

Growing America's Fuel

An Innovation Approach to Achieving the President's Biofuels Target

Vision. New jobs and greater economic vitality in rural America, increased energy independence, reduced economic vulnerability to volatile oil prices and uncertain supplies, technological and industrial leadership in renewable biofuels, and reduced global warming pollution – all will be achieved by fulfilling the President's commitment to meeting Congressional biofuels goals.

Strategy. Supporting the existing biofuels industry, while accelerating the commercial and sustainable establishment of the advanced biofuels industry, by using the best skill and knowledge across many Federal departments, as well as public-private partnerships.

The Existing Situation.

- **The U.S. is producing 12 billion gallons per year of biofuels, mostly from corn grain ethanol, but we are not on a trajectory to reach the Congressional 36 billion gallons per year goal by 2022 or to meet the 100 billion gallons cellulosic biofuels target in 2010.**
 - The recession has raised significant barriers to private sector capital financing and investment in new biofuels production.
 - First-generation corn grain ethanol is a critically important renewable fuel source that is lowering our reliance on foreign petroleum dependent fuels, and cellulosic ethanol will soon be contributing as well.
 - Advanced next generation biofuels will be one of the nation's most important industries in the 21st century.
 - Many next generation biofuels feedstock and process technologies that are promising at bench scale are just beginning to be developed through the scale-up process.
 - Challenges exist in matching existing petroleum fuel distribution infrastructure and current generation biofuels, but cost-effective solutions must be found.
- **Hundreds of projects have been funded, but stronger, more robust supply chains would emerge if there were integration of effort across government agencies.**
 - There has been minimal active management to achieve targets across the federal government or private sector.
 - Significant gaps in the biofuels supply chain need to be addressed. Some key policy tools, such as DOE and USDA project loan guarantees and research programs, could be targeted more effectively to support the emerging industry and to deliver outcome-driven results.

A New Approach – An Outcome-Driven, Re-engineered System.

- **Strong management for results using a regional supply chain systems approach that ensures all fuels produced are compatible with the U.S. transportation fuel infrastructure.**
 - Manage by a small centrally-located team accountable to the President’s Biofuels Interagency Working Group that has clearly defined roles and deliverables for all participating federal department, private sector, tribal, and international partners.
 - Establish Lead-Agency responsibility for each supply chain segment – discovery science, sustainable feedstock development and production, feedstock logistics, pilot scale feedstock conversion to biofuels, commercial-scale feedstock conversion, regulatory, education-extension, and workforce development. This effort will be driven by clearly defined deliverables and milestones, with the understanding that sustainable commercial options will emerge and be rapidly deployed.

Create a collaborative process for delivery of Federal investments to assure a user-friendly, effective and efficient delivery of programs and services offered.
 - Present quarterly reviews to the President’s Interagency Working Group, Secretary(s) of DOE and USDA and EPA Administrator.
- **Continue support on development of first- and second-generation biofuels with additional strong focus on accelerating third generation (drop-in) biofuels development – gasoline, diesel (for transportation, home and industrial use), aviation fuels, and industrial biofeedstocks (such as biobased crude).**
 - Improve current delivery programs to support current generation and advanced biofuels technologies.
 - Streamline strategies that move technology research and development rapidly to pilot-demonstration phase and to full-scale commercial production facility construction for next generation technologies and systems.
 - Comprehensive analysis that addresses up-front the elements of feasibility and sustainability for all existing and new technologies (environmental, technical, management, economic, market, financial) to build confidence for creating markets, investments, and credit to sustain long-term biofuels production.
 - Develop new technologies and alternative processes to improve economic and conversion efficiencies for biofuels production. Multiple conversion routes are researched in parallel, including: biochemical, thermochemical, and hybrid designs.
 - Support development of new uses and markets using existing ethanol infrastructure (e.g., green ethylene and biobutanol) and other vertically produced value-added bio co-products (e.g., biochar, dried distillers grains, synthesis gas) with shortened supply chains to enhance long-term rural wealth creation within regions.

- **Support feedstock research and demonstration to ensure sustainable supply chain development that minimizes transaction costs and creates wealth for farms and rural communities.**
 - The President’s FY2011 Budget will develop five USDA regional feedstock research and demonstration centers with robust partnerships with land grant and other universities, industry, and other federal and state agencies, tribal nations, and internationals.
 - Identify economic, environmental, and social issues up-front for all supply chain segments to build confidence for creating markets, investments, and credit that help provide long-term sustainable biofuels production supply chains.
 - Develop the needed sustainable production and logistic systems that are suited to regional conditions and biofuels refinery specifications.
 - Develop superior genetic biofuels feedstocks for perennial grasses, energy cane, biomass sorghum, oil seeds crops and algae, and woody biomass.
 - Coordinate efforts with research conducted by the DOE Biomass Program’s Regional Feedstock Partnership, the Integrated Biorefinery projects, USDA’s biomass and research activities, and the DOE Office of Science’s Bioenergy Research Centers.

The Existing Situation. The Energy Independence and Security Act of 2007 (EISA) established a goal of 36 billion gallons of biofuels by 2022 to power our cars, trucks, jets, ships, and tractors. This is a substantial goal, but one that the U.S. can meet or beat. However, past performance and business as usual will not get us there. Today, only 12 billion gallons of biofuels are produced annually. EIA’s Reference Case for the 2010 Annual Outlook projects that most of the growth in liquid fuel supply will be met by biofuels – yet EIA also projects that we are not on track to meet Congress’ 2022 goal of 36 billion gallons.

Why is this so? In part, it is because hundreds of projects have been funded, but there has not been an explicit USG management plan for achieving our targets. Also, significant parts of the needed supply chain have received little attention, including varieties of dedicated biomass crops suited to different growing environments across the country, sustainable production systems to produce the needed biomass, production of biofuels compatible with the existing transportation fuels infrastructure, and support for development and demonstration projects that bridge the gap between promising research and commercial deployment. If we are to reach our targets, we will need a more strategic approach that in a new way unleashes the creativity and skills of people in government, in college laboratories, in the garages of aspiring entrepreneurs, and in the R&D facilities of the private sector. This plan calls for 36 billion gallons of biofuels in twelve years. If we are to meet this target, we will have work in a new way and set much more aggressive internal benchmarks for progress.

American farmers know how to efficiently produce corn, and the technology for producing corn-based ethanol is well established. This helps account for the remarkable growth in the agricultural-based ethanol biofuels industry that grew from 1% of the U.S. fuel supply in 2000 to 7% in 2008. However, the Renewable Fuel Standard in the EISA has effectively placed a 15 billion gallon cap on ethanol production from corn starch as part of a new 36 billion gallon target for 2022. The remainder of the target is to be met with advanced biofuels, including cellulosic ethanol, biobutanol,

biomass-based diesel, and other biofuels that are a direct replacement for petroleum-based fuels. Also, as a greater portion of the Nation's fuel supply is met with ethanol, technological barriers to using greater amounts of ethanol in gasoline blends will be approached. EPA could allow higher percentage alcohol blends for use in motor vehicles, if the DOE testing program validates the suitability of E15 or E20 in light duty vehicles. However, there are challenges for higher concentration ethanol blends in the existing transportation fuel distribution and utilization infrastructure, which will likely require investment in different storage, transportation, and distribution infrastructure. Also, other significant users of liquid fuels, such as the air transportation industry and the military, have needs that cannot be fully met today by ethanol or electric power sources. Therefore, expansion of the biofuels industry should focus on advanced biofuels and direct substitute fuels that can leverage the existing American multitrillion-dollar liquid fuels infrastructure.

To reach and exceed our biofuels targets, we will need to take a new strategic approach that continues to support the existing biofuels industry and accelerates the creation and rapid commercial deployment of new technologies so our Nation's efforts to establish an advanced biofuels industry are met. Success in meeting these targets would bring many benefits to the United States: new jobs and greater economic vitality in rural America, increased energy independence, reduced economic vulnerability to volatile oil prices and uncertain supplies, technological and industrial leadership in renewable biofuels, and reduced global warming pollution. In short, America will be in firmer control of its energy future. As we have in the past, when facing significant national challenges, we have a rare opportunity to galvanize our country and its talent.

A New Approach – An Outcome-Driven, Re-engineered System.

A highly focused supply chain approach is used that assures all phases of development (research, pilot-scale demonstration, commercialization, and distribution to customers) complement each other, optimizes government investments, and leads to commercially viable farms and companies that sustainably produce supplies of biofuels. The new approach requires strong management for results using a regional supply chain systems approach.

Key features of the approach are:

- Integrated management approach. Create an overall project management structure through the Biomass Board that builds on the core competencies of all contributors, and integrates all Federal-funded project activities across all supply chain elements. Those agencies that are not leading will participate in any of the segments where appropriate, and partners will be welcomed to contribute in any segment. Provide guidance to the existing Biomass R&D Board co-chaired by DOE and USDA.
- Science and technology deliverables defined by timelines, with coordination among the USDA and DOE Offices of Science, and Energy Efficiency and Renewable Energy. Set outcome timelines for development and discovery science.
- Robust partnerships. Federal leadership is used to develop strategic partnerships among private sector, academic institutions, state and local governments and international partners on all segments of the supply chain. Up-front shared intellectual property rights will establish guiding principles on protection, ownership and dissemination of intellectual property. Innovative public-private partnerships will facilitate rapid adoption of research and technology by private sector companies for the commercial production of goods and services.

- Pre-established market outlets. Secure lead customer purchase commitments to stimulate production of feedstocks and biofuels with a concerted effort directed to our military and airline industry.
- Expanded government use of biofuels. To the extent possible, the U.S. Government will work to utilize greater quantities of biofuels in its cars and trucks with flex fuel vehicles, particularly in the urban areas of the upper Midwest states. Encourage state and local governments to do so as well.
 - Performance-based milestones. Establish interim milestones that are widely shared within and outside the Federal Government that show a pathway to results in achieving outcomes.
 - Regular reviews of progress. Create a Quarterly Progress Review by Under Secretary of USDA and DOE and Deputy Administrator of EPA, and recommend mid-course changes as needed.

Manage the effort by a centrally-located small team. The President's May 5, 2009, memorandum formed the Biofuels Interagency Working Group (IWG) with high-level USDA, DOE, and EPA participation and specific charges. This plan builds on that directive by creating a small, centrally-located Management Team that reports to the IWG. The Team helps establish lead agency responsibilities for each supply chain segment; sees to it that clearly defined roles and deliverables are defined for all participating federal department, private sector, tribal, and international partners; monitors progress and results; works with the private sector and international partners; helps lead corrective actions when efforts get off track; and reports progress. This Management Team will oversee the coordination of efforts between IWG and the Biomass Board.

Establish Lead Agency responsibilities for each supply chain segment. The responsibilities for each segment of the supply chain are based on the core competencies and resources of participating federal departments:

- Discovery Science – DOE (Office of Science). Provide discovery science inquiry that focuses on longer-term, advanced biofuels breakthroughs .
- Feedstock Development – USDA (Research, Economics and Education (REE) and Forest Service (FS)). Focus will be on five classes of feedstocks: perennial grasses such as switchgrass, Miscanthus, and mixed native grasses; energy cane, a biomass form of sugarcane; biomass sorghum; oil seed crops and algae, including canola and camelina oil seeds; and woody biomass from fast-growth trees and wood residues. USDA will coordinate with DOE to enhance work underway through DOE's Regional Feedstock Partnerships and the Bioenergy Research Centers.
- Feedstock Production Systems – USDA (REE and FS). Sustainable feedstock production and harvest systems designed for continued high performance across a range of geographies that will provide opportunities for contributions from both farm and forestlands, and diversify economic benefits to many rural areas across the country. Economic and environmental issues are addressed up-front and evaluated to ensure sustainable biofuels production.

- Pilot-scale Conversion and Biorefinery facilities – DOE Energy Efficiency and Renewable Energy (EERE), USDA (REE and FS). Integrated pilot and ten percent of full-scale conversion facilities will be financed to determine suitable technologies for full-scale commercial deployment.
- Full-scale and Widespread Deployment of Commercial Facilities – USDA (Rural Development (RD) and FS) and DOE. Financing is provided for innovative first time commercial technologies (DOE), the continuation of 1st generation facilities and the development of first-of-a-kind, scaled-up commercial and multiple-commercial deployed 2nd and 3rd generation conversion facilities (USDA).
- Regulatory compliance – EPA and USDA. Provide environmental quality monitoring and regulatory compliance to ensure compliance with regulatory statutes to assess the impact of the industry on air and water. EPA and USDA will be responsible as appropriate for oversight, compliance and licensing protocols for biotechnology crops and organisms
- Sustainability – EPA and USDA. EPA will provide expertise and leadership in assessing the environmental impacts of development and implementation of feedstock and production options. USDA will assess the impacts on the agricultural economy in the development and implementation of feedstock and production options.
- Policy support – All departments and agencies.
- Dissemination of Best Practices and Technical Assistance – USDA/State/Local Extension Offices and partners. New information/technology transfer structures will be developed to target all supply chain components to help ensure new technologies are rapidly utilized. In addition, technical assistance to accessing federal grants and loan programs should be readily and easily available. The DOE Clean Cities program has significant dissemination and outreach capabilities, so it could support infrastructure and end-use deployment.
- Feedstock Supply Chain Workforce Development – USDA (REE, FS, and RD) and universities. New vocational and higher education programs will be developed to ensure the next generations of crop developers, producers, processors, technicians, engineers, analysts, and economists are available.
- The Departments of Labor, Commerce, Defense, Transportation and other federal partners can also play important roles in each of these sectors.

Work back from targets. This effort will be driven by clearly defined deliverables and milestones. Since technology development and deployment usually takes longer than expected, the 2022 target should be aggressively managed to meet or beat the targets. Each supply chain component will have specific goals that are informed by the rest of the supply chain. For example, a feedstock development team will need to deliver commercially robust crops that can be produced and delivered to commercial conversion facilities to produce biofuels so this goal can be achieved. At the same time, a feedstock production team will need to identify and ensure that the necessary feedstocks are available in the required timeframe. To ensure continued management focus, there will be quarterly reporting to the President’s Interagency Working Group, the Secretaries of DOE and USDA, and the Administrator of EPA.

Continue support on development of first- and second-generation biofuels with additional strong focus on accelerating third generation (drop-in) biofuels development – gasoline, diesel, aviation fuels, and industrial feedstocks.

Improve current delivery program processes. Create a collaborative process for delivery of Federal investments to assure a user-friendly and efficient delivery of the programs and services offered in support of all current and advanced biofuels technologies. Program services can be improved by possible joint solicitations, combined agency marketing and outreach programs, leveraged financial and technical resources, and streamlined application processes for grant and payment applicants and loan guarantees. Also, strategies can be put in place to help move promising new technologies more quickly through the research and development phase rapidly through pilot-demonstration phase to full-scale commercial production facility construction.

Comprehensive analysis of facility feasibility. If aggressive goals are to be met, strategic implementation plans must comprehensively cover all aspects of potential facility feasibility and viability. A dedicated biomass commodity sector and next generation biofuels conversion systems are not well understood, so it will be necessary to develop an understanding of all elements of commercial feasibility so viable facilities and predictable markets can be developed. To do this, the elements of feasibility for existing and new technologies must be addressed up-front to build confidence for creating markets, investments, and credit to sustain long-term biofuels production. The elements of feasibility include:

- Technical feasibility. Technical feasibility will need to be demonstrated for the multitude of new conversion and processing technologies that will be created and tested.
- Management feasibility. A wide variety of talents will be needed for the new technologies that are developed in order to demonstrate operability and access the needed people with skills.
- Economic feasibility. The existing corn based ethanol system is mature and widely understood with several metrics that allow predictability. Advanced fuel systems are less well understood, so there are information and modeling needs that will have to be developed to predict the success of new projects.
- Market feasibility. As with any other new product, new companies will have to be assured that they have buyers for their product. Acquiring capital for facility construction costs hinges on committed contracts to buy products at prices adequate to support plant operation costs.
- Financial feasibility. Capital must be brought together with technology before a new project can be financed, and this will depend upon all of the previous elements of feasibility being met.
- Environmental Feasibility. Development and implementation of new feedstock and production systems will need to be addressed to ensure that our investments provide sustainable solutions to the nation's energy needs.

Technology improvement and new technology discovery. A multitude of new technologies and processes will need to be created and tested to improve the economics and conversion efficiencies of biofuels production. The existing first-generation corn-based ethanol, biodiesel and renewable diesel systems are widely understood and predictable in their performance. Yet, there are opportunities to develop new markets for corn-based ethanol that can provide improved economic stability, increased rural wealth and reduced use of petroleum based

feedstocks. To accelerate advanced biofuels supply chains, it will be necessary to develop information from models to demonstrate which technologies and strategies have the greatest opportunities for success. Once promising new technologies are identified, streamlined implementation strategies will need to be developed and deployed to move technically feasible conversion technologies from the research and development phase rapidly through the pilot-scale demonstration phase to full-scale deployment of commercial production facilities. Advanced biofuels will be produced and used where appropriate as defined by the state of technology, economic viability, natural resource quality, policy and regulatory supporting them. Research and development will also support development of new uses and markets using existing ethanol infrastructure, including the production of green ethylene and biobutanol. Multiple conversion routes are researched in parallel, including biochemical, thermochemical, and hybrid designs. In addition, value-added bio co-products (e.g., biochar, dried distiller grains, synthesis gas) will be added to diversify product options and diversify risk.

Support feedstock research and demonstration to ensure sustainable supply chain development that minimizes transaction costs and creates wealth for farms and rural communities.

USDA Regional Feedstock Centers. The President's FY2011 Budget proposes developing five USDA Regional Feedstock Research Centers. Regionalized biofuels feedstock production and conversion systems need to be developed to minimize transaction costs and create new rural wealth. The existing multibillion-dollar national USDA science and research infrastructure will be used to support the establishment of USDA Regional Feedstock Research Centers along with robust partnerships with land grant and other universities, industry, and other federal and state agencies. The centers will develop sustainable supply chain strategies and science-based implementation plans designed to accelerate biofuels feedstock production and reduce transaction costs to feedstock producers and biorefineries. The centers will be responsible for planning and developing regional supply chain systems that link feedstock development, production, logistics, conversion, co-product production, and distribution. USDA will coordinate with DOE to enhance work underway through DOE's Regional Feedstock Partnerships and the Bioenergy Research Centers

Address economic, environmental, and social issues up-front. Expanding the biofuels industry to achieve the 36 billion gallons target by 2022 will require the development of an expanded agricultural and wood fiber commodity sector, and presents many opportunities and challenges. Rural land use is constantly changing, but there are limits to the extent to which existing land uses can change without disrupting existing food, feed, and fiber markets. One strategy for integrating biofuels feedstocks into existing agricultural production systems is to replace higher-risk, less productive crops or abandoned lands with lower-risk and more productive cellulosic feedstock crops. Also, more intensive, multiple-year management strategies could be used to get greater production from the same amount of land, and thus reduce pressure to expand production onto environmentally sensitive or marginally viable lands.

Economic, environmental, and social issues will be addressed up-front for all supply chain components to build confidence for creating new markets, investments, and credit to sustain long-term biofuels production and ensure that soil, water, air and other natural resources are protected. As more farms and forests are utilized for biofuels production, careful consideration of feedstock production practices and location of biomass conversion plants will be required to

avoid serious impacts on existing food, feed, and fiber markets and the quality of natural resources upon which we all depend on for clean air and water.

A large and rapid expansion of U.S. biofuels production affects virtually every aspect of agriculture, ranging from domestic demand and exports to prices and the allocation of acreage among crops. Many aspects of the livestock sector are affected as well. As a consequence of these commodity market impacts, farm income, government payments, and food prices also change. Adjustments in the agricultural sector are already underway and will continue for many years as interest grows in these new markets. Careful monitoring of the development of the structure, conduct and performance of the new markets can help alleviate conflicts and smooth the transition to the new bioeconomy.

The implementation of sustainability management plans for biorefineries and their surrounding landscapes can be accomplished by using decision tools that mimic biophysical and economic conditions throughout the supply chain so planning for sustained production can be done by those who participate in both the supply and market sides of this sector. These new crops will need to be more profitable and as predictable as existing enterprises before operators change what they produce. Contracts between energy crop producers and conversion facility operators can help reduce or shift risk, or build capacity to deal with risk. Lower risk makes farmers more likely to grow energy crops because they will have assured markets for their crops. With contracts, processors can make sure they have uninterrupted supplies of feedstock delivered for biofuels production, which could lead to additional investment in processing facilities. Because this plan is developed around a diverse regional strategy, the benefits of economic development are spread across many rural areas, and the risks of interrupted biofuels supplies due to natural disasters can be appropriately considered.

Attention to regional implementation will optimize a variety of liquid fuels, based on conversion facilities that are supplied with adapted dedicated feedstocks that do not disrupt existing food and fiber production systems, and which can utilize the existing fuel distribution infrastructure. For example, ethanol could form the backbone of the regional E85 strategy in the upper Midwest, while advanced fuels produced from energy cane could be the basis for a new biofuels industry in the Southeast. Having such regional strategies will allow logistics and transportation systems to be optimized, as well as expand new supply chain opportunities across Rural America. Also, significant new markets are emerging for ethanol used in bio-based or green products replacing crude oil, so these opportunities should also be pursued. Even though there is a diversity of regional strategies that will be combined to achieve our targets, all fuels produced must be compatible with the U.S. transportation fuel infrastructure to allow Americans to travel anywhere and be able to fill up their cars, planes, and trucks.

Specialized strategies will be developed to take advantage of opportunities to utilize existing resources within regions. Municipal and farm waste and agricultural and forest residues will be encouraged to be addressed locally or regionally to minimize transportation costs, but the greatest predictable potential for biofuels production will come from dedicated crops.

No one kind of dedicated bioenergy crop or particular region in the U.S. will be able to provide all of the required amounts of feedstocks to produce the needed volumes of biofuels. A diversified suite of dedicated biofuels feedstocks must be adapted to a range of conditions across the country where production will be most economical. A diversity of feedstocks also reduces resource pressure on any one location and provides greater resilience to drought, pests, and other production risks. This strategy focuses on a suite of regionally adapted feedstock types that

are matched to different regions of the U.S, and allows us to take advantage of geographically diverse natural, business, and workforce resources within different regions. To ensure continued productivity from the same land area, utilization of genetic diversity and genetic improvement for adaptation to different environmental conditions will be used to increase resilience of crops to climatic extremes and disease and insect pest challenges. Lessons learned from the past have shown that increased skill in management practices can have as great an effect on increased productivity as genetic improvement does, so improved varieties will be developed to enhance sustainable production and minimize natural resources use. Conventional breeding and advanced genetic methods can also be used to enhance feedstock quality to meet the specifications of the biorefineries, and to enhance the production of value-added co-products in feedstocks that are then recovered as part of the bioconversion process. These courses of action can make feedstocks more valuable to biofuels refineries, so higher prices can be paid to farmers that can make feedstock crop more competitive with other land uses.

Summary. The President's and Congress's mandated biofuels goals will be met by supporting the existing biofuels industry, while accelerating the commercial establishment of advanced biofuels, by increasing communication and having a strategic plan across the U.S. Government, and by employing strategic public-private partnerships. This plan builds upon the President's May 5, 2009, memorandum forming the Biofuels Interagency Working Group (IWG) with high-level USDA, DOE, and EPA participation. We will innovate, grow fuel and create new jobs in America with this plan.