhance profitability and competitiveness of U.S. industry, save energy and reduce oil imports, and improve the environment.

DOE, through the AFP, also plans engineer-

ing research and development for two feedstock processes each year. For example, succinic acid will be processed from corn syrups to demonstrate the feasibility of producing a commodity-type chemical from renewable resources.

The Economic Research Service, with funding from DOE's Office of Industrial Technologies and USDA's CSRS and AARC Center publishes *Industrial Uses of Agricultural Materials Situation and Outlook Report*. DOE and USDA, along with several other federal agencies, also fund a National Research Council project to assess key research areas and potential commercial viability of biobased materials. Finally, DOE, EPA, and USDA signed a memorandum of understanding to jointly develop and commercialize methane recovery systems for livestock producers. It's called the AgSTAR program.

Conclusion

A host of federal efforts aim to develop biobased industrial products. The goals are to create demand for industrial products made from agricultural and forestry feedstocks, improve the competitiveness of the U.S. economy, save energy and cut oil imports, and improve the environment. While these projects show some signs of success, an accurate assessment of the costs and benefits of public efforts to develop "new" industrial uses of biobased products has not been made.

■ For More Information

Bozell, J.J., and R. Landucci (eds.). *The Alternative Feedstocks Program: Technical and Economic Assessment*. Prepared for the U.S. Department of Energy/Office of Industrial Technologies by Argonne National Laboratory, Idaho National Laboratory, National Renewable Energy Laboratory, Oak Ridge National Laboratory, and Pacific Northwest Laboratory, July 1993.

Glaser, L.K., and G. R. Gajewski, coordinators. *Industrial Uses of Agricultural Materials: Situation and Outlook Report*, IUS-1, ERS-USDA, (June 1993).