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Biodiesel Fuel: What Is It? Can It Compete?

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BIODIESEL FUEL: WHAT IS IT? CAN IT COMPETE?

SUMMARY

For some 15 years, there has been a national policy to foster the use of domestically produced renewable resources as a source for transportation fuels. For the past five years, Congress has been putting in place additional policies designed at least in part to further reduce U.S. dependence on gasoline and diesel fuel.

The Energy Policy Act of 1992 establishes a national goal of replacing, by year 2000, 10 percent of motor fuels with nonpetroleum alternative fuels, at least half of which are to be derived from domestic sources, with a further goal of 30 percent displacement by 2010. Within these overall goals, there is no quantitative goal for renewable, domestically-produced replacement fuels.

According to current projections, less than 10 percent of motor fuels will be displaced by alternative fuels by year 2010, with about 25 percent of the replacement fuels from renewable resources.

Biodiesel, a fuel similar to diesel fuel, is being promoted aggressively by two sectors with strong public policy voices: oilseed producers such as soybean farmers, and sustainable development advocates concerned about the impact of fossil fuel consumption on global climate. Biodiesel fuel can be made from new or used vegetable oils and animal fats. It is made from domestic renewable resources. It is biodegradable, requires minimal engine modification when used either as a blending component or as is, and is potentially cleaner-burning than the diesel it replaces.

Biodiesel fuel costs over $2 per gallon, compared to 65 to 70 cents for the diesel fuel it would displace. However, it does have advantages over possible replacements such as alternative fuels. Some of this higher cost would be compensated for by avoiding engine modification costs, fuel storage costs, and infrastructure investments required by alternative fuels such as natural gas and methanol. But these advantages do not fill the gap. Further cost reductions are necessary for biodiesel to compete.

To commercialize biodiesel, an initial subsidy of about the same size as that currently provided fuel ethanol would be needed. Additional technology development, both in the production process and in the fuel/engine system, is also in order. The policy issue is the role of the Federal government in bridging the cost gap and in developing the necessary technology.

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INTRODUCTION

For some 15 years, there has been a national policy to foster the use of domestically produced renewable resources as a source for transportation fuels. This policy was articulated in the Energy Tax Act of 1978 (P.L. 95-618) which, among other provisions, reduced the Federal highway tax on motor fuels containing alcohols derived from biomass. Over the past five years, Congress has put in place three additional laws which include provisions designed at least in part to further reduce the United States' dependence on gasoline and diesel fuel for transportation fuels. The three statutes are the Alternative Motor Fuels Act (AMFA, P.L. 100-494), the Clean Air Act Amendments of 1990 (CAAA, P.L. 101-549), and the National Energy Policy Act of 1992 (EPACT, P.L. 102-486).

EPACT sets as a national goal the replacement by the year 2000 of 10 percent of motor fuels with nonpetroleum alternative fuels, with a further goal of 30 percent replacement by year 2010. In both cases, at least half of the nonpetroleum replacement fuels are to be derived from domestic resources. There is no quantitative goal for renewable, domestically-produced replacement fuels, but interest in this subset has been growing as global climate change has become an issue of both national and international interest. However, according to current estimates, even with these tax, regulatory, and other provisions in place, the penetration of these replacement fuels will not reach even 10 percent by year 2010, let alone the 30 percent goal.[1] Most of this 10 percent will be oxygenates in gasoline; only a small share will be alternative fuels, replacing either gasoline or diesel fuel. Perhaps 25 percent of the 10 percent will be ethanol or ethyl ethers; the rest will be from nonrenewable resources.

Thus, a considerable gap will remain between the EPACT goal of 30 percent replacement and the less-than-10 percent or so replacement likely to be achieved. Further, the renewable component of replacement fuels will be relatively small. Continued congressional attention to both concerns -- more replacement and more renewable resource utilization -- is likely.

Biomass-derived fuels similar to diesel fuel (collectively called biodiesel) are being aggressively promoted by two sectors with strong public policy voices: oilseed producers such as soybean farmers, and sustainable development advocates concerned about the impact of fossil fuel consumption on global climate. They can be derived from biomass. They can be used either as a substitute for or as additives to diesel. Not only would biodiesel be both

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[1] See IB 93009, "Alternative Transportation Fuels: Oil Import and Btu Tax Issues," by David E. Gushee. Regularly updated.

domestically produced and renewable, it is biodegradable, requires minimal engine modification when used either as a blend component or a pure (neat) fuel, and is potentially cleaner-burning than the diesel it replaces.

However, biodiesel is relatively unknown and faces several barriers to gaining widespread commercial use. Biodiesel must overcome a number of regulatory obstacles, and its price must become more competitive, before it will make any significant market penetration. The policy issue facing the Congress is whether greater Federal support should be provided to foster greater biodiesel use and, if so, what forms that help should take.

RAW MATERIALS

A number of raw vegetable oils have properties very similar to those of diesel fuel. In fact, some pure vegetable oils can be used in modified engines as diesel substitutes. However, among other problems such as engine fouling after a few hours of operation, vegetable oils are more viscous than diesel and, in cold weather, are too viscous to be used as fuels.

To overcome these problems, vegetable oils can be chemically reacted with an alcohol (methanol is the usual choice) to produce chemical compounds known as esters. Biodiesel is the name given to these esters when they are intended for use as fuel. Glycerol (used in pharmaceuticals and cosmetics, among other markets) is produced as a co-product.

Much of the current interest in biodiesel production comes from soybean producers faced with an excess of production capacity, product surpluses, and declining prices. Methyl soyate or SoyDiesel[2], made by reacting methanol with soybean oil, is the main form of biodiesel in the United States. About 36,000 gallons of methyl soyate were produced commercially in the U.S. in 1992, mostly by Procter & Gamble. Current capacity is about 15 million gallons per year. Currently, there is limited demand, mostly in a few non-fuel niche markets. For example, methyl soyate is used as a pesticide carrier and asphalt release agent. Biodiesel is currently being tested in bus fleets in about half the states, including Washington, California, South Dakota, Missouri, Colorado, New Jersey, Illinois, Kansas, and Ohio.[3]

Annual U.S. production of soybean oil is about 14 billion pounds, with stocks of about 2.5 billion pounds and going up. Current surplus is about 1 billion pounds per year, from which about 130 million gallons of biodiesel could

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[2] SoyDiesel is the name used by the National SoyDiesel Development Board. "Biodiesel" is widely used in industry literature. For the purposes of this report, the generic term "biodiesel" will be used in place of SoyDiesel and for any of the forms of biomass diesel.

[3] "Interchem Methyl-Ester Biodiesel Being Tested in Bus Fleets All Over U.S." *Mobile Source Report*, July 30, 1993.

be produced. Soybean production could be expanded, either by substituting soybeans for other crops or by adding acreage now not in production. Capacity to extract oil from the beans is greater than current production by about one third. Oil price is currently slightly more than 20 cents per pound.

Waste animal fats and used frying oil (known as "yellow grease") are also potential feedstocks; production is about 2 billion pounds per year, or about 260 million gallons. These are cheaper than soybean oil and are being considered as a way to reduce feedstock costs. Peanuts, cottonseed, sunflower seeds, and canola (a variant of rapeseed) are other candidate oil sources. Esters made from any of these sources can be used successfully in diesel engines, although they may differ slightly in terms of energy content, cetane number (analogous to gasoline's octane rating in terms of engine performance), or other physical properties. Regardless of feedstock, biodiesel is expected to meet commercial diesel fuel specifications described in ASTM D975 standard.

According to the American Biofuels Association, with Government incentives comparable to those provided for ethanol, biodiesel production from seed oils could reach about 2 billion gallons per year, or about 8 percent of highway diesel consumption early in the next century. At this level of market penetration, biodiesel would probably be used as a fuel mostly in bus fleets and heavy-duty trucks (primarily in blends with fossil diesel at the 20 percent level).[4]

Were developments in technology to broaden the raw material base to biomass in general, then the supply would not be limited by seed oil production volumes.[5] Additional land would be needed, or alternatively, current agricultural production patterns would have to be redirected.

Rape methyl ester, a biodiesel made by reacting methanol and rape seed oil, has been produced commercially in Europe for the past several years. Italy, Austria, and France are the major producers, with Italy alone having more than half of the European Community's 30 million gallon per year capacity. An additional 170 million gallons per year of capacity are in various stages of planning and construction, half of which is in France. Several other European countries are also actively involved. The driving forces are similar to those in the United States: reducing oil imports, supporting the agricultural sector, and reaping the environmental benefits of reduced emissions (particularly of particulates) without having to build new engines or fuel delivery infrastructure.

The European Community has proposed limiting the taxation of biodiesel to no more than 10 percent of a given nation's normal fuel tax. This would be a considerable incentive, since European fuel taxes normally account for half or

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[4] Personal communication with William C. Holmberg and Earle E. Gavett, American Biofuels Association, August 1993.

[5] *ibid.*

more of the purchase price.[6] The political strength of the agricultural sectors of various member states coupled with the very high highway taxes in EC countries have helped the biodiesel industry in its efforts to become well established in Europe. Nonetheless, the proposed special tax advantage for biodiesel is running into strong political opposition and has not yet been adopted. Thus, what incentives exist are those of the individual countries.

PRODUCTION PROCESSES AND ECONOMICS

Currently, biodiesel is produced by a process called transesterification. The vegetable oil (or animal fat) is first filtered, then preprocessed with alkali to remove free fatty acids. It is then mixed with an alcohol (usually methanol) and a catalyst (usually sodium or potassium hydroxide). The oil's triglycerides react to form esters and glycerol, which are then separated from each other and purified.

Methyl soyate currently costs over $2 per gallon and seeks to compete with diesel which costs 65 to 70 cents per gallon. Feedstock costs account for over 90 percent of direct production costs, including cost of capital and return of capital.[7] It takes about 7.3 pounds of soybean oil, for example, costing about 20 cents per pound, to produce a gallon. Feedstock costs alone, therefore, are at least $1.50 per gallon of methyl soyate, not counting marketing and overhead expenses and profit. Efforts are ongoing to try to reduce feedstock costs by developing soybean hybrids with higher oil content. Soybeans, for example, contain about 20 percent oil, whereas some other oil seeds contain as much as 50 percent oil. The rape seed used in Europe has an oil content of about 40 percent.[8]

An important factor in biodiesel economics is the market value of the glycerol produced. Glycerol markets are limited; any major increase in biodiesel production would undoubtedly cause glycerol sales prices to decline, meaning that the biodiesel price would have to cover an increasing share of total costs.

Another approach would be to use lower-cost feedstocks. Animal fats and used cooking oils, for example, are about 10 to 15 cents per pound but are not

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[6] "Industrial Uses of Agricultural Materials." U.S. Department of Agriculture, Economic Research Service, June 1993, p. 21.

[7] Capital requirements are less than 30 cents per annual gallon of capacity for a plant operating around the clock and up to about $1.00 per gallon for a small plant operating one shift.

[8] The pressure to develop biodiesel in the U.S. is coming from soybean producers. Rape seed has not been a significant crop in this country.

always available in the right place at the right time.[9] The transesterification process is slightly more expensive. Further, the supply is limited compared to potential fuel demand.

Developments in transesterification technology would also lower the costs of production. Currently, biodiesel is produced in "batches," or small, fixed quantities. Transesterification done on a "continuous" basis would be more efficient and would contribute economies of scale to the production process. Also, the final step of "washing" the biodiesel with water to separate the glycerol coproduct is somewhat inefficient. Research in these areas may eventually lead to lower production costs.[10]

Another alternative for producing biomass-based diesel is to pyrolyze[11] various sources of biomass to generate a synthesis gas from which synthetic diesel could be produced. This method is not currently being employed, although limited research on its potential has begun. Since this process can be applied to almost any type of biomass, this technology would greatly increase the range of biomass from which biodiesel could be produced.[12]

ENVIRONMENTAL IMPLICATIONS

Biodiesel is biodegradable. European tests of rape seed oil-based biodiesel indicate that it is 99.6 percent biodegradable within 21 days.[13] Within one month of being spilled into the environment, biodiesel should completely decompose. This allows biodiesel to be a good alternative fuel for use in environmentally sensitive areas where fuel leakages and spills would be particularly harmful, such as in wetland areas or in watersheds which supply drinking water.

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[9] Personal communication with Lamar Harris, Agricultural Research Service, U.S. Department of Agriculture, August 1993, and "Energetic and Economic Feasibility Associated with the Production, Processing, and Conversion of Beef Tallow to Diesel Fuel," by Richard G. Nelson and Mark D. Schrock, Kansas State University, presented at the First Biomass Conference, Burlington, VT, August 1993.

[10] Personal communication with Lamar Harris, Agricultural Research Service, U.S. Department of Agriculture, August 1993.

[11] Pyrolyzing consists of heating the biomass to very high temperatures in the absence of air. The complex biomass molecules fracture into smaller fragments which are then fed to subsequent chemical process steps.

[12] Synthetic diesel fuel can also be produced by pyrolysis of coal and subsequent chemical rearrangement.

[13] Werner Korbitz, Biodiesel Presentation Outline, Vienna, Austria, 1993.

Sulfur content has been found to correlate with the tendency for particulate formation in diesel engine exhausts. Maximum sulfur content in diesel fuel is currently (since October 1, 1993) being regulated by EPA to 0.05 percent, down from historic levels five and 10 times greater. Desulfurization to the new regulatory limit is adding several cents per gallon to diesel production costs. Unlike conventional diesel, biodiesel requires no desulfurization, as only a trace amount is present.

Aromatics in diesel fuel also contribute to particulate formation, as well as to nitrogen oxide emissions. Unburned and partially burned aromatics adsorb on the particles, contributing to their carcinogenicity. Aromatics content in diesel is often 40 to 60 percent. California Air Resources Board has placed an upper limit of 10 percent on aromatics content for diesel sold in the State. EPA has not set an aromatics limit, but its cetane number specification implies an aromatics content of less than about 35 percent. Biodiesel contains no aromatics.

Emissions data on biodiesel are very limited, not unexpected in light of the short history of interest in it as a replacement for or additive to diesel fuel. Because of biodiesel's cost, interest today focuses mostly on its use as an additive at levels between 20 percent and 40 percent, rather than as a complete substitute. The rate of collection of emissions data is increasing,[14] but much remains to be done before full understanding of the connections among fuel composition, engine design/operation, and emissions is fully explored. Nonetheless, it appears relatively certain that hydrocarbon and carbon monoxide emissions are lower than for conventional diesel fuel.[15] Since these emissions from conventional diesel fuel are already low compared to gasoline engines, the value of this advantage in ozone and CO nonattainment areas may be limited.

One potential disadvantage of biodiesel is that, without engine adjustment, higher amounts of nitrogen oxides (NO_x), a precursor to ground-level ozone, are emitted compared to fossil diesel. The higher the biodiesel content, the greater this effect is. However, small timing adjustments made to the engine ignition system appear to reduce NO_x emissions. One recent test of biodiesel gave the emissions results shown in table 1 below.[16]

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[14] See *Biodiesel Alert*, published by the American Biofuels Association for the National SoyDiesel Development Board, Volume 1, No. 6, May 1993.

[15] "An Overview of the Current Status of Biodiesel," by Thomas B. Reed, Colorado School of Mines, presented at the Burlington, VT Biomass Conference, August 1993.

[16] "Evaluation of Methyl Soyate/Diesel Blend in a DDC 6V-92TA Engine: Optimization of NO_x Emissions." Report 93-E14-21. By Ortech International for Fosseen Manufacturing and Development. July 20, 1993.

Table 1 - Comparison of Emissions
Biodiesel Blend* versus Conventional Diesel Baseline

Pollutant	Baseline Index #2 Diesel	20/80 Blend no timing adjustment	20/80 Blend ignition timing adjustment	20/80 Blend, ignition timing adjustment and catalyst
Carbon Dioxide (CO_2)	100	101	102	101
Carbon Monoxide (CO)	100	87	90	27
Nitrogen Oxides (NO_x)	100	101	95	97
Hydrocarbons	100	84	85	27
Particulate Matter	100	82	83	73

* Biodiesel made from soybean oil. 20/80 blend means 20% biodiesel, 80% conventional #2 diesel (0.05% sulfur)

With the exception of NO_x, the ignition timing adjustment appears to have made no significant difference to emission levels. These initial results indicate that, with minimal engine adjustments and particularly with the addition of an exhaust catalyst, the use of biodiesel blends may lead to significant reductions in diesel engine particulate emissions and hydrocarbon and carbon monoxide emissions, with no significant change in nitrogen oxide emissions. This conclusion, based on admittedly limited data, is buttressed by a number of anecdotal observations.[17] Extensive additional emissions testing is now under way.

The reduction in particulate emissions would be particularly advantageous, because of diesel's historically high particulate emission levels; the reductions in hydrocarbon and CO emissions may be less significant, given diesel's already low levels of these; being able to prevent increases in NO_x emissions is essential. Additional testing is under way.

In theory, the use of biodiesel should not contribute to global warming. While biodiesel emits CO_2, perhaps slightly more than conventional diesel, from the engine, the biodiesel feedstock crops remove CO_2 from the atmosphere during growth. Therefore, there would be no net contribution to atmospheric CO_2. However, fossil energy and fertilizers are used throughout the fuel preparation cycle. A recent German study has concluded that the net greenhouse gas balance on biodiesel from rape seed oil is actually negative. This result stems primarily from high estimates of emissions of CO_2 and nitrogen

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[17] Some of these anecdotal observations have been reported in issues of Biodiesel Alert and in press reports.

dioxide (NO_2) during the cultivation phase.[18] Agricultural practices in the U.S. use less fertilizer and are moving toward low-till or even no-till methods. Further, unlike rape seed, soybeans require little or no nitrogen. These two factors would reduce greenhouse gas emissions compared to the European norm. It will be a while before this issue is resolved; dozens of analyses of the greenhouse gas balance on ethanol vs. gasoline, where there is much more data, have been made, yet that question still remains unresolved.

Another concern may be environmental side effects of increased agricultural activity, should biodiesel use reach significant volumes. The primary points of contention are increased water pollution from increased pesticide and fertilizer use and increased soil erosion, particularly should land be taken out of the U.S. Department of Agriculture's Conservation Reserve Program (CRP) and used for feedstock production. Similar concerns have been voiced over every proposed increase in use of biomass for energy, including ethanol to oxygenate gasoline; the concerns remain as sources of debate.

DEVELOPMENT NEEDS

Biodiesel is a commodity in the early stages of development. For the market to grow and develop, it must attract private investment and government support, and it must meet several regulatory and industrial requirements.

- Under the clean Air Act Amendments of 1990, biodiesel must be approved by the EPA as "substantially similar" to diesel fuel. If not, then it would need a waiver from this requirement.

- EPA must also determine the acceptability of biodiesel in its pending emissions standards for off-road vehicles and clean-fuel regulations for fleet vehicles.

- Biodiesel must be included in the Department of Energy's definition of alternative fuels when it writes the regulations required by EPACT. Most likely, biodiesel would only be considered an alternative fuel in blends of at least 70 percent biodiesel, although it would qualify as a replacement fuel at the lower levels of 20% or 30% in diesel fuel.

- The Engine Manufacturers Association must designate biodiesel an acceptable fuel so that engine manufacturers will extend their warranties to cover repairs on biodiesel-using engines.

Meeting these requirements is a matter of completing the proper technology development and testing. Research and development efforts in engine testing, emissions characteristics, materials compatibility and durability, and cold

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[18] "German Report Expected to be Negative on Biodiesel from Rape Seed Oil," *New Fuels Report*, v.13, n.36, September 7, 1992, p. 5.

conditions performance testing, which would facilitate these approval processes, are well underway.[19]

CURRENT STATUS OF GOVERNMENT R&D

Biodiesel research and development projects are ongoing under the Department of Energy (DOE) in the Alternative Fuels Utilization Program and under the Department of Agriculture (USDA) in the Alternative Agricultural Research and Commercialization (AARC) Center and the Agricultural Research Service (ARS). Additionally, the USDA, the Department of Defense, and the DOE provide some special grant money to biofuels research projects, several of them for biodiesel.

The Alternative Fuels Utilization Program of DOE will spend about $600,000 on biodiesel projects in FY93 and FY94. Currently, the Program is co-sponsoring emissions testing of different biodiesel blends with the National SoyDiesel Development Board (NSDB).[20] DOE may also consider conducting a study of the comparative economics of biodiesel with compressed natural gas, liquified natural gas, and propane. The Energy Office at Department of Agriculture has taken the lead in this project with matching funds from NSDB. Biodiesel has recently been included in the DOE Clean Cities Program. Participating cities have the option of selecting "biofuels" (which includes alcohols and now biodiesel) as their preferred alternative fuel.[21]

USDA's AARC Center is currently spending about $130,000 on engine/fuel testing in conjunction with NSDB. The ARS has about a $900,000 budget for biodiesel projects. In addition to these funds, the USDA expects to receive $600,000 from the Department of Defense through the Office of the Navy for biofuels research.[22] ARS projects typically involve crop research, particularly in developing high oil-content soybean hybrids and in testing other feedstocks for applicability. USDA also plans to further test biodiesel for biodegradability and toxicity.[23]

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[19] Personal communication with Lamar Harris, Agricultural Research Service, U.S. Department of Agriculture, August 1993.

[20] Personal communication with Steven Goguen, Alternative Fuels Division, U.S. Department of Energy, August 1993.

[21] National SoyDiesel Development Board, *Biodiesel Alert*, v.1, n.6, May 1993, pp. 7-8.

[22] Personal communication with Lamar Harris, Agricultural Research Service, U. S. Department of Agriculture, August 1993.

[23] National SoyDiesel Development Board, *Biodiesel Alert*, v.1, n.6, May 1993, p. 6.

FEDERAL LEGISLATION

Given the very high cost of biodiesel relative to conventional diesel, very little market penetration is likely unless steps are taken to reduce the price differential. In addition, natural gas, propane, methanol, and ethanol are so far ahead of biodiesel in terms of market development, investment, and recognition that the biodiesel industry will probably not grow much beyond its current level without government incentives and support.

Federal legislation has already been instrumental in stimulating interest in the development of biodiesel. Title II of the Clean Air Act Amendments of 1990 put statutory pressure on particulate emission standards for heavy duty diesel engines, established limits for the sulfur content of conventional diesel, and set t[illegible] emission standards for clean fuel fleets for ozone nonattainment areas. All of these requirements place premiums on factors for which biodiesel has natural advantages. Also, titles III, IV, and V of the National Energy Policy Act of 1992 define alternative fuels, require Federal agencies to replace some portion of their vehicle fleets with alternative fuel vehicles, and provide for the change-over of State and private vehicle fleets to alternative fuels.

These provisions alone cannot compensate for the price difference between biodiesel and fossil diesel, even when the costs of removing aromatics and desulfurizing diesel or the costs of vehicle and infrastructure changes associated with a move to alternative fuels are taken into account.

S. 465 and S. 1736 in the 103rd Congress, introduced by Senator Daschle, would provide a tax credit for biodiesel similar to that for ethanol. In addition, the tax credit would not be taxable as income, allowing the full credit to flow to the producer. Representative Durbin has signaled that he intends to introduce similar legislation which would provide a 77-cent per gallon tax credit to blenders of biodiesel.[24] These bills may be the springboards the biodiesel industry needs.

Based on a projection by biodiesel proponents that the cost could be reduced from its current level of over $2 per gallon to about $1.60 through technological improvements and economies of scale, the subsidy needed would be about 85 cents per gallon. This translates to about $36 per barrel of diesel displaced, unadjusted for differences in energy content (biodiesel contains about 5 percent less energy than diesel; making this adjustment brings the subsidy to about $38 per barrel). With this level of Government support, according to American Biofuels Association, the biodiesel market could possibly reach about 2 billion gallons per year within 10 years. By that time, improvements in technology would cut biodiesel costs enough, in ABA's view, that the subsidy per gallon could be reduced to 30 cents per gallon at a cost to the Treasury of about $600 million per year. The current subsidy for ethanol is about $23 per barrel of ethanol, or, taking into account the energy difference, about $40 per barrel of

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[24] "Durbin to Introduce Bill Giving Hefty Tax Credit to Blenders of Biodiesel Fuel," *New Fuels Report*, v.14, n.21, May 24, 1993, p. 6.

gasoline displaced. For natural gas, the value of Federal highway tax foregone is about $8 per barrel of diesel displaced. Methanol (made currently from natural gas) and propane are not subsidized; rather, the Federal and State highway tax structures work against them. Gasoline additives like methyl tertiary butyl ether (MTBE) are not subsidized.

SOCIAL COST/BENEFIT CONSIDERATIONS

It would appear that biodiesel will not gain a foothold in American motor fuel markets without a subsidy similar in size to that granted to ethanol -- about $40 per barrel of petroleum-derived fuel replaced. Arguments for biodiesel are the same as those for ethanol: reducing oil imports, creating basic industries and jobs in the farm belt, reducing motor vehicle-related air emissions, and using renewable resources instead of nonrenewable resources.

Arguments against it are also familiar: there are less-expensive alternatives for reducing oil imports and for reducing vehicle-related air emissions. These less expensive alternatives do not, however, derive from renewable resources and do not, in general generate jobs in the farm belt (although they do generate jobs in what may loosely be called the oil patch).

In the last analysis, therefore, the issue is not resolvable by analysis.