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Bioproducts: Developing a Federal Strategy for Success

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Bioproducts are nonfeed or food industrial goods composed to a significant degree from biological products, renewable domestic agricultural materials, or forestry materials. Hydraulic fluids, lubricants, biopharmaceuticals, chemicals, and building materials all fall within the product range of bioproducts. There are a wide variety of feedstocks that can be used to make bioproducts, including grains, wood and plant oils, agricultural and forestry residues, switchgrass, and hybrid poplar.

Agricultural and forestry groups have long been intrigued by the potential of such a nonfood market for their feedstocks. In 1987, a report from the New Farm and Forest Products Task Force to the Secretary of Agriculture recommended diversification of agriculture as a way to improve the economy through the production of biobased products (New Farm and Forest Products Task Force, 1987). The Task Force cited the development of a bioproducts market as a way to address excess capacity, a loss of competitiveness in the international trade arena, and shrinking export markets. In addition, international trade in high value products was seen as increasing (New Farm and Forest Products Task Force, 1987) .

More recently, the cost and security risks of imported oil, environmental concerns, as well as advances in biological sciences have renewed policy interest in biobased products. Biobased products often require less energy to produce than the fossil and inorganic products they replace (Committee on Biobased Industrial Products, 2000). Biobased products can improve air and water quality, as well as reduce waste compared to their competitors. Also, biobased products can sequester large amounts of carbon while adding little if any net carbon emissions to the atmosphere.

A Systems Approach

The efforts of agricultural producers and processors to develop and produce new biobased energy and coproducts have matched growing consumer interest in environmentally friendly products. Bioenergy and bioproducts were largely driven first by government policy research initiatives. Yet, despite substantial investment in research to improve bioproduct production technology, widespread market penetration for bioproducts has not been realized. This does not mean that money for research has been misspent, rather, it is likely that there has been underinvestment in other steps required to bring new biobased energy and coproducts to market.

In the past, the development of bioproducts was focused on basic research. There was a need to determine the efficiency and economics of production from nonpetroleum feedstocks to assess their viability and supply. While basic research provided the information to narrow the focus on feedstock choice and the types of products to produce, it has done little to apply the research to real-world conditions that would allow for investment from the business community.

A more "systematic" approach could result in greater penetration of commercial markets by bioproducts. The process of bringing new products to market may be viewed as consisting of links in a casual chain extending from the research bench and its product prototypes to market acceptance and penetration. Those links include research, testing, regulatory initiatives, product development and commercialization, public sector incentives, and financing, as well as education and outreach programs. We discuss below the links in that casual chain and suggest ways to be more successful in creating a demand pull for bioproducts.

Research

Basic Research

Basic scientific research applied to biological systems seeks to understand fundamental questions about plant and animal genetics, physiology, structure, chemical composition and function of living plants animals, bacteria, and viruses. Basic research, an essential ingredient at the beginning of the causal chain, seeks to discover and understand facts, develop theories about the fundamental workings of biological systems, and to revise those theories as new facts are discovered and understood. The focus of this research is on how cells, organisms, and entities work the way they do, rather than on what products are useful to mankind that can be made from them.

Applied Research

Applied biological research can be thought of as the second link in the causal chain, and builds on the discoveries and understanding of basis research/science. It takes those findings, understanding of systems, and theories about biological systems and asks how these can be used to create effects that improve the lives of living creatures, enhance their performance, and better the circumstances in which humankind finds itself. Here the focus is creating product prototypes that have potential to fill market needs.

The Biorefinery Concept

The results from effective basic and applied research can provide biobased feedstocks that are of increased productivity, more uniform in the characteristics being sought, and can be processed into a wider range of end products at lower cost and greater efficiency. A biorefinery is capable of producing feedstocks into primary components and reassembling those into a range of end-use products that includes products spanning the value spectrum from lower valued products in greater quantity to more specialized and higher value products, albeit in limited quantity. In many respects, a biorefinery mirrors the refining of petroleum and creation of a wide range of products from that process. A number of biorefinery concepts have been developed, including paper mills, wet corn milling to produce ethanol or high fructose corn syrup, and production of bio-plastics from corn.

Testing

Testing of new bioproducts and product prototypes seems to be a critically important step in bringing them to market. An important component of the attributes embedded in these products (such as biodegradability) relates to their affect on the environment; it is important to know whether these products have lower life-cycle costs and environmental footprints than the fossil energy-based products they will replace. Many products currently in use have industry-or user-determined performance standards that represent the threshold performance levels these products must meet.

Regulation

Regulatory initiatives can play an important role in encouraging firms to try new technologies and new products. One example is the renewable fuels standard from the Energy Policy Act of 2005 that creates a market for transporting biofuels. Regulatory flexibility can encourage the use of best practices for environmental management, which often will incorporate bioproducts. Regulatory initiatives also may include tax credits or incentives. Life cycle analysis of biobased fuels from "cradle to grave" could ultimately provide carbon credits for industry trading, thus lowering the net cost of biobased fuel production.

Product Development and Commercialization

Product development involves refinement and fine-tuning of product prototypes to address specific market demands as well as demonstration projects that test the product in use to determine how effectively it fills a market need. Demonstration projects are a critical step and will likely be an interactive process with research and product testing steps, as the developer seeks to create a product that cost-effectively fills a market need. Product demonstration can also play an educational role as potential customers evaluate the usefulness of a product and learn how it might be used in their applications.

Another important step in commercialization of bioproducts involves procurement preferences for federal, state, and other public sector purchasing. These preferences fill at least three important functions in commercialization: First, they provide a broader based and more diverse opportunity to demonstrate the product in use to potential customers: second, they provide a critically important demand base large enough for suppliers to scale up production, thereby achieving economics of scale and decreasing product cost, and finally: public procurement preferences can stimulate sufficient market demand to bring new suppliers and their competitive efficiencies into the market.

Public sector incentives to support new industries often extend

beyond procurement preferences. Tax credits, such as investment and research tax credits, can be used to decrease both risk and cost to private firms that develop, manufacture, and commercialize a new product, use a new and untried production process, or enter new markets. Insurance coverage can be created to support risk management associated with the use of new and untried technology that might be used in producing a new production process, such as cellulosic conversion of plant lignin for use in a new biorefinery, or a new bioproduct.

A Policy Foundation

Major new industries in the United States typically have been supported by a set of public policies. These policies have signaled the support of public policy makers for the new industry and the willingness of the public sector to reduce, or at least make more quantifiable, the risks associated with the new industry. This has been true for the automobile, radio and television, aircraft, computer, and oil industries. Public policy makers have understood this imperative for the bioeconomy and have developed a support base of public funding for basic and applied research and for stimulating product development through grants, loans, and loan guarantees to start up firms. Other policy initiatives such as renewable fuels targets and excise tax exemptions also have under-girded the growth in demand for these new products - as in the case of ethanol and biodiesel.

The policy role is particularly important in the development of the bioeconomy because the benefits of using the products are widely shared in society - the environmental sustainability, carbon cycle management benefits, and public health benefits of biobased products are captured widely by society, not just by those who buy and use the products.

Financing

Financing is a large concern for firms entering into new business ventures or offering new products to the marketplace. The public sector can provide important early stimulus to developing new products and creation of new firms to advance the bioeconomy development. This support typically has been in the form of grants and loans/loan guarantees. Grants are often made available to new business ventures, or to ventures engaging in new product development and marketing. Acquiring equity capital has proven to be an even larger challenge for rural based start-up firms. Equity capital is difficult to acquire, and the tendency, especially with cooperatively organized business firms, is to go forward with the minimal amount of equity capital necessary to support the debt capital used in the start-up. That action can add unnecessary risk to the new business equity because it means there is little built-in financial resiliency to sustain business setbacks.

An array of private sector and public/private sector partnerships can facilitate financing. It is almost always preferable to own part of a successful venture than to own all of a venture with a high risk of failure. Creating competitive access to venture capital and "angel" capital (individual investors) for new business start up and expansion is a problem in rural America, and thus, creating investment networks that focus on rural and biobased businesses may be part of the solution.

Overcoming rate of return barriers on new investments in plants and equipment to support bioproduct production is a particularly difficult issue for private sector firms entering a new and inherently higher-risk market—one that usually has high entrance requirements in terms of capital and technology. Public sector investment partnerships, tax credit plans, and grants can be particularly helpful in enabling the first generation of new production and marketing to gain a competitive foothold.

Access to specialized insurance or other risk-bearing strategies to protect cash flow during periods of business interruptions could prove helpful. Contracts that fix feedstock costs and facilitate market demand also are important for lowering financial risk to levels that business firms are willing to bear.

Education and Outreach

Finally, educational and outreach programs that provide science-based information on biofuels and bioproducts to policymakers, manufacturers, and consumers can be important in obtaining successful market penetration. Understanding product environmental and performance characteristics is key to a product launch. Bioenergy products have to be more than "green"; they also have to be priced competitively and add more value than the competition.

A First Step

USDA is committed to developing a more holistic approach with its programs. On December 7, 2005 Secretary Johanns created an Energy Council under the leadership of Under Secretary for Rural Development, Tom Dorr. The newly formed Council was instructed by the Secretary to review USDA's existing energy

and bioproduct related activities, authorities and resources, and recommend how, with other government and private sector entities, to maximize the effectiveness of USDA's current programs and resources "...so that we have a comprehensive, integrated and intensified effort" (Johanns, 2005).

For More Information

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