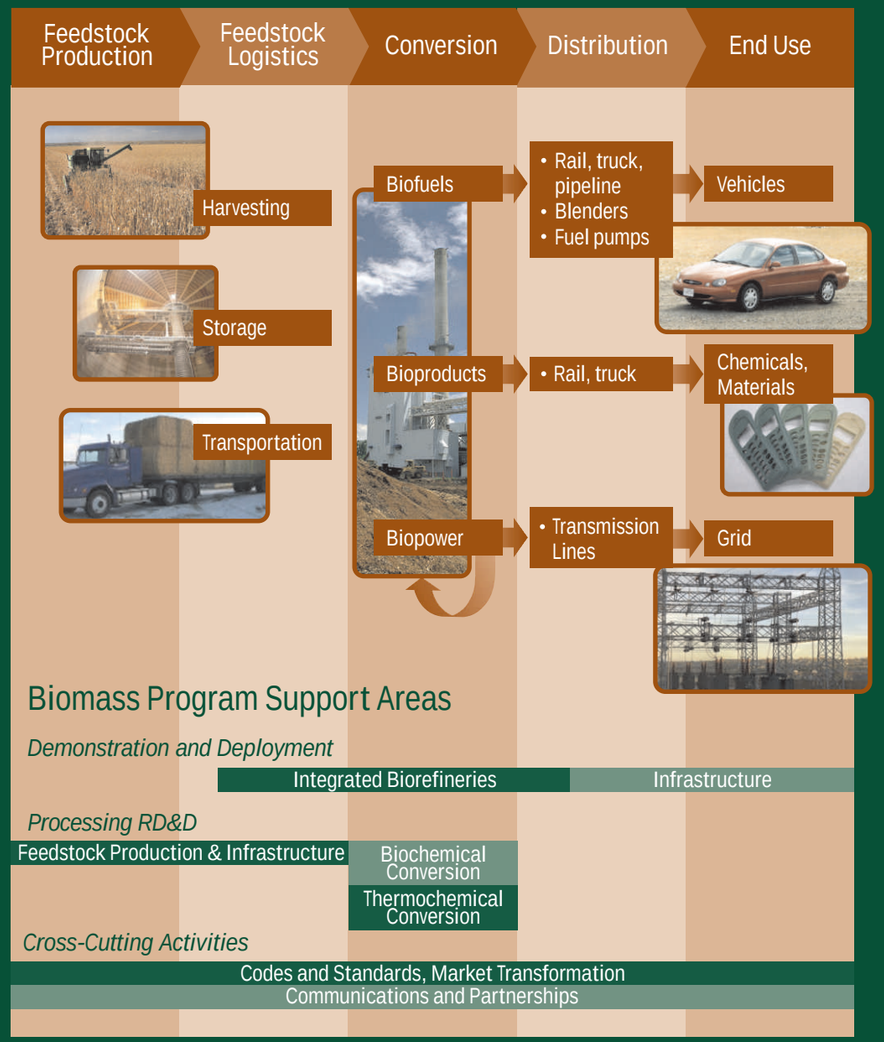
Supply Chain: Biomass to End Use

Meeting production targets will require accelerated research, development, and demonstration (RD&D) activities to convert a wide range of cellulosic feedstocks into ethanol and other valuable products.



For additional information, please contact:

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A Strong Energy Portfolio for a Strong America

Energy efficiency and clean, renewable energy will mean a stronger economy, a cleaner environment, and greater energy independence for America. Working with a wide array of state, community, industry, and university partners, the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy invests in a diverse portfolio of energy technologies.

U.S. Department of Energy
Energy Efficiency and Renewable Energy

The U.S. Department of Energy's Biomass Program

works with research partners to develop, demonstrate, and validate the most efficient and sustainable ways to produce affordable biofuels, bioproducts, and biopower.

Clean and affordable domestic biofuels—supported by an easily accessible, efficient infrastructure—will help reduce America's reliance on oil.

U.S. Department of Energy
Energy Efficiency and Renewable Energy
Bringing you a prosperous future where energy is clean, abundant, reliable, and affordable

Biofuels

Biomass is the only clean, renewable energy source that can help to significantly diversify U.S. liquid transporation fuels right away.

Ethanol and biodiesel made from biomass feedstocks are the most common biofuels. Ethanol can be blended with gasoline, while biodiesel can be mixed with or directly substitute for petroleum diesel.

Benefits

- Decrease dependence on oil
- Boost rural economies
- Avoid use of MTBE or other toxic fuel additives
- Reduce greenhouse gas emissions
- Improve balance of trade

Biofuels offer a broad range of potential benefits to our nation, economy, and environment. Realizing those benefits will require major investments and advances in the following:

Availability of cost-competitive biomass resources

Efficient and affordable conversion technologies

Infrastructure to distribute large quantities of biofuels and bioproducts to consumers

"As world demand for energy continues to grow, so too must our supply of clean, domestic sources of energy."

— *Samuel W. Bodman, U.S. Secretary of Energy*

The Biomass Program conducts research, development, and demonstrations to address the major technical and economic hurdles facing the biofuels industry.

Feedstocks

Meeting the 2017 biofuels goal will require a large, sustainable supply of diverse biomass feedstocks across the country. The Biomass Program is working with the national laboratories and stakeholders to develop the technologies and infrastructure needed to produce and deliver sufficient biomass feedstocks to biorefineries. To address regional variations in biomass feedstock potential, the Biomass Program, along with the U.S. Department of Agriculture and Sun Grant Initiative universities, formed the Regional Biomass Energy Feedstock Partnerships. These partnerships are working to

- determine the types and amounts of biomass feedstock potentially available;
- eliminate barriers to developing feedstock resources;
- develop the infrastructure to harvest, store, and transport biomass to biorefineries; and
- implement strategies that can bring economic benefits to each region.

Conversion Technologies

Cost-effective conversion technologies are essential to developing sustainable biorefineries. The Biomass Program conducts cost-shared research, development, and deployment activities on both biochemical and thermochemical technologies for converting *cellulosic* biomass into biofuels and other useful products.

Biochemical conversion is a multi-step process. The biomass is pretreated, then subjected to enzyme hydrolysis to produce sugars, which are fermented by microorganisms to produce ethanol. In 2007, the U.S. Department of Energy (DOE) is competitively awarding $57 million for cost-shared research on more efficient enzymes and fermentative organisms that can increase the cost-effectiveness of these processes.

Thermochemical conversion research currently focuses on gasification. This process involves heating the feedstock with limited oxygen to produce a synthesis gas (syngas), which can then be converted to ethanol, other alcohols, or other products. Researchers are working to reduce the cost of producing clean syngas and validate its use in producing ethanol.

What are biorefineries?

Biorefineries convert biomass to produce both high-volume liquid transportation fuel and high-value chemicals or products.

BIOMASS
- Living or recently living biological material
- Dedicated energy crops
- Other fast-growing plant matter
- Forest, mill, and agricultural residues
- Post-consumer wastes
- Industrial residues

BIOREFINERY
DOE is pursuing two pathways to convert a broad range of biomass feedstocks into a variety of products:
- Biochemical conversion
- Thermochemical conversion

BIOPRODUCTS
- Fuels
- Chemicals
- Materials
- Heat & Power

Research by the National Renewable Energy Laboratory, Genencor International, and Novozymes helped lower twenty-fold the cost of enzymes for commodity-scale biomass conversion.

R&D 100 AWARD WINNER

Integrated Biorefineries

Researchers and technology developers face formidable challenges in integrating a broad range of biomass feedstocks, sustainable supply networks, and conversion technologies into economical biorefineries. They must prove the technologies and develop reliable performance data to attract investment.

In March 2007, DOE announced funding to support development of six commercial-scale, integrated biorefineries. DOE will invest up to $385 million in these public-private projects that will collectively produce up to 130 million gallons of cellulosic ethanol annually by 2012. Pilot-scale (10%) demonstrations are also planned to validate key technologies before they proceed to commercial-scale demonstration.

Infrastructure

Building an infrastructure to support dramatic increases in ethanol production and delivery poses many challenges. Trucks, rail cars, and pipelines capable of delivering biofuels will be needed to handle larger volumes of biofuels, while fueling stations, pumps, and nozzles must be available to dispense the fuel. In addition, codes and standards for environmental and performance criteria are needed to ensure uniform quality and distribution of biofuels across the nation. The Biomass Program is working with multiple federal and state groups to address these challenges.

Our Goals

By 2012, make ethanol from cellulosic feedstocks cost-competitive. Between 2000 and 2005, research reduced the cost of ethanol production from over $5.00 to about $2.25 per gallon.

By 2017, facilitate production of biofuels to help displace 20% of projected gasoline use. To reach this goal, renewable and alternative fuels are expected to contribute 15%, while vehicle efficiency improvements will contribute 5%.

By 2030, facilitate biofuels production to displace 30% of gasoline use (2004 levels). To achieve this goal, the nation must produce 60 billion gallons of biofuels annually.

Today...

Nearly all ethanol is made from corn.

Tomorrow...

As technology advances, ethanol from cellulosic feedstocks (e.g., agricultural waste, trees, grasses, and other sources) will contribute significantly to meet the growing demand for renewable fuels.

Benefits

- Relies on non-food and waste resources
- Emits up to 86% less greenhouse gases than reformulated gasoline
- Requires 90% less fossil energy to produce than a gallon of gasoline

Growing America's Energy Future