

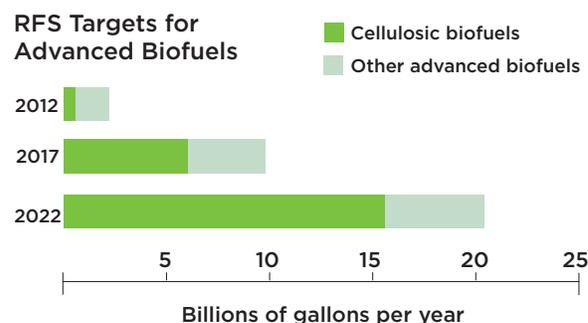
## Sustainably Reducing U.S. Reliance on Fossil Fuels: **THE BIOMASS PROGRAM**

The emerging U.S. bioindustry is using a range of biomass resources to provide a secure and growing supply of transportation fuels and electric power. Displacing an increasing portion of our imported oil with renewable, domestic bioenergy will provide clear benefits:

- Reduced greenhouse gas (GHG) emissions
- A cleaner, more secure energy future
- Sustainable transportation fuels
- Opportunities for economic growth

### Meeting National Energy Goals

The U.S. Department of Energy (DOE) Biomass Program and its partners are developing the technologies and infrastructure to sustainably meet the advanced biofuel production targets set by the Renewable Fuel Standard (RFS) mandated by Congress. Advanced biofuels result in significantly lower GHG emissions than fossil fuels and are made from renewable resources such as cellulosic plant material or algae.



### Creating Green Jobs

Turning biomass into fuel has the potential to stimulate economic and infrastructure development across the country. For example:

- An industry report estimates that the ethanol industry supported creation of about 400,000 jobs in diverse sectors, adding \$53.3 billion to the national GDP in 2009.<sup>1</sup>
- As the industry expands, millions of jobs could be added to the economy within the next 15 to 20 years.<sup>2</sup>

<sup>1</sup> *Outlook 2009*, Renewable Fuels Association, based on input developed by J. Urbanchuk, Director, LECG LLC, February 2010.

<sup>2</sup> *Economic Impact of the Energy Independence and Security Act of 2007*, J. Urbanchuk, Director, LECG LLC, January 2008. Also, *Green Jobs in the U.S. Metro Areas*, U.S. Metro Economies, October 2008.

### MISSION

Transform our renewable and abundant, non-food biomass resources into cost-competitive, high-performance fuels, products, and power via:

- Targeted research, development, and demonstration
- Integrated biorefineries
- Public and private partnerships

### STRATEGIC GOAL

Develop sustainable, cost-competitive technologies to enable the production of biofuels, bioproducts, and biopower that lower carbon emissions and reduce dependence on oil.

### STRATEGIC APPROACH

Coordinate the multi-disciplinary, scientific, and engineering expertise of DOE's National Laboratories, universities, and industry to build a strong technology foundation.

Forge new partnerships and strategic alliances to leverage resources for meeting technological and economic challenges.

## Assuring Sustainability

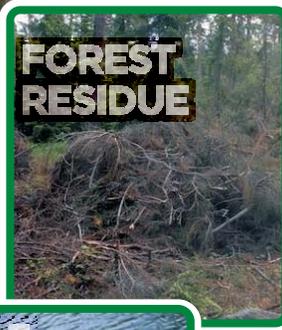
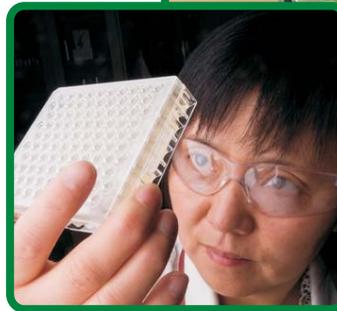
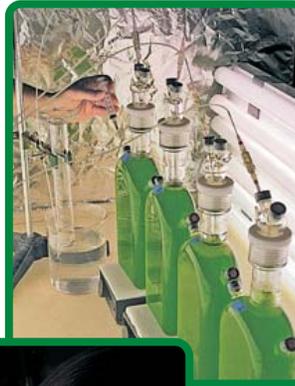
The Biomass Program works with diverse partners to ensure that the U.S. bioenergy industry has a substantially smaller environmental footprint than conventional fuels. In support of this effort, multi-disciplinary teams combine in-field research with advanced analysis to explore potential economic, environmental, and societal impacts over the entire life cycle of biofuels—from seed to end use in vehicles.



## Enabling Science and Discovery

The Biomass Program works with industry, the National Laboratories, and university partners to achieve transformational scientific breakthroughs in biomass conversion processes. This work is helping to enhance the sustainability and lower the cost of diverse biofuels from non-food resources through:

- Advances in enzymes and catalysis
- Discovery of new microorganisms
- Conversion process innovations
- Exploration of new feedstocks
- Sustainability indicators



## Non-Food Biomass Feedstocks

The program focuses on biofuels from feedstocks that do not compete with food crops. Potential biofuel feedstocks include any organic material. Examples include:

- Perennial grasses
- Agricultural and forestry residues
- Short-rotation woody energy crops
- Algae

## Investing in Bioenergy to

In recent years, the U.S. Department of Energy has invested in the bioenergy industry. The goal is to sustainably produce bioenergy, biopower, and bioproducts in integrated

### Priority Research Area

#### Biomass Feedstock Production and Logistics



#### Sustainability



#### Conversion Technology R&D



#### Integrated Biorefineries



#### Infrastructure

## Enhance Our Environment, Economy, and Energy Future

of Energy has strategically invested in the science, technology, and infrastructure to support the emerging U.S. bioenergy produce domestic biofuels and biopower to help meet America’s energy needs. Simultaneous production of biofuels, ted biorefineries is a promising route to lower costs.

Barriers	Sample Activities	Importance
<p>Cost of feedstocks</p> <p>Availability of resources</p> <p>Lack of cost-competitive feedstock supply system</p>	<ul style="list-style-type: none"> <li>✓ Conduct feedstock analyses</li> <li>✓ Coordinate cellulosic feedstock yield and sustainability trials</li> <li>✓ Improve engineering and efficiency of feedstock supply systems</li> <li>✓ Stimulate formation of consortia to develop the supply of algae, cellulosic biomass, and other feedstocks</li> </ul>	<p>Improve feedstocks supply and yields</p> <p>Identify best biomass resources by region</p> <p>Maximize energy efficiency of overall feedstock supply system</p> <p>Stimulate rural economies</p>
<p>Lack of adequate data and analytical tools to assess environmental impacts</p> <p>Protection of soil, water, air, climate</p> <p>Conservation of critical ecological systems</p>	<ul style="list-style-type: none"> <li>✓ Develop a web-enabled GIS framework (Bioenergy Knowledge Discovery Framework) to promote interactive data exchange</li> <li>✓ Conduct field studies to assess optimal locations for dedicated energy crops</li> <li>✓ Identify land to be preserved or utilized, and implement standards for biomass production</li> </ul>	<p>Analyze complex impacts of feedstock, biorefinery, and infrastructure development options</p> <p>Ensure environmental protection while utilizing diverse feedstocks</p> <p>Build knowledge to ensure sustainable bioenergy production</p>
<p>Processing costs and efficiencies</p> <p>Productivity and yields</p> <p>Integration of independent unit operations</p> <p>Application of scientific discovery</p>	<ul style="list-style-type: none"> <li>✓ R&amp;D to improve biochemical conversion <ul style="list-style-type: none"> <li>– Identify improved fermentation microorganisms</li> <li>– Improve enzymes to break down cellulose</li> </ul> </li> <li>✓ R&amp;D to improve thermochemical conversion <ul style="list-style-type: none"> <li>– Develop stabilization processes for pyrolysis oil</li> <li>– Characterize improved catalysts</li> </ul> </li> <li>✓ Engineer integrated processing routes</li> <li>✓ Collaborate with Bioenergy Research Centers to accelerate transitions from basic research to applied R&amp;D of feedstocks, biofuels, and bioproducts</li> </ul>	<p>Maximize efficiency of process designs to lower cost and increase productivity</p> <p>Improve productivity of conversion mechanisms (i.e., catalysts, enzymes, and fermentation organisms)</p> <p>Bridge basic and applied science to lower costs and reduce life-cycle greenhouse gases</p>
<p>Deploying new technologies</p> <p>Attracting financing</p> <p>Expanding existing markets</p>	<ul style="list-style-type: none"> <li>✓ Invest in pilot-scale testing to integrate and optimize technologies</li> <li>✓ Invest in demonstration-scale integrated biorefineries to determine technical and financial risks and readiness for scale-up</li> <li>✓ Invest in commercial-scale integrated biorefineries to reduce financial risk for first-of-a-kind facilities</li> </ul>	<p>Systematically validate and deploy technology</p> <p>Expand portfolio of feedstocks, biofuels, biopower, and bioproducts</p> <p>Prove economic viability</p> <p>Improve sustainability</p> <p>Reduce fossil fuel consumption</p>
<p>System compatibility and availability</p>	<ul style="list-style-type: none"> <li>✓ Study intermediate ethanol blends in vehicles and small engines</li> <li>✓ Expand infrastructure</li> </ul>	<p>Evaluate emissions, compatibility, and performance</p> <p>Increase market uptake</p>

## Accelerating Biofuels Deployment

The U.S. biofuels industry must grow rapidly to meet the legislated production targets. To spur investment, the Biomass Program is providing cost-shared support for biorefineries at the pilot, demonstration, and commercial scales. Existing projects will use various conversion technologies and feedstocks to produce advanced biofuels.

Use of E10 (a blend of 10% ethanol and 90% gasoline) has nearly saturated the vehicle market. To increase near-term market uptake of biofuels, the program is testing E15 and E20 blends. Working with DOE's National Laboratories and the Environmental Protection Agency, the program is conducting blends testing on a variety of vehicles and small engines.

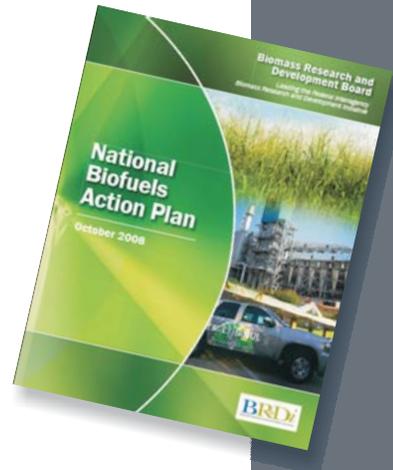


## Coordinating with Our Partners

The Biomass Program taps the expertise of top scientists at DOE's National Laboratories to tackle some of the toughest technological challenges in the economic scale-up of affordable biofuels and biopower. We similarly engage our university partners in many research activities to advance the science and foster development of new talent.

DOE and the U.S. Department of Agriculture jointly co-chair the **Biomass Research and Development (R&D) Board**, which conducts strategic planning and coordinates research across Federal agencies to promote the production and use of biofuels and bioproducts. In 2008, the Biomass R&D Board issued a National Biofuels Action Plan to outline areas in which interagency cooperation will help to transform bio-based fuel production technologies from promising ideas into competitive solutions.

The Biomass R&D Board receives guidance from the **Biomass R&D Technical Advisory Committee**. Approximately 30 representatives of industry, academia, and relevant organizations serve on the committee.



**For additional information visit: [www.biomass.energy.gov](http://www.biomass.energy.gov)**

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