Report to the President of the United States

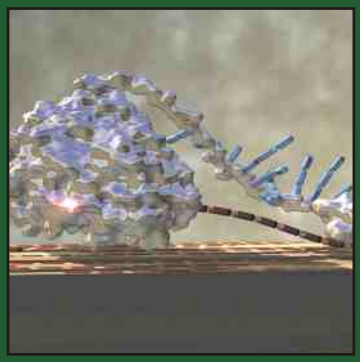
In Response to Executive Order 13134:

"Developing and Promoting Biobased Products and Bioenergy"









Prepared by

U.S. Department of Energy

U.S. Department of Agriculture

February 14, 2000

REPORT TO THE PRESIDENT OF THE UNITED STATES

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Addendum

The content of this report is current as of February 2000. On June 20, 2000, the President signed the Agricultural Risk Protection Act of 2000 (P.L.106-224). Title III of that Act, referred to as the Biomass Research and Development Act of 2000, contains provisions that are designed to improve interagency coordination. This will be accomplished by focusing federal research and development efforts on the conversion of biomass into biobased industrial products (e.g. ethanol, polylactates, and electricity).

As required by Executive Order 13134, this report only addresses actions which have been initiated in response to specific provisions contained therein. However, future reports will be issued in accordance with the applicable provisions of both Title III and the Executive Order.

TABLE OF CONTENTS

EXECUTIVE SUMMARY

This report to the President examines both current and future biobased products and bioenergy activities and concludes that through the promotion of the expanded use of biobased products and bioenergy, the Federal Government can play a major role in bolstering America's farm and forestry sectors, increasing energy independence, strengthening the protection of the environment, mitigating waste problems, and enhancing recycling policies and practices.

In terms of assessing options for modifying existing respective agency programs, the report highlights several ongoing activities that are taking place to examine and coordinate budgets to minimize duplication efforts. One notable example involves the establishment of a National Biobased Products and Bioenergy Coordination Office which is being headquartered at the Department of Energy and will be staffed by employees from various agencies. To safeguard against overlap and redundancies among programs, a permanent Interagency Council on Biobased Products and Bioenergy has been established that includes the Secretaries and Directors of nine Federal organizations involved in biobased products and bioenergy activities. Furthermore, to ensure maximum leverage of investment with the private sector, an Advisory Group is being formed that will be comprised of 20 representatives from the farm and forestry sectors, universities, and other groups.

This report identifies over 30 initiatives and activities for fiscal year 2001 and beyond to achieve the goals of the Executive Order and it outlines outreach efforts to educate the public about the benefits of using biobased products and bioenergy. The report also examines numerous ways that the Federal Government can facilitate biobased production in the 21st century, including providing financial assistance such as tax code modifications and increasing the procurement of biobased products and bioenergy by Federal agencies. A Strategic Plan, due in April 2000, is to provide additional recommendations on potential modifications to existing programs and proposed future activities.

This report was prepared jointly by the U.S. Department of Energy (U.S. DOE) and the U.S. Department of Agriculture (USDA), in consultation with the U.S. Environmental Protection Agency, the U.S. Department of Commerce, the U.S. Department of Interior, U.S. Department of Treasury, the Federal Environmental Executive, the National Science Foundation, the Office of Management and Budget, and the Office of Science and Technology Policy.

1. INITIATIVE OVERVIEW

As we move into the 21st century, a number of key issues challenge our nation's rural economy, energy security, and environment. Recent scientific advances in bioenergy and biobased products have created the potential to develop new economic opportunities for rural America, enhance U.S. energy security, help manage carbon emissions, and protect the environment. On August 12, 1999, the President issued an Executive Order on Biobased Products and Bioenergy (64 FR 44639, August 16, 1999) that will coordinate Federal efforts to accelerate the development of 21st century biobased industries that use trees, crops, agricultural, forest, and aquatic resources to make an array of commercial products including fuels, electricity, chemicals, adhesives, lubricants, and building materials (See Appendix A). In an accompanying Executive Memorandum on these same issues, the President set a goal of tripling U.S. use of biobased products and bioenergy by 2010 (See Appendix A). In the President's remarks at the Executive Order signing ceremony, he stated that reaching the tripling goal "would generate as much as $20 billion a year in new income for farmers and rural communities, while reducing greenhouse gas emissions by as much as 100 million tons a year -- the equivalent of taking more than 70 million cars off the road."

The Executive Order has been complemented by activity on Capitol Hill that has resulted in the introduction of several bills in Congress. Senator Richard Lugar (R-IN) introduced the *National Sustainable Fuels and Chemicals Act of 1999*. This is a research and development bill designed to encourage closer coordination and integration among Federal agencies and national labs, universities, private sector companies, and environmental organizations, to accelerate R&D efforts targeted at overcoming technical barriers to low-cost biomass conversion. Companion biomass bills were introduced by Representative Ewing (R-IL) and Representative Udall (D-CO). House and Senate hearings have been held on these legislative initiatives. The support this issue has received from the White House and from both sides of the aisle in Congress demonstrates the importance of investing in the development of biobased products and bioenergy industries today, which will help the country prosper in the next century.

The research community and industry have also acted in support of this movement. The National Research Council recently completed a study and report entitled "Biobased Industrial Products: Research and Commercialization Priorities," which states that "biobased products have the potential to improve sustainability of natural resources, environmental quality, and national security while competing economically." The report also states that "the conversion of agricultural and forest biological raw materials into value-added industrial products continues to be a promising area of research."

Representatives from the agriculture, forestry, chemical, university, and government sectors have developed two documents that relate to this Initiative: "Agenda 2020" and "Plant/Crop-Based Renewable Resources 2020." "Agenda 2020" is a technology vision and research agenda for America's forest, wood, and paper industry, charting the necessary technological developments to meet the needs of increased forest biomass material in the future. The complementary implementation plan, "Agenda 2020: The Path Forward" describes a plan to ensure the programs undertaken are focused on the issues that address the industry's most pressing needs. "Plant/Crop-Based Renewable Resources 2020" envisions the use of "plant/crop-based renewable resources that are a viable alternative to the current dependence on non-renewable, diminishing fossil fuels." The complementary "Technology Roadmap for Plant/Crop-Based Renewable Resources 2020" identifies research opportunities in basic plant science, production, processing, and utilization to advance the use of biobased feedstocks and obtain a greater market share for biobased materials and products.

Industry and government executives met last year in St. Louis and Washington, D.C. to develop a bioenergy vision for the industry and nation. "The Bioenergy Vision: Achieving Integrated Development and Use of Our Nation's Biologically Derived Renewable Resources" challenges industry and government alike to develop a sustainable energy future founded on science, domestic resources, and the protection of the natural environment. The vision document is currently being reviewed by a large stakeholder group. Stakeholders and customers also participated in workshops designed to kick off the implementation of USDA's national Agricultural Research Service (ARS) programs related to bioenergy and biobased products. ARS will factor stakeholder input from these workshops into developing five-year research plans for these programs.

As a result of the concerted efforts of the scientific community, industry executives, and business leaders, the time is right for the government to invest in the industries that will help the country prosper in the next century. In order to meet the tripling goal set by the President, a joint Initiative needs to be undertaken by U.S. DOE and USDA to combine programs, expertise, and resources to focus on the implementation of existing technologies and the development and deployment of more advanced technologies for biobased products and bioenergy. This Initiative, entitled the Biobased Products and Bioenergy Initiative, will expand the scope of existing implementation activities, research, development, and deployment (RD&D) and speed the development of high-tech feedstocks, conversion technologies, and biobased industrial products, to advance the goals laid out in the Executive Order and the Congressional bills. A program of biomass and biobased industrial product development provides a unique opportunity to achieve marked progress through a market-driven application of biological science breakthroughs to the production and conversion of agricultural and forest products to high-value energy and biobased industrial feedstocks. Government involvement will be required in the early years of this effort to support accelerated commercialization of existing technologies, and scientific discovery and commercialization of new technology to create processing plants and biological refineries that will process agricultural and forest products into a diverse array valuable energy and industrial products.

The important achievements of a biobased products and bioenergy initiative will not be accomplished without an initial government investment in research, development, demonstration, education and outreach programs at the U.S. Departments of Agriculture and Energy.

Implementation of Executive Order 13134

The implementation of Executive Order 13134 calls for the U.S. DOE, USDA, and other Federal agencies to conduct a number of activities, including:

- formation of an Interagency Council,
- creation of an Advisory Committee,
- establishment of a Coordination Office,
- establishment of Departmental Working Groups for U.S. DOE and USDA, and
- completion of annual Strategic Plans.

The Interagency Council is an executive-level body with overall management responsibility for overseeing the implementation of the Executive Order, preparing an annual Strategic Plan, and determining how the goal to triple the use of biobased products and bioenergy can be achieved through programs and integrated planning. The Advisory Committee will be a standing committee of 20 individuals representing various stakeholder groups to provide information and advice for consideration by the Interagency Council in the development of the Strategic Plan. The Coordination Office will conduct the day-to-day activities to oversee and carry out various assignments in support of the Interagency Council and the Advisory Committee. Both the U.S. DOE and USDA have internal working groups that provide strategic planning and policy advice to their agency heads on program directions and priorities as they relate to the implementation of the Executive Order.

The Strategic Plan will outline overall national goals in the development and use of biobased products and bioenergy. These goals include promoting national economic growth with specific attention to rural interests, energy security, and environmental sustainability and protection. The Strategic Plan will be updated annually and reflect the input from the members of the Advisory Committee. The first Strategic Plan is due in April 2000, and is to include:

- a description of priorities for research, development, demonstration, and other investments in biobased products and bioenergy,
- an outline of a coordinated program that builds on the research budgets of each participating agency, and
- proposals for using existing agency authorities, recommendations for modifications of these authorities, and initiatives for creating new authorities, if needed.

The Interagency Council and the Advisory Committee will consider a variety of inputs in their deliberations on the Strategic Plan. An important source of information will be the industry vision and roadmap process that is currently underway for biobased products and bioenergy. The U.S. DOE and USDA have been active participants in this process, which began in November 1998, nine months prior to the issuance of Executive Order 13134. The vision and roadmap process was launched by the U.S. DOE in an effort to strengthen the integration of the U.S. DOE and USDA biomass programs and enhance the involvement of the biomass industries in shaping the directions and priorities of these programs. Several meetings have been held, and a draft Vision document entitled "The Bioenergy Vision: Achieving Integrated Development and Use of Our Nation's Biologically Derived Renewable Resources" has been produced.

The draft Vision contains a situation analysis of the trends and factors that are shaping the future development of the U.S. biobased products and bioenergy industries. It also foresees the emergence of a dynamic, integrated bioenergy and biobased products industry that will use plant products to satisfy a significant portion of the nation's demand for energy, chemicals, building materials, and industrial and commercial products. The document is expected to be released in the near future.

In addition, the draft document:

- discusses the technological, market, and policy challenges that need to be addressed to achieve a successful future for U.S. biobased products and bioenergy industries
- contains a target, consistent with the President's goal, for U.S. bioenergy to "...increase 3-fold by 2010"
- calls for a 10-fold increase in U.S. bioenergy use over today's levels by 2020 and a 2- to 3-fold increase over the 2020 levels by 2050
- calls for the development of a roadmap detailing the technology, policy, market and development activities needed to achieve the goals of the Executive Order.

Another source of information for the Strategic Plan is the USDA Strategic Plan for Biobased Products Through the Biobased Products Coordination Council (BPCC). USDA formed the BPCC, whose goal is to carry out programs to increase the domestic research, development and commercialization of biobased industrial and commercial products. This Council is comprised of USDA staff from across the agency. At a BPCC-sponsored retreat held in October 1998, approximately 75 key people from government, private sector, and university organizations met to identify ways in which USDA can be more successful in increasing the development and commercialization of biobased industrial products from agriculture and forestry resources. The BPCC plan is a result of the input from this meeting and from the work of representatives of each USDA agency with membership in the BPCC. As a result of the Executive Order, the BPCC is being renamed the Biobased Products and Bioenergy Coordination Council.

The current schedule for the implementation of the Executive Order is shown in Figure 1. It lists key activities and sub-activities through the

second quarter of fiscal year 2000. There are other activities that are underway in fiscal year 2000 that contribute to the implementation of the Executive Order. These will be discussed in the next section of this report.

Definition of Biobased Products and Bioenergy

As defined by the Executive Order, the term "biomass" means any organic matter that is available on a renewable or recurring basis (excluding old-growth timber), including dedicated energy crops and trees, agricultural food and feed crop residues, aquatic plants, wood and wood residues, animal wastes, and other waste materials. The term "biobased product" means a commercial or industrial product (other than food or feed) that utilizes biological products or renewable domestic agricultural (plant, animal, and marine) or forestry materials. The term "bioenergy" means biomass used in the production of energy (electricity; liquid, solid, and gaseous fuels; and heat).

Table 1.

Implementation Schedule for Executive Order 13134

Task Name	4th Quarter FY 1999	1st Quarter FY 2000	2nd Quarter FY 2000	3rd Quarter FY 2000	4th Quarter FY 2000	1st Quarter FY 2001	2nd Quarter FY 2001
I. Interagency Council			◆ ◆	◆		◆	◆
1. Conduct quarterly meetings							
II. Advisory Committee							
1. Develop charter		◆	◆				
2. Develop nominees for membership		◆	◆	◆			
3. Committee approval				◆			
III. Strategic Plan							
1. Establish planning process				◆			
2. Draft circulated for comments					◆		
IV. National Coordination Office							
1. Establish Office at DOE				◆			
V. Agency Working Groups							
1. Establish groups	◆						
2. Hold regular internal agency meetings	◆	→	→	→	→	→	→
3. Hold joint agency meetings	◆	→	→	→	→	→	→
VI. Report Called for by Executive Memorandum							
2. Report submitted for final review			◆	→	◆		
VII. Industry Vision Roadmaps							
1. Draft vision released		◆					
2. Vision adoption meeting		◆					
3. Convene roadmap meetings				◆	◆		
4. Vision adoption signing ceremony					◆		
5. Issue roadmap							◆

2. BIOBASED PRODUCTS AND BIOENERGY IMPACTS

Economic and Energy Security

As the productivity of American farmers increases, further attention must be directed toward the development of new products, and new markets for existing farm and forestry products. Industrial uses for agricultural and forestry products represent a largely untapped market opportunity, and may represent the most promising new source of demand for these products. As technological advances increase the efficiency of farmers and foresters, new jobs in the processing of these products into energy and biobased industrial feedstocks and products will add vitality to rural America with increased job growth and income generation, enabling more rural residents to achieve career opportunities where they live, rather than being forced to migrate to urban centers.

The analyses cited in this section provide some dimensions to the potential beneficial effects on farm commodity prices, farm income, and job creation.

- May 1999 - **The Economic Impacts of Bioenergy Crop Production in U.S. Agriculture.** Study results indicate that at $40 per dry ton of energy crops at the "farm gate," about 42 million acres could be planted with energy crops by the year 2008, with annual production of 188 million dry tons of biomass feedstock, equivalent to 3 quads of primary energy, and no significant increase in major commodity prices. Net farm income is estimated to increase by $5.5 billion over the baseline projection from 2000 to 2008.

- April 1999 - **Ethanol and Its Implication for Fuel Supply presented to the EPA Blue Ribbon Panel on Oxygenates.** An OEPNU analysis indicated that increasing ethanol production from 1.6 billion gallons per year in 2004 to 3.4 billion gallons that year, and every year thereafter, will increase farm income by a cumulative $19.3 billion over baseline projection (1999-2010).

- April 1997 - **USDA Analysis of Withdrawing the Ethanol Tax Incentives.** Compared with the FY 1998 President's budget baseline, which retains the Federal ethanol tax exemption, elimination of the Federal tax benefit will lower net cumulative farm income by $5.9 to $10.2 billion during the crop years 1998-2005. Net farm income in nine major corn-producing states will decline by $2.6 to $4.4 billion.

According to an annual report by the Office of Management and Budget, existing annual losses from tax expenditures from an alcohol credit is $15 million. This appears to be far outweighed by the benefits to farm income by continuing the credit, however, analysis will be conducted to examine the advantages and disadvantages of this credit.

The Federal Government has a role to play in the acceptance of the use of biobased products and bioenergy. Realization of this potential will depend on several factors including the relative costs and availability of biobased goods and services. Through its purchasing power, the Federal Government can stimulate business and market development, which can subsequently lead to reductions in cost and increases in product availability.

About three quarters of the world's oil reserves are in the Persian Gulf and the Caspian Basin. The U.S. consumes 25 percent of the world's oil production while holding less than 3 percent of the reserves. U.S. petroleum imports exceed 50 percent of the nation's needs annually and add over $70 billion to the nation's trade deficit. The transportation sector uses most of this oil. In the U.S., alternative fuels make up only about 3 percent of the total transportation fuel. The contributions that renewable fuels can make, using advanced technologies can increase in the very near future. Substantial increases can be derived from liquid fuels, biochemicals, and the production of power and heat. Thus, the prospect of cost-effective access to energy and industrial feedstocks derived from farm and forestry products from within this country has important

implications for national security. This development would substantially improve the U.S. balance of trade and strengthen the nation economically and politically.

Potential Environmental Effects and Benefits

Most scientists now agree that temperatures around the world are rising, that global warming may be occurring, and that there will be high societal costs from unchecked growth in atmospheric concentrations of greenhouse gases. Bioenergy and biobased industrial feedstocks offer sound, economically friendly and environmentally beneficial ways to reduce the pace at which CO_2 and other global warming gases accumulate in the atmosphere. The utility of bioenergy and its co-products can play a major role in mitigation strategies for reducing greenhouse gases.

Potential environmental benefits from biomass include offsetting greenhouse gas emissions and sequestering carbon, improving water quality and reducing soil erosion through the use of perennial cropping systems on marginal lands, and by recovering wastes and capturing methane emissions. These benefits should be compared against other environmental effects. For example, the use of fertilizers in biomass production systems can potentially increase air, soil, and water pollution. Cultivating and harvesting practices cause air emissions from equipment. In some cases, biomass energy conversion technologies require large quantities of water. Life-cycle analysis comparisons of bioenergy systems versus fossil-fuel systems provide the perspective needed to evaluate bioenergy benefits.

Unlike fossil fuels, biomass production systems recapture emissions of carbon dioxide. It has been well documented that biomass energy and product systems have the potential to substantially reduce net greenhouse gas emissions. The relative performance of biomass energy systems in reducing net greenhouse gas emissions depends on the sustainability of the sources of biomass feedstock, the energy requirements of the conversion systems, and overall conversion efficiencies. These vary greatly across biomass systems. A 1999 life-cycle analysis indicates a 95 percent reduction in carbon dioxide emissions from a woody crop-fired integrated gasification combined-cycle (IGCC) system relative to the average coal-fired power system. Direct-fired biomass systems using residues that would otherwise have gone to landfills generated even greater reductions in greenhouse gas emissions by avoiding methane production. A 1995 study by USDA's Office of Energy Policy and New Uses (OEPNU) examines the net energy balance of corn ethanol production and finds that, when using modern processing plants for both fertilizer and ethanol production, and when energy credits are allocated to co-products, corn ethanol has a net positive energy balance making it energy efficient. USDA and U.S. DOE studies further show that compared to gasoline, greenhouse gas emissions can be reduced on a per-gallon basis by 20-30 percent with use of corn ethanol and 85-140 percent with use of cellulosic ethanol. In some cases, a cellulosic ethanol production facility generates more energy from the biomass feedstock than it consumes. The excess electricity is sold to the grid, displacing the need for generating electricity elsewhere and reducing greenhouse gas emissions accordingly. The corresponding greenhouse gases emissions decrease would be 120% or more[1].

The use of biomass for power could have impacts on local air pollution. The impact on conventional air pollutants, nitrous oxides (NO_x), sulfur dioxide (SO_2), particulate matter (PM 10 and PM 2.5,) carbon monoxide (CO), and volatile organic chemicals (VOC) is dependent on the sources of biomass, biomass combustion technology used, the conventional generation technologies being offset, and the emission control devices used. As an example, direct combustion and co-firing biomass may offer improvements in criteria pollutants emissions relative to direct-firing of coal, depending on the

[1]Wang, Michael Q., GREET 1.5 - Transportation Fuel-Cycle Model, Argonne National Laboratory, Report No. ANL/ESD-39, August, 1999

above factors. It follows that certain emissions from advanced coal energy systems now under development by the U.S. DOE may also be moderated by biomass co-firing or co-gasification. Performance data on emissions from pilot-scale gasification systems are currently being collected but more research is needed to optimize performance of gasification systems. The data available indicates that biomass gasification systems would most likely reduce overall emissions relative to most conventional fossil systems (natural gas combined-cycle systems would be the exception). Since the impact of conventional pollutants are primarily local and regional, facility location is also a significant environmental consideration.

Utilization of biobased chemicals may help to reduce risks to human health from environmental releases and workplace exposure to toxic chemicals, particularly those derived from petroleum-based feedstocks. Substitution of biobased products for petroleum-based end products has the potential to reduce pollution from virtually all stages of production, from extraction of the raw material to final product manufacturing and product disposal. Substituting biobased products for inorganic-based products, e.g., wood for steel, bio-cement for cement, and cotton insulation (formaldehyde-free) for fiberglass, can have even more substantial effects on reducing greenhouse gas emissions, as the inorganic-based products are extremely energy-intensive to produce. Substituting a biochemical for a petrochemical that has different properties can reduce the pollution generated by production of the petrochemical, and may also reduce the environmental impact associated with using the chemical in manufacturing final consumer products. Finally, even substituting a biochemical for an identical petrochemical can reduce upstream impacts associated with extraction of the material.

Biomass feedstock production shares many of the potential environmental effects associated with other agricultural systems, including soil erosion, fertilizer and pesticide runoff. However, biomass production systems using perennial crops, such as trees and grasses, that are being developed by the Agricultural Research Service, the Forest Service, Oak Ridge National Laboratory, land grant universities, and others will lower overall chemical use and reduce soil erosion from rates associated with conventional mono-culture crop production. Positive environmental effects have been documented where biomass (perennial crop) production replaces conventional crop production on marginal, highly erodible lands. Additional research is needed to optimize the management systems for a wide variety of soil and climate conditions. Negative environmental effects are more likely if lands are converted from pasture, forest, or other non-intensive agricultural uses. Effects on wildlife habitat and biodiversity will be largely determined by the types of biomass management systems that are developed.

Utilization of biomass products such as compost can also serve as a component of an overall strategy to reduce, reuse, and recycle solid waste. For example, promoting composting is entirely consistent with efforts to enhance recycling. In providing incentives to promote biomass energy from waste, it will be important to understand and mitigate potential instances where diverting waste for energy might have impacts on programs and incentives to promote waste reduction and recycling. It is important to keep in mind that the established, national hierarchy for materials utilization places reuse and recycling above the use of materials for energy recovery. Improvements in handling and management of solid waste, such as capture and use of landfill gas, can reduce emissions of methane, a powerful greenhouse gas, as well as other pollutants. EPA's Landfill Methane Outreach Program is implementing a strategy to double the number of operational landfill gas recovery sites from current levels of close to 300. Animal waste lagoons can also be managed to recover methane emissions using technologies such as anaerobic digestion that produce methane for energy, compost, and liquid fertilizer streams. Direct combustion and gasification of animal and agricultural wastes can also produce energy while at the same time reducing solid waste. In reference to wood burning, emissions from the use of wood in a residential setting can be controlled by using state-of-the-art technology,

Table 2.
Fiscal Year 2000 Funding Summary

	U.S. DOE					USDA				
Programs	**Biofuels**	**Biopower**	**Industries of the Future**	**Fossil Energy**	**Science**	**ARS**	**CSREES**	**FS**	**NRCS**	**OEPNU**
Funding ($M)	$38.9	$31.8	$11.0	$13.5	$29.5	$45.7	$11.0	$9.5	$5.4	$0.6
Total	$124.7					$72.2				

thereby reducing emissions to acceptable levels.

Given that the specific programs and policies are not yet developed under this Initiative, it is premature to provide specifics regarding environmental impacts, but the program is directed toward using biomass in a "clean" fashion. As the vision, roadmapping and strategic planning processes move forward, specific environmental implications will be considered and evaluated. These environmental impacts will be assessed relative to the products, energy sources, and commodities displaced or substituted.

3. CURRENT AND FUTURE BIOBASED PRODUCTS AND BIOENERGY ACTIVITIES

Modification of Existing Programs

U.S. DOE and USDA have begun to evaluate existing programs and consider how they should be modified to achieve the goals outlined in the Executive Order. Both agencies have established internal working groups to provide strategic planning and policy advice within each agency. The two groups have met several times and will continue to work together with other Federal agencies to discuss implementation strategies for the actions called for in the Executive Order.

As mentioned earlier in this report, the process being used to develop the Strategic Plan will be an important mechanism for determining the scope of modifications of existing programs and the extent of new program initiatives at the U.S. DOE, USDA, and other participating Federal agencies. A permanent Interagency Council on Biobased Products and Bioenergy has been established with membership including the Secretaries of Agriculture, Commerce, Energy, and the Interior, the Administrator of the Environmental Protection Agency, the Director of the Office of Management and Budget, the Assistant to the President for Science and Technology, the Director of the National Science Foundation, and the Federal Environmental Executive. The Interagency Council will develop a detailed Strategic Plan that will be presented annually to the President. The first Council meeting was held on January 21, 2000, which was co-chaired by Miley Gonzalez, Under Secretary of Research, Education, and Economics, U.S. Department of Agriculture; and Dan Reicher, Assistant Secretary of Energy Efficiency and Renewable Energy, U.S. Department of Energy. Subsequent interagency coordination activities have developed as a result of the meeting and a second Council meeting will be held in March and June of 2000, and will continue on a quarterly basis.

In order to assist the Council in its efforts, an advisory group is being formed that will be comprised of 20 representatives from biobased industries, farm and forestry sectors, universities, and environmental groups. The Department of Energy was tasked by the Executive Order to determine the membership of the Biobased Products and Bioenergy Advisory Committee, in consultation with the other agencies. U.S. DOE is in the process of finalizing the membership and

will hold a meeting in the coming months.

U.S. DOE and USDA are in the process of established the National Biobased Products and Bioenergy Coordination Office to manage the preparation of interagency budgets and ensure effective day-to-day coordination of actions designed to implement the Strategic Plans and guidance provided by the Council and respond to recommendations made by the Advisory Committee. The office is being headquartered at the Department of Energy. It will be staffed by employees from various agencies. Currently, the positions of U.S. DOE Bioenergy Coordinator, U.S. DOE Director of the Coordination Office, and Advisory Committee Coordinator have been filled by U.S. DOE staff, and USDA has contributed the USDA Director of the Coordination Office.

Fiscal Year 2000 Activities

In fiscal year 2000, the U.S. DOE and USDA received approximately $197 million for research, development, demonstration, commercialization, analysis, outreach, and education activities for biobased products and bioenergy. In addition, the USDA funded $100 million for the production of biobased fuels through the Commodity Credit Corporation (CCC). The U.S. DOE received approximately $125 million and the USDA received approximately $72 million. Table 2 summarizes fiscal year 2000 funding for U.S. DOE and USDA biobased products and bioenergy programs.

Of the U.S. DOE appropriations, approximately $29.5 million will be used for basic research by the Office of Science. The Office of Transportation Technologies will use approximately $38.9 million for ethanol production R&D, biodiesel development, feedstock development, and the regional biomass energy program. This includes $3 million for joint activities for the new Bioenergy Initiative. The Office of Power Technologies will use approximately $31.8 million for thermochemical conversion, systems development, feedstock development, and the regional biomass energy program. This includes $3 million for joint activities for the new Bioenergy Initiative. The Office of Industrial Technologies will use approximately $11 million for the Forest Products and Agriculture *Industries of the Future* programs. The Office of Fossil Energy will use approximately $13.5 million for the development of black liquor gasification processes and associated technology development.

U.S. DOE has elected to utilize a new approach to funding related to biomass related activities. For the first time, an integrated broad-based solicitation has been issued by the Office of Energy Efficiency and Renewable Energy. The scope of the solicitation spans the production of fuels, chemicals, and power. The Offices of Transportation Technologies, Power Technologies, and Industrial Technologies, with the cooperation of the Office of Basic Energy Sciences and the Office of Fossil Energy, have coordinated the development of this and several other solicitations that total $5 million. USDA has been invited to participate in the selection of projects to further extend the integration efforts. The U.S. DOE programs have also issued program relevant solicitations, each with the intent of expanding the resources allocated to bioenergy in FY 2000 and better coordinating on-going programs. This approach offers several advantages, including improved integration and development of technologies, and competitively identifying the best technical ideas and opportunities. This type of solicitation can provide an important private sector complement to the institutional memory and advanced technology capabilities of the national laboratories.

USDA funding is distributed over a wide variety of programs that, in previous years, have supported new non-food, non-feed uses for agricultural and forestry products but which have not been labeled as biobased programs. USDA has been engaged in a range of activities supporting development and implementation of biobased energy and other products for over 100 years. The largest activity in FY 2000 is the effort of the Commodity Credit Corporation (CCC) to provide up to $100 million in bioenergy

incentive payments to encourage production of fuel-grade ethanol and biodiesel from grain.

Fiscal year 2000 funding will also support implementation of Executive Order 13101 (63 FR 49643, September 16, 1998), "*Greening the Government Through Waste Prevention, Recycling, and Federal Acquisition*," including the development, publication, and maintenance of a biobased products list to facilitate the purchase of biobased products by Federal agencies. ARS will use approximately $45.7 million in fiscal year 2000 to conduct research and development of new non-food uses and processes for agricultural products. Technologies developed by ARS include biodegradable plastics and resins; insect attractants; printing inks; petroleum drilling fluids; wheat starch packaging; formaldehyde-free textile finishes; flame retardant textiles; adhesives and glues. The Cooperative State Research, Education, and Extension Service (CSREES) will support research and development in new uses for industrial crops and products through its Agricultural Materials Program, the National Research Initiative, the Small Business Innovation Research program, and formula funding to state land grant universities. Fiscal year 2000 funding is approximately $11 million. The Forest Service (FS) has a long history of forest biomass conversion to chemicals and biofuels. Much of this work is done in collaboration with the U.S. DOE. Total funding for FS is approximately $9.5 million in fiscal year 2000. The Natural Resources Conservation Service (NRCS) provides technical assistance to producers to help them sustain, conserve and enhance their natural resources. Fiscal year 2000 funding is approximately $5.4 million. The OEPNU, in the Office of the Chief Economist, advises the Secretary of Agriculture and USDA on energy policy and coordination on energy issues. OEPNU also analyzes energy-related policies, strategies, and regulations concerning rural America and the marketability of new products from agriculture. Fiscal year 2000 funding is approximately $0.6 million. An additional $10 million will be available in 2000 for competitive grants under USDA's Cooperative State Research, Education, and Extension Initiative for Future Agriculture and Food Systems.

Examples of Potential Initiatives for Fiscal Year 2001 and Beyond[2]

U.S. DOE and USDA collaborated on an enhanced budget request for fiscal year 2001, increasing the agencies combined budget from $197 million in FY 2000 to a combined request of $290 million in FY 2001. This includes a $44 million increase for U.S. DOE and a $45 million increase for USDA. An additional $100 million in FY 2000 and $150 million in FY 2001 will be provided by the CCC to assist processors in purchasing biomass.

These agencies identified a number of potential initiatives and activities for fiscal year 2001 and beyond to achieve the goals of the Executive Order. Table 3 below outlines the funding for these initiatives and activities and brief descriptions of each follow.

Research and Development activities will be funded for:

- Fundamental Science & Engineering:
  - ➛ Further our knowledge of chemical, physical, and biological conversion technologies including biocatalysis, biomass gasification, biomass pyrolysis, separations technologies, and product-recovery systems. Research in these areas is expected to support engineering design and development of unit operations needed for biorefineries.
  - ➛ Reduce the cost of biomass and conversion technologies for integrated systems and equipment such as biorefineries for biobased products and bioenergy.
  - ➛ Reduce costs and improve the conversion efficiency of biomass to biofuels, develop new biobased products, increase knowledge on fundamental biomaterials science.
  - ➛ Examine the potential impacts of genetically modified organisms from bioenergy processes and biobased product production

[2] See Appendices B and C for further examples.

- Power - Combustion and Gasification:
  - ➛ Accelerate the testing and commercialization of advanced co-firing of biomass and fossil fuels in electric power plants in central-station and distributed applications in the Biopower Program. Accelerate the development of small biopower systems for farm and distributed power applications.
  - ➛ Increase Fossil Energy's efforts to ensure that fossil fuel-based *Vision 21* and IGCC Early Entrance Coproduction Plants have the degree of fuel flexibility necessary to utilize a wide range of biomass feedstocks.
  - ➛ Accelerate the timetable on the demonstration and commercialization of new gasification technologies for the pulp and paper industries in the Black Liquor Gasification Program.

- Fuels:
  - ➛ Accelerate the timetable for the commercialization of advanced biobased transportation fuels, including the development of a new suite of low-cost, highly reactive enzymes that are needed to produce low-cost sugars and energy/chemical products in the Transportation Biofuels Energy Systems Program.

- Agriculture:
  - ➛ Expand development of novel crops for value-added biobased products, and improve production and handling of biomass crops for energy through the Agricultural Research Service's national programs.
  - ➛ Develop new technologies for recycling forest products and preserving wood; develop silviculture systems for, and new products from, small-diameter trees by exploring the biological treatment of wood chips for papermaking and composites; and develop new woody crop production systems.
  - ➛ Create a new Initiative under the Environmental Quality Incentives Programs to investigate the use of animal wastes to enhance yields and productivity in commercial forestry and in the development of new biobased products.

- Chemical and Industrial Materials:
  - ➛ Accelerate the development of chemicals and industrial materials; include additional funding in Forest Products Industry of the Future Program for the commercialization of new processes and technologies for the pulp and paper, lumber, and wood products industries; and fund advanced biocatalysis, bioseparations, and other related technology development efforts of interest to the U.S. chemical industries in the Chemicals Industry of the Future Program, and the Agriculture Industry of the Future Program.

- Standards:
  - ➛ Involve the National Institute for Standards and Technology program to assist bioenergy and biobased products research through development of standard reference materials.
  - ➛ Create a coordinating body of all research laboratories that have expertise in the production and utilization of biomass for the purpose of aligning their R&D goals with this Initiative.

Table 3.
Fiscal Year 2001 Funding Summary

	U.S. DOE				USDA							
Programs	**Bio-fuels**	**Bio-power**	**Industries of the Future**	**Science**	**ARS**	**CS REES**	**FS**	**NRCS**	**OE PNU**	**OSEC**	**RD**	**RMA**
Funding ($M)	$54.4	$46.0	$43.8	$29.5	62.5	18.7	19	8.6	1.6	0.8	3.5	1
Total	$173.7				$115.7							

- Environment:
  - ➛ Analyze environmental regulatory concerns related to clean bioenergy technologies, such as combined heat and power, biomass, and black liquor gasification.

Demonstration and Commercialization activities will be funded to:

- Identify and evaluate effectiveness of commercialization strategies that can leverage limited public funding with private sector investment by OEPNU. Support new businesses with early-stage commercialization assistance.

- Revise Federal Acquisition Regulations to support procurement of new biobased products, and obtain General Services Administration (GSA) and Defense Logistics Agency procurement stock numbers for new biobased products.

- Promote foreign market development of biobased products and bioenergy in the Foreign Agricultural Service program.

- Create biobased product and bioenergy testing and certification standards in collaboration with accepted industry testing authorities. Codify performance standards for purchases of biobased products and bioenergy.

- Provide technical assistance and loans:
  - ➛ Develop and implement a program by the Rural Utilities Service to support the location of biomass-fired electric power generation systems in rural and remote locations.
  - ➛ Provide increased assistance from the Rural Business-Cooperative Service to support development of agricultural processing businesses in rural communities to meet consumer demand for increased amounts of biobased energy and other biobased products.

- Collaborate with EPA and local environmental authorities on appropriate regulatory flexibility to promote bioenergy technologies promising superior environmental performance.

Analysis, Outreach, and Education activities will be funded to:

- Information Development:
  - ➛ On net economic benefits to focus program resources on the most productive technology pathways.
  - ➛ Expand the resource and economic assessment of the potential of short-rotation woody crops for wood fiber products.

- Increase the awareness of potential consumers on the relative merits of biobased products and bioenergy as preferable substitutes for their traditional counterpart products.

- Develop training and education assistance to develop comprehensive curricula for Federal personnel and procurement specialists to promote the use and tracking of biobased products and bioenergy services. Develop demonstration pilot programs for use of biobased products and bioenergy services at Federal facilities.

- Technical Assistance:
  - ➛ Include biomass production systems in the Conservation Technical Assistance Program to assist livestock producers in the design and construction of farm demonstration projects of enhanced methane recovery and utilization systems.
  - ➛ Include new efforts for biomass production systems in the Forest Service/NRCS Agroforestry Center by increasing the number of trained field personnel.

Possible Financial Assistance options that may require legislation or incorporation into future Congressional budget requests:

- Provide up to $150 million in bioenergy incentive payments to encourage production of fuel-grade ethanol and biodiesel from grain.

- Create a Domestic Private Investment Corporation to provide financial assistance in the form of loans or loan guarantees to

support private investment in biobased facilities for the production of chemicals, electricity, fuels, and thermal energy. (This will require new legislation.)

- Expand the Resource Conservation & Development Program to include grants for feasibility studies, demonstration projects, and market development efforts to attract private investments for the development of biobased products and bioenergy.

- Implement a new Renewable Energy Insurance Fund that would create a pool of funds to back renewable-energy development projects, including biopower, biofuels, and biochemicals, to mitigate technical and financial risks and increase the likelihood of private investment capital being available for such projects.

- Implement a new Biomass Reserve Program which would establish financial incentives for farmers and foresters to produce crops for biobased products and bioenergy. The financial incentives would involve cost-shared assistance and annual cash payments for up to five years. It is estimated that up to 50,000 acres per year will be enrolled starting in 2001.

- Implement a national Renewable Energy Portfolio Standard that would require that a certain percentage of electric power generation in the U.S. come from renewable energy sources, including biopower and CHP systems that use biobased feedstocks and biofuels.

- Implement Bioenergy Performance Guarantees for biopower and biobased CHP projects to mitigate technical and financial risks and to encourage project developers to commercialize advanced technologies and systems.

- Focus portions of Small Business Innovation Research Program solicitation across all Federal agencies toward areas that complement biobased products and bioenergy initiatives.

4. BIOMASS-RELATED ACTIVITIES IN OTHER FEDERAL AGENCIES

According to the Energy Information Administration's "Annual Energy Outlook 1998," total biomass energy use was about 3 quadrillion Btu in 1998, which is equal to about 3 percent of total energy use. Biomass use was predominately in the form of industrial biomass in the pulp and paper industry, waste-to-energy facilities, residential wood consumption, and landfill gas. Biomass used in ethanol and biomass burned by electric utilities were 0.1 quad and 0.02 quad respectively. Within this context, we recognize that the Executive Order goals are challenging and would require an aggressive and successful R&D effort.

The Environmental Protection Agency is involved with bioenergy-related activities as part of several existing programs. These include such activities as the Landfill Methane Outreach Program and the AgStar Partnership. A variety of EPA and U.S. DOE programs promote the use of renewable energy technologies with superior environmental performance. For example, the joint EPA-DOE EnergyStar Combined Heat and Power (CHP) Award provides recognition to CHP units that generate steam and electricity more efficiently than the current technology. EPA's Project XL (excellence and leadership) is an example of an environmental regulatory flexibility program established as part of the "reinventing government" Initiative which plays a role in removing barriers to environmentally credible bioenergy projects. One XL project currently underway will demonstrate a state-of-the-art black liquor gasifier for the pulp and paper industry which, if successful, will achieve significant reductions in air emissions.

Traditionally, the National Science Foundation (NSF) has emphasized the development of new synthetic methods for use in a wide variety of applications, which continues to be important. Metabolic engineering, separation technology, and process development need to be optimized. For instance, separation of chemical and colloidal components in bioprocesses is often the most expensive and critical part, so NSF research

aimed at improving membranes for such separations is particularly relevant. NSF also supports fermentation and enzyme-catalyzed synthesis activities, which are environmentally benign.

NSF currently supports basic research in science and engineering technologies relevant to fuel or combustion technology. NSF's funding in plant biology, including the Plant Genome Research Program begun in 1998, has substantially advanced knowledge in the area of biological processes involved in plant productivity, potentially leading to understanding the functions of all higher plant genes by the year 2010. NSF also supports research and education on such topics as the effects of climate and oxygen levels on the food web structure, nutrient cycles and plant competition in ecosystems, and forest damage and restoration. Processes such as nitrogen fixation and photosynthesis are studied at the subcellular level.

U.S. DOE and USDA are collaborating with other Federal agencies, including the U.S. Department of Commerce, to identify common areas of interest that can be coordinated in an effort to implement the actions called for in the Executive Order. The Interagency Council is currently developing an interagency budget and program matrix to identify biobased products and biobased programs and funding throughout the Federal Government.

5. FEDERAL GOVERNMENT CONTRIBUTION

By investing in the development and expansion of a biobased products and bioenergy industry today, the Federal Government has the opportunity to bolster America's farm and forestry economy in the 21st century. We are at the forefront of a revolutionary change in biotechnology that will lead to more efficient use of the world's resources, enabling a sustainable energy future. This Initiative will benefit the national interest by addressing several of our nation's key issues:

- diminishing farm income,
- rising oil imports, and
- air and water quality problems.

Driving Forces for Federal Action

Development of biobased products and energy provides a means to facilitate a meaningful decline in reliance on foreign imports of oil over the next decade and beyond, and subsequently lessen our economic and national security vulnerabilities to interruptions in energy supplies. Increased development of biobased products will stimulate new markets for agriculture and forest products, while addressing air and water quality issues and their impacts on human health. However the diversity and decentralization of the stakeholders involved and the substantial technology development risks must be surmounted for these benefits to be realized. A concerted national effort is needed to develop a range of renewable products and energy sources, with this biomass initiative as a centerpiece.

- The Federal Government is committed to rural development.

- Basic research will remain primarily a role of government, however, private capital can be expected to become increasingly active in supporting applied research, product development, and commercialization.

- The Federal Government manages or directly impacts a considerable part of the forest and farm land in the United States.

- Federal seed capital in this area will leverage additional private sector investment if the Federal effort is viewed as creating a favorable investment climate for bioenergy and biobased products (i.e., proven cost efficiencies and profit centers arising from favorable access to Federal markets).

- In the marketplace, many biobased technologies and products are both unfamiliar and unproven. In addition, commercialization of biobased products is viewed by some in private capital markets as a high-risk enterprise with an uncertain time-line for returns. These factors contribute to a

reluctance on the part of private companies to invest in the R&D necessary to bring the products to market.

- The Federal Government is the nation's largest purchaser of goods and services. Public sector leadership is needed to catalyze the production of bioenergy and bioproducts to demonstrate to the private sector the feasibility and cost-effectiveness of these technologies and products.

Potential Tax Code Modifications

Financial incentives could be provided to encourage the production of electricity from agricultural and forest products and certain other sources. Several proposals for tax credits have been assessed and are included in the Administration's FY 2001 budget. The revenue cost of this Initiative is estimated to be almost $1 billion for FY 2001 through FY 2005. These proposals will help to achieve the goals of the Executive Order. A summary of the proposals is provided below.

Extend and Expand Production Tax Credits for Biomass Fired Power Plants

Current law provides taxpayers a 1.5 cent-per-kilowatt-hour tax credit for electricity produced from wind, "closed-loop" biomass (organic material from a plant that is planted exclusively for purposes of being used at a qualified facility to produce electricity), and poultry waste. The electricity must be sold to an unrelated third party and the credit is limited to the first 10 years of production. The credit applies only to facilities placed in service before January 1, 2002. The credit amount is indexed for inflation after 1992.

This proposal would extend the present credit for wind and closed-loop biomass and expand eligible biomass sources, including open-loop facilities. The present credit for wind and closed-loop biomass would be extended for two and one-half years, to facilities placed in service before July 1, 2004 and eligible biomass sources would be expanded for facilities placed in service after December 31, 2000 and before January 1, 2006. Biomass facilities that were placed in service before January 1, 2001 would be eligible for a credit of 1.0 cent per kilowatt hour for electricity produced from the newly eligible sources from January 1, 2001 through December 31, 2003.

Biomass that is co-fired in coal plants to produce electricity would be eligible for the credit at a reduced rate (0.5 cent per kilowatt hour adjusted for inflation after 2000) from January 1, 2001, through December 31, 2005.

Biomass qualifying for the proposed credit would also include (i) open-loop biomass and (ii) any solid, nonhazardous, cellulosic waste material, which is segregated from other waste materials, and which is derived from:

(a) any of the following forest-related resources: mill residues, pre-commercial thinnings, slash and brush, but not including old-growth timber or wood waste incidental to pulp and paper production,

(b) waste pallets, crates, and dunnage, and landscape or right-of-way tree trimmings, but not including unsegregated municipal solid waste (garbage) and post-consumer waste paper, or

(c) agricultural sources, including orchard tree crops, vineyard grain, legumes, sugar, and other crop-by-products or residues.

The tax credit helps make electricity produced from biomass price competitive with other forms of electricity. These biomass derived sources of power produce virtually no greenhouse gas emissions. Expanding eligible biomass sources would increase the use of this renewable energy source.

Provide Tax Credits for Electricity Generated from Methane from Landfills

This proposal would provide a tax credit for the first ten years of production from facilities that produce electricity from landfill methane if the facility is placed in service after December 31, 2000 and before January 1, 2006. The credit for electricity produced from methane from qualified facilities would equal 1.5 cent per kilowatt hour for facilities at landfills that are not subject to

EPA's 1996 New Source Performance Standards/Emissions Guidelines (NSPS/EG) and 1.0 cent per kilowatt hour for facilities at landfills that are subject to NSPS/EG. These credits would be adjusted for inflation after 2000. A qualified facility would include equipment and housing required to generate electricity (but not wells and related systems required to collect and transmit gas to the production facility).

Allowing a tax credit for electricity produced from methane from landfills would reduce greenhouse gas emissions. Methane gas, which has approximately 21 times the greenhouse gas effect as carbon dioxide, accounts for about 10 percent of the warming caused by U.S. emissions. Methane from landfills, the single largest source of methane emissions, accounted for 37 percent of total U.S. methane emissions in 1997.

The success or failure of any of these proposals will be determined by further analysis.

Use of Biobased Products and Bioenergy in Federal Agencies

The potential exists to increase the use of biobased products and bioenergy in Federal agencies. Realization of this potential will depend on several factors, including the relative costs and availability of biobased goods and services. Through its purchasing power, the Federal Government can stimulate business and market development, which can subsequently lead to reductions in costs and increases in product availability.

Increase Energy Efficiency

In 1998, Federal agencies consumed more than 1.5 quadrillion Btus of energy. This amount is more than 1 percent of total U.S. energy consumption and makes the Federal Government the single largest energy consumer in the nation, if not the world. The pattern of energy use is widely dispersed in buildings and facilities, energy-intensive operations in manufacturing and R&D, vehicles, airplanes, and equipment. The Department of Defense accounts for more than 70 percent of energy use, making it the single largest Federal energy consumer. The annual energy bill exceeds $6.2 billion.

Reducing the costs and environmental consequences of energy use is a top priority of the Administration. On June 8, 1999, President Clinton issued Executive Order 13123 (64 FR 30851, June 8, 1999), "*Greening the Government Through Efficient Energy Management.*" The Order tightens the linkage between agency management and the Administration's energy and environmental policies by establishing new and challenging goals. With respect to energy efficiency, the Order establishes a goal to reduce energy consumption per square foot by 35 percent by 2010 compared to 1985 consumption levels. The Order directs Federal agencies to strive to use electricity from clean, efficient and renewable sources and to adopt policies that increase "green power" as a component of their requests for bids for electricity procurement. Bioenergy development can play an important role in achieving the goals of Executive Order 13123. The biggest opportunities are in electricity use and motor vehicle fuels.

Increase Procurement

As the world's largest single purchaser of goods and services, the Federal Government can increase the sale of biobased products by purchasing building materials, paints, inks, and other products that are derived from biobased feedstocks, while complying with other mandates. The USDA has already taken steps to use the Federal purchasing power to support biofuels. Concurrent with the signing of Executive Order 13134, Secretary Glickman issued a commitment to acquire at least 20,000 gallons of biodiesel for use in the USDA fleet in Fiscal Year 2000. Two pilot fueling locations have been opened: one in Maryland and one in South Dakota. USDA is proposing to expand these pilots and add other locations to accelerate these efforts.

Particularly promising applications for expanding the use of bioenergy in Federal agencies include the increased use of ethanol to power Federal fleets and the generation and purchase of electricity from biomass fuels and biomass-fossil

fuel blends. Federal purchases of electricity from these sources can be increased through participation in green power programs. Through these and other measures, it is estimated that under an aggressive program there is the potential for the Federal Government to meet up to 30 percent of its electricity needs from biobased electricity sources by 2010. It is further estimated that achieving this potential in 2010 would involve almost 2 GW of new biobased electric power capacity, saving almost 2 million metric tons of carbon annually.

Increase Alternative Fuel Vehicles

Federal agency use of vehicles powered by biobased fuels can provide significant energy and economic benefits. During the last several years, Federal agencies have acquired large numbers of alternative fuel vehicles to meet the requirements of the Energy Policy Act of 1992 and Executive Order 13101. Currently, over 20,000 of these vehicles are ethanol-capable vehicles, but most still operate on gasoline. The U.S. Postal Service (USPS) alone ordered 10,000 ethanol flexible fuel vehicles in fiscal year 1999, and has placed an order for 11,000 additional ethanol vehicles. In addition, some Federal agencies are exploring the use of biodiesel fuels in heavy-duty vehicles.

The number of ethanol-capable vehicles in the Federal fleet is expected to grow over the next several years. The U.S. DOE, USPS, GSA, and other Federal agencies are now taking the next important step by working with fuel suppliers to make ethanol fuel more readily available to Federal agencies operating these vehicles. Pilot projects in Minneapolis, Chicago, and Denver could result in more than 50 new ethanol refueling stations by the third quarter of fiscal year 2000. The U.S. DOE's Alternative Fuel Vehicle program is helping other Federal agencies to identify fuel suppliers to install even more refueling stations. The first ethanol station in the Washington, D.C. area is scheduled to open in the second quarter of fiscal year 2000.

Increase Market Potential

The Federal Government can use its procurement policies to increase the market for biobased products. Executive Order 13101 calls for the USDA to publish a list of biobased products recommended for purchase by procurement officials. The intent is to use purchasing power to provide assistance to small businesses who are manufacturing biobased industrial products such as absorbents, adhesives, coatings, building materials, lubricants, and solvents. The development of the list of recommended biobased industrial products is an ongoing process with publication expected in fiscal year 2000. Listing criteria were published by the USDA for public comment on August 13, 1999 (64 FR 44185).

The USDA provided critically needed staff assistance to the Office of the Federal Environmental Executive (FEE) throughout fiscal year 1999 to develop the biobased initiatives reflected in this proposal and plans to continue the support this year. The concept of a Biobased Products List appeared first in Executive Order 13101, dated September 14, 1998. FEE has worked with USDA to educate and engage other Federal agencies, including the Federal training institutes, about the benefits of purchasing and using biobased products.

6. PROGRAM AUTHORITIES

U.S. DOE Program Authorities

In 1974, the Solar Energy Research, Development and Demonstration Act (Public Law 93-473) and the Federal Non-Nuclear Energy Research and Development Act (Public Law 93-577) were signed into law. These legislative acts and their amendments authorized Federal programs to provide the nation with options in using biomass and municipal waste technologies as new sources for meeting future energy requirements. The Energy Research and Development Administration, founded in 1975, worked to develop and introduce economically competitive and environmentally acceptable biomass and municipal waste energy technologies. With the passage of the Department of Energy Organization Act (Public Law 95-91) in 1977, responsibilities were assigned to U.S. DOE to develop and implement these programs. Congress passed subsequent

supporting legislation and budgetary provisions to reflect its confidence in the response and direction of U.S. DOE.

Modifications to Existing Program Authorities

U.S. DOE and USDA will be examining potential modifications to existing program authorities over the next several months and will address this issue in the upcoming Strategic Plan.

7. Findings and Recommendations from Recent Documents

Many reports have been completed in the past several years that examine the future of biobased products and bioenergy industries. The relevant findings and recommendations of several of the reports mentioned in the Executive Order are highlighted below. In addition, a summary is provided of the USDA's *Strategic Plan for Biobased Products Through the Biobased Products Coordination Council*. Additional information on these and other related reports can be found in Appendix D.

"Biobased Industrial Products: Research and Commercialization Priorities"

- This 1999 National Academy of Sciences study examines "promising resources, technologies, processes and product lines."

- The report stated that the "expansion of biobased industries will depend on currently unused land and by-products of U.S. agriculture and forestry." It estimates that the long-term potential of the by-products of agriculture could provide up to 10 percent of liquid transportation fuel needs. It also concluded that the expansion of biobased industrial production in the U.S. will require a scale-up of manufacturing capabilities, diversification of processing technologies, and reduction in processing costs.

- The report proposed the following intermediate and long-term targets for the biobased products industry:

  S By the year 2020, provide at least 25 percent of 1994 levels of carbon-based industrial feedstock chemicals and 10 percent of liquid fuels from a biobased products industry

  S Eventually satisfy more than 90 percent of U.S. organic chemical consumption and up to 50 percent of the liquid fuel needs with biobased products; and

  S Form the basis for U.S. leadership of the global transition to biobased products and potential environmental benefits.

"Technology Vision 2020: The U.S. Chemical Industry"

- This 1996 report was prepared by the American Chemical Society, American Institute of Chemical Engineers, Chemical Manufacturers Association, Council for Chemical Research, and Synthetic Organic Chemical Manufacturers Association with encouragement from the U.S. DOE Industries of the Future Program.

- This document is a strategic plan for the chemical industry; the participants in the visioning process concluded that "the growth and competitive advantage of our industry depend upon individual and collaborative efforts of industry, government, and academe to improve the nation's research and development (R&D) enterprise."

- This vision sets goals for the chemical industry over the next 25 years to:

  S Improve efficiency in the use of raw materials, the reuse of recycled materials, and the generation and use of energy;

  S Continue to play a leadership role in balancing environmental and economic considerations;

- S Aggressively commit to longer-term investments in R&D; and

- S Balance investments in technology by leveraging the capabilities of government, academia, and the chemical industry as a whole through targeted collaborative efforts in R&D.

“Plant/Crop-Based Vision 2020 for Agriculture: A Vision to Enhance U.S. Economic Security Through Renewable Plant/Crop-Based Resource Use”

- This 1998 report was developed by the U.S. agricultural, forestry, and chemical communities, with contributions from a wide range of individuals and the support of the U.S. DOE Industries of the Future Program.

- The “Vision” is to provide continued economic growth, healthy standards of living, and strong national security through the development of plant/crop-based renewable resources that are viable alternatives to the current dependence on nonrenewable, diminishing fossil resources.

- Targets for success that are laid out in the document include the following:

  - S 10 percent of basic chemical building blocks arising from plant-derived renewables by 2020 - a five-fold increase; and

  - S Development concepts in place by then to achieve a further increase to 50 percent by 2050.

“The Technology Roadmap for Plant/Crop-Based Renewable Resources 2020"

- This 1999 report identifies critical pathways for the R&D needed to reach the goals identified in the “Plant/Crop-Based Renewable Resources 2020" Vision document.

- This roadmap sets research priorities and will aid both industry and government in making decisions to support R&D critical to the industry’s vision of the future, which is to enhance U.S. security through renewable plant/crop-based renewable resource use.

“Agenda 2020"

- This 1994 vision document was developed for the forest products industry.

- The principal mission of Agenda 2020 is to maximize the efficiency and effectiveness with which the industry executes pre-competitive collaborative research, to ensure that programs that are undertaken are properly focused on the issues which address the industry’s most pressing needs.

- The forestry industry is over 50 percent energy self-sufficient, therefore it can serve as one of the models for a biorefinery concept or for an integrated industry in co-producing energy as well as wood and fiber products.

“Agenda 2020: The Path Forward - An Implementation Plan”

- This 1999 technology roadmap helps define the relationships and roles of the various organizations that are necessary to carry out the actions called for in the Vision document, particularly in the areas of defining the research targets and selecting projects.

- Six task groups were formed to address specific topic areas: wood fiber supply (sustainable forestry), environmental performance, energy performance, recycling, capital effectiveness, and sensors and controls. In this roadmap, each task group identified the technology gaps that needed to be filled in order to achieve the vision.

- The energy performance task group

identified commercialization of advanced biomass and black liquor gasification technologies to be a top priority need of the pulp and paper industry. The American Forest, Wood, and Paper Industry Gasification Combined Cycle Initiative has the potential to add 30 GW of biopowered electric capacity to the nation's power plant mix as the boilers are replaced at the end of their normal useful lives. The pulp and paper industry could become net-generators of electricity by the end of this natural cycle of capital replacement (by 2020-2030).

"Strategic Plan for Biobased Products Through the Biobased Products Coordination Council"

- This June 1999 report is the result of the work of the membership of the Biobased Products Coordination Council during a retreat held in October 1998.

- The goal of the BPCC is to carry out programs to increase domestic research, development, and commercialization of biobased industrial and commercial products.

- The Strategic Plan outlines USDA's goals, objectives, long-term outcome measures, and strategies to accelerate the development and promote the use of biobased products. The plan covers a variety of biobased products, including any commercial or industrial product, other than food or feed, that utilizes biological products or renewable domestic agricultural (plant, animal, and marine) or forestry materials.

- The overall goal is to "increase the domestic research, development, and commercialization of biobased industrial and commercial products." The three strategic objectives are to:

  S "Provide USDA leadership in the Federal Government for increasing research, development, and commercialization of biobased products.

  S Increase USDA's commitment to biobased products.

  S Educate policy makers and the public on the advantages of biobased products."

- The Biobased Products Coordination Council Strategic Plan is now under revision to focus even more emphasis on the goals of E.O. 13134.

8. OUTREACH EFFORTS

Purpose

The Executive Order explicitly recognizes the important role of outreach and communications in developing and promoting biobased products and bioenergy. This section summarizes some of the outreach and communications activities of U.S. DOE and USDA, which are currently taking place, and addresses those which are planned for the future. Appendix E is an inventory of outreach activities.

To meet the President's goal of tripling the use of biobased products and bioenergy by 2010, it is important to have an informed public who can recognize and support the advantages of biobased products and bioenergy. One of the messages that will be conveyed to all target audiences is the concept that the U.S. economy is engaged in revolutionary change, moving from one based on geology (petroleum) to one based on biology (plants and animals). Another message is that through this Initiative economic growth and environmental protection can coexist.

As part of this outreach several key messages about biobased products and bioenergy will be communicated:

- Biobased products and bioenergy are used today in many environmentally sound and

economic applications.

- Expanded development diversifies national energy resources and thereby strengthens the nation's energy and economic security.

- New products from our farms and forests will mean new economic opportunities for rural America.

- An integrated national approach is needed for the full potential to be achieved.

- Bioenergy is a key component to building a clean, renewable, environmentally sound energy supply.

Current Status

Over the years, Federal agencies have produced a number of successful outreach activities associated with their biobased products and bioenergy activities. This section describes those outreach activities.

To set the stage for outreach activities, Federal agencies have engaged target audiences in a variety of planning and implementation exercises. Planning exercises include visioning exercises, road maps, strategic plans, roundtable discussions and colloquies. They can be led by industry or government, and generally aim to include a comprehensive audience base. Implementation activities, such as cooperative research and development agreements, and demonstration projects, directly involve target audiences as partners in ongoing biobased product and bioenergy development.

Federal agencies also have produced a number of traditional print and electronic outreach products, as well as engaged in events and education efforts aimed at promoting biobased products and bioenergy. Print products range from basic primers aimed at general audiences to highly detailed reports aimed at more informed audiences. Most print products have focused on single sector-oriented or agency-oriented perspectives. Electronic products include "hands-on" items, like Web sites, CD-ROMs, and videotapes, and television programs, like public service announcements and special spots devoted to biobased products and bioenergy. Web sites, ranging from very general to highly technical, are operated by both Federal agencies and non-governmental organizations.

Federal agencies have both participated in and sponsored a variety of workshops, symposia and conferences to educate scientific and lay audiences about biobased products and bioenergy. Education efforts include the national network among the biotechnology research community and a variety of educational programs, as well as educational outreach for primary school children, teacher training, and undergraduate and graduate research developed by U.S. DOE and USDA.

Future Outreach Activities

Future outreach activities will build on this successful foundation, and will amplify and extend them to meet the new challenges posed by the Executive Order. They will subscribe to the following promotional goals:

- Build a solid foundation promoting general awareness to increase public acceptance of biobased products and bioenergy.
- Increase awareness of opportunities and willingness of investors and industry to participate in biobased products and bioenergy ventures.
- Create understanding of the benefits of biobased products and bioenergy, such as enhancing rural development, national energy security, and preserving the environment.
- Encourage consumers to preferentially select biobased products and bioenergy.
- Show leadership by stimulating increased use of biobased products and bioenergy use by Federal agencies.

To accomplish these goals, outreach activities must start with a careful identification of target audiences in a comprehensive manner that ensures that all relevant audience segments are

included. Particular attention will be paid to development of new audiences.

Outreach also needs to be directed toward policymakers to ensure their understanding of the need for and success of research and development in biobased products and bioenergy. To ensure that the collection of Federal agencies operates as a coordinated whole to advance the cause of biobased products and bioenergy, activities also will be conducted to reach Federal agency staff.

In addition to establishing a solid foundation of outreach at the government level, outreach activities must be extended to non-governmental sectors. Appeals to the general public will create a broad-based, national understanding of biobased products and bioenergy. Outreach activities also will be aimed at industry and investors to inform them about the benefits of biobased products and bioenergy. Farmers will be encouraged to participate in the production of resources for biobased products and bioenergy and to use those products where possible. Outreach activities will engage public interest groups, like environmentalists, to ensure that their perspectives are incorporated into biobased products and bioenergy from the onset.

Future outreach activities will build on past successful approaches to accomplish the goals of the Executive Order directed at target audiences. To raise national levels of recognition and acceptance of biobased products and bioenergy, outreach activities will emphasize coordination among partnering agencies under unifying themes. These unifying themes will emphasize total life-cycle approaches so that all relevant considerations, such as environmental impacts, will be included.

To achieve the broadest dissemination of information, as much as possible, outreach activities will be pushed down to the local, grass roots level. The Web is an excellent vehicle for providing detailed and continuously updated information. Future outreach activities will create highly-linked, user-friendly Web sites and exercise advanced information technologies on those sites to achieve rapid dissemination of information. Intensity of education efforts will be increased at middle and high school levels to prepare the next generation to comfortably and vigorously use biobased products and bioenergy.

Through efforts like the biobased products list (BPL), being developed by USDA's Biobased Products Coordination Council, under direction of Executive Order 13101, outreach activities will target purchasing agents with educational material to increase recognition of the availability of biobased products and bioenergy.

9. SUMMARY AND CONCLUSIONS

Through promotion of the expanded use of biobased products and bioenergy, the Federal Government can play a major role in bolstering America's farm and forestry sectors, increase energy independence, reduce dependence on oil, and strengthen the protection of the environment, while mitigating waste problems and enhancing recycling policies and practices. Executive Order 13134 establishes clear goals and directions for the U.S. DOE, USDA, and other Federal agencies to integrate, strengthen, and focus existing programs, and establish new programs aimed at tripling the contributions of biobased products and bioenergy to the economy by 2010.

The U.S. DOE, USDA, other participating Federal agencies, private sector organizations, state agencies, national laboratories, and other stakeholders are in the early stages of implementing the Executive Order, including establishing an Advisory Committee, working groups and a Coordination Office, and developing the Strategic Plan. In addition, there is an ongoing vision and roadmap process that was launched by the U.S. DOE and USDA prior to the Executive Order that will be integrated into the implementation process. The level of collaboration among the U.S. DOE, USDA, and other Federal agencies on biobased products and bioenergy has begun to increase since the Executive Order, including, for example, the

recent submission of a U.S. DOE-USDA enhanced budget request for fiscal year 2001. The Interagency Council on Biobased Products and Bioenergy held its first meeting on January 21, 2000.

The vision and roadmap processes, in addition to several other recent studies and planning documents, have led to the development of many options, concepts, potential tax code modifications, policy proposals, and RD&D programs that could be implemented in fiscal year 2001 and beyond to achieve the goals of the Executive Order. The relative merits of all of these suggestions are being evaluated to determine their economic, energy, and environmental impacts in achieving the goals of the Executive Order. The results of these assessments will be provided to the Interagency Council and the Advisory Committee and will be used in the vision and roadmap process. Recommendations on technical directions and priorities will be presented in the first Strategic Plan.

10. ACRONYM LIST

Acronym	Name
ARS	Agricultural Research Service
BPCC	Biobased Products Coordination Council
BPL	Biobased Products List
CCC	Commodity Credit Corporation
CHP	Combined Heat and Power
CSREES	The Cooperative State, Research, Education and Extension Service
EPA	U.S. Environmental Protection Agency
FEE	Federal Environmental Executive
FS	The Forest Service
GMO	Genetically Modified Organisms
GSA	General Services Administration
IGCC	Integrated Gasification Combined-Cycle
NRCS	The Natural Resources Conservation Service
NSF	National Science Foundation
NSPS	New Source Performance Standards
OEPNU	The Office of Energy Policy and New Uses
OSEC	Office of the Secretary
RC&D	Resource Conservation and Development
RD	Rural Development
RMA	Risk Management Agency
R&D	Research and Development
U.S. DOE	U.S. Department of Energy
USDA	U.S. Department of Agriculture
USPS	U.S. Postal Service
XL	Excellence and Leadership

Appendix A

Executive Order 13134 and Executive Memorandum

THE WHITE HOUSE

Office of the Press Secretary

For Immediate Release August 12, 1999

EXECUTIVE ORDER

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DEVELOPING AND PROMOTING BIOBASED PRODUCTS AND BIOENERGY

By the authority vested in me as President by the Constitution and the laws of the United States of America, including the Federal Advisory Committee Act, as amended (5 U.S.C. App.), and in order to stimulate the creation and early adoption of technologies needed to make biobased products and bioenergy cost-competitive in large national and international markets, it is hereby ordered as follows:

Section 1. Policy. Current biobased product and bioenergy technology has the potential to make renewable farm and forestry resources major sources of affordable electricity, fuel, chemicals, pharmaceuticals, and other materials. Technical advances in these areas can create an expanding array of exciting new business and employment opportunities for farmers, foresters, ranchers, and other businesses in rural America. These technologies can create new markets for farm and forest waste products, new economic opportunities for underused land, and new value-added business opportunities. They also have the potential to reduce our Nation's dependence on foreign oil, improve air quality, water quality, and flood control, decrease erosion, and help minimize net production of greenhouse gases. It is the policy of this Administration, therefore, to develop a comprehensive national strategy, including research, development, and private sector incentives, to stimulate the creation and early adoption of technologies needed to make biobased products and bioenergy cost-competitive in large national and international markets.

Sec. 2. Establishment of the Interagency Council on Biobased Products and Bioenergy.(a) There is established the Interagency Council on Biobased Products and Bioenergy (the "Council"). The Council shall be composed of the Secretaries of Agriculture, Commerce, Energy, and the Interior, the Administrator of the Environmental Protection Agency, the Director of the Office of Management and Budget, the Assistant to the President for Science and Technology, the Director of the National Science Foundation, the Federal Environmental Executive, and the heads of other relevant agencies as may be determined by the Co-Chairs of the Council. Members may serve on the Council through designees. Designees shall be senior officials who report directly to the agency head (Assistant Secretary or equivalent).

(b) The Secretary of Agriculture and the Secretary of Energy shall serve as Co-Chairs of the Council.

(c) The Council shall prepare annually a strategic plan for the President outlining overall national goals in the development and use of biobased products and bioenergy in an environmentally sound manner and how these goals can best be achieved through Federal programs and integrated planning. The goals shall include promoting national economic growth with specific attention to rural economic interests, energy security, and environmental sustainability and protection. These strategic plans shall be compatible with the national goal of producing safe and affordable supplies of food,

feed, and fiber in a way that is sustainable and protects the environment, and shall include measurable objectives. Specifically, these strategic plans shall cover the following areas:

(1) biobased products, including commercial and industrial chemicals, pharmaceuticals, products with large carbon sequestering capacity, and other materials; and

(2) biomass used in the production of energy (electricity; liquid, solid, and gaseous fuels; and heat).

(d) To ensure that the United States takes full advantage of the potential economic and environmental benefits of bio-energy, these strategic plans shall be based on analyses of: (1) the economic impacts of expanded biomass production and use; and (2) the impacts on national environmental objectives, including reducing greenhouse gas emissions. Specifically, these plans shall include:

(1) a description of priorities for research, development, demonstration, and other investments in biobased products and bioenergy;

(2) a coordinated Federal program of research, building on the research budgets of each participating agency; and

(3) proposals for using existing agency authorities to encourage the adoption and use of biobased products and bioenergy and recommended legislation for modifying these authorities or creating new authorities if needed.

(e) The first annual strategic plan shall be submitted to the President within 8 months from the date of this order.

(f) The Council shall coordinate its activities with actions called for in all relevant Executive orders and shall not be in conflict with proposals advocated by other Executive orders.

Sec. 3. Establishment of Advisory Committee on Biobased Products and Bioenergy. (a) The Secretary of Energy shall establish an "Advisory Committee on Biobased Products and Bioenergy" ("Committee"), under the Federal Advisory Committee Act, as amended (5 U.S.C. App.), to provide information and advice for consideration by the Council. The Secretary of Energy shall, in consultation with other members of the Council, appoint up to 20 members of the advisory committee representing stakeholders including representatives from the farm, forestry, chemical manufacturing and other businesses, energy companies, electric utilities, environmental organizations, conservation organizations, the university research community, and other critical sectors. The Secretary of Energy shall designate Co-Chairs from among the members of the Committee.

(b) Among other things, the Committee shall provide the Council with an independent assessment of:

(1) the goals established by the Federal agencies for developing and promoting biobased products and bioenergy;

(2) the balance of proposed research and development activities;

(3) the effectiveness of programs designed to encourage adoption and use of biobased products and bioenergy; and

(4) the environmental and economic consequences of biobased products and bioenergy use.

Sec. 4. Administration of the Advisory Committee. (a) To the extent permitted by law and subject to the availability of appropriations, the Department of Energy shall serve as the secretariat for, and provide the financial and administrative support to, the Committee.

(b) The heads of agencies shall, to the extent permitted by law, provide to the Committee such information as it may reasonably require for the purpose of carrying out its functions.

(c) The Committee Co-Chairs may, from time to time, invite experts to submit information to the Committee and may form subcommittees or working groups within the Committee to review specific issues.

Sec. 5. Duties of the Departments of Agriculture and Energy. The Secretaries of the Departments of Agriculture and Energy, to the extent permitted by law and subject to the availability of appropriations, shall each establish a working group on biobased products and biobased activities in their respective Departments. Consistent with the Federal biobased products and bioenergy strategic plans described in sections 2(c) and (d) of this order, the working groups shall:

(1) provide strategic planning and policy advice on the Department's research, development, and commercialization of biobased products and bioenergy; and

(2) identify research activities and demonstration projects to address new opportunities in the areas of biomass production, biobased product and bioenergy production, and related fundamental research.

The chair of each Department's working group shall be a senior official who reports directly to the agency head. If the Secretary of Agriculture or Energy serves on the Interagency Council on Biobased Products and Bioenergy through a designee, the designee should be the chair of the Department's working group.

Sec. 6. Establishment of a National Biobased Products and Bioenergy Coordination Office. Within 120 days of this order, the Secretaries of Agriculture and Energy shall establish a joint National Biobased Products and Bioenergy Coordination Office ("Office") to ensure effective day-to-day coordination of actions designed to implement the strategic plans and guidance provided by the Council and respond to recommendations made by the Committee. All agencies represented on the Council, or that have capabilities and missions related to the work of the Council, shall be invited to participate in the operation of the Office. The Office shall:

(a) serve as an executive secretariat and support the work of the Council, as determined by the Council, including the coordination of multi-agency, integrated research, development, and demonstration ("RD&D") activities;

(b) use advanced communication and computational tools to facilitate research coordination and collaborative research by participating Federal and nonfederal research facilities and to perform activities in support of RD&D on biobased product and bioenergy development, including strategic planning, program analysis and evaluation, communications networking, information and data dissemination and technology transfer, and collaborative team building for RD&D projects; and

(c) facilitate use of new information technologies for rapid dissemination of information on biobased products and bioenergy to and among farm operators; agribusiness, chemical, forest products, energy, and other business sectors; the university community; and public interest groups that could benefit from timely and reliable information.

Sec. 7. Definitions. For the purposes of this order:

(a) The term "biomass" means any organic matter that is available on a renewable or recurring basis (excluding old-growth timber), including dedicated energy crops and trees, agricultural food and feed crop residues, aquatic plants, wood and wood residues, animal wastes, and other waste materials.

(b) The term "biobased product," as defined in Executive Order 13101, means a commercial or industrial product (other than food or feed) that utilizes biological products or renewable domestic agricultural (plant, animal, and marine) or forestry materials.

(c) The term "bioenergy" means biomass used in the production of energy (electricity; liquid, solid, and gaseous fuels; and heat).

(d) The term "old growth timber" means timber of a forest from the late successional stage of forest development. The forest contains live and dead trees of various sizes, species, composition, and age class structure. The age and structure of old growth varies significantly by forest type and from one biogeoclimatic zone to another.

Sec. 8. Judicial Review. This order does not create any enforceable rights against the United States, its agencies, its officers, or any person.

WILLIAM J. CLINTON

THE WHITE HOUSE,
August 12, 1999

THE WHITE HOUSE

Office of the Press Secretary

For Immediate Release August 12, 1999

August 12, 1999

MEMORANDUM FOR THE SECRETARY OF AGRICULTURE
THE SECRETARY OF ENERGY
THE SECRETARY OF THE TREASURY
THE ADMINISTRATOR OF THE ENVIRONMENTAL PROTECTION AGENCY

SUBJECT: Biobased Products and Bioenergy

Today I issued an Executive Order, "Developing and Promoting Biobased Products and Bioenergy," to further the development of a comprehensive national strategy that includes research, development, and private sector incentives to stimulate the creation and early adoption of technologies needed to make biobased products and bioenergy cost-competitive in national and international markets.

Consistent with the objectives and activities in that order and to ensure that the Nation moves efficiently to exploit the benefits of expanded use of biobased products and bioenergy, I hereby direct as follows:

(1) The Secretaries of Agriculture and Energy, in consultation with other appropriate agencies, shall, within 120 days of this memorandum, prepare a report outlining and assessing options for modifying existing respective agency programs in fiscal year 2001 to promote biobased products and bioenergy with a goal of tripling U.S. use of biobased products and bio-energy by 2010. Programs include, among others, conservation and utility programs within the Department of Agriculture (including the Conservation Reserve Program and the Environmental Quality Incentives Program); technology assistance and other small business programs; and education and extension programs. The report also shall include an assessment of: (a) the evidence to determine whether modifications to the tax code are a cost-effective policy option for review by the Department of the Treasury; and (b) the potential to expand use of biobased products and bioenergy by Federal agencies including co-firing with biomass at
Federal facilities, use of biofuels in Federal vehicles, and Federal procurement of biobased products and bioenergy. Such expanded use shall be consistent with agency opportunities and the President's budget.

(2) In preparing this report, the agencies shall:

(a) work closely with the Environmental Protection Agency to ensure that actions recommended reflect a careful review of the environmental benefits, concerns, and net

environmental consequences created by expanded use of biobased products and bioenergy. The factors considered should include:

(i) impact on net emissions of greenhouse gases including carbon sequestered by biomass crops, and substituting low net-carbon, biobased products, and bioenergy for products manufactured from fossil fuels; and

(ii) emissions of criteria pollutants and air toxics and other environmental consequences of production of biobased products and bioenergy; and

(iii) changes in water quality, soil erosion, pesticide and fertilizer use, and wildlife habitat as a consequence of changes in land use associated with biomass production;

and,

(b) consider the findings and recommendations of the recently released National Academy of Sciences report "Biobased Industrial Products;" the recommendations contained in "Technology Vision 2020: The U.S. Chemical Industry" by the American Chemical Society, American Institute of Chemical Engineers, Chemical Manufacturers Association, Council for Chemical Research, and the Synthetic Organic Chemical Manufacturers Association; the recommendations by the U.S. agricultural, forestry, and chemical communities from the "Plant/Crop-based Renewable Resources 2020: A Vision to Enhance U.S. Economic Security Through Renewable Plant/Crop-Based Resource Use;" and, "Agenda 2020" by the U.S. Forest Products Industry; and (c) consider input from other sources, including public-private strategic plans developed by the Departments of Agriculture and Energy, the Environmental Protection Agency, National Science Foundation, Department of the Interior, and other agencies bio-energy (power, fuels, and heat), commercial and industrial chemicals, and other products and materials.

(3) The Secretaries of Agriculture and Energy shall, within 120 days of this memorandum, report on outreach efforts to raise the Nation's awareness of the useful applications, benefits, and costs of producing bio-based products and bioenergy and adopting biobased technologies including workshops on new biomass crops and technologies for producing and marketing biobased products and bioenergy.

WILLIAM J. CLINTON

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APPENDIX B

Sugars Platform Example

The mission of the Biofuels Energy Systems - Transportation Program, managed by the Office of Energy Efficiency and Renewable Energy's Office of Transportation Technologies, is to research, develop, and demonstrate cost competitive technologies for the production of liquid fuels and co-products, in partnership with industry, other government organizations, academic institutions, and others. The recently issued executive order for biobased products and bioenergy provides an opportunity to accelerate the development of biomass hydrolysis technologies to enable the emergence of a cost competitive biofuels and chemicals industry within the next ten years. This industry will become the main contributor to the achievement of the Executive Order goal of tripling the use of biomass for biobased products and bioenergy.

Cellulose from biomass is the most common organic compound found in nature. It has been estimated that when sunlight is transformed to produce biomass via photosynthesis, it is capable of supplying more than 10 times the world's annual energy demand. The key challenge is how to grow, collect, and convert the biomass to useable energy forms and bio-products.

- **Biomass is a cheap source of carbon-based chemicals**. At oil prices ranging from $15/barrel to $35/barrel in 1990, delivered carbon costs 5.7 cents/lb to 13.4 cents/lb, while biomass feedstock costs ranging from $15/ton to $35/ton, yield delivered carbon costs of 1.5 cents/lb to 3.5 cents/lb.

- **Conversion costs are the key to cost savings.** The cost of carbon delivered in the form of fuel ethanol for the same feedstock prices is 7.7 cents/lb to 17.3 cents/lb for petroleum and a substantial higher 36.4 cents/lb to 54.5 cents/lb for biomass. Thus a priority of the Department of Energy's research program is the reduction of the cost of conversion.

- **Biomass sugars are valuable chemical intermediates and products.** At 17.7 cents/lb, the value of carbon in sugar, as utilized by today's sugar market, is significantly higher than the value of the delivered carbon in the fuels market, regardless of the feedstock from which it is derived.

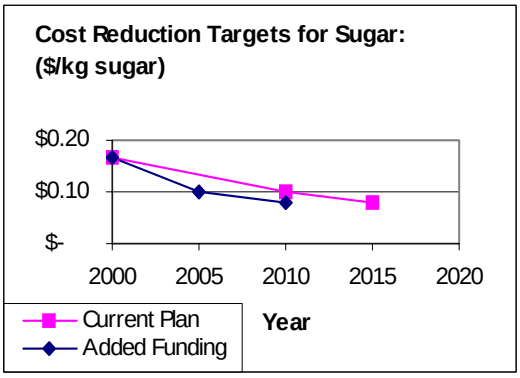
This Initiative will tackle the extremely difficult task of developing a suite of low-cost, highly reactive enzymes needed to produce low-cost sugars and energy/chemical products. It is important that industrial partners become integrally involved in this effort in order to increase the likelihood of successful commercialization of the technology. As a result of dialogues with a number of enzyme producers, it is evident that these companies are positioned to engage with DOE to cost-share enzyme development. These companies have indicated the need for a sustained funding commitment from DOE, as well as technical process development and pilot plant support from DOE's National Renewable Energy Laboratory.

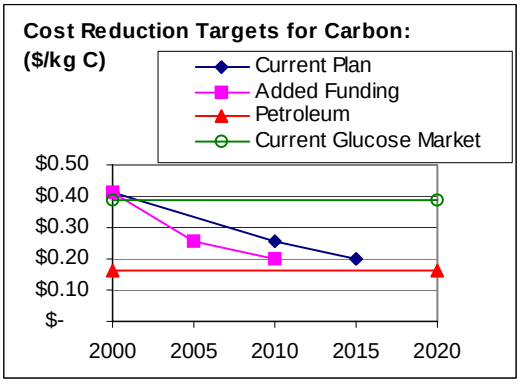
Tremendous capabilities exist in industrial enzyme companies that are not being applied to this problem. While the potential to move bioenergy forward is huge, the risk to these companies is too high for them to make such a substantial investment without Federal assistance. It is widely believed that the capabilities of these industrial labs, if applied to the challenge for 5-7 years, will produce the low cost, high performance cellulase enzymes needed for biomass hydrolysis processes. At currently planned funding levels, it will take at least 10 years to develop the improved enzymes as the research capabilities are being applied at a more limited rate. The increased level of funding will result in improved technology that is needed to reduce the cost of the core biomass hydrolysis process for the production of bioenergy products. Additional investment will be required for microorganism development, feedstock infrastructure development and lignin conversion technologies to achieve full benefits of the improvement in biomass hydrolysis technology. Both public and private investment will make up a part of the additional investments.

The two figures shown on this page summarize the changes in the timeline that can be realized, based on full funding. Note that the current timeline for reducing the cost of sugars is based on the "apparent" cost of sugars produced in the bioethanol process, as opposed to a process designed specifically for sugar production. The second figure puts these cost targets in the perspective of carbon costs as discussed previously. For reference, the value of carbon in petroleum and in corn-derived glucose are shown as horizontal lines at $0.16/kg and $0.39/kg. Under the accelerated target, biomass carbon in the form of sugar significantly undercuts the cost of corn-derived glucose as a carbon feedstock by 2005, while it approaches the cost of carbon in petroleum in 2010.

The advantage of the accelerated schedule should be clear. Under the new funding scenario, biomass hydrolysis technology will be available for commercial deployment as a highly competitive means of producing sugars. Industry will be motivated to scale up and use this technology. Even as the technology begins to establish a commercial track record, continued research will bring the cost down even further, at which point the technology will be well poised for competing in the fuel market.

Achievement of the biomass hydrolysis research and development will lower the cost of biomass sugars to less than 4 cents per pound. Increase in demand for the sugars and products will be huge. Additionally large oxychemical markets would be opened for sugar derivatives. At less than 4 cents per pound the sugar would be economically converted to ethylene and butadiene. Almost 200 billion pounds of sugar per year would be consumed on a worldwide basis for production of these two chemicals. Additional chemical manufacture could demand more than 20 billion pounds of sugar per year. The use of low-cost sugars will be limited only by biomass availability with more than 300 million tons per year available in the United States for less than $50/ton. This is equivalent to more than 400 billion pounds of sugar per year. The energy content of 400 billion pounds of sugar products exceeds 2.5 quads.





Appendix C

Product Demonstration and Commercialization

Goal: Establish the Federal Government, through Executive Orders 13101 and 13134, as the market catalyst for world-wide adoption of biobased products.

Activities: The Federal Government plays a critical role in facilitating the market's acceptance of biobased products. Because of the unfamiliar and unproven nature of biobased technologies, and the relatively high risk and low return attributed to their commercialization in the private sector, public sector leadership is needed to demonstrate the feasibility and cost-effectiveness of these products in the market place. Innovative demonstration and commercialization efforts, coupled with the Federal Government's procurement power (E.O. 13101), are needed to pull these products out of the laboratory and into the marketplace. Examples of Federal commercialization assistance included in this funding proposal are:

- equity, debt, and grant financing to support patent and related intellectual property protection costs, product development and optimization research, commercial-scale demonstration of laboratory prototypes, product performance verification and certification testing, marketing and market penetration activities, start-up seed and working capital.

- affirmative Federal procurement action (E.O. 13101) to help achieve economies of scale in bioproducts manufacturing and spur market recognition and acceptance of biobased products.

Bioproducts suitable for commercialization assistance include:

- Absorbents/Adsorbents
- Adhesives/Inks/Coatings
- Alternative Fuels and Fuel Additives
- Construction Materials/Composites
- Lubricants/Functional Fluids
- Renewable Alternative Fiber Papers/Packaging
- Solvents/Cleaners/Surfactants
- Plant-Based Plastics/Degradable Polymers/Films
- Landscaping Products
- Bioremediation Products
- New Fibers/Filler/Yarn/Insulation
- Enzymes/Intermediate Chemicals
- Renewable Power from Biomass

Since 1993, approximately $47 million has been spent by the Federal Government to help bring these products to market. Several are in the marketplace already, with many others in the advanced stages of performance evaluation and testing.

Targeted Outcomes

By FY 2005 --

- Support approximately 50 new businesses with seed capital and other forms of early-stage commercialization assistance.
- Leverage $40 million in Federal funds with $120 million of private investment capital.
- Develop and codify performance standards and specifications which govern Federal purchases of bioproducts and bioenergy.

- Obtain General Services Administration (GSA) procurement stock numbers for approximately 50 new bioproducts.

Three examples of commercialization activities in these product areas already underway with Federal support include:

Compressed wheat- and soy-straw fiberboard -- USDA's current venture capital commercialization program was an early investor in a Minnesota-based strawboard manufacturer which operates as a joint venture between the owner of its patented manufacturing process and a 1,300 member farmer cooperative. The company's products compete as a lighter-weight, higher-strength alternative to traditional wood or wood-composite products used in furniture, cabinet shelving, doors, underlayment, and laminate flooring. A $30 million strawboard manufacturing facility opened in July 1999 and already, 70 percent of the plant's 40 million board feet production capacity is sold or otherwise under contract to customers. Industry-wide, composite panel sales reached $14.6 billion in 1997 and have averaged 7 percent growth over each of the last three years. The company has generated 65 new manufacturing jobs and will consume approximately 91,000 tons of wheat and soy straw annually. USDA's $3 million investment has spurred an additional $20 million in private debt and equity financing for the company. Funds are needed to provide loan guarantees and similar financing for the construction of additional manufacturing plants.

Bioplastics – Bioplastics represent a category of biobased products with significant, yet unrealized potential. Ten pounds of corn, for example, yields 6.5 pounds of bioplastic. Currently, there is no commercial domestic production of biobased plastics such as bags, plates, cups, etc., that are price competitive with petroleum-based counterparts. With appropriate promotion efforts, such as those administered by USDA's Foreign Agricultural Service, worldwide adoption of bioplastics as a replacement for traditional, petroleum-based plastics could reach 50 million metric tons annually by 2010. At that point, bioplastics will use approximately 77 million metric tons of feeds grains and will achieve $100 billion in sales. Funds are needed to help optimize the production process and demonstrate uniform product quality and an ability to manufacture in commercial volumes.

Vegetable oil-based lubricants -- Vegetable oil based oils and fluids are already commercially available for a variety of applications, including hydraulic fluids, chain saw bar oils, fuel additives, greases. Other formulations are still in the research and development phase, including automotive motor oils. As new feedstocks, such as genetically modified oils, are developed, a broader range of products that meet rigorous performance standards will become available. One commercially available hydraulic fluid is expected to utilize up to 40 million bushels of soybeans annually as demand for non-hazardous lubricants increases. Currently, this oil is two- to three- times more expensive than its petroleum counterpart, but will achieve cost competitiveness with high-volume scale-up. Funds are needed to help optimize the production process, demonstrate uniform product quality and an ability to manufacture in commercial volumes, and for the research and development of new product formulations.

Appendix D

Literature Summary of Documents Cited in Executive Order 13134

Literature Summary

DRAFT

Documents cited in Executive Order 13134, its accompanying memorandum to appropriate agency heads, and the press release All dated August 12, 1999

INTRODUCTION

The following table lists the published documents cited in one of the following three documents mentioned in the Executive Memorandum, but not cited, were strategic plans from different agencies some of which are available such as the USDA's "Strategic Plan for Biobased Products" written by the USDA Biobased Products Coordination Council, June 1999; DOE *Biomass Power* Program - Strategic Plan 1996-2015 produced by DOE EE's Office of Power Technologies; and the Bioethanol Strategic Roadmap - A planning framework for development of biomass- to- ethanol technology (Draft -1999) produced by DOE's Office of Transportation Technologies.

In addition, other reports of relevance include the PCAST 1997 and 1999 reports, the five and eleven lab studies conducted in 1997, presentations by other DOE and USDA offices, organizations that promote the tenents of the Executive Order and have published visions, roadmaps and strategies (not called out in the EO language), published reports that are relevant, and web pages containing information relevant to the EO.

Table 1 contains the full citation of the reports with reference information. Table 2 contains a brief summary of the major conclusions or highlights from the executive summaries or bodies of the reports cited above, any specific goals and objectives which are presented in support of their strategic efforts; and expected outcomes or implications, if any. These are presented in tabular form to allow for comparison.

Table 3 lists the other referenced, but not cited, documents for which relevant information is available relating to the EO. Table 4 provides a brief summary of the documents and their conclusions or recommendations. References to other relevant documents are also provided.

Document (all dated August 12, 1999)	Citations therein	Brief description of citation
Presidential Executive Order 13134	None (0)	
Memorandum to Secretaries of Agriculture, Energy, Treasury and the Administrator of the Environmental Protection Agency	Four (4)	• NAS Study on Biobased Industrial Products • Chemical Technology Vision 2020 • Plant/Crop-Based Vision 2020 for Agriculture • Agenda 2020 Forest Products Industry Vision
Press Release from Office of Press Secretary	One (1)	• PCAST 99 Powerful Partnerships

GENERAL SUMMARY

The general message conveyed by these documents can be summarized as:

- There is a sufficient supply of biomass materials to provide food, feed, fiber and energy, fuels and materials. The precise availability and impact varies.

- Several drivers provide impetus to undertaking a bioenergy and biobased products effort. These include emerging market opportunities, increased rural development needs, reducing environmental impacts, increasing energy security, reducing fossil carbon emissions, and meeting the growing need for energy and materials with sustainable technologies.

- Bioenergy and biobased products are generally emerging industries. Because of the nascent nature of these efforts, a large emphasis on research, development and deployment is needed.

- Technology development is proceeding in several emerging areas for bioenergy and biobased products. Accelerated development in the United States could result in companies that can be competitive in both national and international markets. The growth of many developing countries' markets is significant where biomass resources and energy needs occur simultaneously (electricity is key in developing countries). Technology export opportunities abound as well as for the development of businesses and collaborative ventures.

- There is no single agency, industry, or sector that can meet the challenges and needs to accomplish these aggressive goals on their own. All of these studies call for integrated efforts across federal agencies, industrial sectors, academia, national laboratories, non-profit organizations, professional societies, public interest groups and others.

DOCUMENTATION AND SUMMARIES

TABLE 1 - References cited in Executive Order 13134 and accompanying memorandum and press release - August 12,1999 with its full title and a reference either for hard copy versions or those sites posted on websites (which are generally posted as PDF files).[1]

Title	Reference
Biobased Industrial Products: Research and Commercialization Priorities (1999)	Only available now on the web at the National Academy Press, Nap.edu. Web address: http://books.nap.edu/books/0309053927/html/1.html
Technology Vision 2020: The U.S. Chemical Industry (1996)	Copies available from the American Chemical Society, 202 452-8917; http://www.acs.org. In addition, pdf versions are available from either of these two sites: www.ccrhq.org/vision/index.html or www.oit.doe.gov/chemicals/page10.html
Plant/Crop-Based Renewable Resources 2020: A vision to enhance U.S. economic security through renewable plant/crop-based renewable resource use (1998) **The Technology Roadmap for Plant/Crop-Based Renewable Resources 2020:** ***Research priorities for fulfilling a vision to enhance U.S. economic security through renewable plant/crop-based renewable resource use*** **(1999)**	Reference: DOE/GO-10098-385. Available as printed copies by calling (800) 363-EREC. Web sites are www.oit.doe.gov/agriculture/ or from National Corn Grower's Association site http://ncga.com/05newmarkets/main/index.html Reference: DOE/GO-10099-706. Available as printed copies by calling (800) 363-EREC. Web site is www.oit.doe.gov/agriculture/
Agenda 2020: A Technology Vision and Research Agenda for America's Forest, Wood, and Paper Industry (1994) **Agenda 2020: The Path Forward - An Implementation Plan (1999)**	Available on the web as pdf files at http://www.afandpa.org/Environmental/Agenda2020/ http://www.oit.doe.gov/forest/
Powerful Partnerships - The Federal Role in International Cooperation on Energy Innovation - June 1999	President's Committee of Advisors on Science and Technology - Panel on International Cooperation in Energy Research, Development, Demonstration, and Deployment. Paper copies of all unclassified reports may be obtained from the PCAST Executive Secretary Office (Email: Information@ostp.eop.gov or 202-456-6100; FAX 202-456-6026) http://www.whitehouse.gov/WH/EOP/OSTP/html/OSTP_Home.html

[1] Some cited documents cover topics much broader than biobased renewables. Bioenergy and biobased products are an integral part of the overall strategy. Hence, extraction of information is limited to topics germane to Executive Order 13134.

TABLE 2 - Summary of important points in documents cited in EO 13134, memorandum, and press release. Some items are quoted verbatim, and others are paraphrased to allow inclusion in this summary.

Report	Major Highlights or Conclusions relative to EO 13134	Goals and Objectives	Expected Recommendations or Outcomes
National Academy of Sciences - Biobased Industrial Products: Research and Commercialization Priorities	<u>Raw material resource base:</u> By-products of agriculture could provide up to 10 percent of liquid transportation fuel needs. Only 7 percent of the nation's corn production is used for industrial products and ethanol. The range of possible products is very large and is slowly increasing every year. Some concrete efforts by the Federal Government have been directed towards using biobased resources such as the USDA AARC program, federally funded laboratories and private, non-profit organizations. <u>Processing Technologies</u> Expansion of biobased industrial production in the U.S. will require an overall scale-up of manufacturing capabilities, diversification of processing technologies, and cost reduction. Biorefineries can produce food, feed, fiber, and chemicals and fuels (e.g. corn wet mills and pulp and paper mills). Research on the underlying production processes is needed on the science and engineering necessary to reduce the most significant cost barriers to commercialization.	The NAS committee proposed the following intermediate and long-term targets for the biobased products industry: ▸ By the year 2020, provide at least 25 percent of 1994 levels of organic carbon-based industrial feedstock chemicals and 10 percent of liquid fuels from a biobased products industry ▸ Eventually satisfy over 90 percent of U.S. organic chemical consumption and up to 50 percent of the liquid fuel needs with biobased products; and ▸ Form the basis for U.S. leadership of the global transition to biobased products and potential environmental benefits. These targets are based on estimates of available feedstocks and assumes technological advances are in place to improve the suitability of raw materials and economics of the conversion process. The implementation will be a function of investment by the private sector.	These reports are produced to provide a state-of-the-art review of the topic and recommendations for federal agencies to employ in designing their programs and efforts. Hence the expected outcome of these studies will be recommendations. The committee made two sets of recommendations. One for biology and one for engineering. Generally the biology recommendations suggested increased science in the areas of plants and designing plants for ease of conversion, of protein engineering for biocatalyst development, and of maximizing plant productivity. In engineering the recommendations involved research in designing equipment including handling of solids, reducing costs of processing biomass, improved fermentation and downstream processing technologies.

TABLE 2 - Summary of important points in documents cited in EO 13134, memorandum, and press release. Some items are quoted verbatim, and others are paraphrased to allow inclusion in this summary.

Report	Major Highlights or Conclusions relative to EO 13134	Goals and Objectives	Expected Recommendations or Outcomes
Technology Vision 2020: The U.S. Chemical Industry	This industry must employ technology to address five major issues in the industry: ▸ Increasing Globalization ▸ Sustainability ▸ Financial Performance ▸ Customer Expectations ▸ Changing Work Force Requirements	The chemical industry must: ▸ Improve efficiency in the use of raw materials, reuse of recycled materials, and the generation and use of energy; ▸ Continue to play a leadership role in balancing environmental and economic considerations; ▸ Aggressively commit to longer term investments in R&D; and ▸ Balance investments in technology by leveraging the capabilities of government, academe, and the chemical industry as a whole through targeted collaborative efforts in R&D. Technical recommendations include four technology areas. Key for biobased products and bioenergy is New Chemical Sciences and Engineering: chemical synthesis, bioprocesses and biotechnology, materials, and the enabling technologies of process science and engineering, chemical measurement, and computational technologies.	The U.S. chemical industry expects that the following should occur in meeting its goals. ▸ Generation and use of new knowledge ▸ Ability to capitalize on information technology ▸ Encouragement of the elimination of barriers ▸ Improved legislative and regulatory climate ▸ Improved logistics efficiencies ▸ Increased agility in manufacturing ▸ Harmonized standards ▸ Creation of partnering momentum ▸ Educational improvements

TABLE 2 - Summary of important points in documents cited in EO 13134, memorandum, and press release. Some items are quoted verbatim, and others are paraphrased to allow inclusion in this summary.

Report	Major Highlights or Conclusions relative to EO 13134	Goals and Objectives	Expected Recommendations or Outcomes
Plant/Crop-Based Renewable Resources Vision and Technology Roadmap	The "Vision" is to provide continued economic growth, healthy standards of living, and strong national security through the development of plant/crop-based renewable resources that are a viable alternative to the current dependence on nonrenewable, diminishing fossil resources. ▸ Renewables are not competing directly with non renewables - this is not a competitive replacement strategy ▸ Both renewable resources and nonrenewable resources will be needed to meet the demands in the 20-year timeframe	Directional targets for success include achieving ▸ 10 percent of basic building chemical blocks arising from plant-derived renewables by 2020 - a five-fold increase; and, ▸ Development concepts in place by then to achieve a further increase to 50 percent by 2050	▸ The future utilization of renewable resources will require a multi-disciplinary, cross-industry approach. ▸ Progress in single isolated technical areas will not be sufficient. ▸ It is not likely that one organization can provide the depth and breadth of research skills needed for overall needs.

TABLE 2 - Summary of important points in documents cited in EO 13134, memorandum, and press release. Some items are quoted verbatim, and others are paraphrased to allow inclusion in this summary.

Report	Major Highlights or Conclusions relative to EO 13134	Goals and Objectives	Expected Recommendations or Outcomes
Agenda 2020: A Technology Vision and Research Agenda for America's Forest, Wood and Paper Industry & The Path Forward - An implementation	The principal mission of Agenda 2020 is to maximize the efficiency and effectiveness by which the industry executes pre-competitive collaborative research and to ensure that programs that are undertaken are properly focused on the issues which address the industry's most pressing needs. The basis for research planning is Agenda 2020 and its six area task groups: wood fiber supply (sustainable forestry), environmental performance, energy performance, recycling, capital effectiveness, and sensors and controls.	Each of the six areas has developed its own detailed vision of the technology gaps and prioritized, high-impact research program to meet the technology gaps. The Agenda 2020 has sought to build the collaborative relationships between the industry, its suppliers, academe, the government and its laboratories to meet the needs of the industry. Since this industry is over 50 percent energy self-sufficient, it can serve as one of the models for a biorefinery concept or for an integrated industry in coproducing energy as well as wood and fiber products.	Some expected outcomes include: ▸ Significant gains in wood fiber supply and long-term soil productivity ▸ Economically attractive processes that are based on good science, minimize waste, and provide global competitiveness ▸ Maximum use of forest resources for fiber, reduce use of fossil fuels, minimize impact on environment, and develop successful partnerships with energy providers ▸ Improved global competitiveness through use of modern technologies in manufacturing ▸ Lower energy costs in paper recycling, minimize environmental impacts, better relationships between industry, academe, and laboratories. ▸ Better sensors and controls technology to increase energy efficiency, improve product control, enhance manufacturing processes, and increase worker safety.

TABLE 2 - Summary of important points in documents cited in EO 13134, memorandum, and press release. Some items are quoted verbatim, and others are paraphrased to allow inclusion in this summary.

Report	Major Highlights or Conclusions relative to EO 13134	Goals and Objectives	Expected Recommendations or Outcomes
Powerful Partnerships - The Federal Role in International Cooperation on Energy Innovation	Bioenergy comprises about 3.8 percent of the energy sources in the U.S. and ranks 5th out of 6 energy sources ahead only of hydroelectric. In the world, bioenergy is the fourth leading source of energy and in some countries, bioenergy comprises between 20-50 percent of their energy resources. Bioenergy possesses its own suite of environmental impacts and effects that could be alleviated with more advanced technologies. Integrated systems for energy production are needed.	Under their suggestions for initiatives is one that falls under the category of international cooperation for innovation on energy-supply technologies. It calls for widespread renewables clusters that are aimed at accelerating the development and deployment of biomass, wind, photovoltaic, solar thermal, and other renewable energy technologies ... so that in the second quarter of the 21st century renewables could make contributions to world energy supply comparable to the contributions from fossil fuels today. Specifically related to bioenergy and biobased products, the report suggests that collaborative RD^3 on industrial-scale biomass energy conversion technologies be promoted and emphasize those that provide co-products (heat, fluid fuels, chemicals, food, fiber), as well as collaborative research on the restoration of degraded lands and their use for growing corps optimized to yield multiple products.	Funding in this area on the order of $40M above current agency or PCAST 97 levels by 2001 and $80M by 2005.

TABLE 3 - Referenced, but not cited, documents for which relevant information is available relating to Executive Order 13134 and the accompanying memorandum and press release - August 12,1999.

Title	Reference
Report to the President on Federal Energy Research and Development for the Challenges of the Twenty-First Century Nov, 1997	Paper copies of all unclassified reports may be obtained from the PCAST Executive Secretary Office (Email: Information@ostp.eop.gov or 202-456-6100; FAX 202-456-6026)
USDA Strategic Plan for Biobased Products, June 1999	Prepared by the USDA's Biobased Products Coordination Council, Chair - I. Miley Gonzalez, Under Secretary Research, Education and Economics
Vision for Agricultural Research and Development in the 21st Century	National Agricultural Biotechnology Council - NABC (Consortium of 27 not-for-profit agricultural/life science teaching and/or research institutions in Canada and the USA - Represents majority of state/provincial, not-for-profit Ag research - Composed of top administrators of member institutions)
A Vision for Bioenergy: Growing an Integrated Industry **Growing an Industry: Overview of DOE's Bioenergy Activities and Proposed Plan of Action** (PDF files)	Dan Reicher, Assistant Secretary for Energy Efficiency and Renewable Energy, U.S. DOE http://www.eren.doe.gov/bioenergy_initiative/page3.html
10 Point Action Plan **Bioenergy 2020 - Growing Energy to Power America** **A National Partnership for an Integrated Biomass Industry**	www.eren.doe.gov/bioenergy_initiative/page10.html
Bioethanol Strategic Roadmap: A planning framework for development of biomass-to-ethanol technology (1999) **Bioethanol Multi-Year Technical Plan Fiscal year 2000 and beyond**	Preliminary draft, October 1999, prepared by The National Renewable Energy Laboratory for The Office of Fuels Development, U.S. Department of Energy Preliminary draft, July 6, 1999, Prepared by The National Renewable Energy Laboratory for The Office of Fuels Development, U.S. Department of Energy
Office of Fuels Development Web page	Office of Transportation within DOE's Energy Efficiency and Renewable Energy Office http://www.ott.doe.gov/ofd/
DOE *Biomass Power* Program - Strategic Plan 1996-2015 (1996)	DOE/GO-10096-345, DE97000081. Copies may be available from (800) 363-EREC. Additional information and reports can be obtained from the following web address: http://www.eren.doe.gov/biopower/on_line.html

TABLE 3 - Referenced, but not cited, documents for which relevant information is available relating to Executive Order 13134 and the accompanying memorandum and press release - August 12,1999.

Title	Reference
BioPower Program Reports and Information	BioPower Program at the Office of Power Technologies, Energy Efficiency and Renewable Energy - DOE http://www.eren.doe.gov/biopower/on_line.html
Technology Opportunities to Reduce U.S. Greenhouse Gas Emissions (October, 1997 - *commonly referred to as the 11 Lab study)*	Prepared by National Laboratory Directors for the U.S. Department of Energy. On the web at http://www.ornl.gov/climate_change
Scenarios of U.S. Carbon Reductions - Potential Impacts of Energy Technologies by 2010 and Beyond (1997 - *commonly referred to as the 5 Lab study*)	Prepared by the Interlaboratory Working Group on Energy-Efficient and Low-Carbon Technologies www.eren.doe.gov/carbonstudy/
Crops and Plant Systems Research Priorities for the 21st Century	Coalition for Research on Plant Systems (CROPS'99)(American Society of Agronomy lead effort for which an exact reference wasn't available)
Farm Animal Integrated Research Vision (FAIR 2002)	Coalition for Research on Animal Systems analogous to the CROPS '99 group
National Corn Genome Initiative	Coalition of National Corn Growers Association, Corn Refiners Association, farmers groups and agribusiness interests in promoting the development of a federally funded program in sequencing the corn genome. This has resulted in a more concerted effort in sequencing this grain genome by federal funding agencies.

TABLE 4 - Summaries of the referenced, but not cited, documents found in Table 3

Document or Organization	General Summary and Important Points
Report to the President on Federal Energy Research and Development for the Challenges of the Twenty-First Century Nov. 1997	**Federal role in RET - Renewable Energy Technologies** Private investment as a percentage of revenues is higher than the norm for other energy companies. However, the federal role is also greater for RETs than other energy technologies because the industry is embryonic. "The links among fundamental research, applied R&D, and demonstration and commercialization activities are best forged through industry/national laboratory/university partnerships." **Proposed activities** *Biomass fuels* - Double number of energy crop species under development; develop crop harvest, handling, storage systems. Stimulate fundamental research on perennial species with co-support from DOE Office of Science at up to $2M. Develop integrated power/ethanol plant with the following goals: ethanol at $0.50/gallon, power at $0.04/kWh, produce 28 billion gallons of ethanol per year and develop 36 gigawatts of capacity by 2020. Office of Science to co-support key fundamental research efforts relating to ethanol production at up to $5M level. Launch modest program to produce biofuels from synthesis gas. *Biomass power* - Develop biomass and materials handling; IGCC or integrated gasification combined cycle technology; biogasification-fuel cells; small-scale gasification-stirling engine or other analogous system; cofiring with coal; and other systems with associated cost-shared precommercial demonstrations. Goal of 6 gigawatts in pulp and paper industry by 2010; 25 gigawatt cofiring by 2030. Integrated power/ethanol plants. Cofiring to be cost-shared with DOE fossil fuel program. *Hydrogen* - Launch Initiative with DOE Fossil Energy program on innovative hydrogen production from fossil fuels combined with sequestration and with the Biofuels program on hydrogen production from biomass - additional budget for hydrogen research ramping up to $15M/year, consisting of comparable contributions from the biofuels program, fossil energy program, and Office of Science. *Resource Assessment* - Integrated resource assessment across biomass, hydro, geothermal, solar, wind, and CAES; further develop geographic information systems; develop advanced resource mapping tools and techniques. Systematically extend resource assessment studies to developing countries. *Analysis* - Strengthen program foci on and conduct systematic analyses of technologies.

TABLE 4 - Summaries of the referenced, but not cited, documents found in Table 3

Document or Organization	General Summary and Important Points
USDA Strategic Plan for Biobased Products, June 1999	The biobased products coordination council has a goal to carry out programs to increase the domestic research, development and commercialization of biobased industrial and commercial products. In the next five years their strategic plan is to use the following objectives to guide their efforts: ▸ Provide USDA leadership in the Federal Government for increasing research, development, and commercialization of biobased products ▸ Increase USDA's commitment to biobased products ▸ Educate policy makers and the public on the advantages of biobased products The strategy outlines long-term outcome measures and specific strategies for each of these objectives. A general description of these includes the following: ▸ Increased involvement with other agencies and inter government committees on matters relating to biobased products, specifically DOE, EPA. NSF, and FEE ▸ Craft budgets and proposed budgets that support R&D in biobased products ▸ Increase purchase of biobased products by Federal Government ▸ Conduct outreach to educate the public and other federal agencies on the value of employing biobased products in procurement actions
Vision for Agricultural Research and Development in the 21st Century	Biobased products will provide security and sustainability in Food, Health, Energy, Environment, and Economy Targets for 2020 (relative to now) Liquid fuels from 1-10 percent Organic Chemicals from 10-25 percent Materials from 90-95 percent

TABLE 4 - Summaries of the referenced, but not cited, documents found in Table 3

Document or Organization	General Summary and Important Points
A Vision for Bioenergy: Growing an Integrated Industry Growing an Industry: Overview of DOE's Bioenergy Activities and Proposed Plan of Action 10 Point Action Plan Bioenergy 2020 - Growing Energy to Power America: A National Partnership for an Integrated Biomass Industry	Presentations made by Deputy Assistant Secretary Dan Reicher about his office's Bioenergy Initiative Drivers: Energy security, economic competitiveness, environmental quality, electricity restructuring, climate change. Goals for biomass power, transportation fuels, waste into energy, bio-based products, and forest products were laid out. A need for improved integration is cited and the key government players outlined including DOE, USDA, Treasury, NIH, EOA, NSF, Commerce, Interior, and State departments. Development of an industry-government vision has been started
Bioethanol Strategic Roadmap: A planning framework for development of biomass-to-ethanol technology (1999) Bioethanol Multi-Year Technical Plan Fiscal year 2000 and beyond	Factors influencing technology development: *National security* - energy diversity & economic security. *The Environment* - Air pollution, sustainable development, climate change *The Market* - Alternative fuel & additives market, ethanol selling price and tax incentives Technology platforms Concentrated Acid Hydrolysis Dilute Sulfuric Acid Enzymatic Hydrolysis Fermentation - a key component for all technology platforms Technology pathways driven by cost drivers for reducing conversion processing costs to competitive levels

TABLE 4 - Summaries of the referenced, but not cited, documents found in Table 3

Document or Organization	General Summary and Important Points
DOE *Biomass Power* Program - Strategic Plan 1996-2015 (1996**)**	Mission - To expand domestic and global markets for renewable electricity from sustainable resources by fostering partnerships with U.S. industry, agriculture and forestry. Will encourage the highest standards of stewardship of our air, water, and soil resources, with improved biological diversity, while providing strong economic and environmental benefits to society Twenty Year Vision - The integration of sustainable farms and forests with efficient biomass power production from dedicated feedstocks will be a major cost-competitive contributor to power supplies in both domestic and international markets. Collaborative partnerships between DOE and the private sector will facilitate the commercialization of a range of small-to large-scale systems, substantially revitalizing rural economies through the integrated development of biomass power and coproducts such as feed, fiber, or fuel.
Technology Opportunities to Reduce U.S. Greenhouse Gas Emissions (October, 1997 - *commonly referred to as the 11 Lab study)*	Forty-seven (47) pathways are described that have significant potential to reduce carbon dioxide emissions. The report claims that by 2030 a vigorous RD&D program could deliver a wide array of cost-effective technologies that together could reduce the nation's carbon emissions by 400-800 million metric tons of carbon (MtC) per year. Possible goals for an RD&D program are presented but only those relating to bioenergy and biobased products are noted here. <u>Energy Efficiency</u> ‣ Improve industrial resource recovery and use (e.g. develop an integrated gasification combined cycle power technology, which can convert coal, biomass, and municipal solid wastes into power and products) and industrial processes to save energy (e.g. advanced catalysis and separations technologies). <u>Clean Energy</u> ‣ Change the energy mix to increase use of sources with higher generating efficiencies and low emissions - increased use of natural gas, safer and more efficient power plants, renewable energy (e.g. solar and wind power; electricity and fuels from agricultural biomass), and hydrogen (to produce electricity through fuel cells). ‣ Develop "energyplexes" that would use carbon efficiently without emitting greenhouse gases for the integrated production of power, heat fuels, and chemicals from coal, biomass, or municipal wastes ‣ Switch transportation to energy sources with lower emissions (e.g. trucks that run on biodiesel fuel; ethanol from cellulosic feedstocks).

TABLE 4 - Summaries of the referenced, but not cited, documents found in Table 3

Document or Organization	General Summary and Important Points
Technology Opportunities to Reduce U.S. Greenhouse Gas Emissions (continued)	Carbon Sequestration ▸ Increase the rate at which oceans, forests, and soils naturally absorb atmospheric carbon dioxide. Critical issues raised by this study include the need for basic and applied research to not only develop the technologies to achieve these goals, but to better assess the impacts of these technologies on carbon flows, storage, and emissions; for strategic alliances between public-private entities to develop and deploy these technologies; and for increased RD&D to accelerate the implementation of these technologies. Summary - A national investment in technology RD&D program over the next 3 decades would provide a portfolio of technologies that could significantly reduce greenhouse gas emissions over the next three decades and beyond. To make effective progress against realistic goals and expectations, an outlay of approximately $1B/year above those presently dedicated to these efforts would be a prudent investment of resources. Many technological opportunities exist that could significantly contribute to this goal without harming the nation's economy. A strategic plan that includes deployment policies to complement technology RD&D will be necessary for success.

TABLE 4 - Summaries of the referenced, but not cited, documents found in Table 3

Document or Organization	General Summary and Important Points
Scenarios of U.S. Carbon Reductions - Potential Impacts of Energy Technologies by 2010 and Beyond (1997 - *commonly referred to as the 5 Lab study*)	Conclusions 1. A vigorous national commitment to develop and deploy energy-efficient and low-carbon technologies has the potential to restrain the growth in U.S. energy consumption and carbon emissions such that levels of 2010 are close to those in 1997 (for energy) and 1990 (for carbon). 2. If feasible ways are found to implement the carbon reductions as described above, all the cases (with reductions varying between 120 and 390 MtC/y by 2010) can produce energy savings that are roughly equal to or exceed costs (includes increased technology cost, plus approximate estimate of costs for program and policy implementation). 3. The next generation of energy-efficient and low-carbon technologies promises to enable the continuation of an aggressive pace of carbon reductions over the next quarter century. Biomass power and biofuels production are prominent technologies in the suite of low-carbon technologies considered in this report. Improvements in Kraft recovery boilers used in the pulp and paper industry were shown to provide carbon savings. Improvements in integrated gasification combined cycle processes for the pulp and paper industry and for primary power generation using wood wastes and other feedstocks (bagasse, straws, etc.) are strongly supported. Use of alternative fuels such as biofuels was also evaluated and provides potential carbon savings largely through displacement of fossil fuels but also some savings accrue in processing biomass to biofuels. The chemical processing industry use of biomass feedstocks, new chemical processing and biotechnology for production of commodity and speciality chemicals appears to provide some savings in carbon emissions. This was less well studied in 1997 and current studies provide greater quantification of those benefits.
Crops and Plant Systems Research Priorities for the 21st Century Farm Animal Integrated Research Vision (FAIR 2002)	Both of these visions were crafted by interest groups including government, farmers, academia, and industry participation to outline some of the issues for crops and plant systems research and animal research as it relates to the needs in the 21st century. Energy and biobased products were among the topics considered.

Other documents and organizations of interest and potential value to the Biobased Products and Bioenergy Coordination Office. These will need to be examined for their conclusions, recommendations, and strategies.

New Crops and New Uses: Biodiversity and Agricultural Sustainability," Proceedings of the 4th National Symposium, Phoenix, AZ, November 8-11, 1998.(Jules Janick, ed) ASHS Press, Alexandria, VA 1999

"Biopolymers from Renewable Resources," David L. Kaplan, Dept Chem Engineering, Tufts University, Medford, MA, Springer-Verlag, Berlin/Heidelberg (1998).

New Uses Council: http://www.newuses.org/

United Bioenergy Commercialization Association - www.ubeca.org/about.html

Trade associations such as:

- American Soybean Association

  http://www.oilseeds.org/asa/
- National Corn Growers Association

  http://www.ncga.com/
- Corn Refiners Association http://www.corn.org/
- The Association for the Advancement of Industrial Crops http://www.aaic.org/

Industrial Agricultural Products Center - http://ianrwww.unl.edu/ianr/iapc/research.htm

USDA's National Programs in the Agricultural Research Service - http://www.nps.ars.usda.gov/programs/306b.htm

http://www.nps.ars.usda.gov/programs/307s2.htm

The Carbohydrate Economy document and the Carbohydrate Economy Clearinghouse which are outreach tools of the Institute for Local Self-Reliance http://www.ilsr.org/

The Consortium for Plant Biotechnology http://www.cpbr.org/

Canadian Bioenergy Research Strategy - Strategic plan for bioenergy research - 1998-2003

Technical and Economic Assessment - Thermal/Chemical and Bioprocessing Components prepared for the USDOE Office of Industrial Technologies (1993) - an analysis of hundreds of biobased derived products economics of production. Published by the National Renewable Energy Laboratory

Appendix E

Inventory of Outreach Activities

EXAMPLES OF BIOFUELS/TRANSPORTATION OUTREACH PRODUCTS AND ACTIVITIES 1996-1999	
Electronic Outreach Products	
Product	**Description**
Regional Biomass Energy Program Web Sites http://rredc.nrel.gov/biomass/doe/rbep/ Northeast Region: www.nrbp.org Western Region: www.westbioenergy.org Great Lakes Region: www.cglg.org/projects/biomass	Information about the Regional Biomass Energy Program including mission, objectives, and strategic plan. Regional web pages
National Biofuels Program Web Site www.ott.doe.gov/biofuels http://www.ott.doe.gov/biofuels/media.html	Presents an overview of biomass and biofuels and describes different biomass conversion technologies. Media coverage in biofuels
Biomass Resource Information Clearinghouse www.rredc.nrel.gov/biomass	Web-based database containing biomass resource assessment reports and data.
Bioenergy Information Network http://bioenergy.ornl.gov/	A gateway to information about fast growing trees, grasses, and residues for fuels and power
Energy Efficiency and Renewable Energy Network www.eren.doe.gov	Central point of access to information and news from DOE's OIT, OUT, and OTT, all of which have bioenergy-related programs.
Media Outreach Products	
Product	**Description**
Press Release, Nov. 19, 1999	Better "bugs" lead to cheaper ethanol
Press Release, July 14, 1999	Colorado scientists win national award
Press Release, May 13, 1999	Natural gas vans to help clear the air
Press Release, May 5, 1999	Plant makes fuel out of garbage
Press Release, May 5, 1999	Finding the right filling station for alternative vehicles
Press Release, April 27, 1999	Advisory – Top scientists gather for biotech. conf.
Press Release, March 29, 1999	New rules to boost biodiesel fuel
Press Release, Feb. 24, 1999	Energy Dept. selects partners for corn ethanol
Press Release, Oct. 1, 1998	Advisory - Secretary Richardson to visit NREL
Press Release, May 22, 1998	Nebraska governor to visit NREL
Press Release, April 1998	NREL publications win awards
Press Release, March 25, 1998	Advisory – Local students visit energy bus
Press Release, Feb. 18, 1998	Technology turns garbage and waste into fuel
Press Release, Nov. 19, 1997	Alternative fuel vehicles: drivers survey
Press Release, Oct. 23, 1997	Clean energy technologies ready for climate challenge
Press Release, Sept. 17, 1997	NREL technologies win national awards

EXAMPLES OF BIOFUELS/TRANSPORTATION OUTREACH PRODUCTS AND ACTIVITIES 1996-1999	
Industry and Community Outreach	
Activity	**Description**
Ethanol Workshops--Participants included ethanol producers, environmentalists, and alternative fuel vehicle users.	Ethanol as octane enhancer, in blends, the economic and environmental benefits, and available vehicles.
Biodiesel Workshop–with biodiesel researchers and producers, representatives of the National Biodiesel Board.	Regulatory and legislative issues of biodiesel, feedstocks, costs and economics, environmental effects and uses.
Western Biomass Consortium Workshops– with members of the forestry and power industries.	Raise awareness of forest health and wildfire issues, forest thinning uses such as ethanol and power production.
Front Range Forest Health Partnership Workshops–with members of the forestry industry, state and local governments.	Improve forest health and prevent wildfires by using small-diameter thinnings to produce ethanol.
Quincy Library Group–with DOE, USDA, California Energy Commission, the forestry industry, and community groups.	Extensive feasibility study and public involvement in determining impact of improving forest health by thinning forests and locating biomass ethanol plant in northeast California.
Sealaska Corporation Public Outreach– with DOE , the Alaska Energy Authority, the forestry industry, and community groups.	Feasibility study and public outreach campaign to review potential for ethanol production from waste wood in southeast Alaska.
Black Hills National Forest Biomass Feasibility Study and Outreach– with the forest industry and community groups.	To conduct feasibility study and disseminate information to companies and communities in Wyoming and South Dakota about the potential for improving forest health by using forest waste to produce ethanol.
Enzyme Colloquies–Participants included representatives from government, academia, industry.	Series of meetings with enzyme industry to discuss options for developing economical enzymes for converting biomass to ethanol.
Montana State University– with government, academia, and industry.	Biomass resource assessment to determine potential for producing ethanol from waste wood in western Montana and Idaho.
Bridge to Corn Ethanol– with farmers, community groups, and members of the corn ethanol industry.	DOE-sponsored Initiative to raise awareness and determine feasibility of using crop residues to produce ethanol.
Ethanol Producers and Consumers (EPAC)– with the agricultural community, forestry industry, and ethanol producers.	DOE-sponsored group based in Montana that promotes use of E85.

EXAMPLES OF BIOFUELS/TRANSPORTATION OUTREACH PRODUCTS AND ACTIVITIES 1996-1999	
Events Outreach Activities	
Event	**Description**
TAPPI Conference, November 1999, **4th Biomass Conference of the Americas**, August 1999, **Fuel Ethanol Workshop**, June 1999, **21st Biotechnology Symposium**, May 1999, **5th Clean Cities Conference**, May 1999, **TAPPI Conference**, March 1999, **American Farm Bureau Showcase**, January 1999, **Bioenergy '98**, October 1998, **Society of Industrial Microbiology Annual Meeting**, August 1998, **Corn Utilization and Technology Conference**, June 1998, **Fuel Ethanol Workshop**, June 1998, **4th Clean Cities Conference**, May 1998, **20th Biotechnology Symposium**, May 1998, **TAPPI/Paper Makers Conference**, April 1998, **National Marketplace for the Environment**, November 1997, **Society of American Foresters Annual Convention**, October 1997, **Third Biomass Conference of the Americas**, August 1997, **National Conference of State Legislatures Annual Meeting**, August 1997, **Fuel Ethanol Workshop**, June 1997, **19th Biotechnology Symposium**, May 1997, **3rd Clean Cities Conference**, May 1997, **Society of American Foresters Annual Convention**, October 1996, **Bioenergy '96**, September 1996	Biofuels program displays and exhibits
Education Outreach Activities	
Activity	**Description**
42 "Advancing the Choice" events	DOE/NREL provided information at 42 sites for alternative fuel users about alternative fuel vehicles and refueling options.

EXAMPLES OF BIOMASS POWER OUTREACH PRODUCTS AND ACTIVITIES 1996 - 1999

Electronic Outreach Products	
Product	**Description**
Internet Web Site, http://www.eren.doe.gov/biopower	Biomass Power Program Content.
Biomass power video "Growing America's Energy: The Story of Biomass Power"	Video shows information on biomass power including successful case studies.
Cofiring multimedia CD developed in 1999	Video shows information on burning biomass with coal
Media Outreach Products	
Product	**Description**
Radio Interview	H. Chum interview on National Public Radio at fourth Biomass Conference of the Americas
Press Release, December 1999	Contracts boost biomass power
Press Release, September 18, 1999	Advanced biomass power process wins award
Press Release, August 26, 1999	Media advisory – 4th Biomass Conference
Press Release, July 29, 1999	Nation's largest biomass conference to draw experts
Press Release, June 30, 1999	New book highlights beneficial use of ash
Press Release, March 11, 1999	World technology leaders to gather
Press Release, August 10, 1998	New technologies win national award
Press Release, Feb. 18, 1998	Technology turns garbage and waste into fuel
Industry and Community Outreach	
Activity	**Description**
Professional and industry participation	Representation on several professional and industry Boards of Directors
Trade Institute participation	Participation in Electric Power Research Institute biomass Power Research group
Support development of local legislation and programs to increase biomass power use	State of Nebraska, California Public Interest Energy Research joint DOE and California Energy Commission work
Trade Institute participation	Informal support for United BioEnergy Commercialization Association (UBECA), American BioEnergy Association, and related groups such as American Forest and Paper Association

EXAMPLES OF BIOMASS POWER OUTREACH PRODUCTS AND ACTIVITIES 1996 - 1999

Events Outreach Activities

Event	Description
1999 Biomass Conference of the Americas, Oakland, California	DOE/ NREL sponsored and managed with multiple cosponsors from USA, Canada, Brazil, State of California, and the private sector
1997 Biomass Conference of the Americas, Montreal, Canada	DOE/ NREL sponsored and managed with multiple cosponsors from the Canadian Government, Province of Quebec, and elsewhere
Annual Intervale Festival in September	Included tours of the Burlington Vermont Gasifier in 1998 and 1999
Bioenergy Conferences of 1996 and 1998, 21st Biotechnology Symposium, May 1999, 19th Biotechnology Symposium, May 1999, Energy Month, October 1996, Future Farmers of America, November 1996, American Farm Bureau Show, January 1997, National Assoc. Conservation Districts, February 1997, Tech Advantage, March 1997, Annual Renewable Energy Caucus expositions	Biopower program displays

Education Outreach Activities

Activity	Description
Course presentation	A First Gasification Course, Presented at UBECA November 1999
Laboratory demonstrations and discussions	Hosted a three day visit from representatives of the Energy Technology Center in Pitea, Sweden
Symposium	Hosted a group of 34 scientists from around the world as part of the 27th International Symposium on Combustion
Hands-on experience	Host each year several visiting scientists, students, and graduate students national and international.
Discussions	Participation in National, NE, and SE Biofuels Roundtables
Presentations and preparation of industry partners in discussions with groups from the financing community	Participation in Enterprise Growth Forums
Presentation	Energy Frontiers International
Presentations	"Energy Institutes" set up by the NREL office of State & Local Initiatives
Characterizations	DOE/EPRI Technology Characterizations
Curriculum development	Biomass is part of the renewable energy curricula developed by the NREL K-12
Discussions	Meetings/roundtables with the GreenE New England and Mid-Atlantic meetings
International activity	Hosted USA/ Finland Collaboration Meeting and follow-up meeting in Finland. Researcher exchange program started.

Examples of Key Publications:

First Biomass Conference of the Americas, *Energy, Environment, Agriculture, and Industry*, Volumes I & II, August 30-September 2, 1993, Burlington, Vermont. Proceedings published by National Renewable Energy Laboratory CP-200-5768, DE93010050 (1993)

Second Biomass Conference of the Americas, *Energy, Environment, Agriculture, and Industry*, August 21-24, 1995, Portland, Oregon. Proceedings published by the National Renewable Energy Laboratory CP-200-8098, DE 95009230 (1995)

Making a Business from Biomass in Energy, Environment, Chemicals, Fibers, and Materials, Volumes I & II (R.P. Overend and E. Chornet, eds) Proceedings from the Third Biomass Conference of the Americas (Montreal, Quebec, Canada), Permagon Press, Elsevier Science, Great Britain, 1997.

Biomass-A Growth Opportunity in Green Energy and Value-Added Products, Volumes I & II (R.P. Overend and E. Chornet, eds) Proceedings from the Fourth Biomass Conference of the Americas (Oakland, California, USA), Permagon Press, Elsevier Science, Netherlands, 1999.

Bioenergy ‘98, Expanding Bioenergy Partnerships, Madison, WI, October 4-8, 1998, Proceedings on Compact Disk, Omnipress.

Life Cycle Assessment of a Biomass-to-Electricity System. Spath, P.; Mann, M.; Woodward, S. (1997). Biologue, Vol. 15&16, pp. 16-21.

EXAMPLES OF INDUSTRIES OF THE FUTURE OUTREACH PRODUCTS AND ACTIVITIES 1996 - 1999	
Electronic Outreach Products	
Product	**Description**
Internet website http://www.oit.doe.gov/	Office of Industrial Technologies website
Internet website http://www.oit.doe.gov/forest/	Forest Products Industry of the Future website
Internet website http://www.oit.doe.gov/agriculture/	Agriculture Industry of the Future website
Internet website http://www.oit.doe.gov/chemicals/	Chemicals Industry of the Future website
Media Outreach Products	
Product	**Description**
OIT Times, Newsletter, since 1998, quarterly	Turning industry visions into reality http://www.oit.doe.gov/oittimes/
OIT Project Brochures	Each IOF Project has a brochure available in print form
OIT News - example DOE Awards Over $13 Million in Financial Assistance To Support Bioenergy Executive Order	http://www.oit.doe.gov/news.shtml http://home.doe.gov/news/releases99/augpr/pr99216.htm
Events Outreach Activities	
Event	**Description**
Industry Symposia and Exhibit displaying OIT-sponsored projects, industry and trade association displays.	2nd Industrial Energy Efficiency Symposium and Expo, Washington, DC, Feb. 24-27, 1997 3rd industrial Energy Efficiency Symposium and Expo, Washington, DC, Feb. 7-9, 1999
Technology roadmap roadmapping workshops related to biobased products and bioenergy involving industrial community as well as academia, the federal laboratories, and others	Chemical Industry Roadmap Workshop on Materials for the Future, College Park, MD, Nov. 19-20, 1998
	Separations Roadmaps, 1998 - Separation I - New Orleans. LA, Feb. 4-6, 1998 Separation II - Oak Ridge, TN, May 11-13, 1998 Separations III - St. Louis, MO, May, 1999 Separations IV - Gatlinburg, TN, Oct, 1999 Agriculture Roadmapping Workshops, Indianapolis, IN, Aug.. 27, 1998 and Sept. 1-2, 1998
	Biocatalyst Roadmapping, Palo Alto, CA, Nov 16-18, 1999
Exhibits presented at different conferences and meetings that presented biobased products and bioenergy themes	OIT's Agriculture Team at the 1997, 1998 and 1999 Commodity Classics, convention and trade show of the National Corn Growers and American Soybean Associations in Orlando, FL, Long Beach, CA, and Albuquerque, NM

Examples of Key Publications in Bioenergy

Twentieth Symposium on Biotechnology for Fuels and Chemicals, 3-7 May 1998, Gatlinburg, Tennessee. Presented as Volumes 77-79 of Applied Biochemistry and Biotechnology. Davison, B.H.; Finkelstein, M., eds. Totowa, NJ: Humana Press, 1999, 884 pp.

Nineteenth Symposium Biotechnology for Fuels and Chemicals: 4-8 May 1997, Colorado Springs, Colorado. Presented as Volumes 70-72 of Applied Biochemistry and Biotechnology, Spring 1998. Finkelstein, M. and Davison, B.H., eds. Totowa, N.J: Humana Press, 1998, 1015 pp.

Eighteenth Symposium Biotechnology for Fuels and Chemicals: 5-9 May 1996, Gatlinburg, Tennessee. Presented as Volumes 63-65 of Applied Biochemistry and Biotechnology, Spring 1997. Davison, B.H.; Finkelstein, M.; Wyman, C.E., eds. Totowa, NJ: Humana Press, 1997; 903 pp.

Regional Biomass Energy Program Strategic Plan: Building a Sustainable Economic and Environmental Future: Vision, mission, goals, objectives, and strategic tools, 1997-2003.

Regional Biomass State Grants Report: State funded projects in utilizing renewable biomass resources, bioenergy, and biofuels. September 1998.

Review Report of the Regional Biomass Energy Program Technical Projects - The five Regional Programs - cooperative initiatives and region-wide technical projects. August 1999. NREL Task KXL-9-29061-00

Media Outreach Products	
Product	**Description**
Press Release, August 12, 1999	Remarks by Secretary Dan Glickman White House Executive Order on Biomass/Biobased Products
Press Release, December 6, 1999	Midwest Farmers Get a New Crop from ARS Research for a New Millennium
Press Release, November 22, 1999	Shrub-Derived Latex Products From ARS Research Block Viruses, Bacteria
Press Release, November 18, 1999	Lesquerella Scrutinized by USDA as Oil, Gum, Meal Source
Press Release, October 1, 1999	New Uses for Milkweed From USDA
Press Release, September 13, 1999	Nut Shells on Tap for Industrial Clean Up
Press Release, August 23, 1999	New Gauze, Coatings Improve Medical Uses of Cotton
Press Release, August 16, 1999	New R&D Agreement Aims at Natural Controls for Plant Fungi
Press Release, July 14, 1999	Biotech Bouquet in the Works
Press Release, June 24, 1999	Chicory Is a Biological Plow and Sponge, All in One
Press Release, June 10, 1999	New Liquid Epoxies Created from Cane Sugar
Press Release, May 27, 1999	"Waste" Gypsum Could Help Boost Crop Yields
Press Release, April 29, 1999	Research Helps Midwest Farmers Expand into New Markets
Press Release, April 14, 1999	Alfalfa Plants Vacuum Up Fertilizer Spill
Press Release, April 12, 1999	Recycled Tire “Fluff” and “Crumb” Help the Environment
Press Release, February 2, 1999	USDA Research Agency Honors Scientists for Technology Transfer
Press Release, February 3, 1999	ARS Scientists Win Top Research Awards From Federal Laboratory Consortium
Press Release, January 26, 1999	Coal Burning Byproduct Gives Ol’ Bossy a Leg Up on Mud
Press Release, November 27, 1998	New More Environmentally Friendly Ways to Process Hides into Leather
Press Release, November 23, 1998	USDA Scientists Turn Hide-Tanning Waste into High-Value Products

Media Outreach Products	
Product	**Description**
Press Release, October 14, 1998	USDA Has Designs for Baltimore Harbor's "Spoil-to-Soil" Recycling
Press Release, May 14, 1998	ARS Scientists Win Technology Transfer Honors from Federal Laboratory Consortium
Press Release, April 21, 1998	New Biodiesel Fuels From ARS Solve Cold-Starting Problem
Press Release, March 3, 1998	Soybean Market Could Triple, Thanks to More Soy Oil in Offset Printing Inks
Press Release, February 26, 1998	New Procedure Lets Industry Use More Citrus Peel
Press Release, February 23, 1998	New ARS Agreement Promotes Product Development from Crops
Press Release, December 18, 1997	Gold in Them Thar Hulls
Press Release, December 5, 1997	ARS Presents Awards for Delivering New Research to Market
Press Release, September 22, 1997	White Powder Anchors Farmland Soil
Press Release, April 10, 1997	USDA Scientists Honored for Moving Research to Market by Federal Laboratory Consortium
Press Release, March 14, 1997	USDA Research IncreasesVernonia's potential as Source of Industrial Oils
Press Release, March 7, 1997	Meadowfoam Blooms as Alternative Crop With USDA Research
Press Release, January 22, 1997	ARS Patented Process To Make Latex From Guayule Is Licensed

Recent USDA Publications

Agricultural Uses of Municipal Animal, and Industrial Byproducts, ARS
Survey of Phenolic Compounds Produced in Citrus, ARS
Quarterly Report of Selected ARS Research Results, Industrial (Nonfood) Use
Dividends From Wood Research, January-June 1999
Forest Products Research Laboratory
Cumulative Dividends From Wood Research, January 1996-December 1998

Electronic Outreach Products	
Product	**Description**
ARS National Program # 306 Web Site: New Uses, Quality, and Marketability of Plant and Animal Products http://www.nps.ars.usda.gov/programs/306s2.htm	Describes current needs and ARS research projects to meet those needs, lists research locations and other stakeholder information
Program # 306 Web Site: Annual Report of Research Accomplishments, Fiscal Year 1998 http://www.nps.ars.usda.gov/programs/npar.cfm?npnumber=306	Presents accomplishments reached in this program in that fiscal year
ARS National Program # 307 Web Site: Bioenergy and Energy Alternatives http://www.nps.ars.usda.gov/programs/307s2.htm	Describes current needs and ARS research projects to meet those needs, lists research locations and other stakeholder information
Program # 307 Web Site: Annual Report of Research Accomplishments, Fiscal Year 1998 http://www.nps.ars.usda.gov/programs/npar.cfm?npnumber=307	Presents accomplishments reached in this program in that fiscal year
ARS Research News and Information Web Site http://www.ars.usda.gov/is/	Presents information in a format accessible to stakeholders, including the pubic, on ARS research, including bio-based industrial products and bioenergy.
Web Site on ARS biodiesel fuel demonstration project. http://www.barc.usda.gov/fmod/energy/bdiesel.htm	
TEKTRAN, data base of recent ARS research results including bioindustrial new uses and bioenergy, to facilitate tech transfer. http://www.nal.usda.gov/ttic/tektran/tektran.html	
USDA New Crops Oilseed Database http://www.ncaur.usda.gov/nc/ncdb/search.html-ssi	Data developed about potential oilseed crops, including industrial oilseed potential
ARS's Science 4 Kids web site http://www.ars.usda.gov/is/kids/	Includes material on bio-based industrial products and research.

Events Outreach Activities	
Event	**Description**
International Business Communications Biopesticides Conference, Jan. 27-28, 1997, Washington DC	Presentations, exhibit
BIO '97 International Biotechnology Meeting and Exhibition, June 8-12, 1997, Houston, TX	Presentations, displays
Technology 2007 Conference, September 22-24, 1997, Boston, MA	
The National Marketplace for the Environment, November 18-20, Washington DC	Sponsor, Presentations and Multi-agency Displays
Kansas Value Added Conference, July 29-30, 1998	Sponsorship, presentations, displays
Technology 2008 Conference, Nov. 3-5, 1998, Boston, MA	
Partners in Environmental Technology, Dec. 1-3, 1998	Presentations and displays
AgriTechnology Venture Capital Forum Defining the Expanding Sector, June2-3, 1999, Sacramento, CA	Display
Agricultural Genomics: New Technologies, Functions, and Advances, June 24-25, 1999, San Diego, CA	
United's Washington Public Policy Conference September 9-10, 1999, Washington DC	
IBC Agricultural Biotechnology Symposium: Changing AgrChem and AgBiotech R&D Through Technology, September 23-24, 1999, San Francisco, CA	
2nd Annual Emerging Technology Business Showcase, Oct. 14, 1999, Boca Raton, Fla.	
Environmental Technology Expo, October 20-22, 1999, Atlanta, GA	
Future Farmers of America October 25-30, 1999 Louisville, KY	Exhibits, Information Booth, Handouts
National Workshops on ARS Research Program #306 New Uses, Quality, and Marketability of Plant and Animal Products: May 25-26, Laurel, MD, Nov. 15-17, St. Louis, MO, Dec. 1-3, Atlanta, GA	Working with stakeholders to determine future research needs and directions

Events Outreach Activities	
Event	**Description**
National Workshop on A RS National Program # 307 Bioenergy and Energy Alternatives, April 16-17, Baltimore, MD	Working with stakeholders to determine future research needs and directions
Association for the Advancement of Industrial Crops, Oct. 17-21, Eugene, Oregon	Organized and gave presentations
USDA Biobased Coordination Council Strategic Planning Retreat, Oct. 13, 1998	Hosted
Ag in the Classroom	USDA's Ag in the Classroom had developed a mini curriculum featuring biobased industrial products and bioenergy for the high school level
Science in Your Shopping Cart Video and Publication	ARS's Science in Your Shopping Cart Video and Publication made available to teachers at the National Association of Science Teachers and Future Farmers of America
BPCC Retreat	USDA met in a broadly based "BPCC Retreat" in October of 1998 as an outreach activity to assist USDA in building a strategic approach to increasing biobased product initiatives. From this meeting USDA reached public consensus on the strategic activities to be pursued. These are now encompassed in the USDA Biobased Products and Coordination Council's Strategic Plan.
Ag venture capital forums	Ag venture capital forums that were cosponsored by USDA in June and November of this year. These are a series of meetings under the title of Environmental Technology Exposition occurring next in Atlanta, Georgia, October 25 - 27, 2000.
ARS National Program Workshop	April 15, 1999, in Beltsville, MD, ARS sponsored a workshop designed to obtain stakeholder input into ARS National Program 307, Bioenergy and Energy Alternatives.
ARS National Program Workshop	May 25, 1999, in Laurel, MD, ARS sponsored a workshop designed to obtain stakeholder input into ARS National Program 306, New Uses, Quality, and Marketability of Plant and Animal Products, as the program pertains to animal products, fruits, vegetables, tree nuts, and sugar crops.
ARS National Program Workshop	November 15-16, 1999, in St. Louis, MO, ARS sponsored a workshop designed to obtain stakeholder input into ARS National Program 306, New Uses, Quality, and Marketability of Plant and Animal Products, as the program pertains to cereals, oilseeds, and new crops.

Events Outreach Activities	
Event	**Description**
ARS National Program Workshop	December 1-2, 1999, ARS sponsored a workshop designed to obtain stakeholder input into ARS National Program 306, New Uses, Quality, and Marketability of Plant and Animal Products, as the program pertains to agricultural fibers.
Millennium Village in Disney World	Through Alternative Agricultural Research and Commercialization Corporation (AARCC), USDA has partnered with DISNEY and presents at the Millennium Village in Disney World a life size, interactive model of the biobased products process and opportunities, including renewable energy, for the world to see, touch, feel, and come to understand. This exhibit, inside the newest showcase at EPCOT Center, is a key in raising the Nation's awareness to the values achievable in this initiative. More than 15 percent of the American population and a significant number of foreign visitors are projected to tour the Millennium Village. Through the DISNEY education efforts the themes will reach even more people than our normal efforts.
CREES grants	CSREES works with universities across the country. Their grant activities, and by these activities their education impact, reach the decision makers of the future, today. By promoting university level, biobased product education and research and also commercialization through technology transfer, USDA focuses on spawning new business opportunities in a growth segment of our economy.
Cooperative Extension System	The Cooperative Extension System is a Federal, State and County partnership that is very effective in moving the public investment in agricultural research to commercialization. Outreach and education activities through land grant institutions, ag experiment stations and cooperative extension services include workshops, manuals and demonstration projects. Thumb Oilseed Producers Cooperative in Michigan is a good example of how the extension system can work to develop a new generation cooperative which emphasizes adding value to one or more farm products. The county agent in Huron, who promotes sustainable agriculture and the concept of adding value, was instrumental in leading local farmers to consider a new generation cooperative. The result is the Michigan Rural Development and Community Enhancement Model to produce biobased lubricants made from soybean and canola oils. The motor oil formulation is currently being demonstrated by the Postal Service.

Events Outreach Activities	
Event	**Description**
Academic Partnership with the Private Sector	Michigan Biotechnology International (MBI) is a private, non-profit technology and business development corporation to promote research in biobased technologies and then to transfer these technologies to the private sector for commercialization. This business pipeline serves universities, as well as federal labs and the private sector. MBI's unique collaboration with Michigan State University has resulted in technologies that utilize chiral synthesis and biocatalysts to produce high performance pharmaceutical chemical and food intermediates, development of thermoplastics, and development of high value membranes for medical, semiconductor and environmental applications.
Academic Partnership with Private Sector and State Government	The University of Northern Iowa's Ag-Based Industrial Lubricants Program has partnered with the Iowa Soybean Promotion Board, and Iowa State University to successfully commercialize a number of high performance products based on soybean oil including multigrade hydraulic fluid, electrical transformer fluid, semi-truck fifth wheel grease and a chainsaw bar oil. West Central Cooperative is the first commercial licensee of these products. The coalition of public and private entities has resulted in a requirement for state agencies to give preference to these biodegradable crop oils in government vehicles and equipment when budgets allow. The requirement is a national precedent to promote the use of biobased lubricants.
Biodiesel Fuel Demonstration Project	ARS's Beltsville Agricultural Research Center has been conducting a one-year demonstration project in cooperation with the American Soybean Association and the National Biodiesel Board. For the next year all diesel powered equipment (tractors and trucks) on the East side of the facility will be fueled with biodiesel fuel. This is a blend of 80% diesel and 20% soybean oil. This includes a web site on the program. The tour bus operated by the ARS National Visitor Center uses the fuel as part of the outreach efforts. Workshops are also being held to explain the success of the project to surrounding municipal jurisdictions. http://www.barc.usda.gov/fmod/energy/bdiesel.htm

Agreements

Recent MOU's with states to promote technology transfer of research including biobased industrial products:

- The State of Wisconsin (signed March 18, 1997)
- The State of Louisiana (signed June 19, 1997)
- The State of Kansas (signed September 16, 1997)
- The State of Delaware (signed February 27, 1998)