The Future of Fuel

Forage crops as cellulosic feedstocks. New biorefineries. Increased farm profitability. Inexpensive fish food. Today's bioenergy research will affect all agricultural industries and commodities in a variety of ways.

More than a mere buzzword, biorefining has been an important industry for the United States since World War II, when ARS research helped provide new feedstocks (raw materials) for ethanol to support the war effort. The agency's research didn't stop there, and ARS is still at the forefront of bioenergy research.

Today, new products are hitting the market. Alternative-energy research is on the rise. And ARS scientists around the country are investigating how to improve the genetic development, sustainable production, and biofuel conversion of feedstocks in ways that minimize the impact of these new products on food price and availability.

For example, ARS is advancing research on cell-wall materials, which are abundant and renewable nonfood energy sources. Cellulose, lignin, and other components of plant cell walls are available in corn stover and other plant residues, wheat straw, food wastes, and perennial grasses, like switchgrass. This hardy North American native is the subject of several ARS research projects. In Albany, California, scientists are determining the sequence of thousands of switchgrass gene fragments to help find useful traits. In Lincoln, Nebraska, they're developing new varieties suited to different production conditions. In Madison, Wisconsin, they're identifying genes and strategies to breed switchgrass that's more efficient for biofuel production. In University Park, Pennsylvania, they're assessing the plant's environmental benefits. In Peoria, Illinois, they're identifying microbes that can improve its conversion to biofuel.

ARS is investigating dozens of other potential options, including different grasses, alfalfa, and barley, as well as byproducts from agricultural production and processing, such as manure and citrus peels. These collaborative efforts will help ensure that biorefiners have available a wide range of feedstocks to produce biofuels.

Though much of ARS's research deals with specific crops and commodities, it also integrates scientific and technological advancements to ensure lasting real-world benefit for different communities. What works for a small farm in Pennsylvania might not work on a big farm in California. Determining which feedstock crops should be grown in specific areas of the country, identifying the best practices with which to grow them, and selecting the best biorefining conditions are reflective of the system-wide approach of our research.

Studies like these make it possible to target alternative-fuels solutions to specific farms and regions—making production more efficient, profitable, and sustainable for all involved.

Also emerging from ARS biofuels research are coproducts from a new generation of biorefineries. These products are creating exciting opportunities for agriculture. One great example of this involves glycerol, a coproduct of biodiesel production. Researchers at the ARS Eastern Regional Research Center in Wyndmoor, Pennsylvania, have found countless potential uses for glycerol, such as in the production of polyester biopolymers, which can be used as plastics or adhesives. And new coproducts—such as specialty oils, food additives, and aquaculture feeds—should boost the profitability of current and future biorefineries.

Our feedstock-production research works to optimize the quantity and quality of raw materials for biorefineries so that both farmers and converters will profit. We've developed tools to help farmers and biorefinery operators make investment decisions, and our research is creating tools and methods that maximize biofuel's benefits economically while also protecting our soil, air, and water resources.

ARS scientists are also determining which conversion methods work best for particular crops and identifying feedstock-production systems to maximize profitability and sustainability. Our research has developed tools and methods to expedite the conversion process, resulting in lower production costs. For example, we're currently working to develop sensors to monitor conversion of xylose and arabinose, two sugars that are available in biomass for conversion to ethanol.

ARS is expanding its investigations into farm-based alternative fuels that will help reduce America's dependence on foreign oil and cut greenhouse-gas emissions. Our ultimate goal is to deliver technology and agricultural products that will make it possible to produce bioenergy profitably and sustainably from renewable nonfood resources.

With experts in all the relevant scientific disciplines and in every region of the United States, ARS is in a unique position to integrate the scientific advancements needed in feedstock development, feedstock production, and biorefining, so that biofuel production is economically and environmentally sustainable. And the fact that we have strong relationships with people throughout the U.S. food and agriculture industry means that we will focus on research that properly integrates biofuel production into agriculture.

This research will help create job opportunities while reducing pressure on the environment. We expect tremendous benefits for farmers, industry, and U.S. consumers.

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