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Agriculture-Based Biofuels: Overview and Emerging Issues

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Summary

Since the late 1970s, U.S. policymakers at both the federal and state levels have enacted a variety of incentives, regulations, and programs to encourage the production and use of agriculture-based biofuels. Initially, federal biofuels policies were developed to help kick-start the biofuels industry during its early development, when neither production capacity nor a market for the finished product was widely available. Federal policy has played a key role in helping to close the price gap between biofuels and cheaper petroleum fuels. Now, as the industry has evolved, other policy goals (e.g., national energy security, climate change concerns, support for rural economies) are cited by proponents as justification for continuing policy support.

The U.S. biofuels sector has responded to these government incentives by expanding output every year since 1996, with important implications for the domestic and international food and fuel sectors. The production of ethanol (the primary biofuel produced in the United States) has risen from about 175 million gallons in 1980 to 10.7 billion gallons per year in 2009. U.S. biodiesel production is much smaller than its ethanol counterpart, but has also shown strong growth, rising from 0.5 million gallons in 1999 to an estimated 776 million gallons in 2008 before being impeded by the nationwide financial crisis.

Despite this rapid growth, total agriculture-based biofuels production accounted for only about 4.3% of total U.S. transportation fuel consumption in 2009. Federal biofuels policies have had costs, including unintended market and environmental consequences and large federal outlays (estimated at $6 to $8 billion in 2009). Despite the direct and indirect costs of federal biofuels policy and the small role of biofuels as an energy source, the U.S. biofuels sector continues to push for greater federal involvement. But critics of federal policy intervention in the biofuels sector have also emerged.

Current issues and policy developments related to the U.S. biofuels sector that are of interest to Congress include the following:

- Many federal biofuels policies (e.g., tax credits and import tariffs) require routine congressional monitoring and occasional reconsideration in the form of reauthorization or new appropriations funding.
- The 10% ethanol-to-gasoline blend ratio—known as the “blend wall”—poses a barrier to expansion of ethanol use. The Environmental Protection Agency (EPA) is currently evaluating the viability of raising the ethanol blending limit (per gallon of gasoline) for standard engines from 10% to 15%, which would have important market and policy implications.
- The evolution of EPA’s methodology for estimating lifecycle greenhouse gas emission reductions of different biofuels production paths (relative to their petroleum counterparts) and the treatment of indirect land use changes will determine which biofuels qualify under the Renewable Fuel Standard.
- The slow development of cellulosic biofuels has raised concerns about the industry’s ability to meet large federal usage mandates, which, in turn, has raised the potential for future EPA waivers of mandated biofuel volumes and has contributed to a cycle of slow investment in and development of the sector.

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Introduction

Increasing dependence on foreign sources of crude oil, concerns over global climate change, and the desire to promote domestic rural economies have raised interest in renewable biofuels as an alternative to petroleum in the U.S. transportation sector. However, energy from renewable sources has historically been more expensive to produce and use than fossil-fuel-based energy.[1] U.S. policymakers have attempted to overcome this economic impediment by enacting an increasing number of policies since the late 1970s, at both the state and federal levels, to directly support U.S. biofuels production and use. Policy measures include blending and production tax credits to lower the cost of biofuels to end users, an import tariff to protect domestic biofuels from cheaper foreign-produced ethanol, research grants to stimulate the development of new technologies, loans and loan guarantees to facilitate the development of biofuels production and distribution infrastructure, and, perhaps most importantly, minimum usage requirements to guarantee a market for biofuels irrespective of their cost.[2]

This report reviews the evolution of the U.S. biofuels sector and the role that federal policy has played in shaping its development.[3] In addition, it highlights emerging issues that are critical to the biofuels sector and of relevance to Congress.

Federal Biofuels Policies Have Encouraged Rapid Growth ...

Federal biofuels programs have proven critical to the economic success of the U.S. biofuels industry, primarily ethanol and biodiesel, whose output has grown rapidly in recent years. Yet, despite the rapid growth, U.S. biofuels consumption remains a small share (4.3% on an energy-equivalent basis in 2009) of national transportation fuel use (**Figure 1**).

Furthermore, the sector remains heavily dependent on federal policies that, concomitant with the growth in U.S. biofuels production, have required rapidly increasing federal budget outlays. In 2009, the estimated annual cost of direct federal support for biofuels production and use was in the range of $6-$8 billion. In addition, the rapid expansion of U.S. corn ethanol production to meet the dramatic rise in corn use for ethanol (the U.S. Department of Agriculture estimates that one-third of U.S. corn production was used for ethanol production in 2009) has provoked questions about its long-run sustainability and the possibility of unintended consequences in other markets as well as for the environment.[4]

It is widely believed that the ultimate success of the U.S. biofuels sector will depend on its ability to shift away from traditional row crops such as corn or soybeans for processing feedstock, and toward other, cheaper forms of biomass that do not compete with traditional food crops. Recent federal biofuels policies have attempted to assist this shift by focusing on the development of a

[1] Excluding the costs of externalities (e.g., air pollution, environmental degradation, illness and disease, or indirect land use changes and market-price effects) linked to emissions associated with burning either fossil fuels or biofuels.

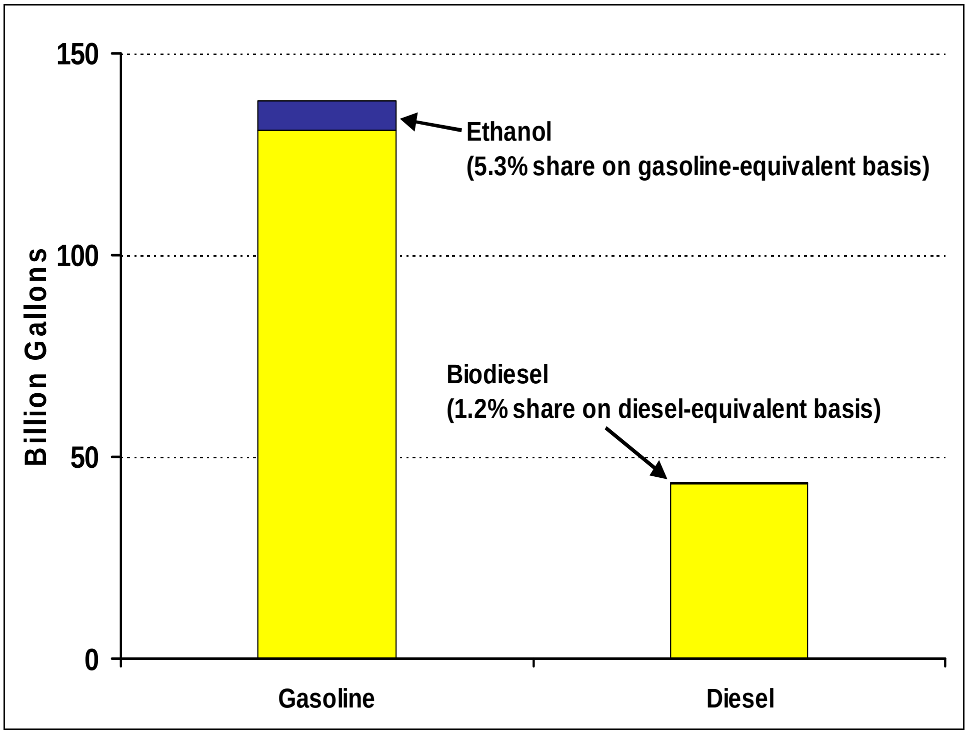
[2] For more details and a complete listing of federal biofuels programs and incentives, see CRS Report R40110, *Biofuels Incentives: A Summary of Federal Programs*, by Brent D. Yacobucci.

[3] For background information on agriculture-based U.S. biofuels, see the list of related CRS Reports available at the CRS website "Issues in Focus: Agriculture: Agriculture-Based Biofuels."

[4] For more information, see CRS Report R40155, *Renewable Fuel Standard (RFS): Overview and Issues*, by Randy Schnepf and Brent D. Yacobucci.

cellulosic biofuels industry.[5] However, the speed of cellulosic biofuels development remains a major uncertainty, since new technologies must first emerge and be implemented on a commercial scale.[6] The uncertainty surrounding the development of such new technologies and their commercial adaptation has been a major impediment to the flow of much needed private-sector investment funds into the cellulosic biofuels sector.

Figure 1. Biofuels Were a Small Share of U.S. Motor Transportation Fuel Use in 2009



Source: Ethanol use: Renewable Fuels Association; Biodiesel and total motor vehicle fuel use: Energy Information Agency (EIA), Department of Energy (DOE).

... And Conflicting Viewpoints

The trade-offs between benefits to farm and rural economies, as opposed to large federal budget costs and the potential for unintended consequences, have led to emergence of both proponents and critics of the government subsidies and mandates that underwrite biofuels production.

Proponents of government support for agriculture-based biofuels production have cited national energy security, reductions in greenhouse gas emissions, and raising domestic demand for U.S.-produced farm products as viable justifications. Under most circumstances, biofuels are more environmentally friendly (in terms of emissions of toxins, volatile organic compounds, and greenhouse gases) than petroleum products. In addition, proponents argue that rural, agriculture-

[5] Cellulosic biofuels are derived from the sugar contained in plant cellulose. For more information, see CRS Report RL34738, *Cellulosic Biofuels: Analysis of Policy Issues for Congress*, by Kelsi Bracmort et al.

[6] For more information, see CRS Report R41106, *Meeting the Renewable Fuel Standard (RFS) Mandate for Cellulosic Biofuels: Questions and Answers*, by Kelsi Bracmort.

based energy production can enhance rural incomes and expand employment opportunities, while encouraging greater value-added for U.S. agricultural commodities.[7]

In contrast, critics argue that, in the absence of subsidies, current biofuels production strategies can only be economically competitive with existing fossil fuels at much higher petroleum prices, or if significant improvements in existing technologies are made or new technologies are developed.[8] Until such technological breakthroughs are achieved, critics contend that the subsidies distort energy market incentives and divert research funds from the development of other renewable energy sources, such as solar or geothermal, that offer potentially cleaner, more bountiful alternatives. Still others question the rationale behind policies that promote biofuels for energy security. These critics question whether the United States could ever produce sufficient feedstock of starches, sugars, or vegetable oils to permit biofuels production to meaningfully offset petroleum imports.[9] Finally, some argue that the focus on development of alternative energy sources undermines efforts for greater conservation to reduce energy waste.

Biofuels Defined

Any fuel produced from biological materials—whether burned for heat or processed into alcohol—qualifies as a “biofuel.” However, the term is most often used to refer to liquid transportation fuels produced from some type of biomass. Biomass is organic matter that can be converted into energy. Common examples of biomass include food crops, crops for energy (e.g., switchgrass or prairie perennials), crop residues, wood waste and byproducts, and animal manure. The term biomass has been a part of legislation enacted by Congress for various programs over the past 30 years; however, its explicit definition has evolved with shifting policy objectives.[10] Over the last few years, the concept of biomass has grown to include such diverse sources as algae, construction debris, municipal solid waste, yard waste, and food waste. The exact definition of biomass is critical, since it determines which feedstocks qualify for the different biofuels programs. For example, a current point of contention regarding the definition is the inclusion of biomass from federal lands. Some argue that removal of biomass from these lands may lead to ecological harm.

Types of biofuels include ethanol, biodiesel, methanol, butanol, and reformulated gasoline components; however, the two principal biofuels are ethanol and biodiesel. Ethanol, or ethyl alcohol, is an alcohol made by fermenting and distilling simple sugars.[11] As a result, ethanol can be produced from any biological feedstock that contains appreciable amounts of sugar or

[7] Examples of ethanol policy proponents include the Renewable Fuels Association (RFA), the National Corn Growers Association (NCGA), and Growth Energy. Biodiesel proponents include the American Soybean Association and the National Biodiesel Board.

[8] Advocates of this position include free-market proponents such as the Cato Institute, federal budget watchdog groups such as Citizens Against Government Waste, Taxpayers for Common Sense, and farm subsidy watchdog groups such as the Environmental Working Group.

[9] For example, see James and Stephen Eaves, “Is Ethanol the ‘Energy Security’ Solution?” editorial, Washingtonpost.com, October 3, 2007; or R. Wisner and P. Baumel, “Ethanol, Exports, and Livestock: Will There be Enough Corn to Supply Future Needs?,” *Feedstuffs*, no. 30, vol. 76, July 26, 2004.

[10] For more information, see CRS Report R40529, *Biomass: Comparison of Definitions in Legislation*, by Kelsi Bracmort and Ross W. Gorte.

[11] For more information, see CRS Report RL33290, *Fuel Ethanol: Background and Public Policy Issues*, by Brent D. Yacobucci.

materials that can be converted into sugar such as starch or cellulose. Sugar beets and sugar cane are examples of feedstock that contain sugar. Corn contains starch that can relatively easily be converted into sugar. Trees, grasses, and most agricultural and municipal wastes are made up of a significant percentage of cellulose, which can also be converted to sugar, although with more difficulty than is required to convert starch.

Ethanol from Corn Starch Dominates U.S. Biofuels Production

Since its development in the late 1970s, U.S. biofuels output has relied almost exclusively on ethanol produced from corn starch (**Table 1**). This contrasts with Brazil, the world's second-largest ethanol producer behind the United States, where sugar cane is the principal feedstock. In 2008, the United States and Brazil accounted for over 90% of the world's ethanol production.[12] Approximately 10.7 billion gallons of ethanol were produced in the United States in 2009, over 95% from corn starch. Other domestic feedstocks used for ethanol production include grain sorghum and sweet sorghum.

Table 1. U.S. Production of Biofuels from Various Feedstocks

Fuel	Feedstock	U.S. Production in 2009
Ethanol	Corn	10.2 billion gallons
	Sorghum, wheat, barley, and brewery waste	Over 450 million gallons
	Cane sugar	1.5 million gallons (plus a projected 200 million gallons imported from Brazil and Caribbean countries)
	Cellulose	No commercial production
Biodiesel	Soybean oil	approximately 470 million gallons
	Other vegetable oils	less than 10 million gallons
	Recycled grease	less than 10 million gallons
	Cellulose	No commercial production
Methanol	Cellulose	No commercial production
Butanol	Cellulose, other biomass	No commercial production

Source: Renewable Fuels Association; National Biodiesel Board; CRS analysis.

Because of concerns over the significant expansion in corn production for use as an ethanol feedstock, interest has grown in spurring the development of motor fuels produced from cellulosic biomass materials. Since these biomass sources do not compete with traditional food and feed crops for prime cropland, it is thought that their use would result in substantially fewer unintended market effects. However, the technology needed for the conversion of cellulose into its constituent sugars before conversion to biofuels, while successful in laboratory settings, remains expensive and has yet to be replicated on a commercial scale. Many uncertainties remain concerning both the viability and the speed of commercial development of cellulosic biofuels.[13]

[12] According to data from the Renewable Fuel Association, U.S. ethanol production in 2008 was 9.237 billion gallons, Brazil's was 6.472 billion gallons, and the world total was 17.335 billion gallons.

[13] For more information, see CRS Report RL34738, *Cellulosic Biofuels: Analysis of Policy Issues for Congress*, by (continued...)

After ethanol, biodiesel is the next most significant biofuel in the United States. Biodiesel is an alternative diesel fuel that can be produced from any type of organic-based oil, including vegetable oils, animal fats, and waste restaurant grease and oils. In the United States and Brazil, biodiesel is primarily made from soybean oil. In the European Union, rapeseed oil is the primary feedstock.

Other biofuels with the potential to play a role in the U.S. market include diesel fuel substitutes and other alcohols (e.g., methanol and butanol) produced from biomass. In addition to expanding domestic production of biofuels, there is some interest in expanding imports of sugar-based ethanol—usually produced from sugar cane in Brazil. U.S. sugar-ethanol imports peaked at 653 million gallons in 2006 (including 434 million from Brazil). Projections for 2009 indicate U.S. imports of about 200 million gallons, mostly from Brazil and Caribbean Basin Initiative (CBI) countries.

Biofuels Value Determinants

The value of a biofuel is determined by its end use. Biodiesel's primary use is as a substitute for petroleum-based diesel fuel. Ethanol is primarily used as a substitute for gasoline; however, it has some additional properties (i.e., oxygenate and octane enhancer) that provide value as a gasoline additive. Both ethanol and biodiesel may derive value as an additive to meet federal usage mandates depending on market conditions. A federal usage mandate (referred to as a Renewable Fuel Standard or RFS) was first introduced in 2006 by the Energy Policy Act of 2005 (P.L. 109-58), which required that a gradually increasing minimum volume of ethanol must be blended into the national transportation fuel supply each year.[14]

With respect to ethanol, there is no difference to the end user between corn-starch ethanol and cellulosic ethanol, although their production processes differ substantially in terms of feedstock, technology, and cost. As a result, they both share the same value determinants. In the presence of government policy, demand for ethanol derives from four potential uses:[15]

- as an additive to gasoline to enhance its octane level;
- as an oxygenate to help improve engine combustion and cleaner burning of fuel;
- as an additive to gasoline to meet federally mandated minimum usage requirements under the RFS; or
- as a substitute for gasoline, either blended with gasoline as a fuel extender at low blend levels (e.g., 10% ethanol to 90% gasoline, known as E10), or in pure (E100) or near pure (E85) form in flexible fuel vehicles.

Ethanol's use as an additive for octane or oxygenate purposes occurs primarily at low blend levels of 2% or 3%, and is small relative to the growth in total usage of recent years. When ethanol is

(...continued)

Kelsi Bracmort et al.

[14] This is described in greater detail later in this report, in the section titled "Evolution of the U.S. Ethanol Sector."

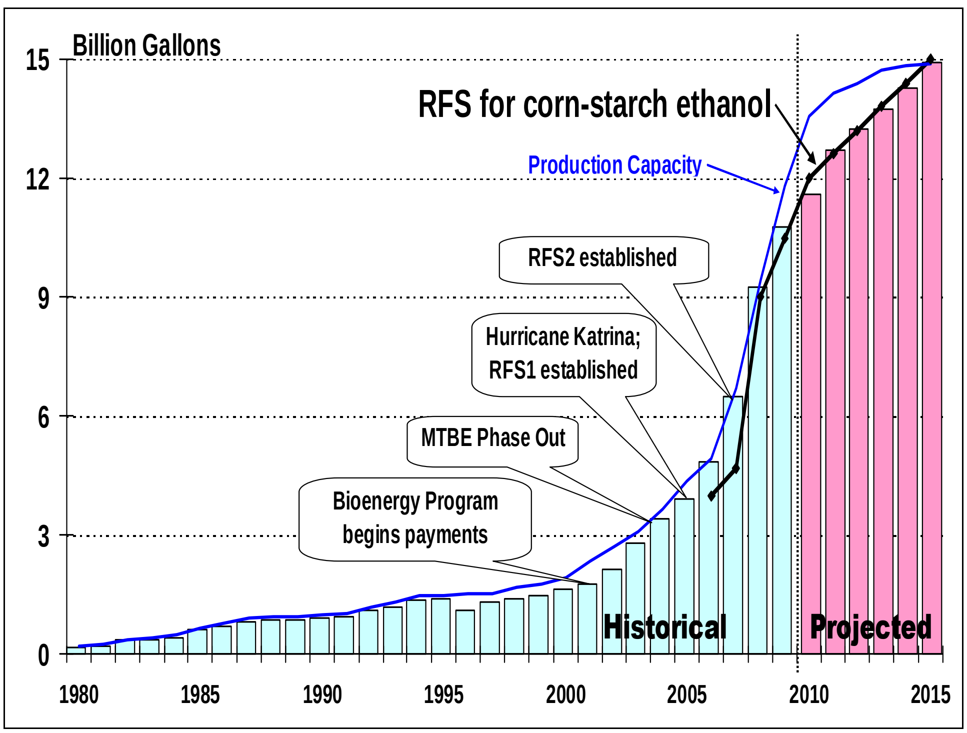
[15] For more information on ethanol fuel specifics, see CRS Report RL33290, *Fuel Ethanol: Background and Public Policy Issues*, by Brent D. Yacobucci.

being added to enhance engine performance rather than as a fuel extender, it is a complement to gasoline and may potentially capture a price premium over standard gasoline.

Federal policy that mandates the use of a minimum volume of biofuel creates a further source of demand that behaves very much as though ethanol were a fuel additive like an oxygenate or octane enhancer. Demand for biofuels to fulfill a mandate is not based on price, but rather on government fiat. As long as the consumption of biofuels is less than the mandated volume, its use is obligatory. However, when the supply of biofuels exceeds the mandated usage volume, its use is no longer obligatory and it must compete directly in the marketplace with its petroleum-based counterpart. As a result, once they have met their RFS blending mandates, gasoline blenders, seeking to maximize their profits, are very sensitive to ethanol and gasoline price relationships.

Since 2006, when the RFS was first introduced, both ethanol production capacity and supply (production and imports combined) have easily exceeded the federally mandated usage levels (**Figure 2**). As a result, ethanol's principal value has been as a transportation fuel (rather than as an additive), where it competes directly with gasoline. Furthermore, since ethanol contains only about 68% of the energy content of gasoline, value-conscious consumers can be expected to willingly pay only about 68% of the price of gasoline for ethanol.

Figure 2. Annual U.S. Corn-Starch Ethanol Production, Historical and Projected, 1980 to 2015



Source: 1980 to 2009, Renewable Fuels Association. Projections for 2010 to 2015 are from FAPRI, "U.S. Baseline Briefing Book," March 2010.

Note: Projections for U.S. cellulosic ethanol production are highly uncertain and have been excluded from this chart.

Evolution of the U.S. Ethanol Sector

Federal Policy Kick-Starts Ethanol Production

Several events contributed to the historical startup and growth of U.S. ethanol production in the late 1970s. First, the global energy crises of the early and late 1970s provided the rationale for a federal policy initiative aimed at promoting energy independence from foreign crude oil sources. In response, the U.S. Congress established a partial exemption for ethanol from the motor fuels excise tax (legislated as part of the Energy Tax Act of 1978). All ethanol blended in the United States—whether imported or produced domestically—was eligible for a $0.40 per gallon tax credit. In 1980, an import duty for fuel ethanol was established by the Omnibus Reconciliation Act of 1980 (P.L. 96-499) to offset the domestic tax credit being applied to foreign-sourced ethanol.

As U.S. ethanol production began to emerge in the 1980s, ethanol became recognized as a gasoline oxygenate. The Deficit Reduction Act of 1984 raised the ethanol tax credit to $0.60 per gallon.[16] Based on its oxygenate characteristic, provisions of the Clean Air Act Amendments of 1990 (CAAA90) favored ethanol blending with reformulated gasoline (RFG).[17] One of the requirements of RFG specified by CAAA90 was a 2% oxygen requirement, which was met by blending "oxygenates," including methyl tertiary butyl ether (MTBE) and ethanol into the gasoline.[18] Ethanol was the preferred oxygenate in the Midwest where it was produced, while MTBE was used in almost all RFG outside of the Midwest.

In addition CAAA90 oxygenate requirements, a small ethanol producer tax credit was established in 1990 (Omnibus Budget Reconciliation Act of 1990; P.L. 101-508) as a $0.10 per gallon supplement to the existing ethanol tax credit, but limited to the first 15 million gallons of ethanol produced by ethanol producers with production capacity below 30 million gallons per year.[19] Aided by these events, the U.S. ethanol industry slowly grew during its first two decades—rising from an estimated 175 million gallons in 1980 to 1.8 billion gallons in 2001. By 2001, ethanol production was using about 7% of the U.S. corn crop.

Government Role Has Grown Since 2000

The first decade of the 2000s experienced a substantial increase in federal involvement in the U.S. biofuels sector. In FY2001, the Bioenergy Program[20] began making payments from the U.S.

[16] "Ethanol Policy: Past, Present, and Future," by James A. Duffield, Irene M. Xiarchos, and Steve A. Halbrook, *South Dakota Law Review*, Fall 2008.

[17] USDA, Office of Energy Policy and New Uses, *The Energy Balance of Corn Ethanol: An Update*, AER-813, by Hosein Shapouri, James A. Duffield, and Michael Wang, July 2002.

[18] "Status and Impact of State MTBE Ban," Energy Information Administration (EIA), U.S. Dept. of Energy (DOE), revised March 27, 3003; available at http://www.eia.doe.gov/oiaf/servicerpt/mtbeban/.

[19] The 30 million gallon threshold was extended to 60 million gallons by the Energy Policy Act of 2005 (P.L. 109-58).

[20] The Bioenergy Program was initiated on August 12, 1999, by President Clinton's Executive Order 13134. On October 31, 2000, then-Secretary of Agriculture Glickman announced that, pursuant to the executive order, $300 million of Commodity Credit Corporation (CCC) funds ($150 million in both FY2001 and FY2002) would be made available to encourage expanded production of biofuels.

Department of Agriculture's (USDA's) Commodity Credit Corporation (CCC)[21] to eligible biofuel producers—ethanol and biodiesel—based on any year-to-year increases in the quantity of biofuels produced. The Bioenergy Program was instituted by USDA because the program's principal goal was to encourage greater purchases of eligible farm commodities used in the production of biofuels (e.g., corn for ethanol or soybean oil for biodiesel).

The executive order creating the Bioenergy Program was followed by a series of legislation containing various provisions that further aided the U.S. biofuels industry. The first of these, the Biomass Research and Development Act of 2000 (Biomass Act; Title III, P.L. 106-224), contained several provisions to expand research and development in the area of biomass-based renewable fuel production.

The 2002 farm bill (P.L. 107-171) included several biofuels programs spread across three separate titles—Title II: Conservation, Title VI: Rural Development, and Title IX: Energy (the first-ever energy title in a farm bill). Each title contained programs that encouraged the research, production, and use of renewable fuels such as ethanol, biodiesel, and wind energy systems. In addition, Section 9010 of Title IX codified and extended the Bioenergy Program and its funding by providing that $150 million would be available annually through the CCC for FY2003-FY2006.[22]

The Healthy Forests Restoration Act of 2003 (P.L. 108-148) amended the Biomass Act of 2000 by expanding the use of grants, contracts, and assistance for biomass to include a broader range of forest management activities. It also expanded funding availability of programs established by the Biomass Act and the 2002 farm bill, and it established a program to accelerate adoption of biomass-related technologies through community-based marketing and demonstration activities, and to establish small-scale businesses to use biomass materials.

The American Jobs Creation Act of 2004 (P.L. 108-357) contained a provision (Section 301) that temporarily extended the existing tax exemptions for alcohol fuels (i.e., ethanol) of $0.51 per gallon. This act also expanded the eligibility threshold for the small ethanol producer's tax credit to plants with a production capacity of 60 million gallons per year (up from the previous threshold of 30 million gallons).

In addition to the growing list of federal and state policies, the U.S. biofuels industry received an additional boost in the early 2000's with the emergence of water contamination problems associated with MTBE in several locations scattered throughout the country. MTBE was thought to be a possible carcinogen and, as a result, posed serious health and liability issues. In 1999, California (which, at the time, consumed nearly 32% of MTBE in the United States) petitioned the U.S. Environmental Protection Agency (EPA) for a waiver of the CAAA90 oxygenate requirement.[23] However, California's waiver request was denied by the EPA in mid-2001 since the EPA determined that there was sufficient ethanol production available to replace MTBE.

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[21] The CCC is a U.S. government-owned and -operated corporation, created in 1933, with broad powers to support farm income and prices and to assist in the export of U.S. agricultural products. Toward this end, the CCC finances USDA's domestic price and income support programs and its export programs using its permanent authority to borrow up to $30 billion at any one time from the U.S. Treasury.

[22] The Bioenergy Program was phased out at the end of FY2006.

[23] "Status and Impact of State MTBE Ban," Energy Information Administration (EIA), U.S. Dept. of Energy (DOE), revised March 27, 3003; available at http://www.eia.doe.gov/oiaf/servicerpt/mtbeban/.

By 2003, legislation that would phase out or restrict the use of MTBE in gasoline had been passed in 16 states, including California and New York (with a 7.5% MTBE market share).[24] Between October 1, 2003, and January 1, 2004, over 43% of MTBE consumption in the United States was banned. According to the EIA, the state MTBE ban would require an additional demand for ethanol of 2.73 billion gallons in 2004.

With the legislative boosts and the MTBE phase-out, investments in the biofuels sector began to show results. The number of plants producing ethanol grew from 50 on January 1, 1999, to 81 by January 1, 2005. Concomitantly, U.S. ethanol production began to accelerate, rising to 3.9 billion gallons by 2005 and using over 14% of the nation's corn crop (**Figure 2**, **Figure 3**, and **Table 2**).

The Ethanol Industry's Perfect Storm in 2005

On the heels of the large MTBE phase-out that occurred in 2004 and the surge in ethanol demand, two major events coincided in 2005 to produce extremely favorable economic conditions in the U.S. ethanol sector that persisted through most of 2006. These events included the following.

- The Energy Policy Act of 2005 (EPACT; P.L. 109-58) was signed into law on August 8, 2005. EPACT contained several provisions related to agriculture-based renewable energy production, including biofuels research and funding, the extensions of existing biofuels tax credits, and the creation of the first-ever national minimum-usage mandate, the Renewable Fuels Standard (RFS1; Section 1501), which required that 4 billion gallons (bgals) of ethanol be used domestically in 2006, increasing to 7.5 bgals by 2012.
- In August and September, Hurricanes Katrina and Rita struck the Gulf Coast region, causing severe damage to Gulf Coast petroleum importing and refining infrastructure, putting them off-line for several months, and driving petroleum product prices sharply higher. Meanwhile, corn prices remained relatively low at about $2 per bushel, creating a period of extreme profitability for the sector.

The combination of high ethanol prices and low corn prices that persisted in 2006 created a period of "unique" profitability for the U.S. ethanol industry. At that time, a 40 million gallon nameplate ethanol plant costing approximately $60 million could recover its entire capital investment in less than a year of normal operations.[25] In addition, the establishment of the first RFS—by guaranteeing a market for new ethanol production—removed much of the investment risk from the sector.

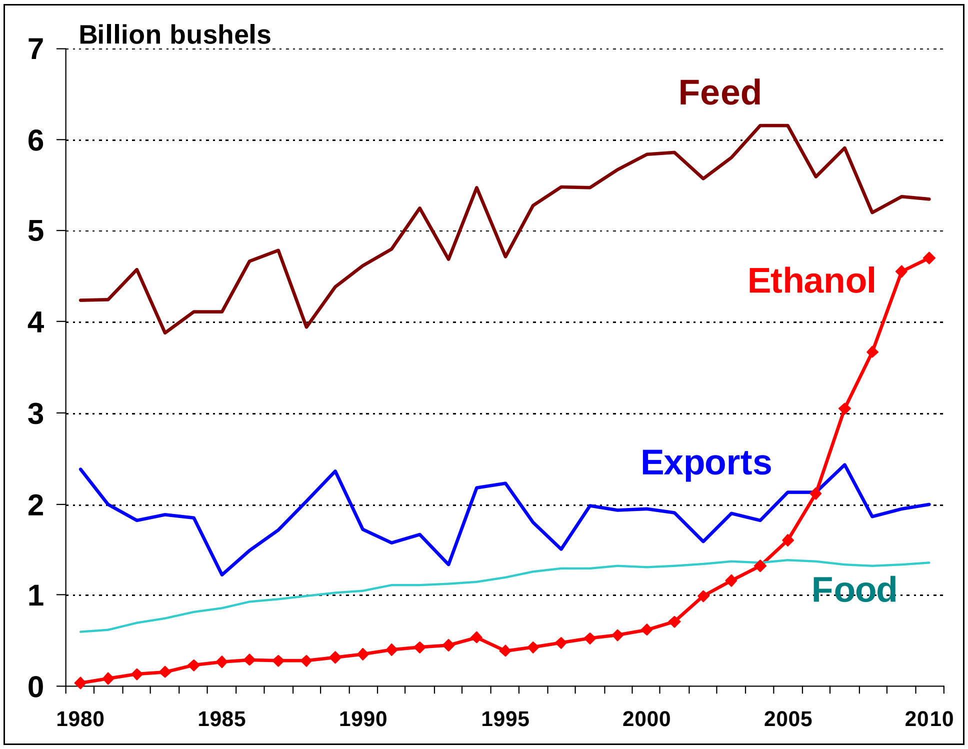
As a result of this "perfect storm" of policy and market events, investment money flowed into the construction of new ethanol plants, and U.S. ethanol production capacity (either in existence or under construction) more than doubled in just two years, rising from an estimated 4.4 bgals in January 2005 to 11.1 bgals by January 2007. The ethanol expansion was almost entirely in dry-mill corn processing plants. As a result, corn's role as the primary feedstock used in ethanol production in the United States continued to grow. In 2006, corn use for ethanol nearly matched

[24] Ibid.

[25] Based on CRS simulations of an ethanol dry mill spreadsheet model developed by D. Tiffany and V. Eidman in *Factors Associated with Success of Fuel Ethanol Producers*, Staff Paper P03-7, Dept of Applied Economics, University of Minnesota, August 2003. Note, nameplate capacity represents the capacity that the design engineers will warrant. In most cases, an efficiently run plant will operate in excess of its nameplate capacity.

U.S. corn exports at about 2.1 billion bushels. In 2007, U.S. corn exports hit a record 2.4 billion bushels; however, corn-for-ethanol use jumped to over 3 billion bushels. For the first time in U.S. history, the bushels of corn used for ethanol production would be greater than the bushels of corn exported (**Figure 3**).

Figure 3. Annual U.S. Corn Use by Major Activity, 1980 to 2010



Source: USDA, Production, Supply, and Distribution (PSD) database, June 11, 2010.

Notes: Feed includes a residual category to balance USDA supply and demand estimates.

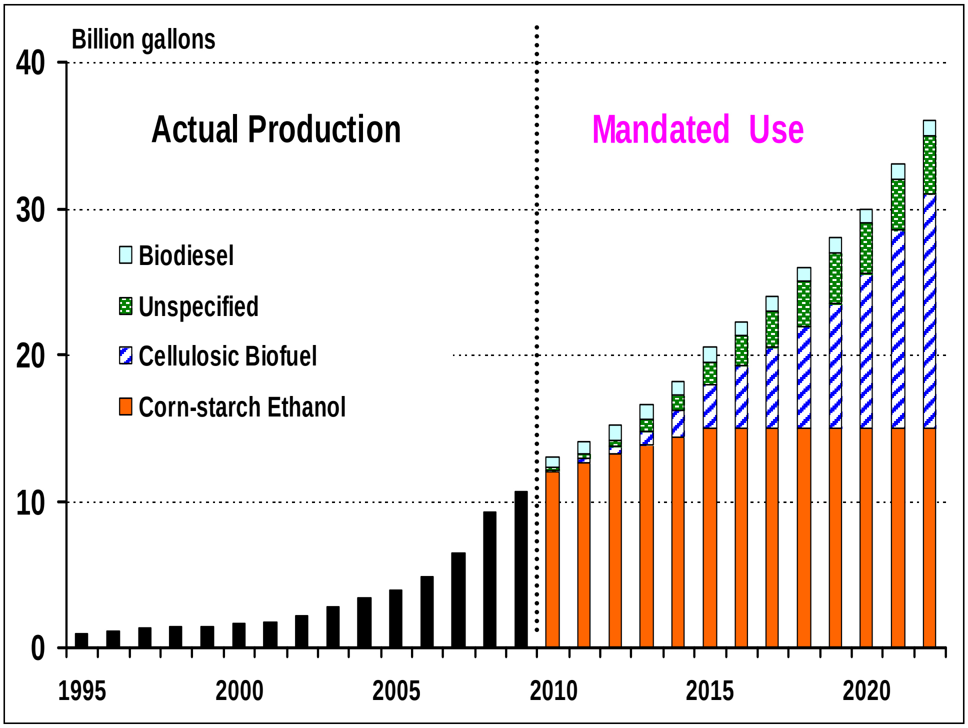
EISA Greatly Expands Mandate, Shifts Focus to Cellulosic Biofuels

In light of the rapid expansion of the U.S. biofuels industry, the RFS1 mandate was quickly outgrown in 2006. On December 19, 2007, Congress dramatically raised the "bar" by passing the Energy Independence and Security Act of 2007 (EISA, P.L. 110-140).[26] EISA superseded and greatly expanded EPACT's biofuels blending mandate relative to historical production (**Figure 4**).

The expanded RFS (referred to as RFS2) required the use of 9 bgals of biofuels in 2008 and expanded the mandate to 36 bgals annually in 2022. The new mandate had some provisos, foremost of which was that only 15 bgals of RFS-qualifying biofuels could be ethanol from corn starch. In addition, all increases in the RFS mandate from 2016 onwards must be met by advanced biofuels (i.e., non-corn-starch biofuels) and no less than 16 bgals must be derived from cellulosic feedstock in 2022. In addition, the new mandate established by EISA carved out specific volume requirements for biomass-based biodiesel.

[26] For more information on EISA and RFS2, see CRS Report R40155, *Renewable Fuel Standard (RFS): Overview and Issues*, by Randy Schnepf and Brent D. Yacobucci.

Figure 4. Renewable Fuels Standard (RFS2) vs. U.S. Ethanol Production Since 1995



Source: Actual ethanol production data for 1995-2009 is from Renewable Fuels Association; data for RFS2 mandates is from EISA (P.L. 110-140).

Meanwhile, prices for many agricultural commodities—including nearly all major U.S. program crops—started a steady upward trend in late 2006. Then, in early 2007, the upward trend for commodity prices turned into a steep rise. By mid-2008 market prices for several agricultural commodities had reached record or near-record levels (**Figure 5**).[27] In particular, both corn[28] and crude oil[29] hit record high prices in both spot and futures markets, thus symbolizing the growing linkage between U.S. field crops and energy markets.

The upward rise in the price of corn in 2007 and early 2008 sucked the profits out of the U.S. biofuels sector and put the brakes on new investment. It also fueled a "food-versus-fuel" debate about the potential for continued expansion in corn use for ethanol to have unintended consequences in other agricultural and environmental markets. While most economists and market analysts agreed that the dramatic price rise of 2008 was due to factors other than biofuels policy, they also are nearly universally agreed that the strong, steady growth in ethanol demand for corn has had an important price effect, not just on the price of corn, but in other agricultural markets including food, feed, fuel, and land.[30]

[27] For more information about markets during this period, see CRS Report RL34474, *High Agricultural Commodity Prices: What Are the Issues?*, by Randy Schnepf. See also, "What Is Driving Food Prices," by Philip C. Abbott, Christopher Hurt, and Wallace E. Tyner, Farm Foundation, July 2008; hereafter referred to as Abbott et al., 2008.

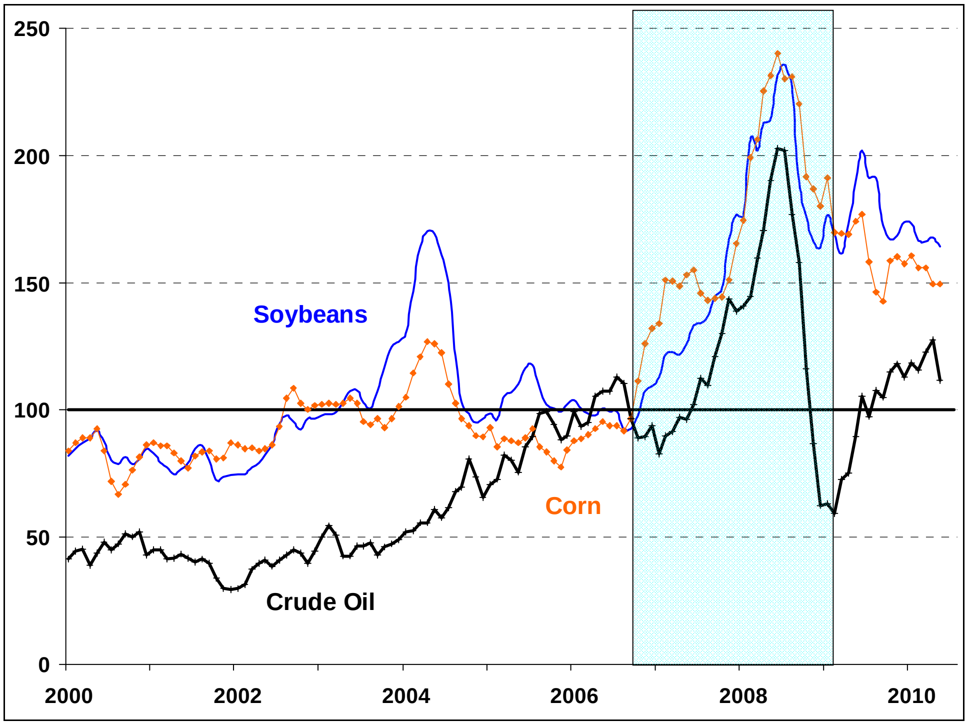
[28] On June 23, 2008, the nearby futures contract for No. 2, yellow corn hit a record $7.65 per bushel on the Chicago Board of Trade.

[29] On July 7, 2008, the nearby futures contract for Crude Oil hit $147.27 per barrel at the New York Mercantile Exchange, while the nearby Brent Crude Oil contract hit $147.50 at the ICE Futures Europe exchange.

[30] Abbott et al., 2008.

Figure 5. Monthly Farm Prices for Corn, Soybeans, and Crude Oil, 2000 to 2010

(Index: 2006 = 100)



Source: Corn and soybean prices are monthly average farm prices, National Agricultural Statistics Service (NASS), USDA; crude oil is the spot price, f.o.b., for West Texas Intermediate, Cushing, OK, EIA, DOE.

Notes: To facilitate comparison of relative price movements, the monthly prices have been converted to an index where the 12-month average for calendar 2006 has been set to 100.

By mid-2008, the commodity price rise had completely reversed itself and turned into a near free-fall, coinciding with the financial crisis that broke in late 2008. The extreme price volatility created many difficulties throughout the marketing chain for agricultural buyers and sellers. The experience of $7.00-per-bushel corn, albeit temporary, shattered the idea that biofuels were a panacea for solving the nation's energy security problem and left concerns about the potential for unintended consequences from future biofuels expansion.

2008 Farm Bill Reinforces Focus on Cellulosic Biofuels

The 2008 farm bill (Food, Conservation, and Energy Act of 2008; P.L. 110-246) extended and expanded many existing biofuels programs.[31] In particular, Title XV ("Trade and Tax Provisions") extended the biofuels tax incentives and the tariff on ethanol imports, although the tax credit for corn-starch ethanol was reduced to $0.45 per gallon. But in the wake of the commodity market price run-up of early 2008, the new farm bill also re-emphasized EISA's policy shift towards research and development of advanced and cellulosic bioenergy in an effort to avoid many of the unintended consequences of relying too heavily on major field crops as the principal biomass feedstock. In addition, it established a new tax credit of $1.01 per gallon for cellulosic biofuel.

[31] For more information, see CRS Report RL34130, *Renewable Energy Programs in the 2008 Farm Bill*, by Megan Stubbs.

Like the 2002 farm bill, it contained a distinct energy title (Title IX) that covers a wide range of energy and agricultural topics with extensive attention to biofuels, including corn starch-based ethanol, cellulosic ethanol, and biodiesel. Energy grants and loans are provided through initiatives such as the Bioenergy Program for Advanced Biofuels to promote the development of cellulosic biorefinery capacity. The Repowering Assistance Program supports increasing efficiencies in existing refineries. Programs such as the Rural Energy for America Program (REAP) assist rural communities and businesses in becoming more energy-efficient and self-sufficient, with an emphasis on small operations. Cellulosic feedstocks—for example, switchgrass and woody biomass—are given high priority both in research and funding. The Biomass Crop Assistance Program (BCAP), the Biorefinery Assistance Program, and the Forest Biomass for Energy Program provide support to develop alternative feedstock resources and the infrastructure to support the production, harvest, storage, and processing of cellulosic biomass feedstocks.

Title VII, the research title of the 2008 farm bill, contains numerous renewable-energy-related provisions that promote research, development, and demonstration of biomass-based renewable energy and biofuels.

One of the major policy issues debated prior to the passage of the 2008 farm bill was the impact of the rapid, ethanol-driven expansion of U.S. corn production. This issue was made salient by the dramatic surge in commodity prices experienced in 2007 and early 2008. In partial consideration, the enacted bill requires reports on the economic impacts of ethanol production, reflecting concerns that the increasing share of corn production being used for ethanol contributed to high commodity prices and food price inflation.

Questions Emerge Concerning Rapid Biofuels Expansion

By 2009, more than half of all U.S. gasoline contained some ethanol (mostly blended at the 10% level or lower). U.S. ethanol consumption in 2009 is estimated at 10.7 billion gallons (bgals), which was blended into roughly 138 bgals of gasoline—this represents only 7.8% of annual gasoline demand on a volume basis, and only 5.3% on an energy basis. With national gasoline consumption stagnant (following the financial crisis of 2008 and ensuing economic recession), ethanol production is fast approaching the 10% ethanol-to-gasoline blend wall (described later in this report) of about 13 bgal.[32]

U.S. ethanol production in 2009 consumed nearly 34% of the U.S. corn crop (**Table 2**), and the effects of rapidly expanding ethanol and corn production were being felt across several other sectors of the U.S. economy. In the long term, the expanded RFS2 is likely to play a dominant role in the development of the U.S. biofuels sector, but with considerable uncertainty regarding potential spillover effects in other markets and on other important policy goals.[33] Emerging resource constraints related to the rapid expansion of U.S. corn ethanol production have provoked questions about its long-run sustainability and the possibility of unintended consequences in other markets as well as on the environment.

[32] For more information, see CRS Report R40445, *Intermediate-Level Blends of Ethanol in Gasoline, and the Ethanol "Blend Wall,"* by Brent D. Yacobucci.

[33] For more information, see CRS Report R40155, *Renewable Fuel Standard (RFS): Overview and Issues,* by Randy Schnepf and Brent D. Yacobucci.

Table 2. U.S. Corn-Use Share of Annual Production by Major Activity, 1980 to 2010

Crop Year	Ethanol	Food	Exports	Feed
1980	1%	9%	36%	64%
1985	3%	10%	14%	46%
1990	4%	13%	22%	58%
1995	5%	16%	30%	64%
2000	7%	14%	21%	62%
2005	14%	12%	19%	55%
2010	34%	10%	15%	40%

Source: Calculations are by CRS from USDA, PSD database, May 10, 2010.

Questions exist about the ability of the U.S. biofuels industry to meet the expanding mandate for biofuels from non-corn sources such as cellulosic biomass materials, whose production capacity has been slow to develop,[34] or biomass-based biodiesel, which remains expensive to produce owing to the relatively high prices of its feedstocks. Finally, considerable uncertainty remains regarding the development of the infrastructure capacity (e.g., trucks, pipelines, pumps, etc.) needed to deliver the expanding biofuels mandate to consumers.

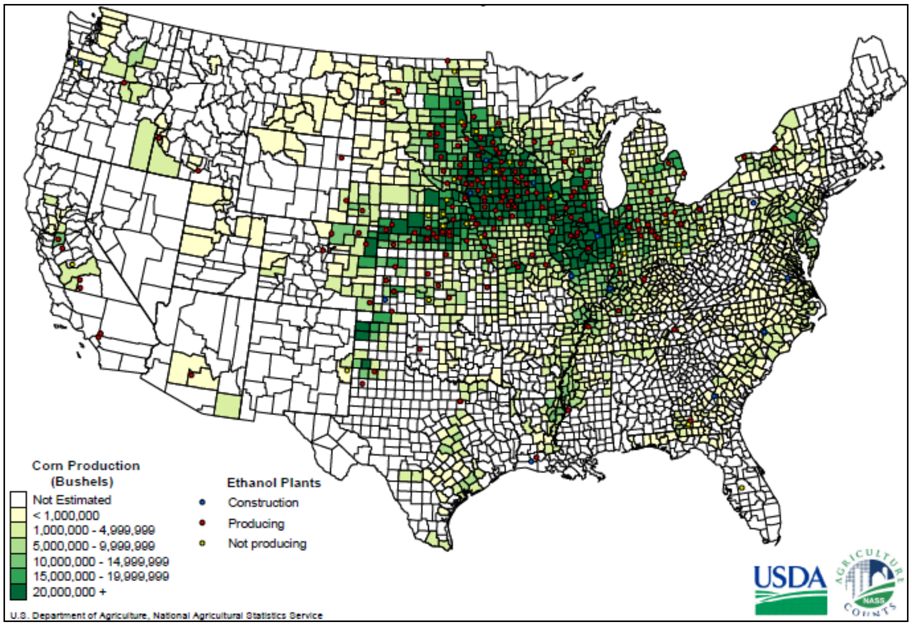
Ethanol Production Capacity Centered on Corn Belt

As of April 27, 2010, U.S. ethanol production was underway or planned in 29 states based primarily around the central and western Corn Belt, where corn supplies are most plentiful (**Figure 6** and **Table 3**). Existing U.S. ethanol plant capacity was estimated at 13.5 billion gallons per year (BGPY), with another 1.1 BGPY of capacity under construction (either as new plants or expansion of existing plants). Thus, total annual U.S. ethanol production capacity in existence or under construction is nearly 14.6 BGPY, well in excess of the 12 bgals RFS2 mandate for corn-starch ethanol in 2010 (**Figure 2**).

Iowa is by far the leading ethanol-producing state, with a 29% share of total U.S. output. The top three Corn Belt states of Iowa, Nebraska, and Illinois account for over 50% of national production (**Table 3**). On a national level, the ethanol industry is operating at about 95% of nameplate capacity. However, several states including Indiana, Kansas, Ohio, Tennessee, Colorado, and the "other" category of states are operating substantially below their nameplate capacity, suggesting that industry profitability varies by geographic circumstance, primarily due to variations in feedstock cost and availability, with current circumstances favoring producers located near ample corn supplies.

[34] For more information see CRS Report R41106, *Meeting the Renewable Fuel Standard (RFS) Mandate for Cellulosic Biofuels: Questions and Answers*, by Kelsi Bracmort.

Figure 6. U.S. Ethanol Production Capacity Is Centered on the Corn Belt



Source: USDA; U.S. corn production for 2008 compared with ethanol plant locations as of Jan. 14, 2009.

Table 3. U.S. Ethanol Output and Production Capacity by State

Rank	State	# of Plants	Operating Production: MGPY	Operating Production: % of output	Operating Production: Cum % output	Current Nameplate Capacity (MGPY)	Under Contr. or Expansion (MGPY)
1	Iowa	40	3,772	29.4%	29.4%	3,772	105
2	Nebraska	26	1,516	11.8%	41.2%	1,544	375
3	Illinois	14	1,229	9.6%	50.8%	1,229	93
4	Minnesota	22	1,095	8.5%	59.3%	1,137	-
5	S. Dakota	15	1,016	7.9%	67.2%	1,016	33
6	Indiana	13	816	6.4%	73.6%	908	214
7	Wisconsin	9	498	3.9%	77.5%	498	-
8	Kansas	13	437	3.4%	80.9%	492	20
9	Ohio	7	424	3.3%	84.2%	538	-
10	N. Dakota	6	348	2.7%	86.9%	358	-
11	Michigan	5	265	2.1%	89.0%	265	5
12	Missouri	6	261	2.0%	91.0%	261	-
13	Texas	4	250	1.9%	93.0%	250	115
14	Tennessee	2	77	1.4%	94.3%	177	38
15	Colorado	4	25	1.0%	95.3%	125	-
	Others	27	601	4.7%	100%	923	150
U.S. Total		213	12,829	100%		13,492	1,148

Source: Renewable Fuels Association as of April 27, 2010.

Note: Output and production capacity data are in million gallons per year (MPGY).

Evolution of the U.S. Biodiesel Sector

Biodiesel can be produced from any animal fat or vegetable oil (such as soybean oil or recycled cooking oil). About 90% of U.S. biodiesel is made from soybean oil. According to the National Biodiesel Board (NBB), biodiesel is nontoxic, biodegradable, and essentially free of sulfur and aromatics. In addition, it works in any diesel engine with few or no modifications and offers similar fuel economy, horsepower, and torque, but with superior lubricity and important emission improvements over petroleum diesel.[35]

Biodiesel is used almost uniquely as a substitute for petroleum diesel. Biodiesel delivers slightly less energy than petroleum diesel (about 95%). As a result, fuel blenders and consumers are very sensitive to price differences between biodiesel and petroleum-base diesel. The price relationship between vegetable oils and petroleum diesel is the key determinant of profitability in the biodiesel industry. About 7.5 pounds of vegetable oil are used in each gallon of biodiesel. Because soybean oil is the primary feedstock for biodiesel, U.S. soybean producers and the American Soybean Association (ASA) are strong advocates for greater government support for biodiesel production.

U.S. Biodiesel Industry Starts Late, Grows Slowly

The U.S. biodiesel industry did not emerge until the late 1990s. Despite strong growth in the 2000s, U.S. biodiesel consumption remains small relative to national diesel consumption levels. In 2009 (**Figure 1**), U.S. biodiesel consumption represented about 1.2% (in diesel-equivalent units) of national diesel transportation fuel use of about 44 billion gallons (including off-road, farm, and military use).[36] Because biodiesel and diesel fuel are so similar, biodiesel can also be used for the same non-transportation activities. In 2008, 16.2 billion gallons of diesel fuel were used for heating and power generation by residential, commercial, and industry, and by railroad and vessel traffic, bringing total U.S. diesel fuel use to nearly 61 billion gallons.

U.S. biodiesel production grew slowly from under 1 million gallons in 1999 to an estimated 776 million gallons in 2008 (**Figure 7**). Bioenergy Program payments provided an initial impetus for plant investments from 2001 through 2006. The American Jobs Creation Act of 2004 (P.L. 108-357) created the first ever federal biodiesel tax incentive—a federal excise tax and income tax credit of $1.00 for every gallon of agri-biodiesel (i.e., virgin vegetable oil and animal fat) that is used in blending with petroleum diesel; and a $0.50 credit for every gallon of non-agri-biodiesel (i.e., recycled oils such as yellow grease).

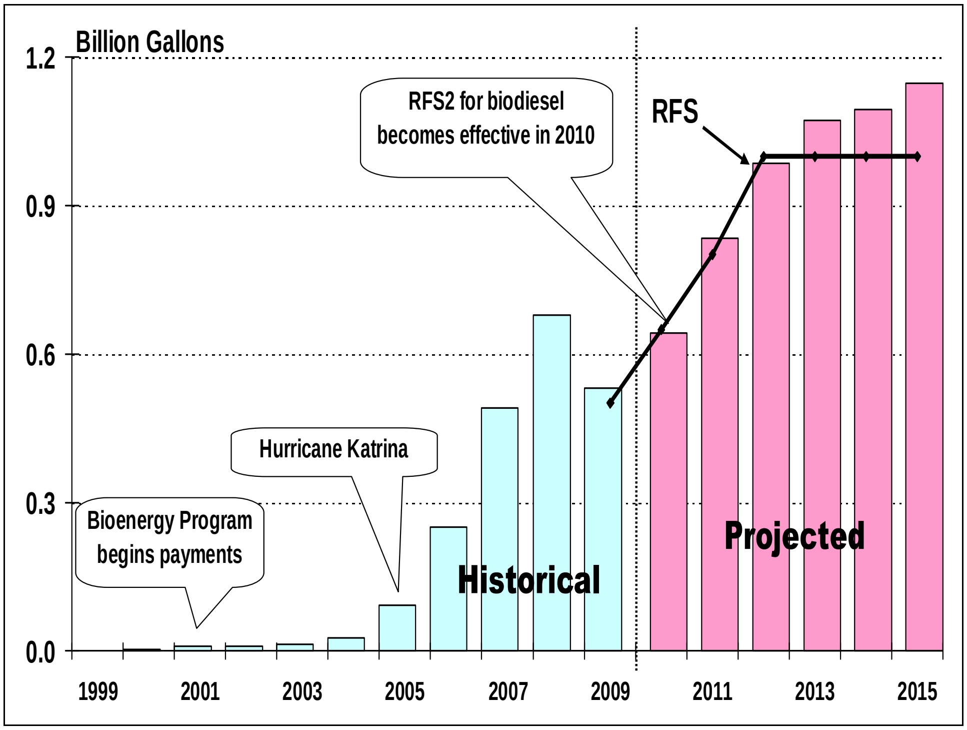
In 2005 the U.S. biodiesel industry received a major economic boost from the same series of market and policy developments described earlier in the ethanol section of this report,[37] and has experienced most of its growth since that period. The Energy Policy Act of 2005 extended the biodiesel tax credit and established a Small Agri-Biodiesel Producer Credit of $0.10 per gallon on the first 15 million gallons of biodiesel produced from plants with production capacity below 60 million gallons per year.

[35] For more information, visit the NBB at http://www.biodiesel.org.

[36] EIA, DOE; biodiesel production estimates from "Monthly Energy Review, April 2010," Table 10.4, Biodiesel Overview; and U.S. Distillate Fuel Oil Sales from "Adjusted Sales of Distillate Fuel Oil by End Use," at http://www.eia.doe.gov/dnav/pet/pet_cons_821dsta_dcu_nus_a.htm.

[37] See section "The Ethanol Industry's Perfect Storm in 2005."

Figure 7. Annual U.S. Biodiesel Production, 1999 to 2015



Source: 1999 to 2009, Energy Information Agency (EIA), Dept. of Energy (DOE). Projections for 2010 to 2015 are from the Food and Agricultural Policy Research Institute (FAPRI), "U.S. Baseline Briefing Book," March 2010.

Notes: Although the RFS2 mandate for biodiesel was to begin in 2009, implementation rules were not available until February 2010. As a result, the RFS2 mandate for 2009 of 500 million gallons was combined with the 2010 mandate of 650 million gallons for a one-time mandate of 1.15 billion gallons in 2010.

Biodiesel was not part of the initial biofuels RFS1 mandate under the Energy Policy Act of 2005, but was included as a distinct category in the RFS2 created under EISA of 2007. The RFS2 biodiesel mandate for 2009 was 500 million gallons. However, since EPA did not have rules in place to operate the biodiesel RFS in 2009, the mandate takes effect for the first time in 2010 under a special one-time arrangement whereby the biodiesel RFS for 2009 is combined with the 2010 mandate (of 650 million gallons) into a single RFS of 1,150 million gallons for 2010. In 2011, the biodiesel mandate returns to its original trajectory of 800 million gallons, rising to 1 billion gallons in 2012.

Since mid-2007, the U.S. biodiesel industry has suffered from unfavorable market conditions—prices for vegetable oil have been high relative to diesel fuel. Most biodiesel plants continued to operate into 2008 in hopes of either higher diesel prices or lower vegetable oil prices, and the industry produced record output of an estimated 678 million gallons.[38] However, the financial crisis of late 2008 and the ensuing economic recession weakened demand for transportation fuel, and petroleum prices (including diesel fuel) fell sharply in the second half of 2008. As a result, the biodiesel industry experienced several bankruptcies and some loss of capacity during 2009. U.S. biodiesel production in 2009 was only 532 million gallons,[39] down nearly 22% from 2008.

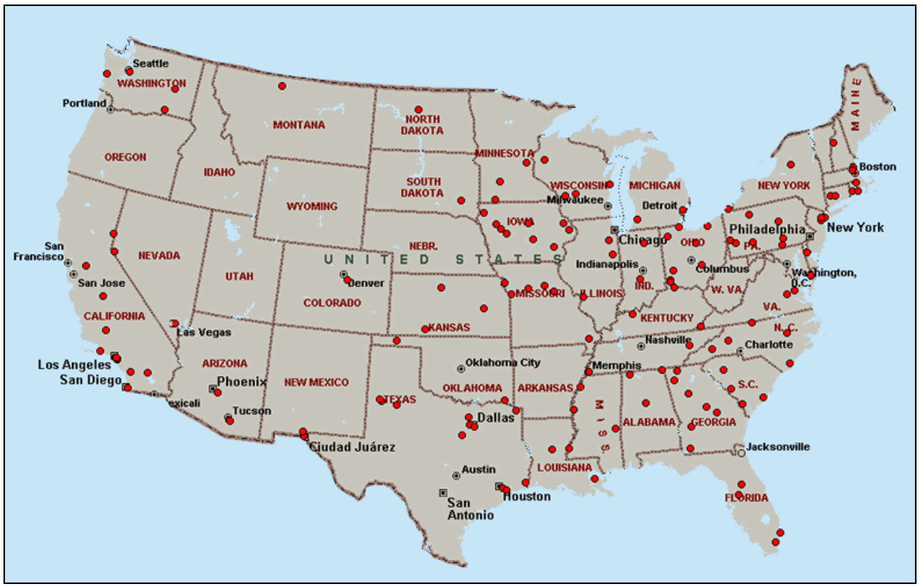
[38] DOE, EIA, *Monthly Biodiesel Production Report,* March 2009.

[39]Energy Information Administration (EIA), DOE.

Biodiesel Production Capacity Spreads Nationwide

As mentioned earlier, the primary feedstock for biodiesel has been soybean oil because of its widespread abundance relative to other vegetable oils. Since soybeans are produced over a greater geographic area than corn, biodiesel plants are more widely dispersed across the United States than are ethanol plants (**Figure 8**).

Figure 8. U.S. Biodiesel Plants Are Widely Distributed Across the Country



Source: National Biodiesel Board, NBB Member Plant Locations, at http://www.biodiesel.org.

Notes: The biodiesel companies listed on the map have indicated that they are still considered operational (as of May 2010), and the estimated total annual production capacity of these plants is approximately 2.737 billion gallons.

According to the National Biodiesel Board (NBB), as of June 22, 2009, there were 173 companies in the United States with the potential to produce biodiesel commercially that were either in operation or idled, with total annual production capacity of 2.69 billion gallons per year. An additional 29 companies were reported to have plants under expansion or under construction but scheduled to be completed within the next 18 months, with an additional capacity of 427.8 million gallons. The combined annual biodiesel production capacity (within the oleochemical industry) once these plants were fully operational (including capacity under construction) would be an estimated 3.12 billion gallons per year. Because many of these plants also can produce other products such as cosmetics, estimated total capacity (and capacity for expansion) is far greater than actual biodiesel production.

As with U.S. ethanol production, Iowa is at the heart of national biodiesel production capacity with a 17% share (**Table 4**). But unlike ethanol, where the top three producing states account for over 50% of national capacity, the top seven biodiesel-producing states must be summed to achieve a 50% share, thus demonstrating the more widespread nature of U.S. biodiesel production capacity.

Table 4. U.S. Biodiesel Production Capacity Partial Estimate as of May 12, 2010

Rank	State	# of Plants	Production Capacity (MGY)	% of output	Cum % output
1	Iowa	12	358.9	17%	17%
2	Nebraska	9	176.5	8%	26%
3	Illinois	6	135.4	6%	32%
4	Minnesota	6	133.0	6%	38%
5	S. Dakota	6	106.0	5%	43%
6	Indiana	2	101.0	5%	48%
7	Wisconsin	3	100.0	5%	53%
8	Kansas	3	90.3	4%	57%
9	Ohio	3	83.0	4%	61%
10	N. Dakota	13	80.5	4%	65%
11	Michigan	8	76.5	4%	69%
12	Missouri	2	62.0	3%	72%
13	Texas	1	60.0	3%	75%
14	Tennessee	4	58.0	3%	77%
15	Colorado	2	51.8	2%	80%
	Others	58	420.9	20%	100%
U.S. Total		138	2,093.8	100%	

Source: National Biodiesel Board (NBB), http://www.biodiesel.org/buyingbiodiesel/plants/showall.aspx.

Notes: This list is limited to members of the NBB. As a result, the total biodiesel production capacity of 2.1 bgals is less than the estimated national production capacity of 2.69 bgals. For more information, see http://www.biodiesel.org/pdf_files/fuelfactsheets/Production_Capacity.pdf.

U.S. Retail Delivery Infrastructure and Vehicle Fleet

A key determinant of the demand for biofuels as a transportation fuel is the U.S. vehicle fleet and the infrastructure that delivers fuel to consumers at the retail level. Because of its physical properties, ethanol cannot be used in the same infrastructure (e.g., pipelines, storage tanks, service pumps) used to deliver retail gasoline. Nor can it be used directly by standard vehicle motors that have not been adjusted for ethanol blends greater than 10%. This both limits ethanol retail delivery opportunities and raises the cost of delivery. In contrast, biodiesel is very similar in nature to petroleum diesel and does not have the same infrastructure limitations.

Gasoline vs. Diesel Vehicles

According to the Department of Energy (DOE), over three-fourths of U.S. transportation fuel is consumed as gasoline or gasoline blends (**Figure 1**). The U.S. Department of Transportation (DOT) estimated that there were 254.4 million registered passenger vehicles (including trucks and buses) in the United States in 2007 (**Table 5**). Of this total, 9.9 million were identifiable as primarily diesel fuel consumers (i.e., large freight trucks and buses), while a portion of passenger vehicles and small trucks may also use diesel fuel.

Table 5. Number of U.S. Registered Highway Vehicles, 2007

Vehicle Type	Millions	Percent
Primarily Gasoline Motors		
Passenger cars (including FFVs)	135.9	53.4%
Flex-Fuel Vehicles[a]	8.0	3.1%
Motorcycles	7.1	2.8%
Mixed Gasoline and Diesel Motors		
Other 2-axle 4-tire vehicles	101.5	39.9%
Primarily Diesel Motors		
Truck, 2-axle 6-tire or more	6.8	2.7%
Truck combination	2.2	0.9%
Bus	0.8	0.3%
Total	**254.4**	**100.0%**

Source: Bureau of Transportation Statistics, Deptartment of Transportation, Table 1-11 "Number of U.S. Aircraft, Vehicles, Vessels, and Other Conveyances," at http://www.bts.gov/publications/national_transportation_statistics/html/table_01_11.html.

a. Government Accountability Office (GAO), *Biofuels: Potential Effects and Challenges of Required Increases in Production and Use*, GAO-09-446, August 2009, p. 123.

Flex-Fuel vs. Standard Gasoline-Blend Vehicles

Ethanol is generally blended into gasoline at the 10% level (E10) or lower, where it can be used in vehicles with standard motors. It can also be used in purer forms such as E85 (85% ethanol and 15% gasoline) in flex-fuel vehicles (FFVs) with motors specially designed for higher ethanol content. However, E85 presently represents less than 1% of U.S. ethanol consumption.[40] Its wider distribution and use is limited by the number of filling station pumps capable of dispensing E85, the number of FFVs in the United States, and the willingness of consumers.

In 2009, ethanol blending as a share of the national gasoline supply approached 8% on a volume basis.[41] A growing share of the national gasoline supply contains up to a 10% blend of ethanol. In many urban retail fuel stations, pure gasoline is no longer available. Instead, gasoline fuel pumps are labeled as containing "up to a 10% blend of ethanol." In these situations, ethanol is treated as indistinguishable from gasoline by consumers.

Standard motor vehicles are not intended for ethanol blend ratios above 10%, as ethanol tends to make the engine run at a higher temperature than standard reformulated gasoline. In addition, the presence of ethanol can be corrosive on rubber and plastic parts in the car engine. As a result, most vehicle warranties will not cover any motor damage resulting from use of ethanol blends above 10%. Only FFVs are capable of using higher ethanol blends.

At blend ratios above 10%, ethanol must compete directly with gasoline as a transportation fuel. For ethanol to operate primarily as a gasoline substitute, at least two things must happen. First,

[40] The most recent EIA, DOE, data on E85 consumption is from 2007, when 54.1 million gallons of E85 were consumed out of over 140 billion gallons of blended gasoline.

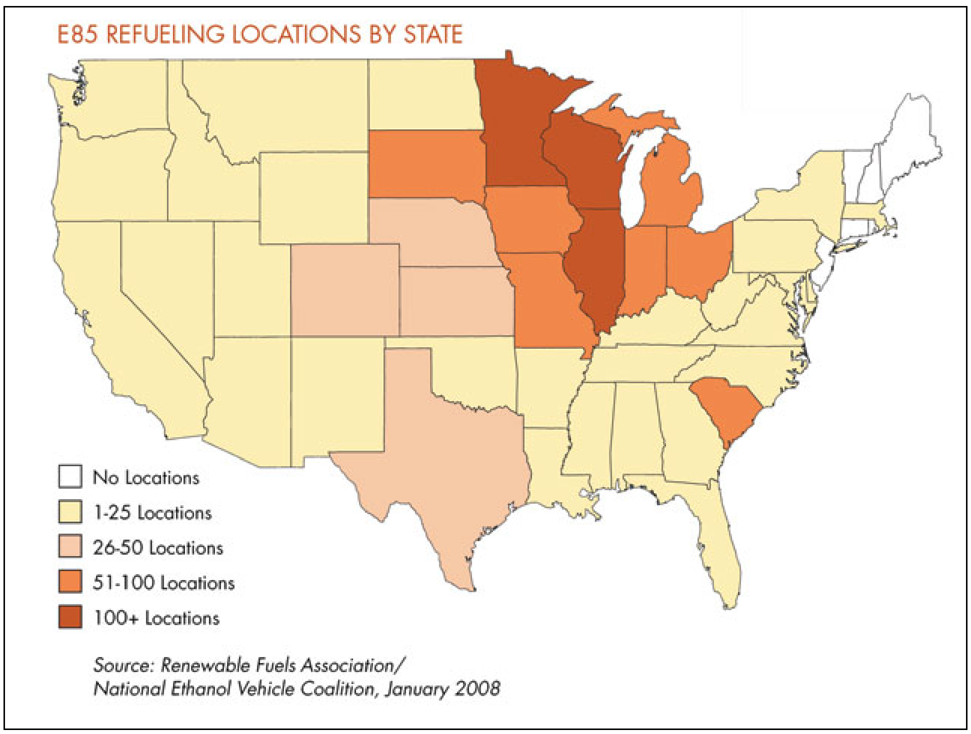
[41] Calculated by CRS as 10.8 bgals of ethanol out of approximately 138 bgals of gasoline and ethanol consumed.

ethanol must be priced competitively with gasoline on an energy-content or miles-per-gallon basis. Second, both the U.S. fleet of FFVs and the number and availability of high-blend-ratio retail pumps must expand.

FFVs can be designed to operate with a varying share of ethanol; however, the most common is the flex-fuel E85 vehicle.[42] For consumers with FFVs that have access to E85 pumps, the price relationship between ethanol and gasoline is important. Varying blend ratios of ethanol with gasoline make the miles-per-gallon calculation more difficult, but the principal holds that, whenever the consumer has a choice between different fuels, he or she is likely to prefer the fuel choice that returns the most miles-per-gallon at the lowest cost.

The market for E85 is limited by both the number of E85 vehicles and the number of E85 fueling stations. According to DOT, there were about 8 million FFVs on the roads in 2007, representing about 3% of U.S. passenger vehicles (**Table 5**).[43] However, not all of those FFVs have access to (or choose to use) E85 retail pumps. As of early 2010, about 2,200 retail stations in the United States offered E85 (1.3% out of 168,000 stations).[44] Most E85 fueling stations are concentrated in the upper midwestern states near the current ethanol production heartland (**Figure 9**).

Figure 9. E85 Refueling Locations by State



Source: Renewable Fuels Association, E-85, http://www.ethanolrfa.org/pages/e-85.

[42] In Brazil, the nation's entire fleet of passenger vehicles is made up of FFVs. All gasoline sold in Brazil contains at least 20% ethanol, while 100% ethanol is also available at every retail service station. Thus, Brazilian consumers make fuel choices based on the price relationship between blended gasoline (E20 to E25) and E100 pure ethanol.

[43] Bureau of Transportation Statistics, Dept. of Trans., Table 1-11 "Number of U.S. Aircraft, Vehicles, Vessels, and Other Conveyances," at http://www.bts.gov/publications/national_transportation_statistics/html/table_01_11.html.

[44] For more information, see the Renewable Fuels Association's E-85 online information site at http://www.ethanolrfa.org/pages/e-85.

Federal Programs That Support Biofuels

As described in the earlier sections on the growth of the ethanol and biodiesel industries, federal policy has played a key role in helping to close the price gap between biofuels and cheaper petroleum fuels. Initially, federal biofuels policies were developed to help kick-start the biofuels industry during its early development, when neither production capacity nor a market for the finished product were widely available. Now, as the industry has evolved, other policy goals (e.g., national energy security, climate change concerns, support for rural economies) are cited as justifications for continuing policy support.

Oversight and implementation of these policies is spread across several government agencies, but the primary responsibility lies with EPA, USDA, and DOE. As the number, complexity, and budgetary implications of federal biofuels policies have grown, so too has the number of proponents and critics. Many biofuels-related policy debates occur along geographic lines. For example, Midwest corn- and ethanol-producing states are major proponents of federal policy support, whereas many residents of the East and West Coast urban states perceive expensive biofuel usage mandates as being forced upon them while their access to cheaper Brazilian sugar-cane ethanol is limited by an import tariff. Another source of biofuels policy conflict has emerged between the major users of corn. Livestock producers have seen their feed costs escalate with the growth in biofuels corn demand and are highly critical of further federal biofuels support; whereas the ethanol and corn sectors are strong advocates for continued support.

Most of the biofuels policies developed and funded by Congress are subject to oversight and periodic reauthorization.[45] Three principal federal programs directly support the U.S. biofuels industry: blending and production tax credits to lower the cost of biofuels to end users, an import tariff to protect domestic biofuels from cheaper foreign-produced ethanol, and volume-specific usage mandates to guarantee a market for biofuels irrespective of their cost. In addition, the biofuels industry is supported by several indirect policies in the form of research grants to stimulate the development of new technologies, and grants, loans, and loan guarantees to facilitate the development of biofuels feedstocks as well as product market and distribution infrastructure.

Tax Credits

Various tax credits and other incentives are available for the production, blending, and/or sale of biofuels and biofuel blends (**Table 6**). Tax credits vary by the type of fuel and the size of the producer. Because of their budgetary cost, the tax credits are rarely extended for more than a year or two at a time. As a result, they routinely require congressional action to be extended.

[45] For a more complete list of federal biofuels incentives, see CRS Report R40110, *Biofuels Incentives: A Summary of Federal Programs*, by Brent D. Yacobucci.

Table 6. Federal Tax Credits Available for Qualifying Biofuels

Biofuel	Tax Credit: $/gallon	Details	Expiration Date
Volumetric Ethanol Excise Tax (VEET) Credit	$0.45	Available in unlimited amount to all qualifying biofuels.	Dec. 31, 2010
Small Ethanol Producer Credit	$0.10	Available on the first 15 million gallons (mgal) of any producer with production capacity below 60 mgal.	Dec. 31, 2010
Biodiesel Tax Credit: virgin oil	$1.00	Available in unlimited amount to all qualifying biodiesel.	Dec. 31, 2009[a]
Biodiesel Tax Credit: recycled oil	$0.50	Available in unlimited amount to all qualifying biodiesel.	Dec. 31, 2009
Small Agri-Biodiesel Producer Credit	$0.10	Available on the first 15 mgal of any producer with production capacity below 60 mgal.	Dec. 31, 2009
Cellulosic Biofuels Production Tax Credit	$1.01	Available in unlimited amount to all qualifying biofuels.	Dec. 31, 2012

Source: CRS Report R40110, *Biofuels Incentives: A Summary of Federal Programs*, by Brent D. Yacobucci.

a. Legislation (H.R.4 213) to extend these tax credits retroactively from January 1, 2010, through December 31, 2010, is pending in Congress.

Import Tariff on Foreign-Produced Ethanol

Most imported ethanol is currently subject to a 2.5% ad valorem tariff and a most-favored-nation duty of $0.54 per gallon of ethanol (for fuel use). In most years the tariff is a significant barrier to direct Brazilian imports. However, some Brazilian ethanol can be brought into the United States duty-free if it is dehydrated (reprocessed) in Caribbean Basin Initiative (CBI) countries.[46] Up to 7% of the U.S. ethanol market could be supplied duty-free in this fashion; historically, however, ethanol dehydrated in CBI countries has only represented about 2% of the total U.S. market.

The Renewable Fuel Standard (RFS)[47]

The RFS requires the blending of renewable fuels (including ethanol and biodiesel) in the national transportation fuel. The RFS includes specific quotas for advanced biofuels (i.e., non-corn-starch ethanol), cellulosic biofuels, and biomass-based diesel fuel, as well as a total biofuels mandate. The RFS also includes a cap on the eligible volume of corn-starch ethanol.

Under the overall biofuels RFS, fuel suppliers were required to blend 9 billion gallons (bgals) of renewable fuel into gasoline in 2008. This requirement increases annually to 36 bgals in 2022, of which only 15 bgals can be ethanol from corn starch. The remaining 21 bgals are to be so-called

[46] For more information on CBI imports, see CRS Report RS21930, *Ethanol Imports and the Caribbean Basin Initiative (CBI)*, by Brent D. Yacobucci.

[47] The initial RFS (referred to as RFS1) was begun by the Energy Policy Act of 2005, (§ 1501; P.L. 109-58). The RFS was greatly expanded (referred to as RFS2) by the Energy Independence and Security Act of 2007 (EISA, § 202, P.L. 110-140). For more information on the RFS, see CRS Report R40155, *Renewable Fuel Standard (RFS): Overview and Issues*, by Randy Schnepf and Brent D. Yacobucci.

"advanced biofuels"—fuels produced from non-corn-starch feedstocks—of which 16 bgals are to be from cellulosic biofuels, 1 bgals from biodiesel, and 4 bgals from other biofuels (most likely imported sugar-cane ethanol from Brazil).

The RFS is administered by EPA and involves tradable certificates—Renewable Identification Numbers (RINs)—assigned to each batch of biofuel.[48] A RIN is a unique 38-character number that is issued to each gallon of biofuel (in accordance with EPA guidelines) by the biofuels producer or importer at the point of biofuels production or the port of importation. When biofuels change ownership (e.g., are sold by a producer to a blender), the RINs are also transferred. When biofuels are blended for retail sale or at the port of embarkation for export, the RIN is separated from the fuel and maybe used for compliance or trade. At the end of the year, each blender must have enough RINs to show that it has met its share of each of the four mandated RFS standards.

In addition to compliance demonstration, RINs can be used for credit trading. If a blender has already met its mandated share and has blended surplus biofuels of a particular RFS category, it can sell the extra RINs to another blender (who has failed to meet its blending mandate for that same biofuel) or it can hold onto the RINs for future use (20% of the current year's RFS obligation may be carried forward either to satisfy the succeeding year's blending requirement or for future sale).

In addition to volume mandates, EISA specified that the lifecycle greenhouse gas (GHG) emissions of a qualifying renewable fuel must be less than the lifecycle GHG emissions of the 2005 baseline average gasoline or diesel that it replaces.[49] Lifecycle GHG emission reduction thresholds were established for each of the four biofuels categories—20% for corn-starch ethanol, 50% for advanced biofuels, 60% for cellulosic biofuels, and 50% for biodiesel.

Some economists that have studied the market effects of the various federal policies have pointed out that the biofuels tax credits are redundant (or superfluous) in the presence of the RFS mandate. Without a tax credit, the full RFS-mandated volume would be used and the RIN value would reflect the full price gap between a biofuels producer's supply price and a biofuels blender's demand price.[50] With both an RFS mandate and a tax credit in effect, the mandate ensures that the RFS volume will be consumed, while the tax credit lowers the value of a RIN. If the biofuels volume consumed exactly equals the RFS mandate, then the tax credit benefits only gasoline blenders. If the tax credit pushes biofuels consumption above the RFS mandate, then the resulting higher biofuels price would also benefit biofuels producers. Either way, the tax credit's true cost is born by taxpayers. Tax credits cost taxpayers more than $5 billion in 2009. If the RFS2 mandates are fully met in 2022, then the tax credits (if extended at their current levels) would cost taxpayers over $27 billion in that year alone and nearly $200 billion over the 14-year period (2009-2022) of the RFS2.

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[48] "Renewable Identification Numbers Are the Tracking Instrument and Bellwether of U.S. Biofuel Mandates," by Wyatt Thompson, Seth Meyer, and Pat Westhoff, *EuroChoices*, vol. 8, no. 3, 2009.

[49] For more information, see CRS Report R40460, *Calculation of Lifecycle Greenhouse Gas Emissions for the Renewable Fuel Standard (RFS)*, by Brent D. Yacobucci and Kelsi Bracmort.

[50] "Mandates, Tax Credits, and Tariffs: Does the U.S. Biofuels Industry Need Them All?" by Bruce A. Babcock, *CARD Policy Briefs 10-PB-1*, Center for Agricultural and Rural Development, Iowa State University, March 2010.

Other Indirect Federal Policies

Several additional biofuels programs have been created to provide various grants, loans, and loan guarantees in support of research and development of related technology, as well as support for biofuels infrastructure development. Federal programs also require federal agencies to give preference to bio-based products in purchasing fuels and other supplies. Cellulosic plant investment is further facilitated by a special depreciation allowance created under the Tax Relief and Health Care Act of 2006 (P.L. 109-432). Also, several states have their own incentives, regulations, and programs in support of renewable fuel research, production, and use that supplement or exceed federal incentives.[51]

In addition to direct and indirect biofuels policies, the U.S. biofuels industry benefits from U.S. farm programs in the form of price and income support programs (i.e., marketing loan benefits and the counter-cyclical payment program) and risk-reducing farm programs (e.g., Acreage Crop Revenue Election (ACRE), Supplemental Revenue Assistance Payments (SURE), federal crop insurance, and disaster assistance), which encourage greater production and lower prices than would occur in the absence of federal programs in a free-market equilibrium.[52] As a result, agricultural feedstocks are both lower-priced and more abundant than without federal farm programs. This helps lower production costs for the U.S. biofuels sector, and makes U.S. biofuels more competitive with foreign-produced biofuels.

Current Biofuels Policy Issues

Several federal biofuels provisions have expired or are set to expire on December 31, 2010.[53] Most of the biofuels policy provisions contained in the 2008 farm bill (P.L. 110-246) were extended through FY2012;[54] however, some of the newer programs—e.g., the Biomass Crop Assistance Program (BCAP)—are still under development, with proposed implementation rules currently being promulgated.

Pending Congressional Actions

Biodiesel Tax Credit Extension or Expiration

Three biodiesel tax credits (biodiesel tax credit, small agri-biodiesel producer credit, and renewable diesel tax credit) expired on December 31, 2009, and have not been renewed. The House approved a one-year extension of these biodiesel tax credits in December 2009, as part of

[51] For more information, see the "Federal & State Incentives & Laws," Alternative Fuels and Advanced Vehicles Data Center, Energy Efficiency and Renewable Energy (EERE), DOE, at http://www.afdc.energy.gov/afdc/laws/.

[52] For more information on U.S. farm programs, see CRS Report RL34594, *Farm Commodity Programs in the 2008 Farm Bill*, by Jim Monke; CRS Report R40422, *A New Farm Program Option: Average Crop Revenue Election (ACRE)*, by Dennis A. Shields; CRS Report R40452, *A Whole-Farm Crop Disaster Program: Supplemental Revenue Assistance Payments (SURE)*, by Dennis A. Shields; and CRS Report R40532, *Federal Crop Insurance: Background and Issues*, by Dennis A. Shields.

[53] For a complete list of federal policies that support the biofuels industry, see CRS Report R40110, *Biofuels Incentives: A Summary of Federal Programs*, by Brent D. Yacobucci.

[54] For more information see CRS Report RL34130, *Renewable Energy Programs in the 2008 Farm Bill*, by Megan Stubbs.

the Tax Extenders Act of 2009 (Sec. 202, H.R. 4213). The Senate passed the American Workers, State and Business Relief Act as a substitute amendment to H.R. 4213 in March 2010. The Senate version also included the one-year extension of the three biodiesel and renewable fuel tax credits, and made them available retroactively to January 1, 2010. Final agreement on H.R. 4213 is pending.

According to the Joint Committee on Taxation, the tax credits are expected to cost $624 million in 2010, and $231 million in 2011. However, if extended through 2010, the biodiesel tax credits would still face expiration on December 31, 2010. Bills to extend the biodiesel tax credits beyond 2010 have been introduced in both chambers and referred to the respective tax committees—H.R. 4070 to the House Committee on Ways and Means and S. 1589 to the Senate Committee on Finance—but no further action has occurred. These bills would extend the three biodiesel tax credits through 2014. In addition, the legislation would change the biodiesel tax incentive from a blender's excise tax credit to a production excise credit. Such a change would prevent the biodiesel tax credits from being applied to imported biofuels.

Ethanol Tax Credits and Import Tariff Extension or Expiration

Two non-cellulosic ethanol tax credits (the volumetric ethanol excise tax credit and the small ethanol producer credit) and the import duty on foreign fuel ethanol are set to expire on December 31, 2010. The cellulosic biofuel tax credit does not expire until December 31, 2012. Legislation to extend both non-cellulosic ethanol tax credits, the cellulosic ethanol tax credit, and the import tariff through 2015 has been introduced—H.R. 4940, referred to the House Committee on Ways and Means, and S. 3231, referred to the Senate Committee on Finance—but no further action has occurred.

The American Farm Bureau, the Renewable Fuel Association, the National Corn Growers Association, and other pro-biofuels industry groups are strong proponents of the tax-extending legislation. In contrast, many groups representing various aspects of the U.S. livestock industry, environmental groups, and groups opposing farm subsidies in general are strongly opposed to any extension of the biofuels tax credits and the import tariff.

Monitoring of BCAP Implementation and Emergence of Cellulosic Biofuel Production

Investors are reluctant to invest in what so far is an unproven technology—the conversion of cellulosic biomass to biofuels. Development of cellulosic biofuels industry hinges on effective use of new feedstocks. The Biomass Crop Assistance Program (BCAP) was created under the 2008 farm bill to facilitate the development of those new feedstocks and kick-start the cellulosic biofuels industry.[55] BCAP (via USDA's CCC) provides financial assistance to producers or entities that deliver eligible biomass material to designated biomass conversion facilities for use as heat, power, bio-based products, or biofuels. Initial assistance will be for the collection, harvest, storage, and transportation (CHST) costs associated with the delivery of eligible materials.

[55] For more information, see CRS Report RL34130, *Renewable Energy Programs in the 2008 Farm Bill*, by Megan Stubbs.

Because BCAP is intended to underwrite an as yet nonexistent industry—the cellulosic biofuels industry—considerable uncertainty exists over how it should evolve so as to be most useful to jump-starting the commercialization of cellulosic biofuels production. USDA published a proposed rule for implementing BCAP on February 8, 2010,[56] and initial annual payments valued at over $224 million have been made under the program.[57] Congress will be monitoring closely both the implementation of BCAP and its effect on the development of the cellulosic biofuels sector.

Pending EPA Actions

Ruling on the Ethanol-to-Gasoline Blending Limit: 10% vs. 15%[58]

In 2010, nearly 13 bgals of ethanol are mandated under the RFS for use in the nation's gasoline supply (including 12 bgals of corn-starch ethanol, 0.95 bgals of imported sugar-cane ethanol, and 0.065 bgals of cellulosic ethanol). The combined level of mandated biofuels represents a 9.4% share of the projected 139 bgals of U.S. gasoline consumption for 2010. At present, the amount of ethanol that may be blended in gasoline for use in standard vehicle motors without modification is limited to 10% by volume, by guidance developed by the EPA under the Clean Air Act, as well as by vehicle and engine warranties, and certification procedures for fuel-dispensing equipment. Regional infrastructure issues suggest that the actual limiting value is something less than the 13.9 billion gallons implied by the 10% limitation. This "blending-limited" volume is often referred to as the "blending wall."[59]

For ethanol consumption to exceed the so-called blending wall and meet the RFS mandates, increased consumption at higher blending ratios is needed. For example, raising the blending limit from 10% to a higher ratio such as 15% or 20% would immediately expand the "blending wall" to somewhere in the range of 20 to 27 billion gallons. The U.S. ethanol industry is a strong proponent of raising the blending ratio. On March 6, 2009, Growth Energy (on behalf of 52 U.S. ethanol producers) applied to the EPA for a waiver from the current Clean Air Act E10 limit. The application requests an increase in the maximum concentration to 15% (E15). EPA has 270 days to grant or deny the request. However, EPA must undertake substantial motor vehicle testing to ensure that a higher blend ratio can be used in standard vehicle motors without modification. EPA has said that it will release its findings by the end of September 2010.[60]

Two additional options to resolving this bottleneck exist but appear to be long-run alternatives. First, increased use of ethanol in flex-fuel vehicles (FFVs) at ethanol-to-gasoline blend ratios as high as 85% (referred to as E85) is a possibility. However, increased E85 use involves substantial infrastructure development, particularly in the number of designated storage tanks and E-85 retail pumps, as well as a rapid expansion of the FFV fleet to absorb larger volumes of ethanol.

[56] Biomass Crop Assistance Program, Proposed Rule (7 C.F.R. Part 1450), *Federal Register*, Vol. 75, No. 25, USDA, Commodity Credit Corporation, February 8, 2010, pp. 6264-6288.

[57] For more information, see the Biomass Crop Assistance Program website, Farm Service Agency, USDA, at http://www.fsa.usda.gov/FSA/webapp?area=home&subject=ener&topic=bcap.

[58] For more information, see EPA Fuel Additive Notices, at http://www.epa.gov/otaq/additive.htm.

[59] For more information see CRS Report R40445, *Intermediate-Level Blends of Ethanol in Gasoline, and the Ethanol "Blend Wall,"* by Brent D. Yacobucci.

[60] "U.S. Decision on Ethanol Blend Put Off Until Fall," Mary Clare Jalonick and Matthew Daly, *Associated Press*, June 18, 2010.

A second alternative is to expand use of processing technologies at the biofuel plant to produce biofuels in a form (e.g., butanol) that can be used by existing petroleum-based distribution and storage infrastructure and the current fleet of U.S. vehicles. However, more infrastructure-friendly biofuels generally require more processing than ethanol and are therefore more expensive to produce.

Waiver of Mandated Use Requirements

The RFS mandates the use of almost 13 bgals of biofuels in 2010. The mandate grows to 20.5 bgals of biofuels use by 2015, of which only 1 bgals is mandated as biodiesel. By 2022, 36 bgals of biofuels must be consumed under the RFS.

Each year EPA must review the likelihood of outyear biofuel production meeting or failing to meet required RFS usage levels, and adjust the mandates accordingly. EPA's biofuels standards for each upcoming year are announced on a preliminary basis in the spring of the preceding year, when EPA issues a notice of proposed rulemaking, and on a final basis by November 30 of the preceding year, when EPA issues a final rule.[61]

The likelihood of meeting RFS mandates hinges both on the "blend wall" and on the slow emergence of a national infrastructure needed to facilitate the distribution and use of the growing mandated biofuel volumes. Even with an expansion of the blending ratio to 15%, the higher blend wall of approximately 20 to 21 bgals would become a real barrier to expanded biofuels use by 2015.

Estimation of GHG Emission Reductions

Under EISA, EPA is responsible for evaluating whether a renewable fuel meets the specific GHG reduction threshold assigned to its RFS category. Determining compliance with the thresholds requires a comprehensive evaluation of renewable fuels on the basis of their lifecycle emissions.[62] The concept of "lifecycle emissions" encompasses an evaluation of GHG emissions along the entire pathway of a biofuel from the production, harvesting, and marketing of its feedstocks to the processing and distribution of the biofuel.

In addition, Congress required that EPA take into consideration both direct emissions and significant indirect emissions such as significant emissions from land uses changes that might result from changes in crop patterns due to the various biofuels incentives (Section 201, P.L. 110-140). More specifically, the concern with respect to indirect land use changes (ILUC) is that expanded field crop production in the United States for ethanol production has led to commodity price increases that, in turn, have induced increased land cultivation in other countries, and as a result, have increased net global GHG emissions. The measurement of ILUC is necessarily inexact because so many potential activities and countervailing forces are involved. As a result, inclusion of ILUC as part of the EPA's lifecycle GHG reduction analysis has been controversial.

[61] CRS Report RS22870, *Waiver Authority Under the Renewable Fuel Standard (RFS)*, by Brent D. Yacobucci.

[62] For more information, see CRS Report R40460, *Calculation of Lifecycle Greenhouse Gas Emissions for the Renewable Fuel Standard (RFS)*, by Brent D. Yacobucci and Kelsi Bracmort.

Initially, EPA's lifecycle GHG reduction models proved very sensitive to assumptions regarding the extent of indirect land use changes, and suggested that some standard biofuels may not be eligible for inclusion under the RFS. EPA models were updated prior to the final RFS rule (February 2009) using newer data and produced more inclusive results. For example, corn-starch ethanol was determined to achieve a 21% reduction in GHG emissions compared to the gasoline 2005 baseline, thus just surpassing the 20% reduction threshold.[63]

EPA models for estimating land use changes and other life-cycle factors involved in GHG emissions are continually re-evaluated as new or better data, methods, or analytical techniques become available. The nature of the future changes to EPA models, and their potential to include or exclude certain biofuels, remains a critical aspect of the RFS mandates and the U.S. biofuels industry's ability to meet the mandates.

Endangerment Findings for Greenhouse Gases (GHGs)

On April 2, 2007, in *Massachusetts v. EPA* (549 U.S. 497 (2007)), the U.S. Supreme Court determined that GHGs are air pollutants covered under Section 202(a) of the Clean Air Act. The Court held that EPA must determine whether or not emissions of GHGs from new motor vehicles cause or contribute to air pollution that may reasonably be anticipated to endanger public health or welfare, or whether the science is too uncertain to make a reasoned decision.[64] This court ruling would allow EPA to regulate GHGs without further congressional action, and could bring into play the issue of indirect land use changes, given their alleged GHG emissions effects, which may put all ethanol production in question. On June 11, 2010, a Senate resolution (S.J.Res. 26) that would have blocked EPA from using the Clean Air Act to regulate GHGs was defeated (53-47).[65] Prior to the vote, on June 8, 2010, the White House had issued a statement saying that if S.J.Res. 26 reached the President's desk (i.e., passed both chambers of Congress), President Obama would veto it.

Other Pending Biofuels Issues

CARB's LCFS Restriction on Midwestern Ethanol

In January 2007, Governor Arnold Schwarzenegger established a Low Carbon Fuels Standard (LCFS) by executive order for California.[66] The governor's executive order directed the state's Secretary for Environmental Protection to coordinate the actions of the California Energy Commission, the California Air Resources Board (CARB), the University of California, and other agencies to develop the protocols for measuring the "life-cycle carbon intensity" of transportation fuels.

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[63] "V. Lifecycle Analysis of Greenhouse Gas Emissions;" Regulation of Fuels and Fuel Additives: Changes to Renewable Fuel Standard Program; Final Rule, 40 CFR Part 80, *Federal Register*, March 26, 2010, p. 14786.

[64] For more information see "Endangerment and Cause or Contribute Findings for Greenhouse Gases under Section 202(a) of the Clean Air Act," EPA, at http://www.epa.gov/climatechange/endangerment.html.

[65] DTN Ag Policy Blog, "Senators Face Emissions Test," Chris Clayton, June 9, 2010.

[66] For more information, see "Low Carbon Fuel Standard," California Energy Commission, at http://www.energy.ca.gov/low_carbon_fuel_standard/index.html.

Under the LCFS, CARB proposed reducing emissions of GHGs by lowering the carbon content of transportation fuels used in California. The LCFS established performance standards that fuel producers and importers must meet each year starting in 2011. As part of its LCFS modeling effort, CARB includes an estimate of the ILUC impact of grain-based ethanol. Largely because of the ILUC value assigned to corn-starch ethanol, most midwestern ethanol production does not qualify for use as a transportation fuel under California's LCFS.[67] If this result stands, it will have important implications for how or whether the federal RFS mandates can be met for the nation as a whole, since California is both the largest state (39 million people), the largest consumer of gasoline, and a major ethanol consumer of approximately 1.5 billion gallons annually.[68]

A recently completed state-of-the-art analysis from Purdue University concludes that CARB overestimated the ILUC impact of grain-based ethanol by a factor of two in developing its LCFS.[69] In a letter sent to CARB Chair Mary Nichols, the Renewable Fuels Association pointed out this dramatic conclusion and reminded CARB of its promise to review and incorporate new science as it becomes available.[70]

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[67] For more information see, "Proposed Regulation to Implement the Low Carbon Fuel Standard," Initial Statement of Reasons, Vol. 1, CARB, March 5, 2009, at http://www.arb.ca.gov/fuels/lcfs/lcfs.htm.

[68] Todd Neeley, "US Scientists Demand Revision of Biofuels Carbon Accounting," DTN Ethanol blog, May 25, 2010.

[69] "New Study Undercuts California Low Carbon Fuel Standard, Shows Evolving Land Use Change Debate," Renewable Fuels Association (RFA), news entry, April 28, 2010, at http://www.ethanolrfa.org.

[70] RFA letter to CARB, April 28, 2010, available at http://ethanolrfa.org/page/-/RFA%20Letter%20to%20ARB.pdf?nocdn=1http://ethanolrfa.org/page/-/RFA%20Letter%20to%20ARB.pdf?nocdn=1.