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NATIONAL SUSTAINABLE FUELS AND CHEMICALS ACT OF  
1999

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Mr. LUGAR, from the Committee on Agriculture Nutrition, and  
Forestry, submitted the following

**REPORT**

[To accompany S.935]

The Committee on Agriculture, Nutrition and Forestry, to which was referred S. 935, a bill to amend the National Agricultural Research, Extension, and Teaching Policy Act of 1977 to authorize research to promote the conversion of biomass into biobased industrial products, having considered the same, reports favorably thereon with amendments and recommends that the bill as amended do pass.

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**BACKGROUND AND NEED FOR THE LEGISLATION**

**BIOBASED PRODUCTS**

Plants, living and dead, are an enormous store of solar energy collected via photosynthesis. As a consequence, grasses, weeds, ag-

ricultural crops and residues, and other organic material form a vast and sustainable energy resource. From this sustainable resource, referred to as "biomass," a host of biobased industrial products can be processed. These include fuels, notably ethanol, important commodity chemicals like ethylene or acetic acid, paint, adhesives, building materials and the production of electrical power. Conversion of biomass into biobased industrial products offers outstanding potential for benefit to the national interest through better use of agricultural resources, improved strategic security and balance of payments, revitalized rural economies, improved environmental quality, near-zero net greenhouse gas emissions, technology export, and sustainable resource supply.

Using nature's renewable raw material for production of needed fuels, chemicals and energy is not a new idea. What is new, however, is that a better understanding of chemistry and molecular biology has led to the development of advanced biotechnologies and processing techniques for efficiently converting plants to energy. With these advances, it is now possible to envisage a future where the world's thirst for additional sources of energy is fueled by biomass—a living, renewable raw material.

Although a focused national research effort will be necessary before biobased products are commercially viable, a bright future fueled by renewable energy is not a distant dream. Already the promise of advanced biotechnology can be seen in the modern corn and soybean processing industry. Corn and soybean mills are working examples of biorefineries that produce an array of useful food, chemical feed and fuel products including ethanol, corn starch, oils, sugars and animal feeds. Through investments in research and process technology, there have been dramatic improvements in the efficiency of the refinement process and an increase in the number of products produced from corn and soybeans. As one example, the cost of producing corn-derived ethanol has dropped from \$4.63 to \$1.22 per gallon in constant dollars since 1979. The corn production and refining industry alone is responsible for 154,000 direct and indirect jobs and contributes more than \$28 billion per year to the American economy.

Building from this base of industrial experience, talented people and infrastructure, biorefineries of the future will be capable of using the entire corn or soybean plant—kernel, stalks, husks and leaves—to produce an even greater array of consumer products. In addition to using the edible parts of corn or other feed grains, future biorefineries will be capable of processing generic grasses, dedicated energy crops and agricultural residues, such as rice straw or sugar cane bagasse, for the production of biofuels and biochemicals.

Expansion of the resource base to include virtually all plant matter places biomass on par with petroleum and serves to lower raw material costs. America produces vast quantities of agricultural residues. According to the 1999 Report by the National Research Council (NRC) of the National Academy of Sciences, enough waste biomass is generated each year to supply domestic consumption of all industrial chemicals that can be made readily from biomass and also contribute to the nation's liquid transportation fuel needs. Corn stover constitutes a significant proportion of waste biomass

and is particularly attractive when considered as a potential raw material because land and planting costs are already accounted through sale of the grain.

Biobased products have the potential to improve sustainability of natural resources, environmental quality and national security while competing economically. The diversity of biobased products and their many uses are staggering. According to the NRC Report, biobased products fall into three categories: commodity chemicals (including fuels), speciality chemicals and materials. Some of these products result from the direct chemical or physical processing of biomass while other products serve as intermediaries or precursors to other organic chemicals required for the production of paints, solvents, clothing, synthetic fibers and plastics. Ethanol is an example of a biobased product that can be used directly as a high performance fuel or as an intermediate chemical. Intermediate chemicals like ethylene and acetic acid are ubiquitous in a modern economy, contributing heavily to the high standard of living enjoyed by Americans. Expanding the United States' strategic reserves of intermediate chemicals with biobased raw materials is important to meet an increasing demand and mitigate economic disruptions caused by oil shortages.

The case for promoting technology that will supply biofuels, biochemicals and biopower can be made independently of whether the world will continue to enjoy low cost supplies of petroleum. However, the Committee is aware of numerous scientific studies that indicate that the world's supply of conventional oil is nearly half exhausted and that with each passing year, the demand for petroleum-derived energy increases. Historically, individual oil wells, oil fields, and national petroleum outputs have all shown a decline in production rates when the level of reserves reaches 50 percent. This is estimated by two noted geologists to occur as early as 2010. A decline in production combined with steadily rising energy demands, may lead to price increases or volatility in petroleum markets. Although the Committee is unable to predict the accuracy of oil reserve estimates and the future price of oil, it is clear that global demand for petroleum will increase with population growth and improving standards of living. The Committee believes there is a need to diversify America's energy options and make greater use of renewable materials as oil and gas reserves are gradually depleted and supply interruptions threaten global stability and the world's economy.

Underscoring the possibility that global patterns of energy usage will soon begin to change dramatically is a 1997 internal study on world energy supplies by Shell International Petroleum. Shell's preferred scenario for sustained growth sees renewable energy sources, including biomass fuels, becoming significant by 2020 and exceeding fossil fuel use by 2060. Fossil fuels' production rates plateau after the next century's second decade. Backing its study with action, Shell recently established a fifth core business organization, with plans to invest nearly half a billion dollars in renewable energy projects over the next five years.

## IMPROVING AMERICAN STRATEGIC SECURITY

Recent pipeline disputes in the Caspian Sea serve as a reminder that oil is a magnet for conflict, arising in many instances from wrangling over the world's few locations that contain abundant supplies. Some two-thirds of the world's petroleum reserves are located in a single geographic region—the oil fields of the Persian Gulf and Caspian Sea.

As long as our dependence on oil from the Persian Gulf continues, Americans can never be confident that there will not be a repeat of the international crises of 1973, 1979, 1990 or worse. In the summer of 1990, Saddam Hussein was about 100 miles from controlling half the world's oil reserves. The world economy could be seriously damaged by a major cutoff of oil supplies, or even by rapid price hikes associated with interruptions in supply.

By contrast, plants, crops and trees are much more widely dispersed throughout the world. As such, biomass has the potential to minimize the chance for conflict arising from localized or state control of an internationally-sought commodity. The Committee believes it would be desirable for the United States to limit its over-dependence on oil imports through aggressive development of technology for producing fuels and chemicals from biomass.

A November 1997 Report of the President's Council of Advisors on Science and Technology (PCAST) calculates that 4.7 quadrillion BTUs of bioenergy (1 quad =  $10^{15}$ ), or five percent of the total energy demand of the United States in 1995, could be available at competitive prices by 2015. Half of this amount would come from agricultural residues, with the balance supplied by just 18 million acres of dedicated energy crops. Under one scenario, this vast bioenergy resource would produce 31 billion gallons of ethanol and 12 gigawatts of electricity as a byproduct of making the liquid fuel. The result: America's gasoline requirements would be reduced by as much as 22 percent, saving more than \$10 billion per year on our bill for imported oil.

With clear potential to be sustainable, low cost and high performance, biobased fuels are compatible with current and future transportation systems and the best means of reducing American dependence on imported oil. The possibility of using biomass as a sustainable raw material for fuels and chemicals offers a way to reduce America's over-dependence on unstable nations of the Middle East and dramatically improve our strategic security.

## CLEANING THE AIR

Biobased fuels are an outstanding way to curb greenhouse gas emissions that threaten climate stability. Because biobased fuels are derived from renewable plant sources, they do not add to the carbon dioxide content of the atmosphere, unlike fuels derived from fossil sources such as oil, natural gas or coal. On this point there is virtual consensus among scientists: when considered as a part of a complete cycle of growth, fermentation and combustion, the use of fuels from biomass, once optimized, will contribute no net carbon dioxide to the atmosphere.

The PCAST Report estimates that using biomass from agricultural residues and energy crops grown on 18 million acres would

produce 4.7 quads of energy per year (equivalent to 5 percent of U.S. energy in 1995) and reduce U.S. emissions of carbon dioxide by at least six percent. This much biomass could be available at attractive costs by 2015. A Department of Energy study conducted by five national laboratories, "Scenarios of U.S. Carbon Reductions," is more optimistic, estimating that biomass has the potential to reduce U.S. carbon emissions by up to ten percent of current emissions by 2010. The Committee believes a shift to biomass fuels stands as an excellent way to introduce an environmentally friendly energy technology that has a chance of both enjoying widespread political and economic support and having a decisive impact on the risk of climate change.

Plants and trees also act as a sink for carbon dioxide, storing increasing amounts as they grow. Although the ability of rapidly grown and harvested plants to serve as carbon sinks is limited, there is likely to be a positive benefit through the use of biomass energy systems. The evaluation of carbon cycle and sequestration by plants and trees is complex and deserves further research.

Combustion and processing of fossil fuels release chemicals that pollute the air, water and soil. Biochemicals and biomaterials can provide functionally superior replacements for many products currently derived from petroleum and have clear potential for product life cycles that are more environmentally benign than their fossil fuel counterparts.

The compatibility of water with biomass-derived products, including ethanol, is an important environmental consideration and a powerful demonstration of green chemistry. If a supertanker loaded with ethanol were to run aground, most of the spill would evaporate, with the balance rapidly broken down by sea water. Another example of the environmental benefits of biobased products is provided by poly-lactic acid (PLA), a polyester substitute manufactured from corn. After a product lifetime equivalent to petroleum-based polyester, PLA fabrics readily break down in soil or salt water, freeing valuable space in landfills.

Advanced biomass processing technologies reduce waste. America generates vast amounts of agriculture residues, 280 million metric tons according to the NRC Report. Corn stover, rice straw, sugar cane bagasse and chicken litter are examples of agricultural waste that present disposal challenges. Rice straw is often burned, a practice soon to be banned by the State of California as the burning contributes to air pollution. In the California's Sacramento Valley, farmers pay \$30 per acre to plow rice straw back into the soil, a cost that diminishes their profits by one-quarter. The ability to convert rice waste into a high-valued added product, such as acetic acid (widely used in the food, textile and pharmaceutical industries) or ethylene (an important commodity chemical because of the value of its numerous derivatives such as polyethylene or acetaldehyde) would provide an additional source of revenue for the farmer while contributing to the clean-up of America's air. What is now environmentally challenging waste becomes a valued commodity product manufactured from a sustainable and home-grown raw material resource.

## STRENGTHENING RURAL COMMUNITIES

The NRC Report estimates the potential market for biochemicals and biomaterials, including adhesives, polymers and oils, to be worth hundreds of billions of dollars per year. A significant percentage of this amount would return to those that till America's fields, providing a sustainable source of revenue that would help strengthen rural economies. Additional commodity markets will be created for agricultural products, diversifying and increasing farm income.

A great strength of the new biotechnologies for biomass conversion is that virtually any plant, crop or crop residue becomes a potential source of income. In addition to extra income, this attribute provides the farmer with increased flexibility regarding crop selection and stewardship of the land. Crops or grasses planted to enrich the soil, prevent erosion or improve local environmental conditions can also be periodically harvested and used as a raw material for biobased products. Scientists who have analyzed energy crop production agree that a significant number of issues related to its environmental impacts are incompletely understood, and urge a cautious approach and further research. Sound land use policies must be followed to protect wildlife habitat and other environmental concerns, but professional land use techniques should readily accomplish this.

Biobased products offer a real possibility of increased rural employment. Biobased industries would likely be sited near the source of the biomass raw material, whether energy crops or agricultural residues, so as to minimize transportation costs. While predictions of employment for an emerging industry depend on extrapolation or approximation, the NRC Report envisions at least one million additional jobs processing agricultural and forest raw materials to chemicals only, without taking fuels such as ethanol into account.

For less developed countries, often based on an agrarian society, the impact of biomass is likely to be far greater. Local communities would be able to generate their own supplies of fuel and farmers could earn extra income simply by collecting agricultural wastes or harvesting grasses or bioenergy crops. If family income is a few hundred dollars per year, earning even an extra \$50-\$100 could mean an improved quality of life. Land damaged by slash-and-burn agriculture could be planted with native grasses or trees, replenishing the soil while at the same time providing a local source of income and fuel. The cleanliness of renewable fuel technologies makes them particularly attractive to lesser developed countries that often lack a sophisticated infrastructure or network of regulatory controls.

At a time when many American farmers are struggling economically, technologies for producing fuels and chemicals from biomass offer new sources of income for farmers and a diversification of agricultural markets. The same technologies that add value to corn stalks and leaves will allow farmers to rotate their crops with grass and forage crops and still receive a good economic return. Biomass will become a commodity and farmers stand to benefit.

## OBSTACLES TO BE OVERCOME

In order for America to accrue the significant economic, environmental and strategic benefits offered by biobased products, the cost of making fuels, chemicals and electricity from biomass must become competitive with existing methods of production.

The cost of biobased products, as with any product, is the sum of delivered raw material costs and processing costs. Industries for producing fuels and chemicals are characterized as having significant raw material costs and minimal processing costs, a result of more than a century of innovation and investment in petroleum refining. Biomass offers the intriguing possibility of being able to produce necessary consumer goods notable for minimal processing and raw material costs.

Generally, the delivered raw material cost per ton of biomass is comparable (e.g. corn grain) or much less (e.g. corn stover) than the cost per ton of petroleum. Crude oil at \$18 per barrel is equivalent to corn at \$27.75 per bushel or about \$110 per ton for each. When compared on an energy equivalency basis, agricultural residues and wastes are often considerably cheaper than petroleum, even in some cases negative as when a farmer has to pay “tipping fees” to haul waste away. An appendix to the NRC Report concludes that corn stover and other similar agricultural residues can be harvested, collected and delivered to the processing plant for only \$20 per ton. Unlike petroleum that arrives at a processing plant as extracted, biomass offers flexibility for optimization prior to processing. Optimization may be achieved through feedstock selection or altering feedstock characteristics (e.g. reduction in lignin content) and is expected to lead to future reductions in the cost for biobased products.

Corn stover constitutes a significant fraction of the agricultural residues produced in the United States each year and is likely to be a primary source of biomass for a nascent biobased products industry. After accounting for stover tilled under to replenish the soil, 100 million metric tons of corn stover are available, an amount that would generate 10 billion gallons of ethanol, approximately six times the amount of ethanol currently produced. The NRC Report concludes: “Sufficient biological wastes exist to supply the carbon for all 100 million metric tons of organic carbon-based chemicals consumed annually in the United States as well as to provide part of the nation’s fuel requirements.”

Processing costs remain the largest hurdle to cost-competitive biobased products. Ongoing research has demonstrated that significant cost reductions are possible in every step of biomass processing. Among the most exciting developments are new genetically modified enzymes capable of efficiently breaking down the cellulosic component of biomass. Although the cost of ethanol, for instance, is significantly higher than gasoline, there is no suggestion that biomass processing is more inherently complicated than petroleum refining. Rather, the chief reason for the high cost is that the world has invested far more effort toward developing efficient methods for processing petroleum.

Research is essential to produce the innovations and technical improvements that will lower the cost of biobased products. At

present, the U.S. is not funding a vigorous program in renewable technologies. Over the last two decades, the Department of Energy's research program has undergone a sharp decline, amounting to a fivefold funding drop in real terms since 1978. The 1997 PCAST Report called the biomass energy programs "substantially underfunded and not ambitious enough with regard to longer-term research and development."

Similarly, research and development of biobased products carried out by agencies within the Department of Agriculture is lagging. According to testimony from Secretary Glickman before this Committee, the USDA currently spends \$9 million annually on biofuels research and \$63 million annually for research on new industrial uses of biobased products. Both accounts have declined in real terms over the past four years. Moreover, agencies within the Department—including the Agricultural Research Service, Forest Service, and the Cooperative State Research, Education and Extension Program—have shifted funds from biomass programs under their jurisdiction into other areas. In many instances, programs administered by the Department of Agriculture designed to achieve other goals could also be used for biomass research or demonstration projects.

Because private sector investment often follows federal government commitment, industrial research and development has also reached new lows. These disturbing trends occur at a moment of national economic prosperity, when both time and resources exist for investing in the potential of biofuels. The Committee believes we cannot afford to wait for the next energy crisis to marshal our intellectual and industrial resources. Both departments should increase their institutional commitment toward making cost-competitive biomass processing a reality.

Despite two Executive Orders, coordination between the Department of Energy and the Department of Agriculture regarding biomass processing research has been inadequate. Failure of the two Federal agencies with principal responsibility in this area to work together has resulted in a duplication of research efforts. Ultimately, both agencies will have to join forces in a coherent fashion, together with other relevant Federal agencies, if biobased products are to result in significant societal benefits.

The Committee strongly believes that as the agency with prime responsibility for America's farming enterprise, the Department of Agriculture should assume a role equal and complementary to the Department of Energy's ongoing biomass research. Both agencies appear to split their biomass programs between basic research and commercialization projects. This has the effect of ignoring the critical middle of fundamental research that is focused on innovation and reduction in processing costs.

In the PCAST Report, a distinguished panel of scientists and industrial experts compared a business-as-usual approach to that offered by a future shaped by vigorous Federal investments in energy technology: "Under business-as-usual conditions, U.S. oil imports could increase from 8.5 million barrels per day at a cost of \$64 billion dollars in 1996 to nearly 16 million barrels per day at a cost of \$120 billion in 2030. With continued R&D to increase domestic production from marginal oil supplies, an aggressive ethanol pro-

gram (based on cellulosic biomass), and rapid development and penetration of the market by [efficient] light- and heavy-duty truck technologies, we estimate that this import could be reduced on the order of 6 million barrels per day oil import demand in 2030.”

The PCAST Report again succinctly frames the need for a focused Federal response: “a plausible argument can be made that the security of the United States is at least as likely to be imperiled in the first half of the next century by the consequences of inadequacies in the energy options available to the world as by inadequacies in the capabilities of U.S. weapons systems. It is striking that the Federal government spends about twenty times more R&D money on the latter problem than on the former.”

#### PURPOSE AND SUMMARY OF THE LEGISLATION

The National Sustainable Fuels and Chemicals Act is designed to effect significant reductions in biomass processing costs through research that will lead to a better understanding of the relevant fundamental chemical, biological and physical processes. The Committee believes that a more complete understanding of the underlying fundamentals will lead to technological innovation and the means to substantially affect scale-sensitive national objectives such as sustainable resource supply, reduced greenhouse gas emissions, healthier rural economies, and improved strategic security and trade balances.

The National Sustainable Fuels and Chemicals Act is an amendment to the National Agricultural Research, Extension, and Teaching Policy Act of 1977. At the heart of the legislation is a novel research Initiative, jointly administered by the Secretary of Agriculture and the Secretary of Energy, that authorizes research for the purpose of overcoming technical barriers to low cost biomass processing and gives priority funding to consortia composed of technical experts from academia, national laboratories, Federal and state research agencies, non-profit organizations and industry. Innovative in both purpose and structure, the Initiative will promote integrated research partnerships as the best means of overcoming technical challenges that span multiple research and engineering disciplines and of gaining better leverage from scarce Federal research funds. The bill authorizes \$49 million per year for six years for the Sustainable Fuels and Chemicals Research Initiative. Given the potential benefits in improved national security, rural development and greenhouse gas reductions, this expenditure represents a very reasonable investment in America’s future and is in line with recommendations from the 1997 PCAST report.

While the Department of Agriculture and Department of Energy are the two lead Federal agencies pursuing research and development of biomass processing, other Departments have important stakeholder roles. To bring coherence and coordination to the Federal effort in biobased industrial products, this Act mandates formation of the Sustainable Fuels and Chemicals Board consisting of senior officials of the Department of the Interior, the Environmental Protection Agency, the National Science Foundation, the Office of Science and Technology Policy and other relevant agencies. The Board will be co-chaired by points of contact designated by the Secretary of Agriculture and the Secretary of Energy.

To advise the Secretary of Agriculture and Secretary of Energy on the technical focus and direction of the request for proposals issued under the research Initiative, a Sustainable Fuels and Chemicals Technical Advisory Committee is established. Modeled on the National Defense Sciences Board, the Advisory Committee consists of experts from academia, prominent engineers and scientists, representatives from commodity trade organizations and environmental or conservation groups. As an independent panel of technical experts, the Sustainable Fuels and Chemicals Technical Advisory Committee will serve an important role in the strategic planning and oversight of research carried out under the Initiative.

#### SECTION-BY-SECTION ANALYSIS

##### *Sec. 1. Short title*

This Act may be cited as the “National Sustainable Fuels and Chemicals Act of 1999”.

##### *Sec. 2. Findings*

This section makes the following findings by Congress:

(1) conversion of biomass into biobased industrial products offers outstanding potential for benefit to the national interest through improved strategic security and balance of payments, healthier rural economies, improved environmental quality, near-zero net greenhouse gas emissions, technology export, and sustainable resource supply;

(2) biomass is widely available at prices that are competitive with low cost petroleum; and the key technical challenges to be overcome in order for biobased industrial products to be cost competitive are finding new technology and reducing the cost of technology for converting biomass into desired biobased industrial products;

(3) biobased fuels, such as ethanol, have the clear potential to be sustainable, low cost, and high performance fuels that are compatible with both current and future transportation systems and provide near zero net greenhouse gas emissions;

(4) biobased chemicals can provide functional replacements for essentially all organic chemicals that are currently derived from petroleum; and have the clear potential for environmentally benign product life cycles;

(5) biobased power can provide environmental benefits, promote rural economic development, and diversify energy resource options;

(6) many biomass feedstocks suitable for industrial processing show the clear potential for sustainable production, in some cases resulting in improved soil fertility and carbon sequestration;

(7) grain processing mills are biorefineries that produce a diversity of useful food, chemical, feed, and fuel products; and technologies that result in further diversification of the range of value-added biobased industrial products can meet a key need for the grain processing industry;

(8) cellulosic feedstocks are attractive because of their low cost and widespread availability; and research resulting in

cost-effective technology to overcome the recalcitrance of cellulosic biomass would allow biorefineries to produce fuels and bulk chemicals on a very large scale, with a commensurately large realization of the benefit described in paragraph (1);

(9) research into the fundamentals to understand important mechanisms of biomass conversion can be expected to accelerate the application and advancement of biomass processing technology by increasing the confidence and speed with which new technologies can be scaled up, and by giving rise to processing innovations based on new knowledge;

(10) the added utility of biobased industrial products developed through improvements in processing technology would encourage the design of feedstocks that would meet future needs more effectively;

(11) the creation of value-added biobased industrial products would create new jobs in construction, manufacturing, and distribution, as well as new higher-valued exports of products and technology;

(12) because of the relatively short-term time horizon characteristic of private sector investments, and because many benefits of biomass processing are in the national interest, it is appropriate for the Federal Government to provide precommercial investment in fundamental research and research-driven innovation in the biomass processing area; and such an investment would provide a valuable complement to ongoing and past governmental support in the biomass processing area; and

(13) several prominent studies, including studies by the President's Council of Advisors on Science and Technology and the National Research Council, support the potential for large research-driven advances in technologies for production of biobased industrial products as well as associated benefits; and document the need for a focused, integrated, and innovation-driven research effort to provide the appropriate progress in a timely manner.

### *Sec. 3. Conversion of biomass into biobased industrial products*

This section adds a new Subtitle N to the National Agricultural Research, Extension, and Teaching Policy Act of 1977.

#### *Sec. 1490. Definitions*

This section defines the following terms used in the Act:

(1) Advisory committee.—The term “Advisory Committee” means the Sustainable Fuels and Chemicals Technical Advisory Committee established by section 1490C.

(2) Biobased industrial product.—The term “biobased industrial product” means any power, fuel, feed, chemical product, or other consumer good derived from biomass.

(3) Biomass.—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, wood and wood residues, plants (including aquatic plants), grasses, agricultural crops, residues, fibers, and animal wastes and other waste materials.

(4) Board.—The term “Board” means the Sustainable Fuels and Chemicals Board established by section 1490B.

(5) Initiative.—The term “Initiative” means the Sustainable Fuels and Chemicals Research Initiative established under section 1490D.

(6) Point of contact.—The term “point of contact” means a point of contact designated under section 1490A(d).

(7) Processing.—The term “processing” means the derivation of biobased industrial products from biomass, including feedstock production; harvest and handling; pretreatment or thermochemical processing; fermentation; catalytic processing; product recovery; and coproduct production.

*Sec. 1490A. Cooperation and coordination in sustainable fuels and chemicals*

This section mandates cooperation and coordination between the Department of Agriculture and the Department of Energy. The Committee encourages both agencies to place a high priority upon biobased product research and development. Improved cooperation and coordination will result in a better focused national effort and avoid duplication of research and administrative costs. The motivating philosophy behind enhanced cooperative efforts of the agencies is to understand the key mechanisms underlying the biomass conversion process in order to develop new and cost-effective technologies that would result in large-scale commercial production of low-cost and sustainable biobased industrial products. In carrying out this joint effort, the agencies must ensure that biobased industrial products are developed in a manner that enhances their economic, energy security, and environmental benefits.

In order to facilitate the Departments of Agriculture and Energy acting in tandem with regard to biobased products, a senior official in each agency is designated as a “point of contact.” The points of contact shall assist in arranging interlaboratory and site-specific supplemental agreements for research, development, and demonstration projects relating to biobased industrial products; serve as cochairpersons of the Board; administer the Initiative; and respond in writing to each recommendation of the Advisory Committee.

*Sec. 1490B. Sustainable Fuels and Chemicals Board*

This section establishes the Sustainable Fuels and Chemicals Board to coordinate programs within and among departments and agencies of the Federal Government. The purpose of the Board is to promote the use of biobased industrial products and bring coherence to Federal strategic planning. The Board shall be co-chaired by the points of contact designated by the Department of Agriculture and the Department of Energy and meet at least quarterly. In addition to the cochairpersons, the board shall consist of senior officers of each of the following agencies who is appointed by the head of the agency and who has a rank that is equivalent to the points of contact: The Department of the Interior; The Environmental Protection Agency; The National Science Foundation; The Office of Science and Technology Policy; and at the option of the

Secretary of Agriculture and the Secretary of Energy, other members appointed by the Secretaries.

The Sustainable Fuels and Chemicals Board is to: (1) coordinate research, development, and demonstration activities relating to biobased industrial products between the Department of Agriculture and the Department of Energy and with other departments and agencies of the Federal Government; and (2) provide recommendations to the points of contact concerning administration of this subtitle.

The Committee encourages each of the agencies represented on the Board to provide funds for any purpose under this subtitle.

*Sec. 1490C. Sustainable Fuels and Chemicals Technical Advisory Committee*

This section establishes a Sustainable Fuels and Chemicals Technical Advisory Committee consisting of representatives from outside the Federal agencies so as to provide for an independent source of technical expertise. The Advisory Committee is to:

- (1) advise the Secretary of Agriculture, the Secretary of Energy, and the points of contact concerning the technical focus and direction of requests for proposals issued under the Initiative; and procedures for reviewing and evaluating the proposals;
- (2) facilitate consultations and partnerships among Federal and State agencies, agricultural producers, industry, consumers, the research community, and other interested groups to carry out program activities relating to the Initiative; and
- (3) evaluate and perform strategic planning on program activities relating to the Initiative.

The Advisory Committee shall consist of the following members appointed by the points of contact:

- (1) An individual affiliated with the biobased industrial products industry.
- (2) An individual affiliated with a college or university who has expertise in biobased industrial products.
- (3) 2 prominent engineers or scientists from government or academia who have expertise in biobased industrial products.
- (4) An individual affiliated with a commodity trade association.
- (5) An individual affiliated with an environmental or conservation organization.
- (6) An individual associated with State government who has expertise in biobased industrial products.
- (7) At the option of the points of contact, other members.

The Advisory Committee shall meet at least quarterly to: (1) advise the points of contact with respect to the Initiative; and (2) evaluate whether, and make recommendations in writing to the Board to ensure that: funds authorized for the Initiative are distributed and used in a manner that is consistent with the goals of the Initiative; the points of contact are funding proposals under this subtitle that are selected on the basis of merit, as determined by an independent panel of scientific and technical peers; and activities under this subtitle are carried out in accordance with this subtitle.

*Sec. 1490D. Sustainable fuels and chemicals research initiative*

This section describes the Sustainable Fuels and Chemicals Research Initiative that is central to The National Sustainable Fuels and Chemicals Act. Under the Initiative, competitively-awarded grants, contracts, and financial assistance are provided to eligible entities to carry out research on biobased industrial products.

The Committee intends that grants distributed under the Research Initiative achieve four important purposes:

- (1) stimulate collaborative activities by a diverse range of experts in all aspects of biomass processing for the purpose of conducting fundamental and innovation-targeted research and technology development;
- (2) enhance creative and imaginative approaches toward biomass processing that will serve to develop the next generation of advanced technologies making possible low cost and sustainable biobased industrial products;
- (3) strengthen the intellectual resources of the United States through the training and education of future scientists, engineers, managers, and business leaders in the field of biomass processing; and
- (4) promote integrated research partnerships among colleges, universities, national laboratories, Federal and State research agencies and the private sector as the best means of overcoming technical challenges that span multiple research and engineering disciplines and of gaining better leverage from limited Federal research funds.

To be eligible for a grant, contract, or assistance under the Initiative an applicant shall be: a college or university; a national laboratory; a Federal research agency; a State research agency; a private sector entity; a nonprofit organization; or a consortium of 2 or more of these entities.

Subsection (c)(2) details the administration of the initiative. Criteria listed in paragraph (2)(B) are important as they mandate how proposals are to be judged and prioritized. It is the belief of the Committee that only a national effort, focused on fundamental research and innovation, will be able to reduce the cost of biomass processing and hence lead to significant benefits in the national interest. This is especially relevant given the relatively small amount of funds authorized for the Initiative. Funding of many different proposals, without consideration of their potential to affect scale-sensitive national objectives, will result in what one leading researcher termed “a thousand flowers blooming” but perhaps not much in the way of reaching the goals of this Act.

(2) Administration—After consultation with the Board, the points of contact, on behalf of the Board, shall

- (A) publish annually 1 or more joint requests for proposals for grants, contracts, and assistance under this section;
- (B) establish a priority in grants, contracts, and assistance under this section for research that
  - (i) demonstrates potential for significant advances in biomass processing;
  - (ii) demonstrates potential to substantially impact scale-sensitive national objectives such as sustainable resource

supply, reduced greenhouse gas emissions, healthier rural economies, and improved strategic security and trade balances; and

(iii) would improve knowledge of important biomass processing systems that demonstrate potential for commercial applications;

(C) require that grants, contracts, and assistance under this section be awarded competitively, on the basis of merit, after the establishment of procedures that provide for scientific peer review by an independent panel of scientific and technical peers; and

(D) give preference to applications that:

(i) involve a consortia of experts from multiple institutions; and

(ii) encourage the integration of disciplines and application of the best technical resources.

Subparagraph (d) (Uses of Grants, Contracts, and Assistance) details three focus areas for the research effort. In broad terms the focus areas are identified as (1) overcoming the recalcitrance of cellulosic biomass, (2) development of biobased products and co-products and (3) research to ensure the economic and environmental benefits of biobased products. The three focus areas are fully supported by recommendations of the 1997 PCAST Report and the 1999 NRC report. In addition, the focus areas were drafted after extensive consultations with leading engineers, scientists, farm and agricultural concerns and environmental organizations.

(d) A grant, contract, or assistance under this section shall be used to conduct:

(1) research on process technology for overcoming the recalcitrance of biomass, including research on key mechanisms, advanced technologies, and demonstration test beds for

(A) feedstock pretreatment and hydrolysis of cellulose and hemicellulose, including new technologies for

(i) enhanced sugar yields;

(ii) lower overall chemical use;

(iii) less costly materials; and

(iv) cost reduction;

(B) development of novel organisms and other approaches to substantially lower the cost of cellulase enzymes and enzymatic hydrolysis, including dedicated cellulase production and consolidated bioprocessing strategies; and

(C) approaches other than enzymatic hydrolysis for overcoming the recalcitrance of cellulosic biomass;

(2) research on technologies for diversifying the range of products than can be efficiently and cost-competitively produced from biomass, including research on

(A) metabolic engineering of biological systems (including the safe use of genetically modified crops) to produce novel products, especially commodity products, or to increase product selectivity and tolerance, with a research priority on the development of biobased products that can compete in performance and cost with fossil-based products;

- (B) catalytic processing to convert intermediates of biomass processing into products of interest;
  - (C) separation technologies for cost-effective product recovery and purification;
  - (D) approaches other than metabolic engineering and catalytic conversion of intermediates of biomass processing;
  - (E) advanced biomass gasification technologies, including coproduction of power and heat as an integrated component of biomass processing, with the possibility of generating excess electricity for sale; and
  - (F) related research in advanced turbine and stationary fuel cell technology for production of electricity from biomass; and
- (3) research aimed at ensuring the environmental performance and economic viability of biobased industrial products and their raw material input of biomass when considered as an integrated system, including research on—
- (A) the analysis of, and strategies to enhance, the environmental performance and sustainability of biobased industrial products, including research on—
    - (i) accurate measurement and analysis of greenhouse gas emissions, carbon sequestration, and carbon cycling in relation to the life cycle of biobased industrial products and feedstocks with respect to other alternatives;
    - (ii) evaluation of current and future biomass resource availability;
    - (iii) development and analysis of land management practices and alternative biomass cropping systems that ensure the environmental performance and sustainability of biomass production and harvesting;
    - (iv) land, air, water, and biodiversity impacts of large-scale biomass production, processing, and use of biobased industrial products relative to other alternatives; and
    - (v) biomass gasification and combustion to produce electricity;
  - (B) the analysis of, and strategies to enhance, the economic viability of biobased industrial products, including research on
    - (i) the cost of the required process technology;
    - (ii) the impact of coproducts, including power and heat generation, on biobased industrial product price and large-scale economic viability; and
    - (iii) interactions between an emergent biomass refining industry and the petrochemical refining infrastructure; and
  - (C) the field and laboratory research related to feedstock production with the interrelated goals of enhancing the sustainability, increasing productivity, and decreasing the cost of biomass processing, including research on—
    - (i) altering biomass to make biomass easier and less expensive to process;

(ii) existing and new agricultural and energy crops that provide a sustainable resource for conversion to biobased industrial products while simultaneously serving as a source for coproducts such as food, animal feed, and fiber;

(iii) improved technologies for harvest, collection, transport, storage, and handling of crop and residue feedstocks; and

(iv) development of economically viable cropping systems that improve the conservation and restoration of marginal land.

(e) Authorization of Appropriations. Subsection (e) authorizes to be appropriated to carry out this section \$49,000,000 for each of fiscal years 2000 through 2005.

*Sec. 1490E. Administrative support and funds*

The Committee is aware of statutory limitations placed on the Department of Agriculture regarding administrative support of intergovernmental boards and advisory committees. Hence, to the extent administrative support and funds are not provided by other agencies, the Secretary of Energy shall provide administrative support and funds of the Department of Energy to the Board and the Advisory Committee as necessary. The Secretary of Agriculture and the heads of the agencies referred to in section 1490B(b)(3) and (b)(4) may, and are encouraged to, provide administrative support and funds of their respective agencies to the Board and the Advisory Committee.

*Sec. 1490F. Reports*

For each fiscal year that funds are made available to carry out this subtitle, the Secretary of Agriculture and the Secretary of Energy shall jointly transmit to Congress a detailed report on (1) the status and progress of the Initiative, including a certification from the Board that funds authorized for the Initiative are distributed and used in a manner that is consistent with the goals of the Initiative; and (2) the general status of cooperation and research efforts carried out by each Secretary with respect to sustainable fuels, chemicals, and electricity derived from biomass, including a certification from the Board that the points of contact are funding proposals that are selected on the basis of merit, as determined by an independent panel of scientific and technical peers.

*Sec. 1490G. Authorization of appropriations for ethanol research pilot plant*

There are authorized to be appropriated to construct a Department of Agriculture corn-based ethanol research pilot plant a total of \$14,000,000 for fiscal year 2000 and subsequent fiscal years

*Sec. 4. Use of conservation reserve land for recovery of biomass used in energy production*

Under this section, farmers would be allowed to produce switchgrass or other biomass crops, on a demonstration project basis, on land enrolled in the Conservation Reserve Program. Proposed projects would be subject to approval by the Secretary. Bio-

mass crops grown on Conservation Reserve Program land under this demonstration authority may be used for no commercial purpose other than the generation of energy, and the Secretary may reduce a producer's contract payment under the Conservation Reserve Program. The Secretary is directed to set standards for the growing and harvesting of biomass crops to ensure that any environmental and wildlife impacts are minimized.

The Committee expects the Secretary to establish an application procedure and approval criteria for proposed projects authorized by this section. Among other requirements established by the Secretary, project proposals should identify: enough land to meet the minimum goals of the project; owners of land under current Conservation Reserve Program contracts who will participate and the specific acres they will make available for the project; and project partners, including the expected end-user(s) of the biomass energy and at least one commercial entity prepared to enter into contractual relationships with land owners.

The Committee urges the Secretary to establish appropriate project parameters to ensure that the type of biomass crops grown and the manner in which they are grown and harvested result in a minimum of interference with wildlife protection and the other environmental goals of the Conservation Reserve Program. Finally, the Committee intends that participation by a land owner in a biomass project authorized under this section shall not preclude or otherwise prejudice a future Conservation Reserve Program enrollment application by that owner, and urges the Secretary to consider establishing a continuous sign-up procedure for such owners to give successful biomass projects maximum flexibility in expanding their acreage.

#### LEGISLATIVE HISTORY AND VOTES IN THE COMMITTEE

The Senate Committee on Agriculture, Nutrition, and Forestry on May 27, 1999, held a hearing on "The New Petroleum:" S. 935 The National Sustainable Fuels and Chemicals Act. Agriculture Secretary Dan Glickman and Assistant Secretary for Energy Efficiency and Renewable Energy Dan Reicher represented the Administration. Two subsequent panels then testified, the first composed of representatives from farm groups and technical experts while the final panel featured environmental advocates and representatives from industry.

Secretary of Agriculture Dan Glickman testified in support of S. 935. USDA currently devotes \$9 million per annum on biofuels research and \$63 million per annum toward development of new biobased products. Secretary Glickman noted that production of ethanol, a well-known biobased product, has risen in twenty years from virtually nothing to 1.4 billion gallons per year, consuming 6–8% of U.S. corn supply. The Secretary testified that S. 935 would reinforce the commitment of Federal agencies to sustainable fuels and chemicals research and would channel Federal funds so that they could be spent efficiently and leveraged with other funds. The Secretary indicated that the Administration hoped to accomplish a number of the goals of the bill through an Executive Order. Secretary Glickman supported Senator Harkin's proposal allowing for pilot projects designed to demonstrate the feasibility of using bio-

mass grown on Conservation Reserve Program and other lands for production of energy.

Assistant Secretary of Energy for Energy Efficiency and Renewable Energy Dan H. Reicher gave an overview of the Administration's integrated bioenergy initiative. Currently the bioenergy industry is small and fragmented, with chemical companies focused on biomass as a source of specialty and commodity chemicals, power companies dedicated to production of electricity, the ethanol industry producing ethanol from corn, the soybean industry developing biodiesel fuel and the forest products industry producing heat energy as well as developing gaseous fuels from biomass. Governmental efforts are also fragmented and Assistant Secretary Reicher testified that S. 935 would be an important first step toward an integrated biomass industry. He also recommended that the bill be complemented by policies to promote bioenergy through the use of the tax code, loan programs, environmental regulation, and increased appropriations. This year DOE requested \$117 million for bioenergy research and development. Assistant Secretary Reicher recommended that the bill place greater emphasis on biopower and that certain sections of the bill be made somewhat less prescriptive.

Dean Kleckner, President of the American Farm Bureau Federation, testified in support of S. 935. He also expressed support for continuing the renewable alcohol tax credits and for ensuring that the development of a cellulosic biomass ethanol industry occur harmoniously with the development of the corn-based ethanol industry. He pointed out that for the farmer—whether growing corn, soybeans, switchgrass or trees—what counts is profit per acre and the possibility of turning biomass into a commodity will increase the farmer's profit per acre.

Professor Bruce Dale of Michigan State University summarized a recently issued Report of the National Research Council of the National Academy of Sciences on "Biobased Industrial Products: Opportunities for Research and Commercialization." The Report concluded that biobased raw materials costs and petroleum costs are already roughly equivalent, with crude oil at \$18 per barrel being energy equivalent to corn at \$2.75 per bushel or about \$110 per ton for each. Furthermore, there already exist low-cost renewable biobased materials available to us which can be economically harvested, collected and transported to a biorefinery. Thus, the key to making economical biobased products is reducing processing costs as opposed to raw material costs.

Another key element that will lower the cost of bioabsed products is the development of advanced biorefineries that would produce a wide variety of co-products including fuels. A complete life cycle analysis of biobased products must be done to ensure sustainability. Professor Dale asserts that careful integration of research efforts will be necessary to achieve the goals of the act and make the best use of taxpayer funds. Such integrated, goal-directed work is best carried out in research centers or consortia. Professor Dale supports S. 935 because it recognized all of these key elements.

Mike Shuter of Frankton, Indiana testified on behalf of the National Corn Growers Association and the American Soybean Association. Mr. Shuter asserted that S. 935 is a good first start toward a biobased economy. He favored developing biomass processing and

technologies not just for cellulosic biomass but for all plant-based resources that can be used for fuels and basic chemical feedstocks. Mr. Shuter urged support for Federal biodiesel research and for the research priorities laid down in the technology road map accompanying the Plant/Crop Renewables 2020 Vision. Mr. Shuter favored an authorization for appropriations for a \$14 million corn to ethanol pilot plant so that small corn processors could band together to form partnerships with others to pursue development and commercialization of new technologies that will improve corn processing. Mr. Shuter testified that the hydrolysis, fermentation and separation technologies developed by the pilot plant could be transferred directly to other crops and cellulosic materials.

John Sellers, a farmer from Corydon, Iowa testified that the development of biomass and ethanol could play a very important role in providing sustainable economic uses for marginal cropland as well as contributing to restoring soils, improving water quality, reducing net atmospheric carbon emissions and establishing domestic energy supplies. Mr. Sellers produces switchgrass for the Chariton Valley Biomass Project in southern Iowa. This is a demonstration project designed to co-fire 5,000 tons of switchgrass with coal. The project uses a 4000 acre supply of switchgrass and is supported by the Department of Energy and Department of Agriculture through the Biomass Power for Rural Development Initiative.

Professors Lee Lynd and Charles Wyman of Dartmouth College testified that widely available biomass feedstocks are available. They have published a study which concludes that at \$40 delivered dry ton the cost of cellulosic biomass is equivalent on an energy basis to oil at \$12.50 per barrel and that ethanol from wood chips could be produced for \$0.50 cents per gallon if specified, foreseeable advances in biomass processing can be accomplished. They support S. 935 because the bill identifies three strategically well-chosen research priorities—overcoming the recalcitrance of cellulosic biomass, product diversification and evaluation of sustainability and economic viability. They also supported the bill's emphasis on applied fundamentals, that is, on understanding the underlying phenomena operative in biomass conversion processing. With this emphasis, S. 935 contrasts with past Federal government support for biomass R & D, that has been mostly targeted to demonstration and commercialization projects.

Jeff Fiedler of the Natural Resources Defense Council strongly endorsed S. 935. Although the environmental performance of biomass technologies is generally far superior to conventional fossil-based fuels and chemical feedstocks, he urged that the bill explicitly include research on the positive and negative aspects of biomass technologies in all their aspects so that there will be no surprises. Mr. Fiedler also recommended that environmental benefits be included in the selection criteria for grants, contracts and assistance under the bill. Realizing the potential of biomass will require both long-term fundamental research and pre-commercial deployment of promising technologies as called for by S. 935.

Steve Clemmer of the Union of Concerned Scientists strongly supported S. 935 for two reasons: first, additional research and development is needed to support the commercialization of new energy crops and advanced technologies for biobased fuels, power,

chemicals and heat; secondly, Federal investment is needed because there are significant public benefits to be captured from increased biomass use. These include economic, national energy security, environmental and public health benefits. Federal investment has a demonstrated record of success. For example, in 1997, it cost a third of what it did in 1980 to produce a gallon of ethanol. Mr. Clemmer recommended that the bill place a greater emphasis on biopower, ensure adequate studies are performed on the environmental impacts of increasing biomass use and support additional R&D to identify and create sustainable markets for biomass use. He also urged support for minimum renewable content standards, extending the tax credit for wind and biomass and expanding the credit to include other biomass resources.

Karl J. Sanford of Genencor International spoke of the need and great potential for moving from a fossil-carbon system centered around petroleum to a renewable carbon system centered around plants. The bulk of the world's supply of fossil carbon is outside of the United States. Hence its use creates balance of payment and national security problems for America. Fossil carbon is non-renewable and its use irrevocably increases the amount of carbon in the environment. By contrast, carbohydrates from plant matter are renewable resources abundant in the United States and around the world. Biobased industrial products have the potential to replace all organic chemicals that are derived from oil, providing enormous environmental, national security and rural economic benefits. But we have a long way to go. However, advances in biotechnology can enable us to reach our goals. The Biotechnology Industry Association endorses S. 935.

Robert Dorsch of DuPont Central Research testified to the economic importance of the chemical industry, which employs over one million Americans at wages that are 133% above the average manufacturing wage. However, the use of fossil carbon as the sole feedstock for fuels and chemicals is exposing us to environmental risk. Dr. Dorsch asserted that the petrochemical and biobased approaches to making fuels and chemicals ought to be seen as complementary rather than rival approaches. He urged that S. 935 recognize not just the need to break down cellulosic materials, but also to improve the catalytic processes that will use that material and consider a broad range of approaches toward the conversion of biomass to finished chemicals so that the farmer can increase his value per acre and the supply/demand balance for petroleum products will not dominate the price of materials to the extent that it does today.

#### COMMITTEE VOTE

The Committee met in open session on Thursday, July 29, 1999, to mark up this bill. An amendment in the nature of a substitute was agreed to by voice vote. The Committee accepted an amendment by voice vote offered by Senator Harkin to allow use of Conservation Reserve Land for collection of biomass used in energy production under very limited circumstances.

The Committee accepted an amendment by recorded vote (9 yeas and 8 nays) offered by Senator Fitzgerald authorizing \$14 mil-

lion for construction of an Ethanol Research Pilot Plant. The roll-call vote was as follows:

YEAS	NAYS
Mr. Conrad (proxy)	Mr. Leahy (proxy)
Mr. Daschle	Mr. Baucus (proxy)
Mr. Johnson	Mr. Kerrey
Ms. Lincoln	Mr. Harkin
Mr. McConnell (proxy)	Mr. Helms (proxy)
Mr. Roberts (proxy)	Mr. Cochran
Mr. Fitzgerald	Mr. Coverdell (proxy)
Mr. Grassley	Mr. Lugar
Mr. Craig	

The Committee then ordered that the bill be favorably reported by a voice vote.

#### COST ESTIMATE

In accordance with paragraph 11(a) of rule XXVI of the Standing Rules of the Senate, the following letter has been received from the Congressional Budget Office regarding the budgetary impact of the bill:

U.S. CONGRESS,  
CONGRESSIONAL BUDGET OFFICE,  
*Washington, DC., August 4, 1999.*

Hon. RICHARD G. LUGAR,  
*Chairman, Committee on Agriculture, Nutrition, and Forestry,  
U.S. Senate, Washington, DC.*

DEAR MR. CHAIRMAN: The Congressional Budget Office has prepared the enclosed cost estimate for S. 935, the National Sustainable Fuels and Chemicals Act of 1999.

If you wish further details on this estimate, we will be pleased to provide them. The CBO staff contact is Jim Langley.

Sincerely,

BARRY B. ANDERSON  
(For Dan Crippen, Director).

Enclosure.

#### *S. 935—National Sustainable Fuels and Chemicals Act of 1999*

Summary: S. 935 would amend the National Agricultural Research, Extension, and Teaching Policy Act of 1977 to authorize research to promote the conversion of biomass into biobased industrial products. The bill would establish a Sustainable Fuels and Chemicals Board to coordinate programs and a Sustainable Fuels and Chemicals Technical Advisory Committee to advise the board. S. 935 would create a Sustainable Fuels and Chemicals Research Initiative to award competitive grants, contracts, and other financial assistance to research entities, and it would authorize the appropriation of \$49 million a year over the 2000–2005 period. The bill also would authorize the appropriation of \$14 million to the U.S. Department of Agriculture (USDA) in 2000 to construct a pilot plant for corn-based ethanol research. Assuming appropriation of the authorized amounts, CBO estimates that implementing the bill

would cost \$274 million over the 2000–2004 period (and an additional \$34 million after 2004).

S. 935 would permit the use of land in the Conservation Reserve for recovery of biomass used in energy production if producers agree to a reduction in their annual Conservation Reserve rental payment. Because the bill would affect direct spending, pay-as-you-go procedures would apply. CBO estimates that direct spending would decrease by less than \$250,000 a year.

S. 935 contains on intergovernmental or private-sector mandates as defined in the Unfunded Mandates Reform Act (UMRA) and would impose no costs on state, local, or tribal governments.

Estimated cost to the federal government: For the purposes of this estimate, CBO assumes that all amounts authorized will be appropriated by the start of each fiscal year. The estimated budgetary impact of S. 935 is shown in the following table. The costs of this legislation fall within budget function 350 (agriculture).

[By fiscal year, in millions of dollars]

	1999	2000	2001	2002	2003	2004
SPENDING SUBJECT TO APPROPRIATION						
Spending under current law:						
Estimated authorization level <sup>1</sup> .....	481	491	502	512	524	535
Estimated outlays .....	456	476	495	505	516	527
Proposed changes:						
Estimated authorization level .....	0	63	49	49	49	49
Estimated outlays .....	0	26	47	51	52	49
Spending under S. 935:						
Estimated authorization level .....	481	554	551	561	573	584
Estimated outlays .....	456	502	542	556	568	576

<sup>1</sup>The 1999 level is the amount appropriated for that year for Cooperative State Research, Education, and Extension Service Research and Education Activities. The amounts shown for 2000 through 2004 are CBO's baseline projections, assuming annual adjustments for anticipated inflation.

**Basis of estimate:** The bill would authorize the appropriation of \$63 million in 2000 and \$49 million each year for 2001 through 2005. Such funds would likely be spent under USDA's program for Cooperative State Research, Education, and Extension Services Research and Education Activities (CSREES). Estimated outlays for the authorized amounts are based on historical spending patterns for the CSREES program.

In addition to providing new discretionary spending, S. 935 would affect direct spending for USDA's Conservation Reserve Program (CRP). CBO estimates that those effects would be less than \$250,000 a year because implementing the legislation would affect only a small amount of land covered by the CRP and would make only a small change in annual payments on such land.

**Spending subject to appropriation:** S. 935 would amend title XIV of the National Agricultural Research, Extension, and Teaching Policy Act of 1977 (7 U.S.C. 3101, et seq.) to add new provisions regarding conversion of biomass into bio-based industrial products. The Secretary of Agriculture and the Secretary of Energy would be required to coordinate policies and procedures that promote research and development of bio-based industrial products. Each department would designate as a point of contact for related activities an official who would be appointed by the President with the advice and consent of the Senate. The bill would establish a Sustainable

Fuels and Chemicals Board to coordinate programs and award research grants and other authorized financial assistance. The bill would also establish a Sustainable Fuels and Chemicals Research Advisory Committee to advise the board and to facilitate consultations and partnerships among eligible parties. The Secretaries of Agriculture and Energy would have to submit annual reports to the Congress on their related activities. The Department of Energy would provide administrative support and funds for the board and the advisory committee. CBO estimates that such administrative support would cost less than \$500,000 a year, subject to the availability of appropriated funds.

Direct spending: S. 935 would amend the Food Security Act of 1985 (16 U.S.C. 3822(a)(7)) to permit the use of CRP land for recovery of biomass used in energy production. The provisions would be limited to owners and operators in not more than six states and would be subject to certain conditions regarding number of acres in each Crop Reporting District, number of acres per contract, and subsequent use of the harvested crop. Owners and operators who harvest crops on CRP land for recovery of biomass would be required to forgo a portion of their annual CRP rental payment. The amount of the reduction in payment would be determined by the Secretary of Agriculture, except that the reduction must not prevent the producer from realizing a reasonable economic return.

Based on information from USDA, CBO estimates that few acres would be harvested for recovery of biomass used in energy production. The lack of easily accessible processing facilities and the cost of harvesting biomass crops would likely result in relatively few owners or operators participating in this program. For those who did participate, the reduction in annual CRP payment would have to be relatively small to permit an economic return. USDA estimates that such a payment reduction would be around \$5 an acre, or around 10 percent of the average CRP rental payment. CBO estimates that initially around 5,000 acres of CRP land would be harvested under these provisions, increasing by about 5,000 acres a year as new facilities are constructed and new research initiatives come to fruition.

Pay-as-you-go-considerations: The Balanced Budget and Emergency Deficit Control Act sets up pay-as-you-go procedures for legislation affecting direct spending or receipts. S. 935 would reduce outlays for direct spending programs by less than \$250,000 a year. The bill would not affect governmental receipts.

Estimated impact on State, local, and tribal governments: S. 935 contains no intergovernmental mandates as defined in UMRA and would impose no costs on state, local, or tribal governments. State agencies and public universities could receive some of the research funds authorized by this bill.

Estimated impact on the private sector: This bill contains no new private-sector mandates as defined in UMRA.

Estimated prepared by: Jim Langley.

Estimate approved by: Paul N. Van de Water, Assistant Director for Budget Analysis.

## EVALUATION OF REGULATORY IMPACT

In compliance with paragraph 11(b) of rule XXVI of the Standing Rules of the Senate, the following evaluation is made concerning the regulatory impact of enacting this legislation: The Committee has determined that this legislation will have no detrimental impact on the private sector as a result of regulatory requirements. Slight modifications to existing grant regulations may be required in order to administer the program. Additionally, the use of conservation reserve land for recovery of biomass authorized in this bill is strictly on a voluntary basis and any regulatory impact on landowners would be solely at their own behest. We expect a positive economic impact, no adverse impact on the personal privacy of the individuals affected by the legislation, and no amount of additional paperwork resulting from enactment of the bill.

## CHANGES IN EXISTING LAW

In compliance with paragraph 12 of rule XXVI of the Standing Rules of the Senate, changes in existing law made in the bill, as reported are shown as follows (existing law proposed to be omitted is stricken, new material is printed in italic, existing law in which no change is proposed is shown in roman):

**NATIONAL AGRICULTURAL RESEARCH, EXTENSION, AND TEACHING POLICY ACT OF 1977**

\* \* \* \* \*

***Subtitle N—Conversion of Biomass into Biobased Industrial Products***

**SEC. 1490. DEFINITIONS.**

*In this subtitle:*

(1) *ADVISORY COMMITTEE.*—The term ‘Advisory Committee’ means the Sustainable Fuels and Chemicals Technical Advisory Committee established by section 1490C.

(2) *BIOBASED INDUSTRIAL PRODUCT.*—The term ‘biobased industrial product’ means any power, fuel, feed, chemical product, or other consumer good derived from biomass.

(3) *BIOMASS.*—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, wood and wood residues, plants (including aquatic plants), grasses, agricultural crops, residues, fibers, and animal wastes and other waste materials.

(4) *BOARD.*—The term ‘Board’ means the Sustainable Fuels and Chemicals Board established by section 1490B.

(5) *INITIATIVE.*—The term ‘Initiative’ means the Sustainable Fuels and Chemicals Research Initiative established under section 1490D.

(6) *POINT OF CONTACT.*—The term ‘point of contact’ means a point of contact designated under section 1490A(d).

(7) *PROCESSING.*—The term ‘processing’ means the derivation of biobased industrial products from biomass, including—

- (A) feedstock production;
- (B) harvest and handling;
- (C) pretreatment or thermochemical processing;
- (D) fermentation;
- (E) catalytic processing;
- (F) product recovery; and
- (G) coproduct production.

**SEC. 1490A. COOPERATION AND COORDINATION IN SUSTAINABLE FUELS AND CHEMICALS RESEARCH.**

(a) *IN GENERAL.*—The Secretary of Agriculture and the Secretary of Energy shall cooperate with respect to, and coordinate, policies and procedures that promote research and development leading to the production of biobased industrial products.

(b) *PURPOSE.*—The purpose of the cooperation and coordination shall be to—

(1) understand the key mechanisms underlying the recalcitrance of biomass for conversion into biobased industrial products;

(2) develop new and cost-effective technologies that would result in large-scale commercial production of low cost and sustainable biobased industrial products;

(3) ensure that biobased industrial products are developed in a manner that enhances their economic, energy security, and environmental benefits; and

(4) promote the development and use of agricultural and energy crops for conversion into biobased industrial products.

(c) *AREAS.*—In carrying out this subtitle, the Secretary of Agriculture and the Secretary of Energy, in consultation with heads of appropriate departments and agencies, shall promote research and development to—

(1) advance the availability and widespread use of energy efficient, economically competitive, and environmentally sound biobased industrial products in a manner that is consistent with the goals of the United States relating to sustainable and secure supplies of food, chemicals, and fuel;

(2) ensure full consideration of Federal land and land management programs as potential feedstock resources for biobased industrial products; and

(3) assess the environmental, economic, and social impact of production of biobased industrial products from biomass on a large scale.

(d) *POINTS OF CONTACT.*—

(1) *IN GENERAL.*—To coordinate research and development programs and activities relating to biobased industrial products that are carried out by their respective Departments—

(A) the Secretary of Agriculture shall designate, as the point of contact for the Department of Agriculture, an officer of the Department of Agriculture appointed by the President to a position in the Department before the date of the designation, by and with the advice and consent of the Senate; and

(B) the Secretary of Energy shall designate, as the point of contact for the Department of Energy, an officer of the Department of Energy appointed by the President to a position in the Department before the date of the designation, by and with the advice and consent of the Senate.

(2) DUTIES.—The points of contact shall jointly—

(A) assist in arranging interlaboratory and site-specific supplemental agreements for research, development, and demonstration projects relating to biobased industrial products;

(B) serve as cochairpersons of the Board;

(C) administer the Initiative; and

(D) respond in writing to each recommendation of the Advisory Committee made under section 1490C(c)(2).

**SEC. 1490B. SUSTAINABLE FUELS AND CHEMICALS BOARD.**

(a) ESTABLISHMENT.—There is established the Sustainable Fuels and Chemicals Board to coordinate programs within and among departments and agencies of the Federal Government for the purpose of promoting the use of biobased industrial products by—

(1) maximizing the benefits deriving from Federal grants and assistance; and

(2) bringing coherence to Federal strategic planning.

(b) MEMBERSHIP.—The Board shall consist of:

(1) The point of contact of the Department of Agriculture designated under section 1490A(d)(1)(A), who shall serve as cochairperson of the Board.

(2) The point of contact of the Department of Energy designated under section 1490A(d)(1)(B), who shall serve as cochairperson of the Board.

(3) A senior officer of each of the following agencies who is appointed by the head of the agency and who has a rank that is equivalent to the points of contact:

(A) The Department of the Interior.

(B) The Environmental Protection Agency.

(C) The National Science Foundation.

(D) The Office of Science and Technology Policy.

(4) At the option of the Secretary of Agriculture and the Secretary of Energy, other members appointed by the Secretaries (after consultation with members described in paragraphs (1) through (3)).

(c) DUTIES.—The Board shall—

(1) coordinate research, development, and demonstration activities relating to biobased industrial products—

(A) between the Department of Agriculture and the Department of Energy; and

(B) with other departments and agencies of the Federal Government; and

(2) provide recommendations to the points of contact concerning administration of this subtitle.

(d) FUNDING.—Each agency represented on the Board is encouraged to provide funds for any purpose under this subtitle.

(e) MEETINGS.—The Board shall meet at least quarterly to enable the Board to carry out the duties of the Board under subsection (c).

**SEC. 1490C. SUSTAINABLE FUELS AND CHEMICALS TECHNICAL ADVISORY COMMITTEE.**

(a) **ESTABLISHMENT.**—*There is established the Sustainable Fuels and Chemicals Technical Advisory Committee to—*

(1) *advise the Secretary of Agriculture, the Secretary of Energy, and the points of contact concerning—*

(A) *the technical focus and direction of requests for proposals issued under the Initiative; and*

(B) *procedures for reviewing and evaluating the proposals;*

(2) *facilitate consultations and partnerships among Federal and State agencies, agricultural producers, industry, consumers, the research community, and other interested groups to carry out program activities relating to the Initiative; and*

(3) *evaluate and perform strategic planning on program activities relating to the Initiative.*

(b) **MEMBERSHIP.**—*The Committee shall consist of the following members appointed by the points of contact:*

(1) *An individual affiliated with the biobased industrial products industry.*

(2) *An individual affiliated with a college or university who has expertise in biobased industrial products.*

(3) *2 prominent engineers or scientists from government or academia who have expertise in biobased industrial products.*

(4) *An individual affiliated with a commodity trade association.*

(5) *An individual affiliated with an environmental or conservation organization.*

(6) *An individual associated with State government who has expertise in biobased industrial products.*

(7) *At the option of the points of contact, other members.*

(c) **DUTIES.**—*The Advisory Committee shall—*

(1) *advise the points of contact with respect to the Initiative; and*

(2) *evaluate whether, and make recommendations in writing to the Board to ensure that—*

(A) *funds authorized for the Initiative are distributed and used in a manner that is consistent with the goals of the Initiative;*

(B) *the points of contact are funding proposals under this subtitle that are selected on the basis of merit, as determined by an independent panel of scientific and technical peers; and*

(C) *activities under this subtitle are carried out in accordance with this subtitle.*

(d) **MEETINGS.**—*The Advisory Committee shall meet at least quarterly to enable the Advisory Committee to carry out the duties of the Advisory Committee under subsection (c).*

**SEC. 1490D. SUSTAINABLE FUELS AND CHEMICALS RESEARCH INITIATIVE.**

(a) **IN GENERAL.**—*The Secretary of Agriculture and the Secretary of Energy, acting through their respective points of contact and in consultation with the Board, shall establish and carry out a Sustainable Fuels and Chemicals Research Initiative under which com-*

*petitively-awarded grants, contracts, and financial assistance are provided to, or entered into with, eligible entities to carry out research on biobased industrial products.*

*(b) PURPOSES.—The purposes of grants, contracts, and assistance under this section shall be to—*

*(1) stimulate collaborative activities by a diverse range of experts in all aspects of biomass processing for the purpose of conducting fundamental and innovation-targeted research and technology development;*

*(2) enhance creative and imaginative approaches toward biomass processing that will serve to develop the next generation of advanced technologies making possible low cost and sustainable biobased industrial products;*

*(3) strengthen the intellectual resources of the United States through the training and education of future scientists, engineers, managers, and business leaders in the field of biomass processing; and*

*(4) promote integrated research partnerships among colleges, universities, national laboratories, Federal and State research agencies, and the private sector as the best means of overcoming technical challenges that span multiple research and engineering disciplines and of gaining better leverage from limited Federal research funds.*

*(c) ELIGIBLE ENTITIES.—*

*(1) IN GENERAL.—To be eligible for a grant, contract, or assistance under this section, an applicant shall be—*

*(A) a college or university;*

*(B) a national laboratory;*

*(C) a Federal research agency;*

*(D) a State research agency;*

*(E) a private sector entity;*

*(F) a nonprofit organization; or*

*(G) a consortium of 2 or more entities described in subparagraphs (A) through (E).*

*(2) ADMINISTRATION.—After consultation with the Board, the points of contact, on behalf of the Board, shall—*

*(A) publish annually 1 or more joint requests for proposals for grants, contracts, and assistance under this section;*

*(B) establish a priority in grants, contracts, and assistance under this section for research that—*

*(i) demonstrates potential for significant advances in biomass processing;*

*(ii) demonstrates potential to substantially impact scale-sensitive national objectives such as sustainable resource supply, reduced greenhouse gas emissions, healthier rural economies, and improved strategic security and trade balances; and (iii) would improve knowledge of important biomass processing systems that demonstrate potential for commercial applications;*

*(C) require that grants, contracts, and assistance under this section be awarded competitively, on the basis of merit, after the establishment of procedures that provide for sci-*

entific peer review by an independent panel of scientific and technical peers; and

(D) give preference to applications that—

(i) involve a consortia of experts from multiple institutions; and

(ii) encourage the integration of disciplines and application of the best technical resources.

(d) *USES OF GRANTS, CONTRACTS, AND ASSISTANCE.*—A grant, contract, or assistance under this section shall be used to conduct—

(1) research on process technology for overcoming the recalcitrance of biomass, including research on key mechanisms, advanced technologies, and demonstration test beds for—

(A) feedstock pretreatment and hydrolysis of cellulose and hemicellulose, including new technologies for—

(i) enhanced sugar yields;

(ii) lower overall chemical use;

(iii) less costly materials; and

(iv) cost reduction;

(B) development of novel organisms and other approaches to substantially lower the cost of cellulase enzymes and enzymatic hydrolysis, including dedicated cellulase production and consolidated bioprocessing strategies; and

(C) approaches other than enzymatic hydrolysis for overcoming the recalcitrance of cellulosic biomass;

(2) research on technologies for diversifying the range of products than can be efficiently and cost-competitively produced from biomass, including research on—

(A) metabolic engineering of biological systems (including the safe use of genetically modified crops) to produce novel products, especially commodity products, or to increase product selectivity and tolerance, with a research priority on the development of biobased products that can compete in performance and cost with fossil-based products;

(B) catalytic processing to convert intermediates of biomass processing into products of interest;

(C) separation technologies for cost-effective product recovery and purification;

(D) approaches other than metabolic engineering and catalytic conversion of intermediates of biomass processing;

(E) advanced biomass gasification technologies, including coproduction of power and heat as an integrated component of biomass processing, with the possibility of generating excess electricity for sale; and

(F) related research in advanced turbine and stationary fuel cell technology for production of electricity from biomass; and

(3) research aimed at ensuring the environmental performance and economic viability of biobased industrial products and their raw material input of biomass when considered as an integrated system, including research on—

(A) the analysis of, and strategies to enhance, the environmental performance and sustainability of biobased industrial products, including research on—

(i) accurate measurement and analysis of greenhouse gas emissions, carbon sequestration, and carbon cycling in relation to the life cycle of biobased industrial products and feedstocks with respect to other alternatives;

(ii) evaluation of current and future biomass resource availability;

(iii) development and analysis of land management practices and alternative biomass cropping systems that ensure the environmental performance and sustainability of biomass production and harvesting;

(iv) land, air, water, and biodiversity impacts of large-scale biomass production, processing, and use of biobased industrial products relative to other alternatives; and

(v) biomass gasification and combustion to produce electricity;

(B) the analysis of, and strategies to enhance, the economic viability of biobased industrial products, including research on—

(i) the cost of the required process technology;

(ii) the impact of coproducts, including power and heat generation, on biobased industrial product price and large-scale economic viability; and

(iii) interactions between an emergent biomass refining industry and the petrochemical refining infrastructure; and

(C) the field and laboratory research related to feedstock production with the interrelated goals of enhancing the sustainability, increasing productivity, and decreasing the cost of biomass processing, including research on—

(i) altering biomass to make biomass easier and less expensive to process;

(ii) existing and new agricultural and energy crops that provide a sustainable resource for conversion to biobased industrial products while simultaneously serving as a source for coproducts such as food, animal feed, and fiber;

(iii) improved technologies for harvest, collection, transport, storage, and handling of crop and residue feedstocks; and

(iv) development of economically viable cropping systems that improve the conservation and restoration of marginal land.

(e) **AUTHORIZATION OF APPROPRIATIONS.**—In addition to any other amounts that are authorized to be appropriated, there are authorized to be appropriated to carry out this section \$49,000,000 for each of fiscal years 2000 through 2005.

**SEC. 1490E. ADMINISTRATIVE SUPPORT AND FUNDS.**

(a) **IN GENERAL.**—To the extent administrative support and funds are not provided by other agencies under subsection (b), the Secretary of Energy shall provide such administrative support and funds of the Department of Energy to the Board and the Advisory

Committee as are necessary to enable the Board and the Advisory Committee to carry out this subtitle.

(b) *OTHER AGENCIES.*—The Secretary of Agriculture and the heads of the agencies referred to in section 1490B(b)(3) and (b)(4) may, and are encouraged to, provide administrative support and funds of their respective agencies to the Board and the Advisory Committee.

**SEC. 1490F. REPORTS.**

For each fiscal year that funds are made available to carry out this subtitle, the Secretary of Agriculture and the Secretary of Energy shall jointly transmit to Congress a detailed report on—

(1) the status and progress of the Initiative, including a certification from the Board that funds authorized for the Initiative are distributed and used in a manner that is consistent with the goals of the Initiative; and

(2) the general status of cooperation and research efforts carried out by each Secretary with respect to sustainable fuels, chemicals, and electricity derived from biomass, including a certification from the Board that the points of contact are funding proposals that are selected on the basis of merit, as determined by an independent panel of scientific and technical peers.

**SEC. 1490G. AUTHORIZATION OF APPROPRIATIONS FOR ETHANOL RESEARCH PILOT PLANT.**

There are authorized to be appropriated to construct a Department of Agriculture corn-based ethanol research pilot plant a total of \$14,000,000 for fiscal year 2000 and subsequent fiscal years.

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**FOOD SECURITY ACT OF 1985**

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Section 1232(a)(7) not to conduct any harvesting or grazing, nor otherwise make commercial use of the forage, on land that is subject to the contract, nor adopt any similar practice specified in the contract by the Secretary as a practice that would tend to defeat the purposes of the contract, [except that the Secretary may permit harvesting] *except that the Secretary—*

(A) *may permit—*

(i) *harvesting* or grazing or other commercial use of the forage on land that is subject to the contract in response to a drought or other similar [emergency, and the Secretary may permit limited] *emergency; and*

(ii) *limited grazing* on such land where such grazing is incidental to the gleaning of crop residues on the fields in which such land is located and occurs during the 7-month period in which grazing of conserving use acreage is allowed in a State under the Agricultural Act of 1949 (7 U.S.C. 1421 et seq.) or after the producer harvests the grain crop of the surrounding field for a reduction in rental payment commensurate with the limited economic value of such incidental grazing; *and*

*(B) shall approve not more than 18 projects under which crops on land subject to the contract may be harvested for recovery of biomass used in energy production if—*

*(i) no acreage subject to the contract is harvested more than once every other year;*

*(ii) not more than 25 percent of the total acreage enrolled in the program under this subchapter in any crop reporting district (as designated by the Secretary), is harvested in any 1 year;*

*(iii) no portion of the crop is used for any commercial purpose other than energy production from biomass;*

*(iv) no wetland, or acreage of any type enrolled in a partial field conservation practice (including riparian forest buffers, filter strips, and buffer strips), is harvested;*

*(v) the owner or operator agrees to a payment reduction under this section in an amount determined by the Secretary;*

*(vi) the owner or operator agrees to commission and submit to the Secretary a study and report, to be conducted and written by a third party approved by the Secretary, on the impact of the biomass production and harvesting on wildlife; and*

*(vii) the owner or operator agrees to such other terms and conditions as the Secretary, in consultation with the State technical committee for the State and appropriate conservation and wildlife advocates, may establish to ensure that the production and harvesting of biomass crops minimize disturbance of wildlife habitat and are otherwise consistent with the purposes of the program established under this subchapter, with any biomass harvesting project permitted to harvest at least 50,000 acres per year.*