

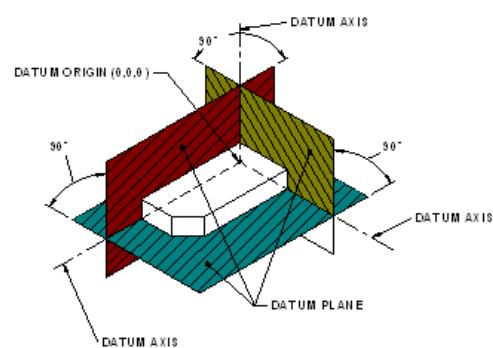
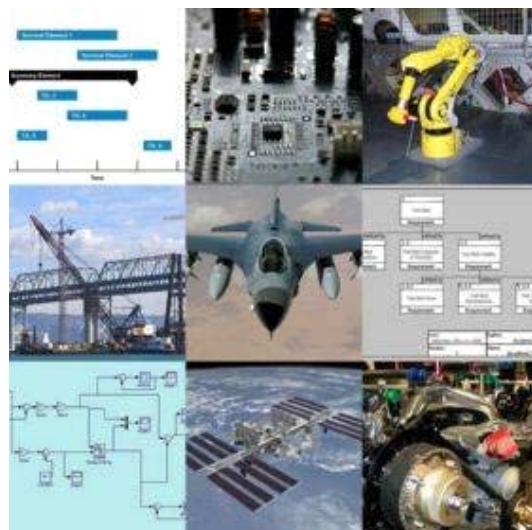


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Biomass Research and Development Board

*Leading the Federal Interagency
Biomass Research and Development Initiative*

National Biofuels Action Plan

October 2008



This document was developed through the efforts of the Biomass Research and Development Board

For additional information about the Biomass Research and Development Board, please contact the Departments which Co-Chair the Board: U.S. Department of Agriculture (USDA) and U.S. Department of Energy (DOE).



Office of the Assistant Secretary Energy Efficiency and Renewable Energy (EERE), DOE at (202) 586-9220. The DOE EERE website is located at <http://eere.energy.gov/>



Office of the Under Secretary for Rural Development, USDA at (202) 720-4581. The USDA Rural Development website is located at <http://www.rurdev.usda.gov/>



The Biomass Research and Development Initiative (BRDi) website provides information about the Board, the Technical Advisory Committee (TAC), and the Initiative. The BRDi website is located at <http://www.brdisolutions.com>

The interagency Biomass Research and Development Board was created by the Biomass Research and Development Act of 2000 and is comprised of numerous Federal Departments and agencies.



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Current National Fuel Challenges

America has one-third of the world's automobiles (230 million) and uses twenty-five percent of the world's oil. The American economy depends on liquid transportation fuels, principally derived from petroleum, to power our cars, buses, trucks, locomotives, barges and airplanes. Use of these fuels has given rise to energy security concerns, contributions to climate change and other environmental challenges. In the absence of alternatives to petroleum products, the Energy Information Administration projects that reliance on foreign producers for oil will increase 30% through 2030, and our transport sector's greenhouse gas emissions will grow by nearly 40% (see AEO 2007 tables 11 and 18). Action is needed now to ensure that viable petroleum alternatives are developed in conjunction with efficiency improvements to address these growing concerns.

Administration Action

Biofuels is one of the Administration's near-term strategies to address energy security and climate change. In his 2006 State of the Union Address, President Bush declared that America "is addicted to oil" and rolled out the Advanced Energy Initiative (AEI), which included increased research funding for cutting edge biofuel production processes. In early 2007 President Bush announced the "Twenty-in-Ten" initiative, a plan to reduce gasoline consumption by 20% in 10 years. A major element of the plan was a request that Congress mandate an increase in domestic renewable and alternative fuels production to 35 billion gallons per year (BGY) by 2017.

Congress responded in December 2007 by passing a Renewable Fuel Standard (RFS) as part of the Energy

Figure 1: U.S. petroleum production capacity and demand

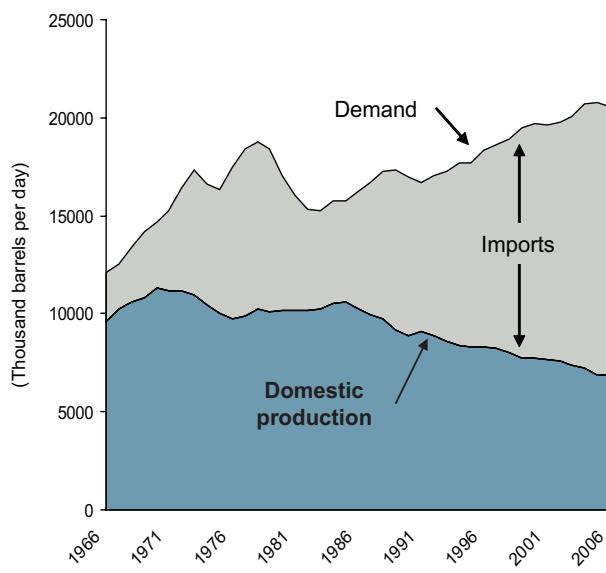
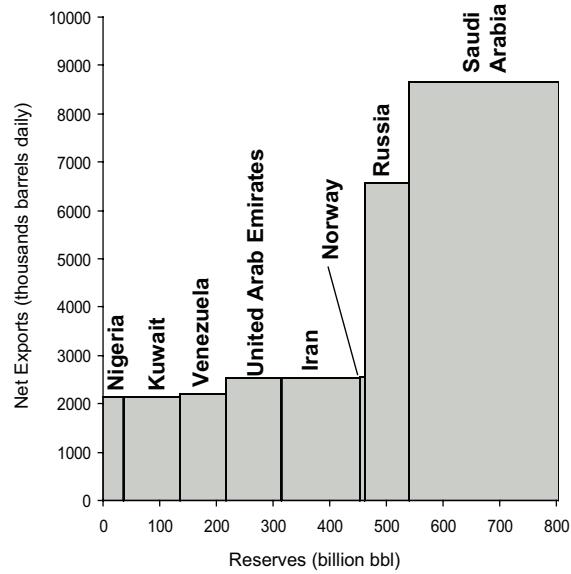


Figure 2: Top eight world-wide countries for petroleum reserves and net exports



Source: EIA Top World Oil Producers & Consumers. Available at http://www.eia.doe.gov/emeu/cabs/topworldtables1_2.htm; BP Statistical Review of World Energy, 2007



Independence and Security Act (EISA) of 2007 that the President signed into law. The RFS requires 36 BGY of biofuels by 2022, and includes specific provisions for advanced biofuels, such as cellulosic ethanol and biomass based diesel contributions that pave the way for advanced technologies.

Also in 2007, the Bush Administration proposed a Farm Bill that included \$1.6 billion in new renewable energy and energy efficiency-related spending at the U.S. Department of Agriculture (USDA), including \$210 million to support loan guarantees for cellulosic ethanol projects. In May 2008, Congress passed the 2008 Farm Bill, titled the Food, Conservation, and Energy Act of 2008, with just over \$1 billion in mandatory funding for such energy activities.

Meanwhile, Federal agencies have taken major steps since 2006 to implement the AEI. The Department of Energy (DOE) has announced plans to invest nearly \$1 billion in partnership with the private sector and academia to research, develop, and deploy advanced biofuel technologies by 2012. This includes up to \$272 million for commercial-scale biorefineries, up to \$240 million for demonstration scale biorefineries working on novel refining processes, and more than \$400 million for bioenergy centers.

Biomass R&D Board

To help industry achieve the aggressive national goals, Federal agencies will need to continue to enhance their collaboration. The Biomass Research and Development (R&D) Board was created by Congress in the Biomass Research and Development Act of 2000, as amended, “to coordinate programs within and among departments and agencies of the Federal Government for the purpose of promoting the use of bio-based fuels and bio-based products by (1) maximizing the benefits deriving from Federal grants and assistance; and (2) bringing coherence to Federal strategic planning.” The Board is co-chaired by senior officials from the Departments of Energy and Agriculture and currently consists of senior decision-makers from the DOE, USDA, Treasury, Transportation (DOT), Interior, Commerce, Defense (DoD), Environmental Protection Agency (EPA), National Science Foundation (NSF), Office of the Federal Environmental Executive, and the President’s Office of Science and Technology Policy.



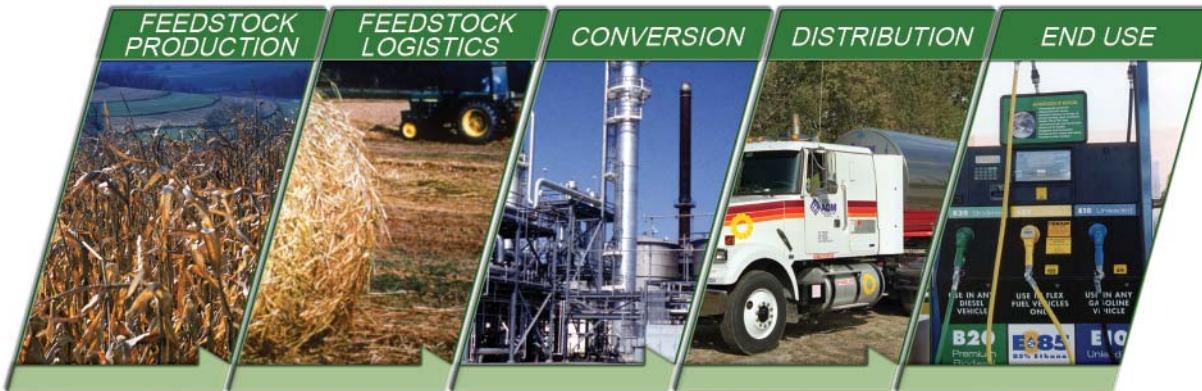


Figure 3: The biofuels supply chain

The Board's Action Plan

This Action Plan outlines areas where interagency cooperation will help to evolve bio-based fuel production technologies from promising ideas to competitive solutions. In developing the plan, the Board used a five part supply-chain framework (see Figure 3) to identify Board action areas:

- **Feedstock Production** comprises the cultivation of biomass resources such as corn, crop residues, and woody residues used as raw material inputs for biofuels production and is discussed in Action Area 2: Feedstock Production.
- **Feedstock Logistics** consists of harvesting or collecting feedstock from the area of production, processing it for use in biorefineries, storing it between harvests, and delivering it to the plant gate. The Board addresses these issues in Action Area 3: Feedstock Logistics.
- **Conversion** is the transformation of the processed feedstock to liquid fuels. Currently, cellulosic ethanol and other technologies essential to achieving the EISA production targets are too costly to compete effectively in the marketplace. Because the pace of technological breakthroughs required to lower costs is inherently uncertain, the availability of advanced technologies to contribute to the EISA goal on an economically and ecologically sustainable basis cannot be assumed. The Board addresses these R&D issues in Action Area 4: Conversion Science and Technology.
- **Distribution** is the transfer of the fuel from the biorefinery to the point of retail sale. A network of trucks, trains, barges, blending and storage

terminals, and, possibly, pipelines, must be able to handle significant volumes safely and economically. The Board's approach to meeting these challenges is outlined in Action Area 5: Distribution Infrastructure.

- **End Use** is the purchase of biofuels by the consumer for use in either traditional vehicles at low level blends or vehicles that are specially modified to accommodate higher biofuels blends. Action Area 6: Blending describes the need for increasing blending from E10 to meet EISA, articulates the challenges to doing so, and describes activities the Board has undertaken in this area including the Board's statement on intermediate blends.

In addition, the Board has identified two crosscutting action areas:

- Supporting the **sustainability** of biofuels production and use, such that the social, economic, and environmental requirements of Americans can be met now and into the future. Action Area 1: Sustainability explores this theme;
- Ensuring the **environment, health, and safety** of the public and those working at all stages of the supply chain as new fuels and processes come into use. These topics are explored in Action Area 7: Environment, Health, and Safety.

In the final section, Moving Forward, the Plan draws these individual actions into a cohesive vision for allowing industry to deploy advanced technologies in the market and achieve significant production scale in the next 15 years.

Board Action Area 1: Sustainability

As President Bush recently noted in a major address to the renewable energy community, the production volumes specified by EISA are not just goals; they are mandatory requirements. He further added that these volumes are needed for the “sake of economic security, national security, and for the sake of being good stewards of the environment.” The Federal government is playing a vital role in achieving all of these objectives by mobilizing teams of the best and brightest scientists from all agencies.

A key goal of the National Biofuels Action Plan is to maximize the environmental and economic benefits of biofuels use by advancing sustainable practices and improvements in efficiency throughout the biofuels supply chain from feedstock production to final use. The Board aims to provide the interagency leadership to steer biofuels development on a sustainable path through the compilation and evaluation of biofuels sustainability criteria, benchmarks and indicators. The Board activities will promote close coordination among federal and state agencies and industry to identify best agricultural and land use practices and the most efficient production, conversion, transportation and storage systems that assure economic growth and viability of the biofuel system while protecting ecosystem and human health.

Historical Context

“Sustainable” as defined by Executive Order 13423 means to “create and maintain conditions under which human and nature can exist in productive harmony, that permits fulfilling the social, economic, and other requirements of present and future generations of Americans.” The EISA amendments to the RFS program promote sustainability by (1) directing that significant reductions in greenhouse gasses be achieved for different feedstocks; (2) requiring that biofuels production not adversely impact the environment or natural resources; (3) focusing on the development of cellulosic and other feedstocks which will promote the sustainable production of biofuels;

(4) stipulating that every 3 years EPA assess and report to Congress on environmental impacts of biofuel systems.

Biomass R&D Board Actions

As demonstrated by EISA and domestic environmental, agricultural, and conservation policies, the U.S. is an international leader in promoting sustainable biofuels production. The Board will continue its focus on active issues by receiving briefings on key aspects of United States policy including EPA methodologies for greenhouse gas lifecycle analysis conducted under its RFS requirements and the State Department’s involvement in the Global Bioenergy Partnership. To further advance its leadership, the Board is:

- Defining, by November 2008, a set of science-based national criteria and identifying science-based indicators to assess sustainable production of biofuels across the biofuels supply chains. These criteria and indicators will be coordinated with ongoing international activities, and will be used to evaluate the environmental, economic, or social performance of biofuels production and use.
- Establishing a Sustainability Interagency Working Group led by DOE, USDA, and EPA, with participation from other agencies, to facilitate strategic planning and coordinate Federal activities; interface with industry and environmental groups; coordinate EISA studies across different agencies; and define and evaluate sustainability criteria, benchmarks and indicators.
- Planning a series of workshops with internal and external stakeholders. Internal workshops will inventory key research efforts in the area of sustainability; identify relevant models, and identify strengths and weaknesses of existing models and gaps. External workshops will involve discussions of analytical and modeling efforts to address pressing issues/challenges, and also inform R&D priorities through dialogues between decision-makers and scientists.



Board Action Area 2: Feedstock Production

The rapid growth of the biofuels industry has been driven by private sector innovation. To sustain that growth it is essential for the Federal government to work in partnership with the private sector to achieve improvements across feedstocks likely to be in use over the near- and longer-terms:

- **First generation** feedstocks include corn for ethanol and soybeans for biodiesel. These feedstocks are currently in use and their yields have been increasing.
- **Second generation** feedstocks consist of the residues or “left-overs” from crop and forest harvests. They show much promise for near-term adoption with the development of cellulosic conversion technologies.
- **Third generation** feedstocks are crops which require further R&D to commercialize, such as perennial grasses, fast growing trees, and algae. They are designed exclusively for fuels production and are commonly referred to as “energy crops”. They represent a key long-term component to a sustainable biofuels industry.

Federal agencies are conducting R&D into high-yield biomass systems and dedicated energy crops that do not disrupt current production paradigms and sustain and enhance the critical natural resource assets required for their production (e.g., water, air, and soil). They are also developing dedicated bioenergy crops through traditional breeding and advanced biotechnology.

Next Steps

Interagency studies suggest that the U.S. has enough indigenous biomass available to meet the EISA targets. However, key activities need to take place in order to do so:

- Environmental implications and balance between food, feed, and fiber, need to be considered as use of first generation feedstocks (e.g., oilseeds and grain) increases. Environmental implications, such as the effect of feedstock production on soil, water and air quality, and market implications of increased production of feedstocks used for biofuels, for food, feed, and fiber, need to be considered as use of first generation feedstocks (e.g., oilseeds and grain) increases.
- Utilization of second generation feedstocks should sustain and enhance water and air quality and other ecosystem services. The availability and cost of these feedstocks need to be inventoried to qualify plant siting opportunities.
- Third generation feedstocks should be developed to increase drought and stress tolerance; increase fertilizer and water use efficiencies; and provide for efficient conversion.
- Improvements in the yields of all feedstocks will be necessary to support future targets.

Biomass R&D Board Actions

- The Board has commissioned an interagency feedstock working group to address feedstock availability and cost, sustainability, and greenhouse gas emissions from feedstock activities. The group initially delivered, in June 2008, a feedstock availability and cost study to provide perspective on likely feedstock costs associated with meeting biofuels production targets.
- Another feedstock working group will develop a long-term integrated feedstock research plan across the Federal government by December 2008 to promote enhanced coordination and collaboration.
- The Board will use this information to address the impact of current regulatory processes on the introduction of modified energy crops and to work with farmers and foresters to increase acceptance and introduction of new crops and trees.
- The Board also seeks greater collaboration with private sector researchers, academia, and state governments, as well as international partners and agencies not currently represented on the Board to ensure leveraging of existing funds. As a first step, Federal agencies including EPA, DOE, USDA and NSF will inventory their current partnerships in these areas in order to develop an engagement plan by November 2008.
- The Board will further promote interagency knowledge sharing by expanding the USDA-DOE scientist exchange program to include the NSF and other agencies in the near future.



Board Action Area 3: Feedstock Logistics

The vast expansion in biofuels production and use mandated by EISA will require the development of new methods and equipment to collect, store, and pre-process biomass in a manner acceptable to biorefineries. These activities, which constitute as much as 20% of the current cost of finished cellulosic ethanol, are comprised of four main elements:

- **Harvesters & collectors** that remove feedstocks from cropland and out of forests.
- **Storage facilities** that support a steady supply of biomass to the biorefinery, in a manner that prevents material spoilage.
- **Preprocessing/grinding equipment** that transform feedstocks to the proper moisture content, bulk density, viscosity, and quality.
- **Transportation of feedstocks** from the field to the biorefinery (as noted in Board Action Area 5: Infrastructure).

Federal agencies are actively collaborating with universities and industry to address this critical segment of the biofuels supply chain. Despite the important role of logistics and the relative immaturity of the needed equipment, to date this area of the supply chain has received limited Federal attention. Increased attention and R&D effort will be required for this supply chain element to achieve targets for delivered biomass.

Next Steps

Highly effective process management must be integrated with specialized equipment to ensure feedstocks maintain quality, consistency, and reliability of supply over time, while maintaining a reasonable delivered cost. However, natural irregularities of the agricultural system, including year-to-year variations in production, crop rotations, and maintenance of soil nutrients over the long term make cost-cutting measures a challenge. The hurdles that must be overcome fall into two main categories:

- **Logistics enterprise design & management:** The design of feedstock collection, storage and preprocessing systems will vary based on feedstock type, regional geography, and system ownership structures. The challenge is to reduce labor and fuel costs which constitute virtually all the expenses in this supply chain element.
- **Technology development:** New technologies are required to support efficient, economic, and sustainable biomass collection and handling. These include creative approaches to moving feedstocks from field to plant, such as sending slurry through dedicated pipelines, single pass harvesters for agricultural residue collection during commodity crop harvest and in-forest grinders to enable forest residue densification at time of collection. Equipment is being developed and tested by industry and academia to facilitate the collection of these new biomass resources.

Biomass R&D Board Actions

- The Board will facilitate collaboration to develop and deploy logistics systems that can supply cellulosic feedstocks to demonstration facilities currently planned for construction. An active interface with private sector partners will be critical to the success of this research. A working group consisting of the USDA, DOE, and other agencies will lead a planning process to develop milestones culminating in the implementation of logistics systems demonstrations in partnership with industry.
- The Board will ensure that consideration of feedstock logistics issues is integrated into the work of both the Feedstock Production working group (Board Action Area 2) and the Board's Transportation Infrastructure activities (Board Action Area 5).



Board Action Area 4: Conversion Science and Technology

Although R&D progress in biomass-based transformation science will biofuels economic barrier is the plant fiber that The scientific are formidable understand lignocellulose breakdown biotechnology of genomics developing cellular, and re-engineering come recalculations.

Another key material breakthrough is potential thermochemical catalysis. In basic research to meet the commercial needs will be needed biofuels.

To date, research on cellulosic first cellulosic

able. But the potential also exists to produce other fuels including higher alcohols, "green" gasoline and diesel, and aviation fuels produced via enzymatic and microbial and/or chemical catalytic processing

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