The Bioeconomy and Agricultural Research
U. S. Department of Agriculture
Research, Education, and Economics

As the 21st century unfolds, America faces economic, social, and environmental challenges that require innovative systems of food, agricultural, and environmental science for answers. A key part of finding those answers lies in creating a thriving bioeconomy – a marketplace built on the necessary transition our society will need to make from traditional fossil fuels to fuels that come from renewable biomass and sustainable agricultural stocks. To meet the energy challenges that lie ahead, the Administration released the *National Bioeconomy Blueprint* to offer a roadmap that will help realize the full potential of the US bioeconomy[1]. The Blueprint's objectives are to:

- Support Bioeconomy R&D investments;
- Facilitate the commercialization of bioinventions from lab to market;
- Develop and reform regulations to reduce barriers and costs of production while protecting human and environmental health;
- Meet the national workforce needs to support the bioeconomy; and,
- Promote and support public-private partnerships to learn from successes and failures.

The Challenge

The Energy Independence and Security Act of 2007 called for the production of 36 billion gallons per year of renewable fuels by 2022 from renewable biomass to offset traditional petroleum. At the core of this shift is the continued sustainable production of food and fiber to meet a growing population, an environment that provides clean and abundant water and air, and safe human health and well-being conditions. The global chemical industry is projected to expand by 6 percent per year by 2025. Biobased chemicals can comprise over 20 percent of that growth[2]. The bioeconomy will require tight linkages between a diversity of agricultural sciences with other biological, chemical, and engineering technical fields. Underpinning this growth is the role rural America plays, because the materials needed to build the bioeconomy are largely produced on farms and forests.

The United States Department of Agriculture has been working on these challenges for decades and is a global leader in all the elements that comprise the foundation of the American bioeconomy: devising agricultural solutions for economic growth, climate change mitigation, food security, and the creation of cost-effective and diverse renewable energy options to replace fossil fuels.

---

[1] National Bioeconomy Blueprint, April 2012
http://www.whitehouse.gov/sites/default/files/microsites/ostp/national_bioeconomy_blueprint_april_2012.pdf
[2] USDA. *U.S. Biobased Products Market Potential and Projections Through 2025,* February 2008 (OCE-2008-1)
http://www.usda.gov/oce/reports/energy/BiobasedReport2008.pdf

The Opportunity

The agricultural sector is essential for ensuring sustainable, reliable, and accessible production of biobased products that: 1) replace the use of petroleum and other strategic materials that would otherwise need to be imported, 2) create higher-value revenue streams for producers in rural and agricultural communities, 3) improve the nutrition and well-being of animals and humans; and 4) provide ecosystem services such as ensuring clean air and water, biodiversity, and nutrient cycling to the environment and society.

The growth of the bioeconomy depends upon understanding and addressing three areas of importance: 1) understanding the entire supply chain of the bioeconomy; 2) rural America's role in the bioeconomy; and, 3) the role of research and development.

The Entire Supply Chain of the Bioeconomy

Although the focus of the bioeconomy is usually on increased availability of bioproducts such as pharmaceuticals, chemicals, fuels, and co-products, many diverse disciplines and sectors are essential components along the entire bioeconomy supply chain - providing intermediate research, products, services, and opportunities for economic growth in rural areas. This supply chain includes biomass production, feedstock harvesting and transportation, processing and value-addition, cost-effective and safe testing and distribution, and successful integration of bioproducts into the marketplace. Success will depend upon a diversity of public and private sector stakeholders partnering to develop bioproducts and bring them to market.

Rural America's Role

USDA views rural wealth creation as a top priority[3] and is actively engaged in helping rural communities and agricultural producers thrive. Because many materials needed for the bioeconomy are produced in rural areas and transferred to more urban areas, the bioeconomy offers great benefits to communities across the spectrum that are currently in need of an economic boost. The bioeconomy can also benefit other communities currently struggling, including tribal communities, who are also located in rural areas. Strong regional bioeconomies are built on local farmers and landowners who provide the essential feedstocks for bioproducts.

To sustain a bioeconomy, the agricultural sector must be able to cost-effectively provide a variety of feedstocks at a range of scales for increasingly diverse end-use purposes. This ensures that the natural and human resources upon which the sector depends continue to regenerate and

[3] USDA Strategic Plan, FY 2010-2015. http://www.ocfo.usda.gov/usdasp/sp2010/sp2010.pdf

thrive. Increased diversity of feedstocks and growers will ensure economic opportunities for both small and large-scale producers and reduce risks for manufacturers.

Role of Research and Development

Producers of food, feed, fuel, fiber, and other biobased products hope to optimize and fully utilize the beneficial characteristics of the biomass they produce in order to ensure economic success and well-being. Scientific research is the engine that allows producers to use and manage these materials in innovative ways and develop a wide array of bioproducts. To ensure a growing bioeconomy:

- Scientists must have access to a wide range of genetic diversity to design varieties and systems that are resilient to unfamiliar pests, diseases, and environmental stresses. These varieties will be needed to supply growing new industries and ensure the long-term health of soil and other natural resources that enable the productivity of the system;
- Scientific research and the policies it supports must enable fiscally sound biorefineries to produce a variety of low cost, high-performance bioproducts that compete effectively against petrochemical materials in the marketplace; and
- We must develop and cultivate a new generation of scientists, farmers, and ranchers who have the technical skills to support these emerging industries.

A Path Forward

USDA strategically sustains and enhances its research, education, and implementation programs to support all components of the bioeconomy supply chain. The Agricultural Research Service (ARS), the National Institute of Food and Agriculture (NIFA), and the Forest Service support regional research programs that focus on improving biomass varieties and production systems to boost the performance of biobased products and to enable higher value uses of co-products while protecting or enhancing vital ecosystem services. It is essential for these agencies to sustain and enhance these programs to support a growing bioeconomy. The Department coordinates specific research and workforce development programs with their data and economic analysis capacities; strategic partnerships to enhance technology and knowledge transfer as well as community development and stakeholder feedback; and financial and technical assistance programs to identify the bioproducts that hold the most promise for expanded markets, rural economic development, and solutions to societal grand challenges.

The National Agricultural Statistics Service (NASS) currently coordinates with USDA's other agencies to ensure that they collect the salient statistics that support analysis of the growing bioeconomy. Similarly, the Economic Research Service and the Office of the Chief Economist conduct analyses using NASS data and data from external partners to inform decisions made by USDA agencies as well as to understand the status and economic feasibility of the bioeconomy.

Progress to Date

USDA research has developed and deployed various tools to improve the characteristics of plants and animal systems, such as yields, ranges, and cost-effectiveness, to maximize their use as the base for bioeconomy products. Some of these tools include improved nutrient recycling, water utilization, and seed production improvement.

ARS, NIFA, and the Forest Service have established regional research centers and projects with private partners that focus on the development of biofuels and biobased products to support and build the bioeconomy. This investment of over $200 million supports the entire bioeconomy supply chain while also serving as incubators for small businesses and education centers for landowners and biomass managers.

The Critical Agricultural Materials Program and the Biomass Research and Development Initiative have supported public-private partnerships to breach the commercial "valley of death," a term coined by economists to describe the time between development of a product/proof of concept and the ability to bring it to market. Along with ARS and Forest Service scientists, these programs have recruited outside capital investments and promoted the growth of biobased products, while supporting the growth of advanced manufacturing technology in rural communities.

The USDA BioPreferred program was initiated by the Farm Bills of 2002 and 2008. This program has the goal of increasing the purchase and use of biobased products within the Federal government. The BioPreferred program has identified more than 25,000 products available on the market.

Through the ARS Office of Technology Transfer and the Cooperative Extension System, USDA has been able to effectively bring together federal, state, university, and industry efforts to enhance and accelerate commercialization and adoption of bioeconomy research and application. These partnerships unite USDA research, agricultural producers, and manufacturers to create goods and services for the public benefit.

NIFA has established several education programs to enhance and develop the scientific and professional workforce by working in cooperation with public institutions, private sector partners, and the Land-Grant University System. These programs support education, teaching, and workforce development to strengthen agricultural and natural resources sciences literacy in K-12, higher education, and the scientific and professional workforce. Education grants provide funding opportunities to innovate and revitalize curricula, expand teacher competencies, and develop research and teaching capacity at minority-serving institutions.

Through the wealth of such initiatives, USDA is focused on ensuring that all Americans benefit from the bioeconomy, which will strengthen rural communities, enhance their economic well-being and provide a solid foundation upon which our nation can build an economy that is strong and self-sufficient.