Ethanol: Economic and Policy Issues

(name redacted)
Specialist in Agricultural Policy

April 2, 2009

Congressional Research Service
7-....
www.crs.gov
R40488

CRS Report for Congress
Prepared for Members and Committees of Congress

Summary

Biofuels are a major source of renewable energy in the United States. Ethanol produced from corn starch accounts for 90% of the biofuels consumed, but only 5% of all light-duty motor transportation fuel consumption. Ethanol is blended with gasoline to increase octane and reduce emissions, and used as a substitute for gasoline to reduce consumption of petroleum-based fuels.

Ethanol has the potential to provide many benefits. As an alternative to gasoline refined from imported oil, its use can improve U.S. national energy security, albeit marginally. Although the exact magnitude is subject to debate, ethanol is thought by many to produce lower greenhouse gas (GHG) emissions compared with gasoline. For this reason, its increased use is seen by many as playing a potential key role in reducing the contribution of the transportation sector to global climate change. U.S.-produced ethanol can also boost demand for U.S.-produced farm products, stimulate rural economies, and provide "green" jobs in rural areas.

An ethanol-centric policy does have its critics. For example, ethanol has been implicated as a factor in rising commodity and food prices. As ethanol production increases, corn is diverted from feed and export markets and acreage is diverted from other crops, such as soybeans. The extent to which ethanol is responsible for these impacts has been the subject of debate and wide-ranging estimates. Also, the potential to displace gasoline and increase national energy security is limited by the land available to grow corn.

Since the 1970s, ethanol has received support from the U.S. government. Presently, federal support is provided in the form of mandated levels of consumption, financial incentives such as grants and loan guarantees, tax credits, tariffs on ethanol imports, and federally funded research and development efforts. Tax credits made available to blenders of ethanol are expected to total nearly $6 billion in 2009. Incentives were initially provided to get the ethanol industry off the ground—many now argue that the ethanol industry has matured and these resources should be used elsewhere.

Federal support for biofuels and ethanol in particular is likely to be an issue facing the 111th Congress. Ethanol has received more federal support than other types of renewable energy. Some argue that the market, rather than the government, should direct investment, whether it be for ethanol, wind, solar, geothermal, or other alternatives. In addition, ethanol is used in internal-combustion engines that mostly use fossil fuels, unlike alternatives such as battery or plug-in-electric vehicles, which do not consume fossil fuels directly.

Other issues of congressional interest may include financial support for ethanol during the recession and the extension of the blender's tax credit and the import tariff, both of which expire after 2010. The renewable fuel standard (RFS), which mandates increasing volumes of renewable fuel use through 2022, may become an issue if biofuels production shortfalls occur and the mandate cannot be met. The U.S. Environmental Protection Agency (EPA) is drafting rules on the calculation of lifecycle greenhouse gas emissions that will determine which fuels qualify for the RFS. These rules will likely attract congressional scrutiny if they exclude major stakeholders in the ethanol industry. In addition, continuation of the RFS itself may be the subject of debate.

Contents

Figures

Tables

Contacts

Introduction

The United States consumes about 186 billion gallons of light-duty road motor transportation fuel annually, most in the form of petroleum-based fuel (i.e., gasoline and diesel). However, biofuels are a small, yet growing, component of U.S. fuel consumption, accounting for an estimated 10 billion gallons in 2008, or 5% of total light-duty road motor transportation use by volume. Ethanol and biodiesel are the most common agriculture-based biofuels. Ethanol accounted for about 92% of agriculture-based biofuels consumption in 2008, and biodiesel for 8%, on an energy-equivalent basis.[1] Together with imports, U.S. ethanol consumption was 6.7 billion gallons in 2007 and 8.9 billion gallons in 2008.[2] Although a small volume compared with total liquid fuel consumption, it nevertheless displaced roughly 88 million barrels of oil in 2007 and 125 million barrels in 2008, compared with oil imports of about 3.7 billion barrels.

This report focuses on "first generation" biofuels—that is, those currently in commercial production (corn-starch ethanol[3] and foreign-produced sugar cane ethanol).[4] "Second generation" biofuels, primarily cellulosic biofuels, are not yet produced on a commercial scale in the United States.[5]

Historically, fossil-fuel-based energy has generally been less expensive to produce and use than energy from renewable sources. However, 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 energy. These programs have proven critical to the economic success of rural renewable energy production. The benefits to rural economies and to the environment are not always clear and come with costs, leading to a lively debate between proponents and critics of government subsidies that underwrite agriculture-based renewable energy production.

Proponents of government support for agriculture-based biofuels have cited national energy security, environmental benefits (such as reductions in greenhouse gas (GHG) emissions to moderate climate change rates), and higher domestic demand for U.S.-produced farm products as viable justifications.[6] In addition, proponents argue that rural, agriculture-based energy production can enhance rural incomes and employment opportunities, while expanding the value added to U.S. agricultural commodities.

In contrast, petroleum industry critics of biofuels subsidies argue that technological advances in seismography, drilling, and extraction continue to expand the fossil-fuel resource base, which has

[1] On an energy-equivalent basis to gasoline. The energy in a gallon of ethanol is equal to that in .67 gallon of gasoline.

[2] CRS estimate based on data from the U.S. Department of Energy's Energy Information Agency.

[3] Unless otherwise specified, this report covers corn-starch ethanol (corn ethanol) produced from starch in the corn kernel and does not include biofuels produced from other parts of the corn plant.

[4] First generation biofuels also include ethanol produced from sorghum, a small amount of which is produced in the United States.

[5] For information on cellulosic biofuels, see CRS Report RL34738, *Cellulosic Biofuels: Analysis of Policy Issues for Congress*, by Tom Capehart.

[6] For examples of proponent policy positions, see the Renewable Fuels Association (RFA) at http://www.ethanolrfa.org, the National Corn Growers Association (NCGA) at http://www.ncga.com/files/pdf/POLICYPOSITION_1.pdf, and the American Soybean Association (ASA) at http://www.soygrowers.com/policy/.

traditionally been cheaper and more accessible than biofuels supplies.[7] Other critics argue that current biofuels production strategies can only be economically competitive with existing fossil fuels in the absence of subsidies 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 potential renewable energy sources, such as wind, 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 either starches, sugars, or vegetable oils to permit biofuels production to meaningfully offset petroleum imports.[9] Finally, there are those who argue that the focus on development of alternative energy sources undermines efforts to conserve and reduce the nation's energy dependence.

The Renewable Fuel Standard (RFS) is the most significant government intervention in the ethanol industry. The RFS mandates that increasing volumes of renewable fuels be blended with conventional fuels through 2022. In 2009, 11.1 billion gallons of biofuels must be used, of which 10.5 billion gallons may be corn ethanol. The RFS is discussed in detail below.

This report examines the role of government intervention and economic, trade, and environmental issues related to ethanol that are likely to be discussed in the 111th Congress.

Issues for Congress

Ethanol will likely be central to discussions of renewable fuel issues during the 111th Congress. This report's discussion of ethanol presupposes the continued dominance of the internal combustion engine and the current infrastructure for petroleum fuel extraction and refining and biofuels feedstock production and refining—as opposed to the major near-term market penetration of alternatives such as plug-in-electric automobiles. The following highlights major topics of potential legislative interest that are discussed in this report.

Renewable Fuel Standard Statutory Waiver

In April 2008, Texas Governor Rick Perry applied to the U.S. Environmental Protection Agency (EPA) for a waiver of the renewable fuel standard, citing economic damage to the livestock and poultry industries in his state. EPA denied the request in August 2008 after determining that implementation of the RFS mandate during the time period at issue would not severely harm the economy of a state, region, or the United States.[10] Around the same time, legislation (S. 3031) was introduced to limit the RFS to 9 billion gallons annually, compared with 15 billion under the

[7] For example, see Elizabeth Ames Jones, "Energy Security 101," *Washington Post*, October 9, 2007.

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

[9] For example, see James and Stephen Eaves, "Is Ethanol the 'Energy Security' Solution?" *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] EPA, "Notice of Decision Regarding the State of Texas Request for a Waiver of a Portion of the Renewable Fuel Standard," *Federal Register*, vol. 73, no. 157, August 13, 2008.

current law. Proponents cited the RFS and corn ethanol production as contributing to rising food prices and high input costs for livestock and poultry producers. Opponents of the reduction claimed it would set back efforts to increase national energy security and achieve environmental goals. They also argued that high fuel costs played a much larger role in food price increases than the higher price of corn attributable to the mandate. The bill was referred to the Committee on Environment and Public Works, but no action was taken. Statutory changes to the RFS might be considered in the 111th Congress.

Ethanol Trade Issues

Most ethanol imported into the United States is subject to a tariff of $0.54 per gallon. During the 110th Congress, legislation was introduced to eliminate the import tariff on ethanol (H.R. 6137), to reduce the tariff to parity with the blender's tax credit (H.R. 6324), and to extend the tariff (S. 1106, H.R. 2419). The tariff was extended through 2010 in the 2008 farm bill (P.L. 110-246). Several factors may generate debate on the tariff during the 111th Congress: (1) beginning in 2009, the tariff is $0.09 per gallon higher than the blender's tax credit it was intended to offset, (2) as the RFS increases and becomes more difficult to fulfill, imports may play a greater role in reaching mandated volumes, and (3) if the price of imported ethanol was lower (without the tariff), blenders would be likely to blend more ethanol into gasoline, achieving one of the benefits of ethanol—reduced emissions. The tariff is discussed in more detail later in this report.

Potential Market Effects

The use of food crops to produce energy has altered the dynamics of agricultural markets. The U.S. Department of Agriculture (USDA) projects that nearly a third of the 2008/2009 corn crop will be refined into ethanol. Corn production has increased in recent years to accommodate higher demand, resulting in higher prices and shifts in acreage to corn from soybeans and other crops. High corn prices have boosted costs for the livestock industry. Congress may continue its debate and oversight in this area, possibly focusing on two areas: first, the role of speculation in increasing the magnitude and volatility of agricultural and food prices, and second, the response to higher food prices by domestic and international providers of food aid. Both are likely to be examined during the 111th Congress as they were during the 110th. For more information on the food versus fuel debate, see CRS Report R40155, *Selected Issues Related to an Expansion of the Renewable Fuel Standard (RFS)*, by (name redacted) and Tom Capehart.

Greenhouse Gas Emissions

The Energy Independence and Security Act of 2007 (EISA, P.L. 110-140) requires that biofuels eligible under the RFS reduce greenhouse gas (GHG) emissions by certain levels compared with fossil fuels. EPA is charged with formulating rules for calculating GHG emissions using lifecycle analysis that includes both direct and significant indirect effects (see section below on GHG emissions for more detail). The methodology selected by EPA could potentially eliminate certain biofuels from the RFS—with major economic implications for segments of the renewable fuels industry. If EPA rules on GHG emissions are perceived as overly restrictive, some in Congress could introduce legislation to relax the rules.

Ethanol Blend Rates

Ethanol industry proponents are concerned that, even as production of corn ethanol increases, limitations in distribution infrastructure and vehicle absorption capacity will create a bottleneck, known as the "blend wall," holding down potential consumption. The blend wall occurs when the maximum allowable percentage of ethanol in conventional gasoline (e.g., gasoline meant for all vehicles) does not absorb the volume of ethanol mandated by the RFS. For instance, current annual gasoline consumption of 140 billion gallons allows for theoretical ethanol consumption of 14 billion gallons at the current maximum blend of 10% (E10). Thus 14 billion gallons is the blend wall. However, it is not practical to blend every gallon of fuel consumed in the United States at the 10% level, so the actual amount of ethanol consumed is slightly less—closer to 12.5 billion gallons. The blend wall is reached when the volume of ethanol mandated under the RFS is greater than the volume which can be consumed as E10 plus the very small amount consumed as E85. Currently, the ability to consume E85 is very limited due to the lack of infrastructure and the small number of flexible fuel vehicles (FFVs)—annual E85 consumption is about 10 million gallons per year,[11] accounting for less than 1% of total ethanol consumption.

One solution to the blend wall is to increase the proportion of ethanol in gasoline consumed by conventional vehicles. Increasing the allowable blend to E12 could raise potential consumption to 17 billion gallons without any additional investment in infrastructure or vehicle modifications. This solution is very popular with corn and ethanol producers, who claim an increase in green jobs, benefits to rural economies, and the displacement of foreign-produced petroleum. U.S. Secretary of Agriculture Tom Vilsack has supported a shift to E15. Those against increasing the blend rate, such as livestock producers and retail food interests, claim that higher food and feed prices will result from higher corn demand. EPA has been assessing the feasibility of increasing the ethanol blend rate. In addition to market impacts, concerns include the effects of higher blends on motorcycles, small engines, and emission control and fuel systems, especially in older vehicles.

Federal Support for the Ethanol Industry[12]

The ethanol industry has received substantial support from the federal government. However, some ethanol industry supporters argue that the current economic environment justifies additional government support. Recent industry proposals include guaranteed operating loans targeted to ethanol refiners and tax credits for "green" job creation or preservation. The blender's tax credit (or volumetric ethanol excise tax credit) is an income tax credit of $0.45 per gallon on each gallon of ethanol blended into gasoline for sale or consumption. It is scheduled to expire during the 111th Congress—at the end of 2010—and ethanol proponents are expected to argue for its extension. While the cellulosic biofuels production tax credit and the small producer's tax credit do not expire during the 111th Congress, either could be modified as the debate progresses. Proponents of other types of renewable energy contend that available resources could be better used supporting wind, solar, or other types of renewable energy and they will likely argue for a shift of government support away from ethanol.

[11] DOE, Energy Information Administration (EIA), Report #:DOE/EIA-0383 (2009).

[12] For detailed information on incentives for ethanol, see CRS Report R40110, *Biofuels Incentives: A Summary of Federal Programs*, by (name redacted).

Some critics of the ethanol industry maintain that government expenditures in the form of tax credits and other subsidies for the ethanol industry are excessive. They question whether the industry will ever be viable without government assistance. Others question the balance between support for biofuels and other forms of renewable energy. A recent Environmental Working Group report based on U.S. Department of Energy (DOE) analysis shows that biofuels accounted for three-quarters of the tax benefits and two-thirds of all federal subsidies allotted for renewable energy in 2007.[13] According to data compiled by DOE's Energy Information Agency, the corn-based ethanol industry received $3 billion in tax credits in 2007, more than four times the $690 million in credits to other forms of renewable energy, including solar, wind, and geothermal power.

Proponents of the ethanol industry urged policymakers to direct economic stimulus package resources authorized by the 111th Congress toward the ethanol industry. Among the support requested was a $1 billion short-term credit facility to finance current operations, additional loan guarantees for new production capacity and infrastructure, job creation tax credits for new jobs created by production operations, and expanded federal support for research and development.[14] However, the final stimulus plan (the American Recovery and Reinvestment Act of 2009, P.L. 111-5) does not contain specific additional support for ethanol, although it expands the tax credit for E85 fuel pumps and storage facilities.

U.S. Ethanol Supply and Use

U.S. ethanol production in 2008 exceeded 9.2 billion gallons per year (bgpy), 42% above 2007, following rapid increases during the past decade. Production in 2007 reached 6.5 bgpy, a 33% advance from 2006 (see **Figure 1**). Production in 1998 was only 1.4 bgpy. The United States also imports ethanol, increasing the supply by about 400 to 700 million gallons per year (mgpy). Total supply in 2007 was 6.9 bgpy and 9.8 bgpy in 2008.

Since 2005, the United States has surpassed Brazil as the world's leading producer of ethanol.[15] Several events contributed to the historical growth of U.S. ethanol production: the energy crises of the early and late 1970s; a partial exemption from the motor fuels excise tax (legislated as part of the Energy Tax Act of 1978); ethanol's emergence as a gasoline oxygenate; and provisions of the Clean Air Act Amendments of 1990 that favored oxygenate blending with gasoline.[16] Ethanol production is projected to continue growing rapidly through at least 2015 on the strength of both the extension of existing government incentives and the possible addition of new ones. These include the per-gallon blender's tax credit of $0.45, the conventional biofuels RFS of 10.5 bgpy rising to 15 bgpy by 2015, and a $0.54 per gallon tariff on most imported ethanol.[17]

---

[13] *Ethanol's Federal Subsidy Grab Leaves Little For Solar, Wind And Geothermal Energy,* Environmental Working Group, http://www.ewg.org/node/27498, January 9, 2009.

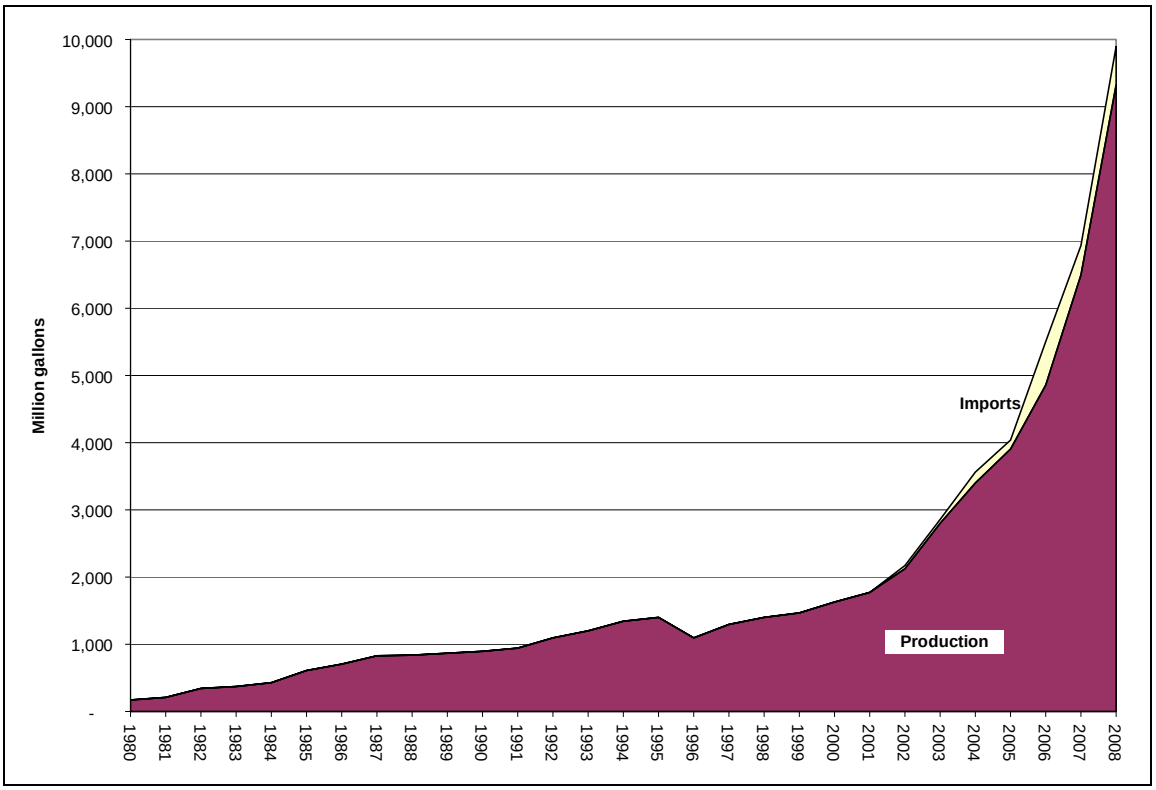
[14] AgWeb.com, "Ethanol Industry's 'Wish List'; Food Before Fuel Coalition Response," press release, December 16, 2008, http://www.agweb.com/news_printer.aspx?articleID=147855.

[15] Renewable Fuels Association, World Ethanol Production by Country, http://www.ethanolrfa.org/industry/statistics.

[16] 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.

[17] For more information, see CRS Report RL33572, *Biofuels Incentives: A Summary of Federal Programs,* by (name red acted).

Figure 1. Ethanol Supply: Production and Imports, 1980-2008



Source: Renewable Fuels Association 1980-2007, CRS estimate for 2008.

U.S. Ethanol Production

As of November 2008, ethanol was produced in 27 states by 172 refineries with 10.3 billion gallons per year capacity (see **Table 1**). Most refineries are in the Corn Belt, but some are located on the West Coast and in the Southeast. Ethanol is generally produced in rural areas where corn is grown, to limit transportation costs for feedstocks. Ethanol plants range in size from 20 mgpy to over 100 mgpy. Corn is the principal feedstock for ethanol produced in the United States, accounting for about 97% of total output. Sorghum and a very small quantity of wheat are also used. These feedstocks, along with sugar, produce what are known as "first generation" biofuels. Biofuels produced from cellulosic feedstocks such as corn stover, prairie grasses, or woody biomass are known as "second generation" biofuels.[18]

In early 2009, not all ethanol plants were producing at full capacity. Some plants owned by financially troubled companies have closed and others are on standby or operating at reduced levels until more profitable circumstances exist. In 2008 an additional 23 refineries, accounting for 3.3 bgpy capacity, were under construction, although many of these projects are now on standby or have been cancelled.

[18] First and second generation biofuels are not analogous to conventional and advanced biofuels as defined in the RFS. Under the RFS, advanced biofuels include those produced from sorghum, wheat, and sugar feedstocks (as long as they meet applicable greenhouse gas reduction requirements), although they are considered first generation biofuels.

Table 1. Ethanol Production Capacity by State

(as of December 2008)

		Operating Capacity		Expansion Capacity		Under Construction	
Rank	**State**	**(mil. gal./year)**	**(percent)**	**(mil. gal./year)**	**(percent)**	**(mil. gal./year)**	**(percent)**
1	IA	2,439	24%	425	40%	880	24%
2	NE	1,213	12%	360	34%	511	14%
3	IL	925	9%	55	5%	355	10%
4	IN	912	9%	0	0%	198	5%
5	SD	835	8%	35	3%	160	4%
6	MN	769	7%	15	1%	275	8%
7	OH	516	5%	0	0%	74	2%
8	WI	504	5%	30	3%	0	0%
9	KS	363	4%	0	0%	115	3%
10	ND	283	3%	0	0%	100	3%
11	MO	215	2%	0	0%	0	0%
12	MI	214	2%	50	5%	50	1%
13	TN	167	2%	38	4%	0	0%
14	NY	150	1%	0	0%	5	0%
15	CA	144	1%	19	2%	55	2%
16	TX	140	1%	0	0%	355	10%
17	CO	139	1%	10	1%	14	0%
18	GA	100	1%	35	3%	10	0%
	Other	294	3%	0	0%	467	13%
	U.S. Total	10,321	100%	1,072	100%	3,624	100%

Source: "Ethanol Plant List," *The Ethanol Monitor*; published by Oil Intelligence Link, Inc., Editor & Publisher: Tom Waterman; The Ethanol Monitor©2008 December 2, 2008. Accessed March 23, 2009.

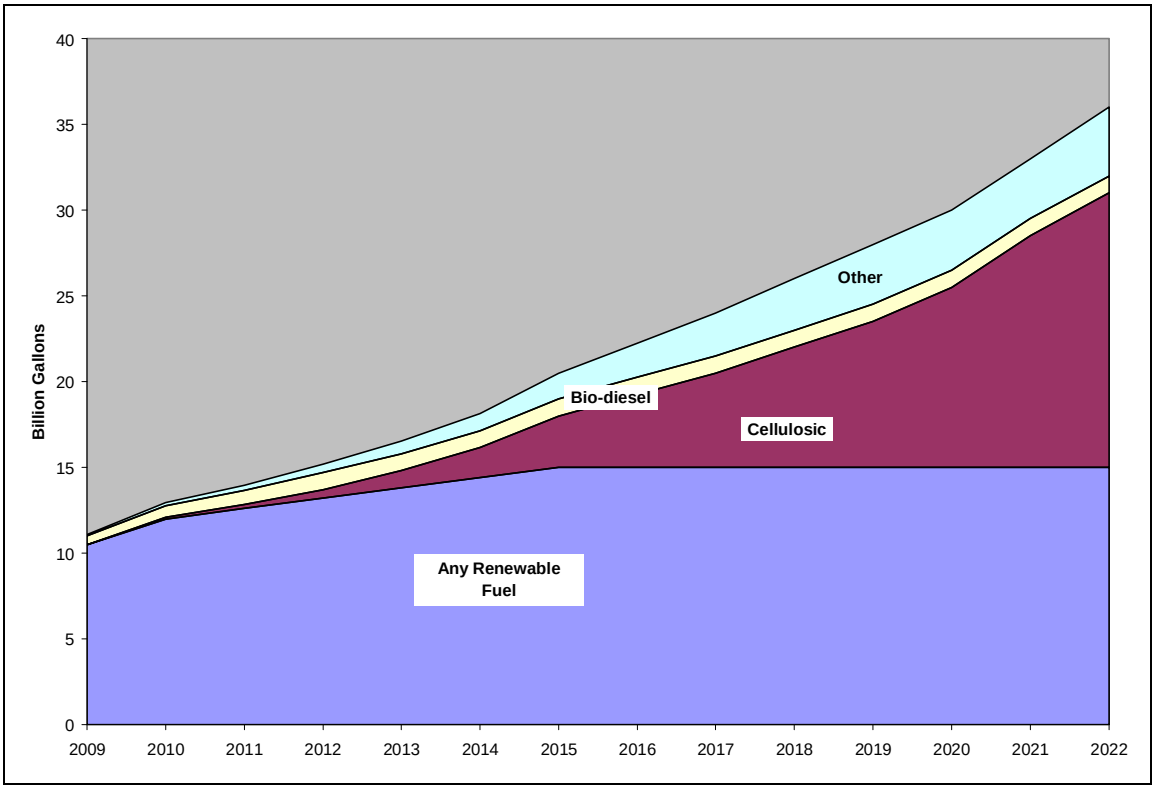
Notes: Expansion capacity includes plants that are permitted, under construction, and "likely" to be completed..

Renewable Fuel Standard (RFS)

The expanded renewable fuel standard (RFS) in the Energy Independence and Security Act of 2007 (EISA, P.L. 110-140) mandates renewable fuels blending requirements for fuel suppliers. It expands the earlier renewable fuel standard in the Energy Policy Act of 2005 (EPAct 2005, P.L. 109-58) by increasing mandated volumes and creating carve-outs for different types of biofuels. The expanded RFS consists of two main categories. The first is an unspecified category that may be filled with any type of biofuel, including corn ethanol, which predominates. The second category is "advanced biofuels," and can be fulfilled with biofuels other than corn ethanol. Within the advanced biofuels category are carve-outs for cellulosic, biodiesel, and other advanced biofuels.

The RFS requires that 11.1 billion gallons of renewable fuels be blended into gasoline in 2009. The total blending requirement grows annually to 36 billion gallons in 2022 (see **Figure 2**)[19]. The unspecified portion of the RFS is capped at 10.5 billion gallons in 2009 and increases annually until it is capped at 15 billion gallons from 2015 through 2022. This component of the mandate is likely to be filled by corn-starch ethanol, although any renewable biofuel may be used as long as it meets the lifecycle greenhouse gas emissions requirement. Although advanced biofuels may be used to fulfill the non-advanced renewable fuels portion of the mandate, corn ethanol cannot be used to meet the advanced biofuels mandate.

Figure 2. Renewable Fuel Standard Under EISA



Source: Energy Independence, and Security Act, (EISA, P.L. 110-140, Section 202)

Notes: The "Any Renewable Fuel" portion is a cap, whereas other categories are floors—the unspecified portion may be filled by corn ethanol or an advanced biofuel.

As previously discussed, eligibility under the RFS also requires that biofuels achieve GHG emissions reductions. For corn ethanol from new refineries,[20] a reduction of 20% compared with gasoline's emissions is required. Advanced biofuels have a more stringent GHG reduction requirement of 50% compared with gasoline, and eligible cellulosic biofuels must have a 60% reduction. The rules for calculating lifecycle greenhouse gas emissions are currently being formulated by EPA and are due to be announced in 2009. These regulations will determine which fuels are eligible for the RFS and will therefore have a significant impact on the future of the

[19] EPA, Renewable Fuel Standard: Notice of 2009 Requirement, http://www.epa.gov/fedrgstr/EPA-AIR/2008/November/Day-21/a27613.pdf.

[20] Plants that commenced construction after passage of EISA in December 2007.

biofuels industry. EISA requires consideration of both direct and indirect lifecycle emissions. Indirect GHG emissions caused by land use changes are particularly difficult to calculate (see section on GHG emissions below).

The Ethanol Production Process

Ethanol, or ethyl alcohol, is an alcohol made by fermenting and distilling simple sugars. It can be produced from any biological feedstock that contains appreciable amounts of sugar or materials that can be converted into sugar such as starch or cellulose. Sugar beets and sugar cane are examples of feedstocks that contain sugar. Corn and sorghum contain starch that can relatively easily be converted into sugar. In the United States, corn is the principal ingredient used in the production of ethanol; in Brazil, sugar cane is the primary feedstock.

Corn-starch ethanol can be produced using either of two processes: wet milling or dry milling. These processes differ in the initial processing of the corn prior to fermentation. During the early stages of the ethanol industry, the wet milling process was predominant. Most new plants have used the dry mill process.

The shift over time from the wet mill process to the dry mill process has resulted in improved efficiencies. The cost of inputs, especially energy, per gallon of ethanol produced has been reduced.[21]

Feedstocks, water, energy, labor, and capital are the major inputs for ethanol production. Ethanol yields in 2008 ranged from 2.5 to 2.9 gallons per bushel of corn, with a weighted average of 2.75 gallons per bushel.[22]

Most ethanol plants operate using natural gas or coal, although some plants use biomass or manure. Electrical energy is used to operate plant machinery, and steam or hot air are used in liquefaction, fermentation, distillations, and drying by-products. Distillers grains for livestock feed are an important byproduct of ethanol production but must be dried before shipping long distances to reduce weight. Since drying distillers grains is a major use of energy for ethanol producers, refineries often locate near users of animal feed, such as large cattle operations, and ship distillers grains wet to cut processing costs.

Water is a major input into the distillation process and an important environmental consideration. Improved recycling processes have reduced water use in newer ethanol plants.[23]

U.S. Ethanol Imports

In addition to domestic production, the U.S. ethanol supply includes imports of sugar-cane ethanol from Brazil and the Caribbean Basin Initiative (CBI) nations of El Salvador, Costa Rica,

[21] Adam J. Liska et al., "Improvements in Life Cycle Energy Efficiency and Greenhouse Gas Emissions of Corn-Ethanol," *Journal of Industrial Ecology* (December 2008).

[22] Lihong Lu McPhail and Bruce A. Babcock, *Short-Run Price and Welfare Impacts of Federal Ethanol Policies*, Center for Agricultural and Rural Development, Working Paper 08-WP 468, Ames, IA, June 2008, http://www.card.iastate.edu.

[23] Dennis Keeney, Ph.D., *Water Use by Ethanol Plants: Potential Challenges*, The Institute for Agriculture and Trade Policy, October 2006, http://www.agobservatory.org/library.cfm?refid=89449.

Jamaica, and Trinidad and Tobago. Ethanol imports reached 557 million gallons in 2008, or 6% of U.S. supply. Brazil, which ranks second behind the United States in ethanol production, traditionally accounts for about half of U.S. ethanol imports, with the remainder shipped from CBI countries. (Much of this is originally produced in Brazil and transshipped to CBI countries, where it is dehydrated to qualify for tariff-free status when shipped to the United States.) Under the CBI, an unlimited amount of ethanol may be shipped to the United States duty-free if indigenous feedstocks are used in its production. Ethanol refined in CBI countries from foreign feedstocks or foreign ethanol that is substantially altered prior to shipment can be shipped duty-free up to a volume no greater than 7% of U.S. use. This rule has encouraged countries, for instance Jamaica, to import hydrous ethanol from Brazil, dehydrate it to remove moisture, and ship the anhydrous ethanol to the United States duty-free.

U.S. imports of ethanol are subject to a $0.54 per gallon duty. Originally, the duty was intended to deny the benefit of tax credits available to ethanol blended in the United States to imported ethanol. These credits are $0.45 per gallon beginning in 2009, $0.09 per gallon less than the tariff, increasing its discriminatory impact. In addition, a much smaller ad valorem tariff of 2.5% is levied on imported ethanol.[24] Many argue that a tariff on ethanol increases costs to consumers.

Ethanol imports benefitted from a duty drawback[25] provision through September 2008. Imported ethanol received a duty drawback if a "like commodity" to ethanol, or its final product, a gasoline-ethanol mixture, was exported. Jet fuel was considered a like commodity to the gasoline-ethanol mixture and was frequently exported to trigger the duty drawback. However, a provision in the Food, Conservation, and Energy Act of 2008 (the 2008 farm bill, P.L. 110-246) eliminated the duty drawback for fuels that do not contain ethanol (such as jet fuel).

The ethanol tariff will likely be of interest for the 111th Congress. During the 110th Congress, several bills were introduced to eliminate, reduce, or extend the tariff on ethanol. Proponents of the tariff cite the need to support the ethanol industry against lower-priced imports until it reaches maturity. They contend that it prevents imported ethanol from benefitting from the blender's tax credit, which is intended, among other things, to promote U.S. energy independence. Opponents of the tariff claim that the industry is generally profitable and has matured to the point where such incentives are unnecessary. Opponents also point out that imports of Brazilian ethanol may be essential to fulfill the RFS mandate in coming years and should therefore be encouraged.

Legislation (S. 622) has been introduced in the 111th Congress to address the lack of parity between the blender's tax credit and the tariff on ethanol. The bill would periodically reduce the tariff on ethanol by the same amount as any reduction in income or excise tax credit applicable to ethanol so that the tariff is equal to, or less than, the applicable income or excise tax credit.

Economics of Ethanol

The economics underlying ethanol production include decisions concerning capital investment, plant location (relative to feedstock supplies, population centers, and by-product markets),

[24] An ad valorem tariff is based on a percentage of the declared value of an imported good.

[25] A duty drawback is a refund of duty paid on imports that have been re-exported or, in their place, a like commodity has been exported.

production technology, and product marketing and distribution, as well as federal and state production incentives and usage mandates.[26]

Demand for ethanol is dependent on regulatory mandates, its price relative to gasoline, and, until 2006, its use as an oxygenate.[27] Profitability for an ethanol refiner depends primarily on the cost of the main input, corn, relative to the value of ethanol (adjusted for any applicable tax credits), and the value of co-products produced.

Co-products are an important economic consideration for ethanol producers. For each gallon of ethanol produced using the dry mill process, an average of 6.7 pounds of dried distillers grains (DDG) (at 10% moisture) is produced. For every gallon of ethanol produced in a dry mill plant, about $0.25 of distillers dried grains and $0.006 of CO_2 can be sold.[28]

The Ethanol Industry During the Recession of 2008-2009

During 2005 and much of 2006, the ethanol industry enjoyed a period of significant profitability. However, the fundamentals for ethanol production began to shift in 2008. In late 2008, ethanol prices exceeded gasoline prices and remained higher through early 2009. Discretionary blending above the RFS mandate stopped and demand for ethanol slipped. Simultaneously, the overall economic climate worsened—demand for fuel declined, further reducing demand, and credit tightened. Ethanol refineries cut back production, and many with heavy debt loads were forced into bankruptcy.

At the same time, corn prices reached record levels before falling in early 2009. At that time, ethanol prices of $1.66 per gallon combined with corn prices of $4.10 per bushel (nearby month on the futures market) and gasoline prices around $1.68 per gallon resulted in reduced ethanol demand and losses by refiners. When ethanol is priced below gasoline (on an energy-equivalent basis), as it was during the 2006-2008 period, ethanol reduces the price consumers pay at the pump. However, beginning in the last half of 2008 and early 2009, ethanol prices were higher than gasoline, and blending actually increased the pump price.[29]

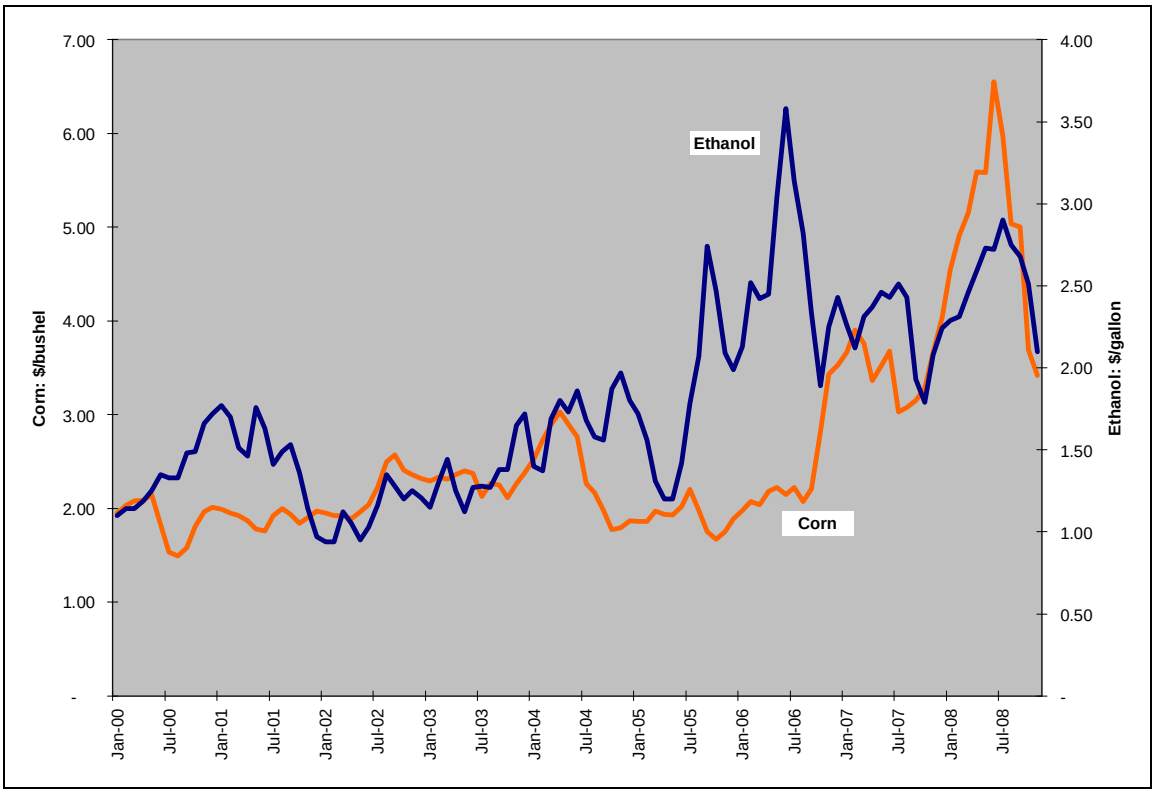
[26] For more information on the economics underlying the capital investment decision, see D. Tiffany and V. Eidman, "Factors Associated with Success of Fuel Ethanol Producers," Dept of Appl. Econ., Univ. of Minnesota, Staff Paper P03-7, August 2003; hereafter referred to as Tiffany and Eidman (2003). For a discussion of ethanol plant location economics, see B. Babcock and C. Hart, "Do Ethanol/Livestock Synergies Presage Increased Iowa Cattle Numbers?" *Iowa Ag Review*, vol. 12, no. 2 (Spring 2006).

[27] Oxygenates were added to gasoline to reduce carbon monoxide emissions that are created during the burning of the fuel. In May 2006, the oxygenate requirement in the federal reformulated gasoline requirement was eliminated.

[28] Hosein Shapouri and Paul Gallagher, *USDA's 2002 Ethanol Cost of Production Survey*, U.S. Department of Agriculture, Office of the Chief Economist, Office of Energy Policy and New Uses, Agricultural Economic Report Number 841, July 2005, p. 2.

[29] Dave Juday, "Ethanol at the Blend Wall," *World Perspectives Inc.*, January 20, 2009, p. 6 (by subscription).

Figure 3. Corn Versus Ethanol Prices, 2000-2008



Source: Corn, No. 2 yellow, Central Illinois; USDA Agricultural Marketing Service; Ethanol are rack, f.o.b. Omaha, Nebraska Ethanol Board, Lincoln, NE., Nebraska Energy Office, Lincoln, NE.

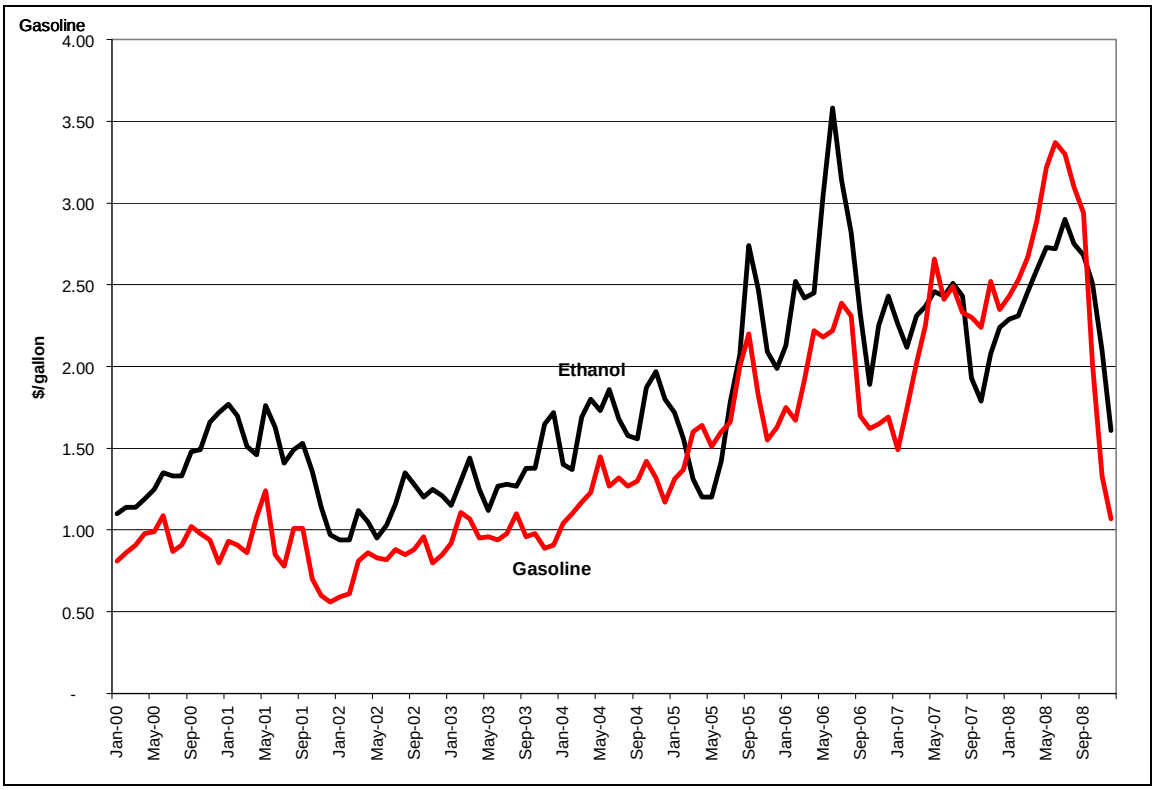
Notes: Prices are monthly averages.

A radically different picture emerged in mid- to late 2008 as the economy began to slow and credit markets tightened. The recession has provided numerous challenges for the ethanol industry. Volatility in the corn and petroleum markets have made it difficult to maintain profitability. Tightening credit markets stopped most plant construction. Ethanol production was reduced to 80% to 90% of capacity as crush margins tightened, low-priced gasoline was more competitive, and overall demand for transportation fuel fell. Illustrative of the industry's recent problems, VeraSun, a major ethanol producer, filed for bankruptcy on October 31, 2008, and is selling its refineries.[30] Other plants have suspended operations or are operating at reduced capacity. At the end of 2008, some estimates placed the total industry output at 84% of its potential.[31]

[30] " Ethanol Producer VeraSun Expects to Report 2008 Losses," *DTN Ethanol Center*, March 16, 2009, http://www.dtnethanolcenter.com/index.cfm?show=10&mid=78&pid=30.

[31] "US Ethanol Output Edges Up in December 2008, Stocks Down," *DTN Ethanol Center*, February 27, 2009, http://www.dtnethanolcenter.com/index.cfm?show=10&mid=78&pid=4.

Figure 4. Ethanol and Gasoline Prices, 2000-2008



Source: Ethanol and unleaded gasoline rack prices per gallon. F.O.B. Omaha, Ethanol Board,, Lincoln, NE. Nebraska Energy Office, Lincoln, NE.

Notes: By volume.

Some analysts have predicted substantial consolidation as the next step for the maturing ethanol industry.[32] However, consolidation lately has been slowed by tight credit markets. Nevertheless, some of the larger ethanol producers, including Poet and Archer Daniels Midland (ADM) have expressed interest in buying up smaller, struggling plants. [33] Many of these smaller, cooperative-owned, older plants buy local corn and have a local market for ethanol. They have more favorable balance sheets than recently constructed 100 mgpy plants with heavy debt loads and are under little pressure to sell. The sale at auction of VeraSun's 16 refineries may contribute to further consolidation. Despite the difficult economic times, five ethanol plants, with a total production capacity of 485 mgpy, came online during October and November 2008.[34]

Impact on Commodity Markets

USDA estimates that 3.7 billion bushels of corn (about one-third of total U.S. corn production) from the 2008 corn crop will be used to produce ethanol during the 2008/2009 (September-

[32] Bryan Sims, "Surviving the Economic Storm," *Ethanol Producer Magazine*, January 1, 2009, http://www.ethanolproducer.com/issue.jsp.

[33] "Ethanol Industry Faces Consolidation," *Feedstuffs*, December 1, 2008, p. 1.

[34] Bryan Sims, "Plants Come On Line During Challenging Economic Times," *Ethanol Producer Magazine*, January 2009.

August) corn marketing year. Ethanol's share of corn production was 20% (2.119 billion bushels) in 2006/2007 and expanded to 23% (3.026 billion bushels) in 2007/2008.[35] In its annual baseline projections (February 2009), USDA projects that U.S. ethanol production will use 35% (5.1 billion bushels) of the corn crop by 2018. In March 2009, the Food and Agricultural Policy Research Institute (FAPRI) projected that 2018 U.S. ethanol production will reach 17.7 billion gallons and use 44% (5.4 billion bushels) of the U.S. corn crop.[36]

As corn prices rise, so too does the incentive to expand corn production either by planting on more marginal land or by altering the traditional corn-soybean rotation that dominates Corn Belt agriculture. This shift could displace other field crops, primarily soybeans, and other agricultural activities. Further, corn production is among the most energy-intensive of the major field crops. An expansion of corn area could have important and unwanted environmental consequences due to the increases in fertilizer and chemical use and soil erosion. The National Corn Growers Association claims "there is still room to significantly grow the ethanol market without limiting the availability of corn."[37] However, other evidence suggests that effects are already being felt from the current expansion in corn production.

The increasing share of the U.S. corn crop utilized by ethanol blenders, and other market conditions, has resulted in declining U.S. exports. Tight global corn supplies contributed to high commodity prices, impacting consumers, especially in low-income countries where grains form a large share of diets and food is a major expenditure.

Supporters of corn ethanol claim that biofuels production and use will have enormous agricultural and rural economic benefits by increasing farm and rural incomes and generating substantial rural employment opportunities.[38] Opponents maintain that continued expansion of corn-based ethanol production could have significant negative consequences for traditional U.S. agricultural crop production and rural economies. Large-scale shifts in agricultural production activities could likely also have important regional economic consequences that have yet to be fully explored or understood.

For more information on the impact of ethanol on food and feed prices, see CRS Report RL34265, *Selected Issues Related to an Expansion of the Renewable Fuel Standard (RFS)*, by (name redacted) and Tom Capehart. For more information on commodity price impacts, see CRS Report RL34474, *High Agricultural Commodity Prices: What Are the Issues?*, by (name redacted).

Impact on Domestic Food Markets

Critics of first generation ethanol claim it was responsible for a large proportion of recent food price increases that occurred in early 2008. As evidence they cite USDA's estimate that the U.S.

[35] USDA, *World Agricultural Supply and Demand Estimates*, WASDE-468, March 11, 2009, http://www.usda.gov/oce/commodity/wasde/latest.pdf.

[36] Food and Agricultural Policy Research Institute, *US Baseline Briefing Book*, FAPRI-MU Report #01-09, Columbia, MO, March 2009, http://www.fapri.missouri.edu.

[37] National Corn Growers Association, *Killing Myths on Ethanol*, Washington D.C., 2008, http://www.ncga.com/node/71, accessed March 23, 2009.

[38] For example, see John M. Urbanchuk (Director, LECG LLC), *Contribution of the Ethanol Industry to the Economy of the United States*, white paper prepared for National Corn Growers Assoc., February 21, 2006.

Consumer Price Index (CPI) for all food increased 5.5% in 2008, and 4.0% in 2007, compared with an average rate of increase of 2.5% for 1997 to 2006.[39] In analyzing this criticism, however, it is important to distinguish between prices of farm-level commodities and retail-level food products, because most consumer food prices are largely determined by marketing costs that occur after the commodities leave the farm.[40] The price of a particular retail food item varies with a change in the price of an underlying input in direct relation to the relative importance (in value terms) of that input. For example, if the value of wheat in a $1.00 loaf of bread is about 10¢, then a 20% rise in the price of wheat translates into a 2¢ rise in a loaf of bread.

Considering corn's relatively small value-share in most retail food product prices, some contend that it is unlikely that the ethanol-driven corn price surge is a major factor in current food price inflation estimates.[41] Furthermore, many economists agree that the majority of retail food price increases were not mainly ethanol-driven, but rather were the result of various other factors, including a sharp increase in energy prices that rippled through all phases of marketing and processing channels, and the strong increase in demand for agricultural products in the international marketplace from China and India (a product of their large populations and rapid economic growth).[42]

Energy Efficiency

An examination of energy efficiency can help determine whether ethanol provides an improvement over gasoline or other fuels. Does it take more fossil fuel to produce a gallon of ethanol than the energy available when that gallon of ethanol is consumed? The net energy balance (NEB) of a fuel is a useful means of comparing different fuels for public policy purposes. The NEB is expressed as a ratio of the energy produced from a production process relative to the energy used in that production process. An output/input ratio of 1.0 implies that energy output equals energy input. The critical factors underlying ethanol's energy efficiency include (1) corn yields per acre (higher yields for a given level of inputs improves ethanol's energy efficiency); (2) the energy efficiency of corn production, including the energy embodied in inputs such as fuels, fertilizers, pesticides, seed corn, and cultivation practices; (3) the energy efficiency of the corn-to-ethanol production process: clean burning natural gas is the primary processing fuel for most ethanol plants, but several plants (including an increasing number of new plants) use coal; and (4) the energy value of corn by-products, which act as an offset by substituting for the energy needed to produce market counterparts.

[39] USDA Economic Research Service, Food CPI, Prices, and Expenditures Briefing Room, http://www.ers.usda.gov/briefing/cpifoodandexpenditures/Data/cpiforecasts.htm.

[40] Helen H. Jensen and Bruce A. Babcock, "Do Biofuels Mean Inexpensive Food is a Thing of the Past?" *Iowa Ag Review*, vol. 13, no. 2 (Spring 2007), pp. 1-3.

[41] For examples, see Food & Water Watch, "Retail Realities: Corn Prices Do Not Drive Grocery Inflation," Sept. 2007; and John M. Urbanchuk (Director, LECG LLC), "The Relative Impact of Corn and Energy Prices in the Grocery Aisle," white paper prepared for National Corn Growers Assoc., June, 14, 2007.

[42] For examples, see Jacque Diouf, Director General of the U.N. Food and Agriculture Organization, "Why Are Food Prices Rising?" in *Financial Times Online*, Nov. 26, 2007, http://media.ft.com/cms/s/2/f5bd920c-975b-11dc-9e08-0000779fd2ac.html?from=textlink. See also Keith Collins, Chief Economist, USDA, testimony before the House Committee on Agriculture, October 18, 2007.

Over the past decade, technical improvements in the production of agricultural inputs (particularly nitrogen fertilizer) and ethanol, coupled with higher corn yields per acre and stable or lower input needs, appear to have raised ethanol's NEB. About 82% of the corn used for ethanol is processed by more efficient dry milling (a grinding process) and about 18% is processed by wet milling plants. All new plants under construction or coming online are expected to dry mill corn into ethanol: thus the dry milling share will continue to rise for the foreseeable future.

A 2007 report by the National Renewable Energy Laboratory (NREL) summarized recent reports on the NEB for corn ethanol. Results varied widely, but most reports using similar assumptions found the NEB for corn ethanol to be positive. In 2004, USDA reported that, assuming best production practices and state of the art processing technology, the NEB for corn ethanol (based on 2001 data) was a positive 1.67—that is, 67% more energy was returned from a gallon of ethanol than was used in its production. Other researchers have found much lower NEB values under less optimistic assumptions, leading to some dispute over corn-to-ethanol's representative NEB. A 2006 review of several major corn-to-ethanol NEB analyses found that, when co-products are properly accounted for, the corn-to-ethanol process has a positive NEB that is improving with changing technology.[43] This result was confirmed by another comprehensive study that found an NEB of 1.25 for corn ethanol.[44] However, these studies clearly imply that inefficient processes for producing corn (e.g., excessive reliance on chemicals and fertilizer or bad tillage practices) or for processing ethanol (e.g., coal-based processing), or extensive trucking of either the feedstock or the finished ethanol long distances to plant or consumer, can result in an NEB significantly less than 1.0. In other words, not all ethanol production processes have a positive energy balance. A few studies have concluded that corn ethanol does not have a positive NEB (that is, that it takes more fossil energy to produce a gallon of ethanol than it contains).[45] However, these studies were distinguished by much higher energy inputs in the agriculture, transport, refining, and distribution components of the ethanol manufacturing process than other studies.[46]

Lifecycle Greenhouse Gas Emissions

Lifecycle greenhouse gas (GHG) emissions are the aggregate quantity of GHG emissions (including direct emissions and significant indirect emissions such as emissions from land use changes) accounting for all stages of fuel and feedstock production and distribution, from feedstock generation or extraction through the distribution, delivery, and use of the finished fuel to the ultimate consumer.[47]

---

[43] Alexander E. Farrell et al., "Ethanol Can Contribute to Energy and Environmental Goals," *Science*, vol. 311, no. 5760 (January 2006), pp. 506-508.

[44] Hill et al., "Environmental, Economic, And Energetic Costs And Benefits Of Biodiesel And Ethanol Biofuels," Proceedings of the National Academy of Science, 2006.

[45] David Pimentel and Tad W. Patzek, "Ethanol Production Using Corn, Switchgrass, and Wood; Biodiesel Production Using Soybean and Sunflower," *Natural Resources Research*, vol. 14, no. 1 (March 1, 2005), pp. 65-76.

[46] Natural Resources Defense Council and Climate Solutions, *Ethanol: Energy Well Spent A Survey of Studies Published Since 1990*, February 6, 2006, https://inlportal.inl.gov/portal/server.pt/gateway/PTARGS_0_1830_12167_0_0_18/ethanol_review%20of%20lit.pdf.

[47] 42 U.S.C. § 7545(o)(1).

Many link GHG emissions to global climate change,[48] so the relative emissions from different types of fuels are of great interest. Although the use of ethanol has been touted by proponents as reducing GHG emissions compared with conventional fuels, some contend that the benefits are nonexistent or minimal. Under the Energy Independence and Security Act of 2007 (EISA P.L. 110-140, Section 202), GHG emissions reductions must be calculated by the U.S. Environmental Protection Agency (EPA) using a methodology yet to be determined. Estimates for GHG reductions from ethanol vary widely depending on the methodology used. As noted above, provisions in the EISA require the reduction of lifecycle emissions including "direct emissions and significant indirect emissions such as those from land use changes." For example, some studies have concluded that, if ethanol production displaces another crop that is then grown on newly cleared forest land (such as a rainforest in Brazil), the resulting GHG emissions could be substantial, and if high enough, could render the fuel ineligible under the RFS.[49] Different methodologies will allot varying weights to these impacts and hence benefit different stakeholders. EPA is required to establish rules defining the methodology for measuring lifecycle GHG emissions under the RFS.

Section 202 of EISA required EPA to develop revised RFS regulations no later than one year after enactment (December 19, 2008). This deadline has passed, and a proposed rule is expected to be issued soon, followed by a comment period. These rules will likely be the subject of intense debate because they will determine whether a fuel is eligible for the RFS. Congress granted wide latitude to EPA in drafting the rules for calculating lifecycle GHG emissions. Depending on the outcome of EPA's rulemaking, Congress might revisit this issue.

Most studies show a 10% to 20% reduction in GHG emissions for corn ethanol compared with gasoline.[50] Estimates vary based on the system boundaries used, cultivation practices (e.g. minimum as opposed to normal tillage) used to grow the corn, and the fuel used to process the corn into ethanol (e.g., natural gas versus coal). These studies do not take into account indirect GHG emissions due to land use changes.[51] One controversial study (based on direct and indirect lifecycle GHG emissions) comparing vehicles powered by various sources claimed more health and environmental harm from E85 ethanol-powered vehicles than from battery-electric-powered vehicles (from all alternative sources of electricity generation including coal with carbon sequestration).[52]

EISA requires that corn ethanol produced in facilities that commence construction after enactment (December 2007) must achieve at least a 20% reduction in lifecycle GHG emissions compared with gasoline. This provision applies to roughly 4 billion gallons of capacity out of 13.7 billion gallons of current and under-construction plants. Enough grandfathered capacity currently exists to nearly fulfill the 15 billion gallon maximum ethanol mandate that becomes effective in 2015 under the RFS. EISA also enables EPA to reduce the GHG reduction requirements if it is

[48] See CRS Report RL34513, *Climate Change: Current Issues and Policy Tools*, by (name redacted).

[49] Timothy Searchinger, Ralph Heimlich, and R. A. Houghton et al., "Use of U.S. Croplands for Biofuels Increases Greenhouse Gases Through Emissions from Land Use Change," *Science*, February 29, 2008, p. 1238, http://www.sciencemag.org/cgi/rapidpdf/1151861.pdf.

[50] EPA, *Greenhouse Gas Impact of Expanded Renewable and Alternative Fuels Use*, April 2007; Ferrell et. al.

[51] Michael Wang, Ph.D., *Ethanol, the Complete Energy Lifecycle Picture*, U.S. Department of Energy, Energy Efficiency and Renewable Energy, March 2007, http://apps1.eere.energy.gov/news/pdfs/ethanol_energy_lifecycle.pdf.

[52] "Wind, Water And Sun Beat Biofuels, Nuclear And Coal for Clean Energy," *Science Daily*, December 11, 2008, http://www.sciencedaily.com/releases/2008/12/081210171908.htm.

determined that "generally such reduction is not commercially feasible for fuels made using a variety of feedstocks, technologies, and processes to meet the applicable reduction."[53]

Ethanol industry proponents are calling for GHG emissions to be calculated using only significant indirect factors and to exclude international land-use effects until EPA develops "objective and peer reviewed methodology" for their calculation.[54]

Distribution and Consumption Issues

Distribution and absorption constraints may hinder the utilization of ethanol. As the RFS progresses, greater volumes of advanced biofuels (i.e., cellulosic or non-corn-starch ethanol, biodiesel, or imported sugar ethanol) would need to be used to fulfill the rising advanced biofuels mandate. Currently the infrastructure required to ship this volume of ethanol and the vehicles to consume it do not exist.

Distribution Bottlenecks

Distribution issues may hinder the efficient delivery of ethanol to retail outlets. Ethanol, mostly produced in the Midwest, must be transported to more populated areas for sale. The current ethanol distribution system is dependent on rail cars, tanker trucks, and barges. Ethanol cannot be shipped in pipelines designed for gasoline because ethanol tends to separate and attract water in gasoline pipelines, causing corrosion. As a result, ethanol would need its own dedicated pipeline. This would be enormously expensive; however, some Members of Congress have introduced legislation calling for such a pipeline.[55] Preliminary assessments of a 1,700 mile ethanol pipeline from Minnesota to New York are being conducted by a major ethanol producer and petroleum pipeline operator.[56] Because of competition, options (especially for rail cars) are often limited. As non-corn biofuels play a larger role, some infrastructure concerns may be alleviated as production is more widely dispersed across the nation. Also, if biomass-based diesel substitutes are produced in much larger quantities, some of these infrastructure issues may be mitigated. However, ethanol would still need to be stored in unique storage tanks and blended immediately before pumping, requiring further infrastructure investments. See CRS Report R40155, *Selected Issues Related to an Expansion of the Renewable Fuel Standard (RFS)*, by (name redacted) and Tom Capehart.

Alternative Blend Levels and the "Blend Wall"

The "blend wall" is the maximum possible volume of ethanol that can be blended into conventional U.S. motor gasoline at a given blend level. At a 10% ethanol blend (E10) this is roughly 14 billion gallons of ethanol. This limit becomes problematic as the volume under the RFS exceeds this level—which is expected to occur in 2012 when the RFS reaches 15 bgpy. Once

[53] EISA, P.L. 110-140, Title II, Subtitle A, Section 202(c)(4)(A).

[54] Comments from the Renewable Fuels Association (RFA) to EPA on the Advance Notice of Proposed Rulemaking (ANPR) regarding Regulating Greenhouse Gas (GHG) Emissions under the Clean Air Act (CAA). 73 Fed. Reg. 44,354 (July 30, 2008).

[55] H.R. 864, Renewable Fuel Pipelines Act of 2009, Rep. Leonard Boswell.

[56] POET, "POET Joins Magellan Midstream Partners to Assess Dedicated Ethanol Pipeline," press release, March 16, 2009, http://www.poetenergy.com/news/showRelease.asp?id=155&year=2009&categoryid=0.

the potential volume utilized by conventional vehicles has been reached, additional increases in volume will have no market except for the very limited number of flex fuel vehicles (FFVs) that can use higher blends. Although greater use of E85 could absorb additional volume, it is limited by the lack of E85 infrastructure (limited by the considerable expense of installing or upgrading tanks and pumps) and the size of the FFV fleet.

Proposed legislation in the 111th Congress, the E-85 Investment Act of 2009 (H.R. 1112), would increase the credit against income tax for E85 refueling property (filling station pumps, tanks, and other related equipment) to 75% from 30% for property placed in service prior to 2012. The credit maximum is $30,000 for depreciated property and $1,000 for other property. The credit maximum is gradually reduced for property placed in service after December 2012 through 2016.

An increase in the tax credit for E85 infrastructure was included in the enacted 2009 economic stimulus package (The American Recovery and Reinvestment Act of 2009, P.L. 111-5) and is available for the cost of installing alternative fueling equipment. P.L. 111-5 provides a temporary increase in the credit to 50% of the cost for equipment placed into service on or after December 31, 2008, and before January 1, 2011, not to exceed $50,000. The credit is also increased for residential fueling equipment.

To increase potential ethanol use without the infrastructure and vehicle changes required for E85, some have proposed raising the ethanol blend level for conventional vehicles from E10 to E15 or E20. For such an increase to take place, EPA must issue a waiver under Section 211(f) of the Clean Air Act,[57] thereby allowing a higher ethanol blend. In addition, automobile and motor equipment manufacturers would have to extend warranties to include higher blends, and infrastructure such as pumps and storage tanks would have to be certified for the higher level. Most automotive manufacturer warranties are currently valid for E10 only.

Recently, Underwriter's Laboratories (UL) certified gasoline dispensing equipment for blends up to 15% ethanol.[58] However, given that the actual ethanol content of E10 ranges from 7% to 13% , it is likely E15 blends will contain up to 18% percent ethanol, and would not be covered in the UL certification.

On March 6, 2009, Growth Energy, a major organization promoting ethanol, applied to EPA (on behalf of 52 ethanol producers) for a waiver of Section 211(f)(4) of the Clean Air Act to allow an immediate increase in the maximum ethanol blend level from E10 to E12 or E13, and later allowing blends up to E15 to be used by conventional vehicles. EPA must grant or deny the waiver request within 270 days of receipt (December 1, 2009). This is significant because, even without any increase in the consumption of E85, raising the blend rate for conventional vehicles would enable an additional 7-8 billion gallons of ethanol in gasoline. This would raise the "blend wall" to roughly 22 billion gallons. The waiver request is supported by corn and ethanol interests and opposed by livestock and environmental groups.

Legislation addressing supply and distribution issues has been introduced in the 111th Congress. The Open Fuel Standard Act of 2009 (H.R. 1476), would require 50% of the automobiles

[57] 42 U.S.C. 85.

[58] Underwriter's Laboratories, Underwriter's Laboratories Announces Support for Authorities Having Jurisdiction Who Decide to Permit the Use of Existing UL Listed Gasoline Dispensers with Automotive Fuel Containing up to a Maximum of 15% Ethanol, Northbrook, IL., February 19, 2009.

powered by internal combustion engines that are manufactured in the United States to be capable of operating on either 85% ethanol, 85% methanol, or biodiesel beginning in 2012, and 80% to be capable of operating on either 85% ethanol, 85% methanol, or biodiesel beginning in 2015.

Federal Intervention in the Ethanol Industry

The federal government provides incentives and support for the ethanol industry though tax credits, research and development, grants and loan guarantees for plant construction, import tariffs, and perhaps most important, the RFS usage mandate, which was discussed above.

Historically, federal subsidies have played an important role in encouraging investment in the U.S. ethanol industry. The Energy Tax Act of 1978 first established a partial exemption for ethanol fuel from federal fuel excise taxes. The Highway Trust Fund, funded by gasoline excise tax receipts, was reduced by the amount of the exemption so that increased ethanol use resulted in reduced funding for state transportation programs and highway projects. In addition, dealers sometimes purchased exempted gasoline and then failed to blend it with ethanol, even though they paid the reduced excise tax. In 2005, a volumetric ethanol excise tax credit, paid out of the general fund, replaced the partial tax exemption and eliminated these problems. The credit has no impact on the Highway Trust Fund and is based on the volume of ethanol in the blended fuel, reducing the opportunities for fraud. A discussion of this credit and other subsidies follows. For more information on biofuels incentives, see CRS Report RL33572, *Biofuels Incentives: A Summary of Federal Programs*, by (name redacted).

Blender's Tax Credit

The blender's tax credit, or volumetric ethanol excise tax credit, is an income tax credit based on the volume of ethanol blended with gasoline for sale or use. For each gallon of ethanol blended, an income tax credit of $0.45 per gallon is available. The credit was established by Section 301 of the American Jobs Creation Act of 2004 (P.L. 108-357). The 2008 farm bill (P.L. 110-246) extended the credit through 2010 and reduced it from $0.51 per gallon to $0.45 per gallon beginning the first calendar year following calendar-year production exceeding 7.5 billion gallons. Since 2008 production exceeded this threshold, the tax credit reduction became effective in January 2009. Credits under this program are estimated at $5 billion in 2008.[59] The Energy Improvement and Extension Act of 2008 (P.L. 110-343, Division B, Section 203) limits the blender's credit to fuels that are to be consumed in the United States. The credit is administered by the Internal Revenue Service.

Small Producer Credit

A small producer income tax credit (26 U.S.C. 40) of $0.10 per gallon for the first 15 million gallons of production is available to ethanol producers whose total output does not exceed 60 million gallons of ethanol per year. The credit applies to the first 15 million gallons of a refiner's output. Based on the number of refiners with less than 60 million gallons output in 2008, credits under this program applied to approximately 1.6 billion gallons in 2008.[60] The small producers

[59] CRS estimate based on production and import data from DOE, Energy Information Agency.

[60] CRS estimate based on refinery data from Renewable Fuels Association.

credit terminates on December 31, 2010. This credit was established by the Omnibus Budget Reconciliation Act of 1990 (P.L. 101-508) and is administered by the Internal Revenue Service.

Alternative Fuel Infrastructure Tax Credit

The alternative fuel infrastructure tax credit is available for the cost of installing alternative fueling equipment placed into service after December 31, 2005. Although not a credit for biofuels per se, it applies to retail pumps and other equipment used for E85 ethanol. A maximum credit of 30% of the cost, not to exceed $30,000, is available for equipment placed into service before January 1, 2009. The economic stimulus package (the American Recovery and Reinvestment Act of 2009, P.L. 111-5) provides a temporary increase in the credit to 50% of the cost for equipment placed into service on or after December 31, 2008, and before January 1, 2011, not to exceed $50,000. Fueling station owners who install qualified equipment at multiple sites are allowed to use the credit toward each location. Consumers who purchase residential fueling equipment may receive a tax credit of up to $1,000, which increases to $2,000 for equipment placed into service after January 1, 2009, and before January 1, 2011. The alternative fuel infrastructure tax credit is administered by the Internal Revenue Service.

Ethanol Import Tariff

A $0.54 per gallon most-favored-nation tariff on most imported ethanol was extended through December 31, 2010, by a provision in the 2008 farm bill. Caribbean Basin Initiative countries are exempt from the ethanol duty up to a volume equal to 7% of total U.S. consumption. Imports of ethanol during recent years have been approximately 500 million gallons. The tariff is administered by U.S. Customs and Border Protection.

Grant and Loan Programs

The Business and Industry Guaranteed Loan Program

The Business and Industry (B&I) Guaranteed Loan Program is a long-standing program authorized by Section 310B of the Consolidated Farm and Rural Development Act of 1972 (P.L. 92-385) and administered by USDA Rural Development. The program is intended to improve, develop, or finance business, industry, and employment in rural areas. Biofuel projects, such as ethanol refineries, have frequently utilized the B&I Program.

The percentage of guarantee, up to the maximum allowed, is to be negotiated between the lender and USDA. The guaranteed principal is limited to 80% for loans of $5 million or less, 70% for loans between $5 and $10 million, and 60% for loans exceeding $10 million. A loan is limited to a maximum guarantee of $10 million. An exception to this limit may be granted for loans of up to $25 million under certain circumstances. FY2009 appropriations for the Business and Industry Guaranteed Loan Program are $43 million, to support $993.0 million in loan authorizations—unchanged from FY2008.

Repowering Assistance Program

The Repowering Assistance Program provides grants to biorefineries that use or convert to renewable biomass to reduce or eliminate fossil fuel use. The program is authorized by the 2008 farm bill (P.L. 110-246) and is available to all refineries in existence at the date of enactment. The program provides mandatory funding of $35 million for FY2009 that will remain available until the funds are exhausted. The farm bill also authorizes additional funding of $15 million per year, from FY2009 through FY2012, subject to appropriations. No appropriations were authorized for FY2009. Rules for implementation of the Repowering Assistance Program are currently being developed by USDA.

Author Contact Information

(name redacted)
Specialist in Agricultural Policy
#redacted#@crs.loc.gov, 7-....