Potential Niche Fuel Markets for Biodiesel And Their Effects on Agriculture

by

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Abstract: This analysis estimates possible biodiesel demand in three niche fuel markets the biodiesel industry has identified as likely candidates for commercialization: Federal fleets, mining, and marine/estuary areas. If a 20-percent biodiesel blend becomes a competitive alternative fuel in the coming years, these markets could demand as much as 100 million gallons of biodiesel. The Food and Agricultural Policy Simulator, an econometric-based simulation model of U.S. agriculture, was used to estimate the impacts of 20, 50, and 100 million gallons of soybean-oil-based biodiesel production on the agricultural sector. The results indicate the effect of increased soybean oil demand on the soybean complex (beans, oil, and meal) and net farm income would be small.

Keywords: Biodiesel, alternative fuels, renewable energy, soybean oil, agricultural commodities.

Biodiesel, a fuel derived from vegetable oils, animal fats, and waste cooking oils, may be one of the alternative fuels, along with ethanol, compressed natural gas, and methanol, to help government and industry meet requirements of the Clean Air Act Amendments of 1990 (CAAA) and the Energy Policy Act of 1992 (EPACT) (see past issues of this report for more information). While some studies have looked at the economic feasibility of biodiesel production, little has been done to examine the effects of an expansion of demand for vegetable oil on the agricultural sector. One exception is a study by the University of Missouri (*2*). However, this study only examines the effects of a hypothetical increase in the demand for soybean oil without attempting to estimate the potential expansion in demand caused by the creation of niche markets. This analysis, therefore, examines potential niche fuel markets for biodiesel if a 20-percent biodiesel blend becomes a competitive alternative fuel, and estimates how the increase in soybean oil demand will affect U.S. vegetable oil prices, commodity markets, and farm income.

Conceptual Framework

This analysis estimates possible biodiesel demand in three niche fuel markets the biodiesel industry has identified as likely candidates for commercialization: Federal fleets, mining, and marine/estuary areas (*5*). Data were gathered on diesel fuel use in each niche market. If biodiesel is used commercially, it may be as a 20-percent blend with 80-percent regular diesel fuel. Therefore, the potential for biodiesel in each of these markets is 20 percent of diesel fuel use.

Although biodiesel can be made from various vegetable oils, tallow, and waste cooking oil, to simplify the analysis, it is assumed that soybean oil is the sole feedstock. The amount of soybean oil required to produce biodiesel was calculated for each of the markets. Both biodiesel and soybean oil use were summed to estimate total potential demand. The Food and Agricultural Policy Simulator (FAPSIM), an econometric-based simulation model of U.S. agriculture, was then used to simulate the economic adjustments that might occur if 20, 50 and 100 percent of this demand materialized. FAPSIM's advantage is its ability to simulate exogenous changes. Hence, the model can track the impact of the possible production of soybean oil-derived biodiesel over a broad range of agricultural commodities.

Three Potential Niche Fuel Markets

Although biodiesel is widely used in Europe because of environmental concerns and tax breaks, it has yet to make a significant market appearance in the United States. At present, neat (100 percent) biodiesel is defined as an alternative fuel under EPACT Section 490.2 (*7*). However, for biodiesel to be competitive as an alternative fuel given current production costs, it will need to be blended with diesel fuel. The current pump price for petroleum diesel is $1.28 per gallon, including average Federal and State taxes. While there is no current commercial price for biodiesel and biodiesel blends, the median hypothetical market price for biodiesel is $4.25 per gallon, according to anecdotal information received by USDA's Office of Energy and New Uses (OENU). An estimated wholesale price for a 20-percent biodiesel blend is $1.99 per gallon (56 cents per gallon for the 80-percent diesel, 85 cents for the 20-percent biodiesel, 44 cents for Federal and State taxes, and 14 cents mark up). The biodiesel industry has targeted niche fuel markets, such as Federal fleets, mining, and marine environments, where biodiesel use could help mitigate environmental and health-related externalities and/or purchasers may be willing to pay its higher price as their first targets for commercialization.

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Federal Fleets. The potential of Federal fleets as a niche market is driven by Federal policies implemented in EPACT and CAAA. The U.S. Department of Energy (DOE) recognizes that Federal fleets' relatively large market share within on-highway use and their high vehicle turnover rate create a potential niche market for alternative fuels (*1*). One advantage of Federal fleets for alternative fuel suppliers is logistics; the demand could be met with a relatively few number of outlets as Federal fleets are centrally fueled at motor pools. Regular commuters, on the other hand, would have to search for refueling stations that may not be within a reasonable vicinity. Another benefit of having Federal fleets as a niche market is the uniformity of regulations, whereas other fleets may be subject to various State and local laws.

The Federal fleet diesel market amounted to an estimated 288 million gallons in 1991 (table A-1). Data were calculated based on the energy content of diesel fuel and average truck and bus fuel-consumption weights (*1*). This estimate is conservative because (*1*) the sample is limited to trucks and buses from civilian agencies, the Postal Service, and the military, and (2) on-highway transportation is a small fraction of total government demand. A 20-percent biodiesel blend equates to a niche market of 58 million gallons of biodiesel, with a soybean oil equivalent of roughly 443 million pounds.

Table A-1--Diesel use by Federal fleet trucks and buses in fiscal 1991, and potential biodiesel and soybean oil use

Vehicle type	Diesel use 1/	Potential biodiesel use 2/	Soybean oil equivalent 3/
	Million gallons		Million pounds
Buses	0.6	0.1	0.9
Trucks	287.0	57.4	442.0
Total	287.6	57.5	442.9

1/ Derived from total fuel use (estimated by on-highway energy content) based on the share of diesel fuel use for trucks and buses. Sources: (1, 4). 2/ As a 20-percent blend with diesel fuel. 3/ A gallon of biodiesel equals roughly 7.7 pounds of soybean oil.

Mining. The potential benefits of using biodiesel in underground and surface mining originate from the possible health and environmental externalities that biodiesel could address directly through its use as a fuel and indirectly as a dust suppressant. The U.S. Department of Labor's Mine Safety and Health Administration is working with the National Institute for Occupational Safety and Health and the U.S. Environmental Protection Agency to draft new regulations and guidelines on the possible detrimental health effects of diesel exhaust and silica (*3, 8*).

Even though the impacts of diesel exhaust are not fully known, one possible benefit includes biodiesel's potential ability to mitigate some carbon monoxide, particulate matter, soot, and volatile organic compounds in underground mining. A study is underway comparing the costs and benefits using biodiesel blends versus exhaust aftertreatment technologies, such as water scrubbers, dry particulate filters, and ceramic filters (*10*). This information will help determine how cost competitive biodiesel can be in the underground mining market. Another possible benefit entails spraying mineral dust with neat biodiesel instead of petroleum diesel so it will stay on the ground. Dust suppression is needed to help prevent silicosis, a lung disease known as Black lung, which stems from breathing crystalline silica. Thus, because of its biodegradability, biodiesel would not contribute to water pollution in surface and underground mines.

In 1992, the mining industry (SIC codes 1011 to 1499) used 186 million gallons of diesel fuel (*6*). With a 20-percent blend, this niche market amounts to almost 37 million gallons of biodiesel and 285 million pounds of soybean oil (table A-2).

Marine/Estuary Areas. The idea of marine environments as a potential niche market focuses on the use of biodiesel

Table A-2--Diesel use by U.S. mining industries in 1992, and potential biodiesel and soybean oil use

Industry	Diesel use 1/	Potential biodiesel use 2/	Soybean oil equivalent 3/
	Million gallons		Million pounds
Bituminous coal and lignite minerals	117	23	180
Bituminous coal underground minerals	3	1	5
Crude and petroleum natural gas	14	3	22
Drilling oil and gas wells	14	3	22
Oil and gas field services	2	4/	3
Lead and zinc ores	10	2	15
Gold ores	10	2	15
Iron ores and miscellaneous nonmetallic minerals	4	1	6
Crushed and broken limestone and granite	9	2	14
Construction gravel	3	1	5
Total	186	37	285

1/ Source: (6). 2/ As a 20-percent blend with diesel fuel. 3/ A gallon of biodiesel equals roughly 7.7 pounds of soybean oil. Numbers do not add due to rounding. 4/ Less than 1 million gallons.

Table A-3--Recreational boat fuel use in 1991, and potential biodiesel and soybean oil use

	Fuel use 1/	Potential biodiesel use 2/	Soybean oil equivalent 3/
	Million gallons		Million pounds
Gasoline	893	--	--
Diesel	47	9	69
Other fuels	15	--	--
Total	955	9	69

-- = Not applicable. 1/ Source: (9). 2/ As a 20-percent blend with biodiesel. 3/ A gallon of biodiesel equals roughly 7.7 pounds of soybean oil.

as a method to mitigate the dangers of diesel fuel leaks and spills on lakes, rivers, and estuaries. A study conducted by the University of Idaho for USDA's Cooperative State Research, Education, and Extension Service, demonstrated that when compared to petroleum diesel, biodiesel and biodiesel blends are more biodegradable in an aquatic environment and, therefore, less of a danger to water quality and ecological degradation (*11*).

According to a biodiesel industry analyst, the commercial barge and shipping industries are unlikely to adopt biodiesel voluntarily due to the competitive nature of those industries, absence of regulatory pressure to move away from petroleum-based diesel fuel, and the fact that fuel presents a significant portion of overall operating costs (*10*). Biodiesel could, however, find a market as a fuel for large recreational boats. Boat owners are more likely to purchase biodiesel blends because they generally have higher discretionary incomes, are more likely to be concerned about the condition of their local marine environment, and fuel purchases are a small portion of annual boating expenditures. Based on a national diesel-fuel-consumption survey in 1991 of large privately owned recreational vessels done by Price Waterhouse for the U.S. Fish and Wildlife Service and the U.S. Coast Guard (*9*), the marine niche market for biodiesel is estimated at roughly 9 million gallons, an equivalent of 69 million pounds of soybean oil (table A-3).

While biodiesel may help lessen the impact of diesel fuel on marine environments, it is uncertain what the net pollution effects of increased biodiesel production would be. For instance, it is unknown how much the rise in soybean production would add to soil erosion, sedimentation, and fertilizer and pesticide runoff, and water pollution. This issue is currently being addressed by a joint project conducted by USDA and DOE through a life-cycle analysis of biodiesel (see the fats and oils section for information).

Total Demand. Table A-4 summarizes the potential demand for biodiesel and the corresponding increase in the demand for soybean oil in the United States from the three possible niche markets. Federal fleets constitute roughly 55 percent of potential biodiesel demand, followed by mining, 36 percent, and marine environments, 9 percent.

Three demand scenarios of 20, 50, and 100 million gallons of biodiesel are used in this analysis to gauge the impacts of low, medium, and high market penetration. Approximately 50 million gallons of biodiesel could be produced with current industrial capacity, according to OENU. Additional capacity would have to be pulled from soap and detergent manufacturing or would need to be built.

Table A-4--Possible increase in soybean oil demand from the three potential biodiesel niche markets

Item	Market penetration		
	Low	Medium	High 1/
	Million gallons		
Potential demand			
Federal fleets	11	27	54
Mining	7	19	37
Marine	2	5	9
Total	20	50	100
	Million pounds		
Soybean oil use			
Federal fleets	85	208	416
Mining	54	146	285
Marine	15	39	69
Total	154	393	770

1/ Potential biodiesel use in the niche markets sums to 104 million gallons, which was rounded to 100 million gallons by dropping fleet use from 57.5 million gallons to 54 million gallons.

Table A-5--Average annual impacts from an expansion in biodiesel use, 1996-2000

Item	Niche market scenario		
	Low	Medium	High
	Percent change from baseline		
Soybean oil			
Production	0.3	0.8	1.6
Domestic use	0.8	2.0	3.9
Decatur price	2.8	7.2	14.1
Soybean meal			
Production	0.3	0.8	1.6
Domestic use	0.2	0.6	1.1
Decatur price	-0.7	-1.7	-3.3
Soybeans			
Production	0.1	0.2	0.4
Crush	0.3	0.8	1.6
Farm price	0.4	1.0	2.0
Corn			
Production	0.0	-0.1	-0.2
Feed use	-0.1	-0.2	-0.3
Farm price	0.0	-0.1	-0.1
Livestock prices			
Broilers, farm price	-0.3	-0.7	-1.4
Hogs, farm price	-0.1	-0.4	-0.7
Choice steers, Omaha	-0.1	-0.2	-0.3
Net farm income	0.1	0.2	0.3

FAPSIM Model Results

The low-, medium-, and high-demand scenarios were simulated with FAPSIM by shifting the U.S. domestic demand for soybean oil by 154, 393, and 770 million pounds. It is assumed that the demand curve shifted by a constant amount each year during 1996-2000 in each of the simulations.

If soybean-oil-derived biodiesel was commercially used in the estimated amounts, the largest direct impacts would occur in the soybean oil market (table A-5). Depending on

the scenario, increased demand would cause soybean oil prices to rise by 2.8 to 14.1 percent on average during the 5-year period. This corresponds to an increase of 0.6 to 3.1 cents per pound. Higher oil prices would reduce the demand from other sources of domestic use. For example, under the high-demand scenario, even though demand initially shifts upward by 770 million pounds, domestic demand would only increase by 526 million pounds each year. Higher oil prices also may lead biodiesel producers to seek cheaper feedstocks.

Higher soybean oil prices would have indirect impacts on other parts of the soybean complex. For instance, higher oil prices would increase the profitability of processing raw soybeans into oil and meal, which would lead to an expansion in the demand for raw soybeans by processors. Because of the greater demand, the price received by farmers for soybeans would increase 0.4, 1.0, and 2.0 percent, respectively, under the low-, medium-, and high-demand scenarios. However, as more soybeans are crushed, oil and meal production would increase, which would lead to an average decline in meal prices from 0.7 to 3.3 percent over the 5-year period.

Higher soybean oil demand would affect the corn and feed markets only slightly. Higher soybean prices would lead to a very small drop in corn production under the medium- and high-demand scenarios, as farmers shifted from corn to soybean production. The feed demand for corn would decline a bit more because lower soybean meal prices would cause livestock producers to feed more soybean meal and less corn.

The decline in meal prices would increase the profitability of livestock producers, which would lead to expanded livestock production. Larger retail supplies of meat and poultry products would drive down farm-level and consumer prices. The impacts on the poultry market would be particularly pronounced, since soybean meal constitutes a larger portion of the feed ration for poultry relative to other livestock.

Under all three scenarios, higher soybean prices would lead to higher cash receipts for crops, while lower farm prices for livestock would result in lower cash receipts for these products. Since these two components of cash receipts move in opposite directions, the effects on total cash receipts would be mixed over the simulation period, increasing in some years and decreasing in others. Lower soybean meal prices, however, would reduce livestock production expenses enough to lead to a slight average increase in net farm income.

Conclusions

This analysis estimates possible biodiesel demand in three niche fuel markets the biodiesel industry has identified as candidates for commercialization: Federal fleets, mining, and marine/estuary areas. If a soybean-oil-based, 20-percent biodiesel blend becomes a competitive alternative fuel in the coming years, these markets could account for an additional 770 million pounds of soybean oil use. Based on FAPSIM simulations, the impact on U.S. agriculture would be small.

This is not a full cost-benefit analysis of shifting to biodiesel. It merely quantifies the possible impact on the U.S. agricultural sector if niche fuel markets for biodiesel should develop and soybean oil was the sole feedstock. However, if biodiesel commercialization occurs, cheaper raw materials, such as waste cooking oil and tallow, may be the primary feedstocks. Further scientific and economic studies are also needed to determine biodiesel's health and environmental costs and benefits.

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