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Biodiesel Fuel and U.S. Agriculture

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Summary

Increased concerns about energy security, greenhouse gas emissions, and pollution, plus the desire to support farm incomes, have led to an increase in congressional interest in renewable, agriculture-based fuels or biofuels (including ethanol and biodiesel). Biofuels are generally more expensive than gasoline, diesel fuel, and other petroleum-based counterparts. However, a growing body of environmental regulations and energy security provisions have evolved since the Clean Air Act Amendments of 1990 that have created economic opportunities for producers and users of biofuels and biofuel feedstocks. In addition, supporters maintain that biodiesel — a major biofuel — offers several environmental and health benefits over petroleum-based diesel fuel.

Recent provisions in the 2002 U.S. Farm Bill (P.L. 107-171) offer some incentives for production of biodiesel. In addition, provisions affecting renewable energy sources such as biodiesel are included in the omnibus energy bills passed by the House (H.R. 6) and being considered by the Senate (S. 14). This report will be updated as needed.

Introduction

Statistics suggest a significant U.S. market potential for biodiesel. In 2001 total U.S. diesel fuel use was estimated at 39.5 billion gallons; including 33.2 billion of on-road (highway) use, 3.4 billion of farm use, 2.5 billion of off-road use, and 346 million of military use.[1] Biodiesel can substitute directly for petroleum-based diesel fuel with generally no engine modification.[2] An estimated 34.3 million gallons of biodiesel were produced in the United States in 2001 from an industry-projected biodiesel production capacity of between 60 and 80 million gallons per year.[3] Currently, then, biodiesel accounts for less than 0.1% of diesel fuel consumption in to the United States.

[1] DOE, Energy Information Administration (EIA), Form EIA-821, "Annual Fuel Oil and Kerosene Sales Report," for 1997-2001 and Petroleum Supply Annual," Vol. 1, 1997-2001.

[2] National Biodiesel Board (NBB), [http://www.biodiesel.org/pdf_files/CommonlyAsked.pdf]

[3] The biodiesel production estimate is from a Food and Agricultural Policy Research Institute (FAPRI) study cited in footnote 10 of this report. The production capacity estimate is from NBB, [http://www.biodiesel.org/pdf_files/Capacity.PDF].

Commonly-cited Advantages of Biodiesel

Renewable fuel source. Biodiesel can be produced from several agricultural feedstocks (aka "energy crops") including soybeans, sunflowers, canola, peanuts, corn, cottonseed, and animal fats such as tallow, yellow grease (used restaurant deep-fry grease), and lard. Unlike fossil-fuels which have a fixed resource base that declines with use, agricultural feedstocks may be produced anew every year.

Health, safety, and environmental benefits. Proponents of biodiesel contend that it offers several health and environmental benefits relative to petroleum-based diesel: biodegradable; less carbon monoxide (CO) and sulfur oxides (SO_2) emissions; less odor; less particulate or soot emissions in some engines; and safer handling due to a higher flash point.[4] In addition, biodiesel use may reduce CO_2 (a greenhouse gas), oral and dermal toxicity, ozone precursors, and mutagenic and carcinogenic compounds associated with diesel exhaust.[5] From their perspective, increased substitution of biodiesel for petroleum-based diesel fuel may offer the broader public greater access to cleaner air and water, safer fuels, and a lower risk of cancer, respiratory, and other health problems associated with air and water pollution, ozone depletion, and climate change.

Energy security effect. A widely touted virtue of increased production and use of renewable, agriculture-based biofuels is less dependence on foreign sources for petroleum and potential improvements in the U.S. trade balance.

Farm income effect. Growing demand for biodiesel and other biofuel products increases the demand for their feedstocks — vegetable oils and animal fats — and offers the potential for higher prices and incomes for the farmers and ranchers that produce those feedstocks. Recent studies offer evidence in support of these assertions. In 2001 FAPRI completed a study of the effects of increased use of both biodiesel and ethanol.[6] In the FAPRI study, demand for soybean oil for biodiesel hypothetically increases from 264 million pounds in 2001 to almost 2.5 billion pounds in 2010 (an average annual increase of about

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[4] Flash point measures the temperature to which a fuel must be heated so that the mixture of vapor and air above the fuel can ignite. The higher the flash point, the less likely a fuel will ignite accidentally.

Environmental Protection Agency (EPA) analysis suggests that SO_2 emissions are fully eliminated with 100% biodiesel since it contains no sulfur. A 20% biodiesel blend may reduce emissions of CO by about 12% and particulates by 12%, while 100% biodiesel may reduce emissions of CO by 47% and particulates by 48%. EPA, *A Comprehensive Analysis of Biodiesel Impacts on Exhaust Emissions*, Draft Technical Report, EPA420-P-02-001, Oct. 2002.

[5] According to EPA, 20% biodiesel blend may reduce emissions of air toxicity by about 12-20% and mutagenicity by 20%, while 100% biodiesel may reduce emissions of air toxicity by 60-90% and mutagenicity by 80-90%. EPA, Draft Technical Report, EPA420-P-02-001, Oct. 2002.

For more information see: *U.S. Biodiesel Development: New Markets for Conventional and Genetically Modified Agricultural Products*, by James Duffield, Hosein Shapouri, Michael Graboski, Robert McCormick, and Richard Wilson; USDA, Economic Research Service (ERS), Office of Energy, AER 770, Sept. 1998, p. 11. [http://www.ers.usda.gov/publications/aer770/aer770.pdf].

[6] FAPRI was established by a grant from Congress and frequently conducts research in response to Congressional inquiries. FAPRI, "Impacts of Increased Ethanol and Biodiesel Demand," FAPRI-UMC, Oct. 2001. [http://www.biodiesel.org/resources/reportsdatabase/reports/gen/20011001_gen-311.pdf]

No economic study focusing strictly on biodiesel was available. For more information on ethanol see: CRS Report RL30369, "Fuel Ethanol: Background and Public Policy Issues," by Brent D. Yacobucci and Jasper Womach, June 6, 2003; and DOE, "Alternative Fuels Data Center," information website. [http://www.afdc.doe.gov/]

200 million pounds), substantially above the baseline projection of 200 million pounds in 2001 growing to 380 million by 2010. The study's hypothetical scenario is equivalent to a renewable fuels standard (RFS) of about 1.2% in 2002 growing to 2.8% by 2010.[7] No mandated RFS currently exists. However, an RFS similar to this scenario is proposed in the omnibus energy policy bills in the 108th Congress and in other legislative proposals.[8] FAPRI also projected substantial growth in use of corn for ethanol as part of the study. Key study projections concerning the economic impact of the increased demand for both biodiesel and ethanol include:

- Biodiesel use increases to 320 million gallons (up from 34.3 million gallons in 2001) and requires an additional 2 billion pounds of soybean oil by 2010.
- Soybean oil prices increase gradually to about 14% over baseline levels by 2010 due to the increased demand for biodiesel.
- The increased crush demand for soybeans to produce oil for biodiesel results in lower average ending stocks and higher soybean prices through 2010.
- Livestock and poultry sectors are only modestly affected as higher corn prices (due to larger ethanol demand) are partially offset by lower prices for key feedstuffs that are by-products of biofuels — soybean meal, and corn gluten feed and gluten meal.
- Farm crop cash receipts exceed baseline levels by $3.8 billion by 2010.
- Higher farm prices result in lower government program outlays.

A separate study (Urbanchuk, 2001) also examined the potential economic effects of increased demand for biofuels due to a hypothetical renewable fuels content mandate (encompassing both ethanol and biodiesel) of 1.2% in 2002 rising to 4% in 2016.[9] Study results included an indirect energy security effect — renewable fuels would displace 2.9 billion barrels of imported crude oil over the next 15 years, lowering the U.S. trade deficit by $63.4 billion (1996 constant dollars). Other results were similar to the FAPRI study.

Disadvantages of biodiesel

Higher cost relative to petroleum diesel. Biodiesel's higher costs of production relative to petroleum diesel have been a barrier to its development. Table 1 provides a cost comparison of the wholesale price of petroleum diesel with the cost of biodiesel production. Biodiesel costs are broken out as the cost of feedstock plus the costs of converting the feedstock into biodiesel less the value of the byproduct glycerol.

For example, the 1997 to 2001 average annual wholesale price for soybean oil was reported as 18.38 cents per pound or $1.38 per gallon. Including the cost of converting it to biodiesel, the wholesale price is $1.90 per gallon for biodiesel. This compares with the average wholesale price for No. 2, diesel fuel for the same period of $0.84 per gallon. The prices of biodiesel feedstocks, as well as petroleum-based diesel fuel, vary over time

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[7] An RFS sets the minimum percentage by volume of the biofuel share of total fuel consumption. The study does not explicitly describe the policy tool used to obtain the increase in biofuel use; however, an RFS, tax incentives, or possibly other subsidies could produce similar increases in biofuel use. A tax incentive is currently in place for ethanol production.

[8] See details in the later section on Public Laws.

[9] Prepared by John M. Urbanchuk of AUS Consultants, *An Economic Analysis of Legislation for a Renewable Fuels Requirement for Highway Motor Fuels*, November 7, 2001. This study is widely cited by the Am. Soybean Assoc. and the United Soybean Board, and is posted to the USDA, ARS, "Biofuels information website," at: [http://www.ncga.com/ethanol/pdfs/Urbanchuk_Final_Report.pdf]

based on domestic and international supply and demand conditions. As a result, the price relations presented in Table 1 may change substantially from year to year.

Table 1. Wholesale Cost Comparison of Diesel Fuel from Various Sources, 1997-2001

Diesel Type	Wholesale price[1]	Wholesale price[1]	Production costs[3]	Total wholesale cost
	Cents/pound		$/gallon	
Biodiesel feedstocks				
Soybean oil	18.38	1.38	0.52	1.90
Corn oil	19.21	1.44	0.52	1.96
Cottonseed oil	22.33	1.67	0.52	2.19
Sunflower oil	20.58	1.54	0.52	2.06
Peanut oil	38.29	2.87	0.52	3.39
Tallow	15.18	1.14	0.52	1.66
Lard	15.27	1.15	0.52	1.67
Yellow grease	11.60	0.87	0.52	1.27
No. 2, diesel (petroleum)[2]	—	—	—	0.84

Chart prepared by CRS using data from USDA and DOE sources as cited in the following footnotes.

[1] Annual averages for 1997 — 2001; USDA, ERS, *Oil Crops Outlook*, OCS-0603/June 12, 2003; table 9, p.11. Yellow grease price is a 1993-95 average from USDA, ERS, AER 770, Sept. 1998, p. 9.

[2] Annual ave. for 1997 — 2001; U.S. DOE, EIA, *Petroleum Marketing Monthly*, June 2003, table 16, p. 33.

[3] The biodiesel production cost estimate is based on operating costs for a 2.3-million-gallon-per-year biodiesel plant. It includes $0.58/gallon cost of converting vegetable oil or animal fat to biodiesel, plus $0.33/gallon for general overhead; less $0.39/gallon for the sale of the byproduct glycerol. USDA, ERS, AER 770, Sept. 1998, p.11.

At the national level, retail diesel prices are significantly higher than wholesale prices, averaging between $1.15 and $1.75 per gallon from July of 2001 through May of 2003. The price difference includes Federal and State taxes as well as a marketing margin. In the absence of any tax exemptions, both petroleum- and biofuel-based sources are subject to the same taxes and marketing margins.

These price data indicate that biodiesel is not competitive with petroleum-based diesel at current market prices. Either its production costs must drop substantially, or petroleum prices must nearly double before it becomes economical. Alternately, some combination of federal and/or state subsidies (such as fuel tax exemptions) or some type of federal and/or state regulation (such as a renewable fuel mandate) could provide greater economic incentive for biodiesel fuels. While the potential positive consequences of these government policy options are outlined in the FAPRI study, there are also potential negative consequences including: market distortions and economic inefficiencies associated with any market price intervention;[10] increased budgetary outlay by government to finance a subsidy must either add to the deficit or take funding away from another program; and increased fuel costs to consumers in response to a biofuels RFS. Also, there is a negative feedback problem related to the economics of biodiesel. Any demand-related price increase for

[10] For example, see C. Peter Timmer, *Getting Prices Right*," Cornell University Press, Ithaca, NY, 1986.

vegetable oils that results from increased demand for biodiesel will, in turn, raise the cost of producing the biodiesel.

Performance and Environmental issues. Biodiesels, especially those made from highly saturated feedstocks, may cause cold-weather engine problems, although blending can help alleviate this problem. Biodiesels often emit higher levels of nitrous oxide, a regulated emission.[11] Finally, fuel oxidation happens more quickly with biodiesel fuel, thereby reducing its storage life. Genetic engineering research has been proposed or is underway intended to alleviate many of these problems.

Other concerns. Some environmentalists argue against government intervention in the biofuels area because they claim that other energy sources — such as solar or geothermal — offer cleaner, more bountiful alternatives. Some in the petroleum industry argue that technological advances, such as in seismography, drilling, and extraction, continue to expand the fossil-fuel resource base which remains far cheaper and more accessible than biofuel supplies. Some question whether the net environmental benefit of biodiesel is positive when accounting for farm machinery used produce feedstocks and for trucks used to move biodiesel to market.

Public Laws that Support Biodiesel Production and Use

Clean Air Act Amendments of 1990 (CAAA; P.L. 101-549). The CAAA requires the EPA to identify and regulate air emissions from all significant sources, including on- and off-road vehicles, urban buses, marine engines, stationary equipment, recreational vehicles, and small engines used for lawn and garden equipment. All of these sources are candidates for biodiesel use. Biodiesel has been approved by the EPA, DOE, and Dept. of Transportation as an environmentally positive or "clean" alternative fuel. However, biodiesel does not qualify for the federal fuel tax exemption that is applied to ethanol-blended fuels.[12]

Energy Policy Act of 1992 (EPACT; P.L. 102-486). Energy security provisions of EPACT favor the expanded production of renewable fuels. EPACT's alternative-fuel motor fleet program implemented by the DOE requires federal, state, and alternative fuel providers to increase purchases of alternative-fueled vehicles. Under this program, DOE has designated neat (100%) biodiesel as an alternative fuel. Biodiesel is increasingly being adopted by major fleets nationwide. The U.S. Postal Service, the U.S. military and many state governments are directing their bus and truck fleets to incorporate biodiesel fuels as part of their fuel base. Currently over 300 fleets use the fuel.[13]

U.S. Department of Agriculture (USDA). In December 2000, USDA launched a Bioenergy Program that provides cost incentives for the production of biodiesel.[14] Initially the eligible feedstocks included barley, corn, grain sorghum, oats, rice, wheat, soybeans,

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[11] A 20% biodiesel blend may raise nitrous oxide emissions by about 2%, while 100% biodiesel may raise emissions by 10%. Source: EPA, *A Comprehensive Analysis of Biodiesel Impacts on Exhaust Emissions*, Draft Technical Report, EPA420-P-02-001, October 2002.

[12] Blenders of gasohol (with 10% ethanol) receive a $0.052 per gallon federal tax exemption. The tax exemption is $0.52 per gallon of pure ethanol. The tax exemption is per 26 U.S.C. 40.

[13] NBB,"Biodiesel 2002 Backgrounder." [http://www.biodiesel.org/pdf_files/backgrounder.PDF]

[14] The initial program's final rule is at: *Federal Register*, Nov. 13, 2000 (Vol. 65, No. 219), pp. 67608-67616.

sunflower seed, canola, crambe, rapeseed, safflower, flaxseed, mustard seed, and cellulosic crops such as switchgrass and short rotation trees.[15] The 2002 Farm Bill (P.L. 107-171) reauthorized the program and broadened the list of eligible feedstocks to include animal byproducts and fats, oils and greases.[16] Mandatory spending of up to $150 million is provided annually for FY2003 through FY2006.[17] In effect, this program reduces the price of biodiesel feedstocks by lowering the manufacturing cost.

Under the Bioenergy Program, USDA makes incentive payments through the Commodity Credit Corporation to eligible biofuel producers to encourage increased purchases of eligible commodities (energy feedstocks) for the purpose of expanding production of bioenergy and supporting new production capacity. To be eligible for payments, a bioenergy producer with a new plant must enroll that plant in the program during the announced sign-up period.[18] The 2002 Farm Bill also contains provisions for biobased product development. Annual mandatory spending of $1 million is authorized for FY2003 through FY2006 in the form of grants to nonprofit organizations that educate fleet operators and the public about the benefits of biodiesel.[19]

State laws. In 2001, 15 states enacted legislation favorable to biodiesel. In 2002, Minnesota enacted the first ever statewide law requiring that all diesel fuel sold in the state contain at least 2% biodiesel. In June 2003, Illinois announced a tax incentive for biodiesel as well as grants for construction or improvements of renewable fuels production facilities in the state.[20]

Legislation proposed in 108th Congress. Provisions affecting renewable energy sources, particularly agricultural feedstocks, are included in the omnibus energy bills as passed by the House (H.R. 6) and considered by the Senate (S. 14). Section 17101 of H.R. 6 would require that a minimum volume of vehicle fuel be derived from renewable energy sources, including various forms of ethanol and biodiesel. An RFS would start in 2005 at 2.7 billion gallons per year and grow to 5.0 billion by 2015.[21]

Several other bills (H.R. 130, H.R. 318, H.R. 837, H.R. 1279, H.R. 1447, H.R. 1942, S. 154, S. 355, S. 356, S. 385, S. 791) supporting the use of renewable fuels such as biodiesel and ethanol have been introduced in 2003. Several of these bills (H.R. 1279, H.R. 1942, and S154) would give biodiesel a partial fuel excise tax exemption. S. 791 (Section 101) would set an RFS — of 2.6 billion gallons in 2005, rising to 5.0 billion gallons in 2012 — and it is expected to be added to S. 14.

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[15] USDA, Farm Service Agency, "USDA Bioenergy Program website," Fact Sheet, Bioenergy Program: 7CFR 1424, Nov. 2000. [http://www.fsa.usda.gov/daco/bio_daco.htm]

[16] USDA News Release No. 0146.03, May 7, 2003.

[17] The Farm Security and Rural Investment (FAIR) Act of 2002 (Section 9010) is the authority for making payments on increased bioenergy production.

[18] *Federal Register*, May 7, 2003 (Vol. 68, No. 88), pp. 24596-24603.

[19] FAIR Act of 2002 (Section 9004).

[20] NBB, online press releases, June 12, 2003 [http://www.biodiesel.org/]

[21] For more information see: CRS Issue Brief, IB10041, "Renewable Energy: Tax Credit, Budget, and Electricity Production Issues," by Fred Sissine, May 12, 2003.