BY THE U.S. GENERAL ACCOUNTING OFFICE

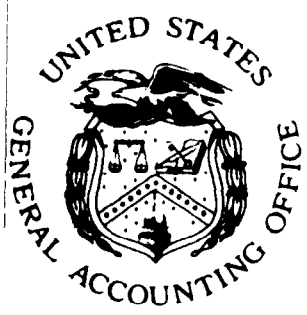
Report To The Honorable Charles H. Percy, David Durenberger, And J. James Exon United States Senate

Importance And Impact Of Federal Alcohol Fuel Tax Incentives

Federal tax incentives have been, and continue to be, vital to the growth of the alcohol fuel (ethanol) industry With these incentives, the industry increased production tenfold between 1979 and 1982.

The net impact of the incentives on the overall economy has been small Specifically, total economic activity, employment, and the nation's trade balance have not been significantly affected by ethanol production. The net impact on the federal budget is not large. The budgetary cost of the subsidy is at least partially offset by savings in agricultural price support programs due to the added demand for corn for ethanol production Finally, ethanol production has marginally enhanced national energy security by displacing small quantities of imported oil

Balancing the incentives' costs and benefits, GAO believes that sufficient justification exists to continue the incentives until their current scheduled 1992 expiration date.



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WASHINGTON, D.C. 20548

RESOURCES, COMMUNITY,
AND ECONOMIC DEVELOPMENT
DIVISION

B-214580

The Honorable Charles H. Percy
The Honorable David Durenberger
The Honorable J. James Exon
United States Senate

As requested in your October 29, 1982, letter, this report discusses the costs and benefits associated with federal alcohol fuel tax incentives. In particular, it addresses the importance of incentives to the fuel ethanol industry and the impact of fuel ethanol production on various aspects of the nation's economy and energy security.

Unless you publicly announce its contents earlier, we plan no further distribution of this report until 7 days from the date of the report. At that time we will send copies to interested parties and make copies available to others upon request.

J. Dexter Peach
Director

GENERAL ACCOUNTING OFFICE REPORT
TO THE HONORABLE CHARLES H. PERCY,
DAVID DURENBERGER, AND
J. JAMES EXON
UNITED STATES SENATE

IMPORTANCE AND IMPACT OF FEDERAL ALCOHOL FUEL TAX INCENTIVES

D I G E S T

Since 1978 the federal government has provided a variety of tax incentives to promote the development of the domestic ethanol (an alcohol fuel) industry. The most important of these incentives has been the exemption of gasohol--a blend of 10 percent ethanol and 90 percent gasoline--from federal gasoline excise taxes. Through 1992, gasohol is exempt from 5 cents of the 9 cent federal gasoline tax. Since only one-tenth of a gallon of ethanol is needed to exempt the entire gallon of mixed fuel from tax, the tax subsidy amounts to 50 cents per gallon of ethanol. (See p. 4.)

At the request of Senators Charles H. Percy, David Durenberger, and J. James Exon, GAO gathered data on some of the costs and benefits associated with the gasohol and related tax incentives. In particular, GAO addressed the

--importance of federal tax incentives to the domestic fuel ethanol industry,

--domestic economic effects of fuel ethanol production,

--net impact of the incentives on the federal budget,

--international trade impacts associated with fuel ethanol production,

--fuel ethanol industry's impact on national energy security, and

--federal tax subsidies to other energy industries. (See p. 6.)

IMPORTANCE OF INCENTIVES

GAO found that federal tax incentives have been vital to the establishment and development of the domestic fuel ethanol industry. Without a subsidy, ethanol cannot compete with gasoline at

current prices and would not be used as a fuel. The best available ethanol production cost data indicates that at the time of our review, the 5-cent tax exemption may have been somewhat higher than necessary to sustain profitable operations by some existing producers. However, it is likely that the current subsidy was and is necessary for new producers to successfully enter the industry and expand the industry's production capacity. (See p. 8.)

At this time it is difficult to determine how long the fuel ethanol industry will be dependent on federal subsidies. Such a determination depends heavily on future oil prices, corn prices, technological development, and other factors which cannot be reliably predicted.

DOMESTIC ECONOMIC EFFECTS AND FEDERAL REVENUE IMPACTS

From virtually any perspective, the fuel ethanol industry has had only a modest impact on the U.S. economy. Fuel ethanol production met only about one-fifth of 1 percent of gasoline demand in 1982 and is projected to meet only about 1 percent of gasoline demand by 1990.

Accordingly, while economic impacts on certain localities could be significant, the industry's impact on national output, employment, agricultural prices, and the federal budget is very small. For example, concerning the federal budget, GAO found that in 1982 the incentives resulted in about a $100 million tax loss to the Treasury. This loss was at least partially offset by reduced agricultural support program costs attributable to the ethanol industry's demand for corn. Because the industry's impact on total national output and income cannot be precisely calculated with available information, it is not possible to calculate the industry's impact on tax revenue. Consequently, it is impossible to conclusively determine the industry's net revenue impact. In any case, the impact is not large. (See p. 20.)

INTERNATIONAL TRADE IMPACT

Like the industry's domestic economic impact, small ethanol production levels suggest a modest impact on the nation's international trade balance. GAO found that in 1982 fuel ethanol production and use reduced oil imports and increased the value of agricultural exports by

raising their prices, but also increased fuel ethanol imports. Considering these factors alone, domestic fuel ethanol production and use resulted in about a $210 million improvement in the nation's nearly $43 billion merchandise trade deficit. However, there may be other trade impacts GAO could not quantify which would reduce or reverse this modest improvement. (See p. 31.)

IMPACT ON NATIONAL ENERGY SECURITY

Domestically produced fuel ethanol enhances national energy security by reducing U.S. dependence on imported oil from the Middle East and other politically unstable regions. However, as with the industry's domestic economic and international trade impacts, fuel ethanol's impact on national energy security is small because the industry's current and projected output represents only a small fraction of gasoline demand. (See p. 37.)

GAO found that stockpiling fuel ethanol in a manner comparable to the Strategic Petroleum Reserve could somewhat enhance the role of fuel ethanol in reducing U.S. vulnerability to an oil supply disruption. However, while GAO's exploratory analysis indicated that ethanol stockpiling could be feasible, its cost effectiveness would be questionable. (See p. 42.)

OTHER ENERGY INDUSTRY TAX BENEFITS

GAO found that the total value of tax subsidies received by conventional energy industries such as oil and gas have historically dwarfed that received by the fuel ethanol industry and other conservation and alternative energy sources. Projections prepared by the Joint Committee on Taxation suggest that through at least 1988 conventional energy industries will continue to receive the vast majority of total energy tax subsidies although on a per barrel basis, the subsidies provided the oil and gas industries are not as large as the ethanol subsidy.

GAO points out the large value of the subsidies provided to conventional energy industries to demonstrate that fuel ethanol does not compete in a free energy marketplace. (See p. 49.)

The administration has opposed federal fuel ethanol tax incentives because such incentives distort the energy marketplace and contribute to

a misallocation of economic resources. Recognizing the tax incentives offered to encourage production by conventional energy industries, this argument could just as easily be applied to these incentives. Not to do so seems somewhat inconsistent. (See p. 53.)

CONCLUSIONS AND OBSERVATIONS

Based on its assessment of currently identifiable costs and benefits surrounding the federal fuel ethanol tax incentives, GAO believes it would be appropriate to continue these incentives until their 1992 scheduled expiration date. The private sector has invested considerable sums of money in fuel ethanol plants--total plant value exceeds $1 billion--with the expectation that the market created by the tax exemption in particular would be present until 1992 when the exemption is scheduled to expire. Removing the incentives at a time when ethanol remains uncompetitive with gasoline could be viewed as a break in faith that would not be justified by any expectation of major budget savings or significant economic gains. GAO believes, however, that an increase in the incentives would not be justified because combined federal and state incentives are adequate to make ethanol competitive. GAO further believes that the need for the incentives should be periodically reviewed. If relative costs between gasoline and ethanol narrow appreciably, federal subsidies would no longer be essential. (See p. 55.)

AGENCY COMMENTS

GAO provided drafts of this report to the Departments of Agriculture, Energy, and the Treasury for official comment. The Department of Agriculture chose not to provide comments. The Department of Energy generally agreed with our findings and conclusions while the Department of the Treasury disagreed with our principal conclusion that the tax incentives should continue until the scheduled expiration date. Treasury's primary objections to our conclusion are that (1) oil and gasoline price decontrol made the incentives obsolete and (2) the marketplace is the most efficient allocator of economic resources and incentives such as those provided to alcohol fuels distort that marketplace.

GAO believes that strict application of marketplace economic theory does not take into account (1) the potential long-term economic value of supporting a new industry over a short period of time, (2) the national security advantages which could accrue to building an industry capable of producing an alternative automotive fuel, (3) the importance of the government meeting its commitment to individuals and businesses that have invested in fuel ethanol plants with the expectation that the federal incentives would be in place through 1992, and (4) the significant distortions which have already been made in the energy marketplace by tax incentives to conventional energy industries. (See p. 56.)

Tear Sheet

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ABBREVIATIONS

BEA	Bureau of Economic Analysis
BLS	Bureau of Labor Statistics
DOE	Department of Energy
EEC	European Economic Community
FAPSIM	Food and Agriculture Policy Simulator
GAO	General Accounting Office
GATT	General Agreement on Tariffs and Trade
SAFURE	Strategic Alcohol Fuels Reserve
SPR	Strategic Petroleum Reserve
USDA	U.S. Department of Agriculture

CHAPTER 1

INTRODUCTION

Historically, more than 50 percent of the nation's oil consumption has occurred in the transportation sector. Of this, 80 percent has been used by automobiles. While dropping slightly the last 3 years, U.S. motor vehicle gasoline consumption continued at roughly a 100 billion gallon a year pace in 1982. As part of its effort to develop alternative fuels, the federal government began promoting the production and use of alcohol fuel (ethanol) in the late 1970's. In the years that have followed, the government has helped establish the new domestic fuel ethanol industry and market in several ways. These include providing tax incentives, loan guarantees, cooperative agreements, project feasibility study grants, and research and development grants.

Since the federal support began, a debate has continued over the reasonableness of that support and the value of the industry to the nation. As the industry and the level of associated government investment has grown, the debate has intensified. It reached a peak when the administration issued a call for repeal of the major tax incentives as part of its fiscal year 1983 budget submission. In response to this and related proposals, 57 Senators and over 200 Representatives signed a resolution opposing the tax incentives' repeal. In this context, Senators Charles H. Percy, David Durenberger, and J. James Exon asked us to assess the costs and benefits associated with the federal fuel ethanol tax incentives as well as the fuel ethanol industry's contribution to the nation's energy security and economic vitality. This report responds to that request.

BACKGROUND

Ethanol is not a new fuel. It was used on a limited basis as an automobile fuel in the United States from the early 1900's up to the 1930's. Because of low oil prices, interest in fuel ethanol essentially disappeared until the oil price shocks of the 1970's. During this period of oil supply disruptions and rapidly escalating prices, ethanol was promoted as a means of extending available gasoline supplies through its use in the form of gasohol--a mixture of 10 percent ethanol and 90 percent gasoline. As oil supply problems have waned and oil prices stabilized, ethanol marketing emphasis has shifted from a fuel extender to a gasoline octane enhancer.

Ethanol production and use as an automotive fuel have expanded rapidly in recent years. From practically zero in 1978, U.S. domestic ethanol production reached about 210 million gallons in 1982 according to the best available industry estimate. In a 10-percent blend with gasoline, ethanol has proved to have many valuable attributes. Although ethanol contains one-third less energy than gasoline, it provides almost identical fuel

economy; it offers a high octane rating,[1] burns well in existing vehicles, and produces emission levels no worse than gasoline; and, it is produced from renewable domestic resources.

Although ethanol can be produced from virtually any raw material containing sugar or carbohydrates, the vast majority of U.S. fuel ethanol is produced from corn. Ethanol is made from corn through either wet or dry corn milling processes. In the wet milling process the various components of the corn kernel are separated in a water solution before processing into a wide variety of products. The starchy portion of the kernel has traditionally been converted by the wet milling industry into sweeteners and processed starch products. With the advent of the fuel ethanol market, the industry was able to divert some of this starch to begin producing ethanol with minimal additional capital investment and relatively minor changes in its operations. Instead of processing the starch into sweeteners, it fermented the sugars into ethanol and distilled the crude ethanol into anhydrous (water free) grade fuel quality. According to ethanol industry estimates, the wet corn milling industry accounted for about 75 percent of 1982 fuel ethanol production. Of this, the vast majority was produced by two large firms--Archer Daniels Midland Company and Pekin Energy Company. A modern corn wet milling ethanol production facility is shown on the following page.

Because of the relative simplicity of operations and lower capital requirements, much of the new fuel ethanol production coming on line by 1985 will involve the dry milling process. When ethanol is produced this way, the kernel is not separated into components before processing but is ground up in its entirety. The dry milling process has historically been used to make corn flour, corn meal, and grits. Industry sources estimate that about 25 percent of 1982 fuel ethanol production from corn involved the dry milling process.

Regardless of the production method, each 56-pound bushel of corn generally yields about 2.5 gallons of anhydrous ethanol plus a variety of coproducts. Since only the starch portion of the corn is used to make ethanol, the protein and fiber portions remain for use as animal feed supplements. With the wet milling process, these supplements take the form of corn gluten meal (about 2.6 pounds per bushel and used primarily as a chicken and cattle feed component), corn gluten feed (about 12.8 pounds per bushel used in feed rations for cattle, poultry, and swine), and corn oil (about 1.6 pounds per bushel used primarily in the food and industrial markets). With dry milling, the coproduct is

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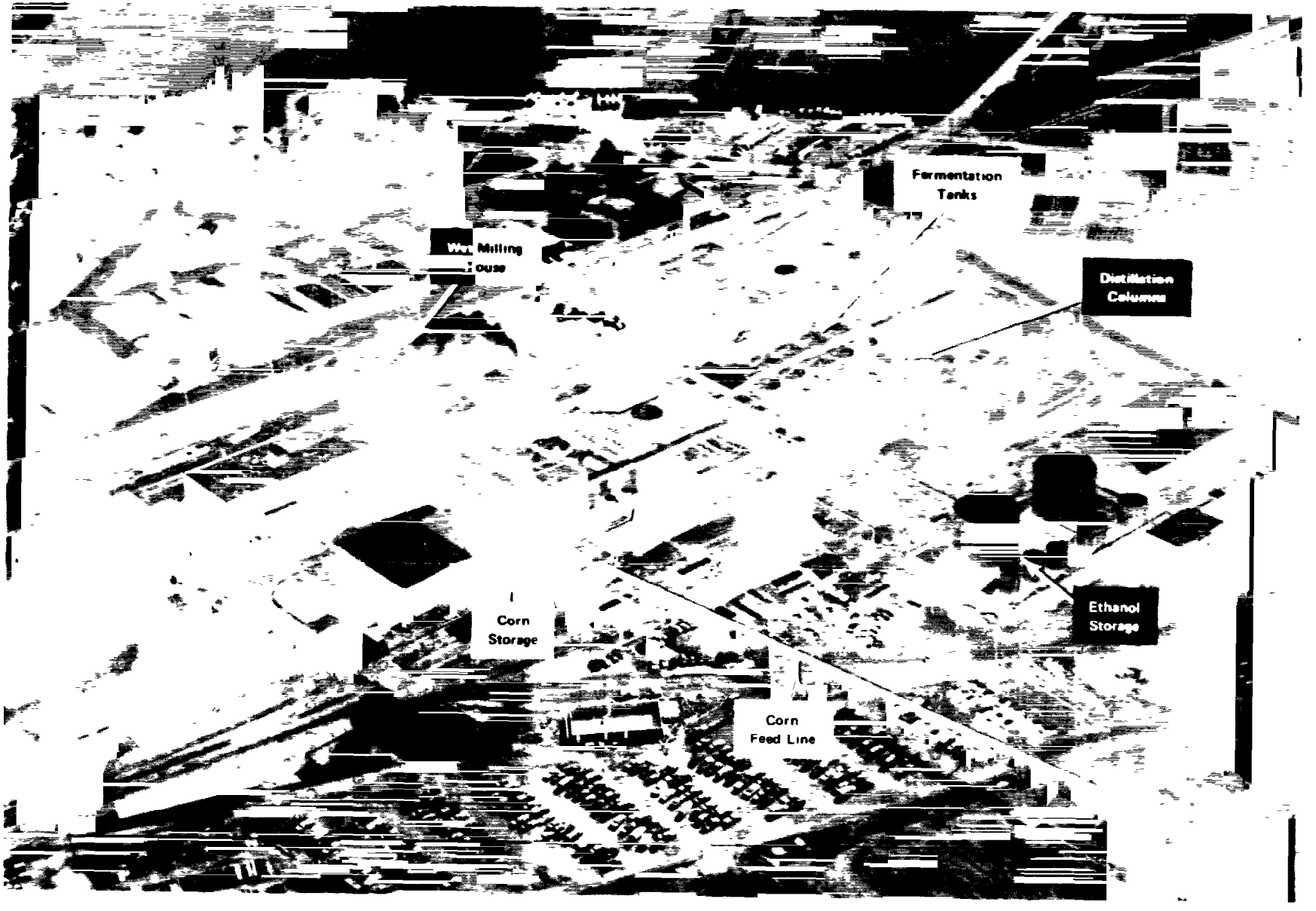
[1]Octane rating is a measure of a fuel's ability to resist knock and ping in gasoline engines. Under the scale used on gasoline pumps, a typical regular grade unleaded has an octane rating of 87 while super unleaded has a rating of 91 to 93. Ethanol has an octane rating well over 100 and in a 10-percent blend with gasoline increases the gasoline's octane by about 3 points.



Modern Fuel Ethanol Production Facility

distillers dried grains with solubles (nearly 18 pounds per bushel used primarily for cattle feed). In addition, both processes yield a significant quantity of carbon dioxide gas which can be captured and marketed as well.

Ethanol can also be produced synthetically from ethylene--a petroleum derivative. In 1982, up to about 200 million gallons of ethanol was produced in this manner. Because federal tax incentives are provided only to fuel ethanol produced from renewable resources, virtually no ethanol used for fuel is produced synthetically.

FEDERAL FINANCIAL INCENTIVES TO FUEL ETHANOL INDUSTRY

The federal government has provided a variety of financial incentives to promote the development of the domestic fuel ethanol industry. The federal incentives essentially authorized a short-term program to develop the new alcohol fuel industry to the point where it could ultimately provide an alternative to petroleum fuels in automobile transportation. Moreover, the Congress included expiration dates on the incentives it provided demonstrating its intent that the incentives not be considered permanent but a short-term effort to help alcohol fuels become competitive.

The cornerstone of the incentives was provided in the Energy Tax Act of 1978 (Public Law 95-618, Nov. 9, 1978). This act exempted fuels containing at least 10 percent ethanol produced from renewable resources from the federal gasoline excise tax--then set at 4 cents per gallon--through September 30, 1984. Because only one-tenth of a gallon of ethanol was needed to exempt the entire gallon of mixed fuel from tax, the tax advantage amounted to 40 cents per gallon of ethanol.

The gasoline tax exemption has subsequently been amended by other legislation. The Crude Oil Windfall Profit Tax Act of 1980 (Public Law 96-223, Apr. 2, 1980) extended the tax exemption's termination date from 1984 to 1992. It also provided an equivalent 40-cents per gallon income tax credit to those businesses using or selling ethanol either as a straight fuel or in a blend with gasoline. The incentives were structured so that only one of the two benefits could be claimed to prevent double dipping. The act also provided a 10-percent energy investment tax credit through 1985 on investments in equipment to produce ethanol from renewable resources. This credit is in addition to the 10-percent investment tax credit available to any business investing in new machinery or equipment.

The Highway Revenue Act of 1982 (Public Law 97-424-Title V, Jan. 6, 1983) increased the tax advantage provided to ethanol. Effective April 1, 1983, this act increased the federal excise tax on gasoline from 4 cents to 9 cents. At the same time, it increased the exemption for gasohol from 4 cents to 5 cents.

It also adjusted the income tax credit from 40 cents to 50 cents per gallon of ethanol. At 50 cents a gallon, the subsidy amounts to $21 a barrel.

In addition to tax incentives, the fuel ethanol industry has benefitted from other forms of financial incentives. Both the Department of Energy (DOE) and the Department of Agriculture (USDA) have issued, and are continuing to issue, loan guarantees to fuel ethanol projects.

DOE has the authority to issue about $800 million in loan guarantees. With its funding, DOE has issued one $127 million guarantee for a plant with a 52.5 million gallon per year capacity and has five additional conditional commitments outstanding. If all the guarantees were issued at their current request level, the guarantees would total about $400 million. Beyond the conditional commitments already made, DOE is not planning to issue any new loan guarantees.

USDA has issued several small guarantees and has conditional commitments pending to about 20 more projects ranging in size from less than $3 million to over $35 million. USDA has about $75 million available to issue additional loan guarantee commitments and is currently reviewing several applications. According to financing experts, federal loan guarantees have proven to be vital to new producers' ability to attract the financing necessary to construct new fuel ethanol facilities and enter the industry. The guarantees have also enabled guarantee recipients to obtain interest rates lower than would otherwise be available on the open market.

A number of fuel ethanol projects also received feasibility study grants, cooperative agreements, and research and development grants under DOE competitions held for a variety of alternative fuel technologies. The feasibility study grants helped fund studies of a project's technical and economic feasibility or such activities as preliminary design work. Cooperative agreement awards advanced projects from the feasibility stage to construction and operation by funding activities such as preparing final designs and finalizing permits. Most of the research and development grants were provided under an appropriate technology grant program and were designed to help prospective producers advance small-scale production technology. Each of these programs has been terminated and no further funding is being offered.

In addition to the federal incentives, many states provide a variety of incentives to fuel ethanol production. Of most significance, as of July 1983, 32 states offer some exemptions from their gasoline taxes to fuels containing ethanol. The exemptions ranged from 1 cent a gallon in Connecticut and Nevada, to 11 cents a gallon in New Mexico, with most states offering 3 cents to 5 cents a gallon.

OBJECTIVES, SCOPE, AND METHODOLOGY

In an October 29, 1982, letter, Senators Charles H. Percy, David Durenberger, and J. James Exon asked us to assess the costs and benefits associated with the federal gasoline excise tax exemption for gasohol and the associated blender tax credit. Specifically, they asked us to address the

- --importance of the incentives to the industry's previous and future growth;
- --total domestic economic activity associated with the domestic fuel ethanol industry;
- --net costs and benefits to the federal government in terms of outlays and revenues, including the costs of agricultural support programs;
- --ethanol industry's impact on the nation's trade balance and national security; and
- --precedents for similar federal incentives to stimulate "critical materials" industries.

We also assessed the impact of fuel ethanol production on agricultural commodity and consumer food prices. We further agreed to limit our assessment of similar federal incentives to those offered conventional energy industries, in particular oil and gas.

In conducting our review, we analyzed previously issued studies on the fuel ethanol industry and the associated federal tax incentives. In addition, we interviewed and obtained further ethanol documentation from private and government organizations involved with fuel ethanol production and use. These organizations included:

- --Ten fuel ethanol producers which together represent the vast majority of the industry's capacity.
- --Sixteen federal government agencies and laboratories, including DOE; USDA; the Bureau of Economic Analysis (BEA), Department of Commerce; the Bureau of Labor Statistics (BLS), Department of Labor; and the Federal Highway Administration, Department of Transportation.
- --Fourteen trade associations representing nearly all aspects of the fuel ethanol and automotive fuel businesses.
- --Twenty-six state governments having or considering ethanol tax incentives, 2 governors conferences, and 2 state universities having examined fuel ethanol issues.

--Four financial services companies that have been involved with either arranging financing for fuel ethanol plants or assessing the fuel ethanol business.

--Eight companies involved with fuel and chemical storage.

We also visited three fuel ethanol plants--two large wet milling facilities and one small dry milling facility. A listing of the organizations we contacted during our review is shown in appendix I.

On two aspects of our review, we supplemented information we obtained from these sources with detailed analysis using available economic models. Concerning the economic activity associated with the fuel ethanol industry, we prepared estimates using a conventional input-output model developed by BEA. The input-output model is discussed on page 21. We extended the results of this analysis to estimate associated employment in related industries by using an employment model prepared by BLS. We qualified these estimates by placing them in the context of the results that would be predicted by conventional economic theory.

We also employed an econometric model in estimating the fuel ethanol industry's impact on agricultural prices. In this case, we used a simulation model USDA has used for several years to test the effects of alternative policy proposals. The model is described on page 25. To assess the model's results, we obtained independent evaluations from several members of the academic community with experience in making similar estimates.

We performed our review in accordance with generally accepted government auditing standards.

CHAPTER 2

IMPORTANCE OF FEDERAL TAX INCENTIVES TO THE FUEL ETHANOL INDUSTRY

Federal fuel ethanol tax incentives have been successful in achieving their primary objective--expanding the production of alcohol fuels as an alternative to petroleum fuels in automobile transportation. A domestic fuel ethanol industry has been created and is growing at a rapid pace largely because gasohol is exempt from federal gasoline excise taxes. This federal exemption has been, and continues to be, needed to make ethanol competitive with gasoline in the fuel marketplace. Further, the current incentive level is needed to attract new investors and promote industry expansion. At the same time, the incentives may be providing some existing producers with more revenues than necessary to sustain profitable operations. The future need for the incentives depends on future oil prices, improvements in ethanol production technology, and a variety of other factors, including the price of grain that cannot be accurately projected at this time.

INCENTIVES VITAL TO INDUSTRY ESTABLISHMENT AND EARLY GROWTH

Federal tax incentives have been vitally important to the establishment and development of the U.S. fuel ethanol industry. The most significant incentive has been the exemption of gasohol from federal gasoline excise taxes; the blender's income tax credit has been used to only a very limited extent. Before the exemption was established in 1978, there was essentially no domestic fuel ethanol production. Since the exemption, a growing domestic fuel ethanol industry has been put into place. In fact, despite some highly, unfavorable conditions for introducing an alternative fuel, namely, falling gasoline demand coupled with high interest rates, the fuel ethanol industry has established a foothold in the marketplace and has increased production tenfold between 1979 and 1982. Available data suggests the industry expanded by perhaps 50 percent more in 1983. Based on industry members' and observers' views, a measurement of the differential between the prices of ethanol and unleaded gasoline, and available cost of production estimates, there is little doubt that the industry's success would not have been possible without the federal incentives.

Ethanol producers, fuel distributors, and financial analysts said that without the federal gasoline tax exemption there would not be a domestic fuel ethanol industry today. The producers said that they invested in fuel ethanol production because of the federal gasoline tax exemption. However, without the subsidy provided by the tax exemption, they said that they would have been unable to sell the ethanol they produced and hence would not have entered the business. The producers also said that if the exemption was eliminated they would scrap plans for future

capacity expansion and would most likely scale down or cease existing production. Fuel distributors and industry financial analysts agreed that only with substantial government subsidies has ethanol been able to enter the national automotive fuel stream and thereby attract potential producers to the business. These officials told us that they relied on the good faith of the federal government in making their investment decisions and believed premature termination would represent a break in that faith.

A straightforward comparison of ethanol and unleaded gasoline selling prices demonstrates why a subsidy has been essential. Fuel distributors have to pay much more for ethanol than unleaded gasoline. In the last 3 years, ethanol has sold from $.59 a gallon to $.86 a gallon more than gasoline. As of March 1984, ethanol sold for about $1.65 a gallon while unleaded gasoline sold for about $.88 a gallon at the wholesale level. These prices show that a subsidy of about $.77 a gallon would be needed to equalize the ethanol and unleaded gasoline prices to the fuel distributor and thereby make fuel ethanol sales possible. However, because fuel distributors incur additional handling and marketing expenses when selling ethanol-gasoline blends, it is possible that more than $.77 a gallon subsidy could be needed. With the $.50 federal subsidy and an additional subsidy of $.40 or more in many states, fuel distributors are willing to buy $1.65 a gallon ethanol and mix it with their gasoline supplies. The table on the next page illustrates the role of federal and state excise tax exemptions in making ethanol a marketable fuel at current prices. Because of the exemptions, many fuel distributors are able to pay nearly twice as much for ethanol as they do for gasoline, mix it with gasoline, and sell the resulting product at an after-tax cost about the same as gasoline.

Comparative Costs of Gasoline and Gasohol to Fuel Distributors

Cost factor	Gasoline	Gasohol
Wholesale gasoline[a]	$0.88	$0.79 (9/10 gal. @.88 a gal.)
Ethanol[a]	-	.17 (1/10 gal. @1.65 a gal.)
Excise taxes (federal and state)[b]	.20	.11
Additional handling expenses	-	.01
Total (wholesale price + taxes)	$1.08	$1.08

[a]As of March 14, 1984.

[b]State gasoline taxes and exemptions for alcohol fuels vary. According to information from the American Association of State Highways and Transportation Officials, the average state gasoline tax is 11 cents a gallon. We chose 4 cents a gallon as a representative state gasohol exemption based on information obtained from the Highway Users Federation. Combined with the 5-cent federal exemption, we arrived at a 9-cent total reduction in excise taxes for gasohol.

The table shows that ethanol is priced about as high as it can be to be marketable, even with existing exemptions. Based on available cost-of-production estimates which are discussed in the following sections, it is possible that ethanol could be sold at a somewhat lower price, making a somewhat lower incentive level necessary. However, because these available cost estimates indicate that it costs considerably more to make ethanol than gasoline, it is apparent that some subsidy has been and continues to be crucial to ethanol marketability.

CURRENT INCENTIVES NEEDED TO EXPAND INDUSTRY

The current federal incentives are probably just as important to the ethanol industry's expansion as it was to the industry's establishment. If new producers are to be attracted to the fuel ethanol business and expand production, the existing federal subsidy is needed. Fuel ethanol production cost estimates prepared by DOE as well as several private firms seeking DOE loan guarantees indicate that new plants could probably not attract capital without the revenue made possible by the full

federal subsidy. Arranging for new plant financing is difficult now; at a much lower incentive level it probably would not be possible.

In assessing new plant economics, we reviewed production cost estimates from three sources: DOE, a new producer now building a 50 million gallon a year ethanol plant with a DOE loan guarantee, and a financial services company which has prepared cost estimates for several applicants seeking DOE loan guarantees. The estimates are for dry milling plants. Because dry milling plants are less complex and capital intensive than wet milling plants, most new producers entering the business are expected to use the dry milling process. Assuming $3 a bushel corn costs, pretax fuel ethanol production cost estimates for these plants are in the range of $1.75 to $2 a gallon. At current higher corn prices, estimates would be higher.

The DOE production cost estimate for a new producer with a 50 million gallon a year facility is shown in the following table.

DOE Production Cost Estimate for New Plants
(1980 prices escalated for 2-year construction period)

Cost element	Cost per gallon
Corn[a]	$1.20
Other raw materials[b]	.22
Operating costs[c]	.43
Depreciation & debt repayment[d]	.53
Total	2.38
Credit for sale of coproduct[e]	-.61
Total	$1.77

[a]Assumed corn costs $3 a bushel.

[b]Includes coal, gasoline denaturant, enzymes, and chemicals.

[c]Includes labor, utilities, maintenance, freight and transportation, and other expenses.

[d]Includes straight line 15-year depreciation on fixed plant assets, plus debt repayment at 15 percent. Loan amount totals $120 million of $150 million total project costs.

[e]Based on distillers dried grain sales at $170 a ton.

This cost estimate excludes consideration of profit and investment tax credits. After these factors are considered, DOE estimates costs would total $1.86 a gallon.

DOE's estimate is quite comparable to the other production cost forecasts we reviewed. Each of the latter forecasts assumed the projects involved would complete their first full year of production in 1986. Each project was forecasted to operate at a loss for several years even with the federal incentives. Only by allocating the project's initial operating losses and other tax benefits to reduce income tax liability were investors projected to receive a positive return on their investment. Without federal tax incentives, the projects would almost certainly not be able to demonstrate a market for their ethanol and as a result be unable to attract the equity capital necessary to get the project started. For now at least, expanding the fuel ethanol industry is dependent on large federal incentives.

refinery with a number of alternatives. These alternatives include toluene, benzene, xylene, methanol, tertiary butyl alcohol, methyl tertiary butyl ether, as well as octane generated by additional gasoline processing. Each of these octane source options is currently much cheaper than ethanol. While each of these octane enhancers is currently produced from either natural gas or petroleum, methanol and potentially other options can be produced from either coal or renewable resources albeit at a higher than current price. There are many major impediments to widespread production and use of methanol from coal and renewable resources, however.

Ethanol's refinery-use potential is also impacted by the industry's limited production capacity which precludes its use in large refineries. These large refineries require much larger volumes of octane components than the fuel ethanol industry can currently deliver. A more realistic target for ethanol may be small- to medium-sized refineries. At least one such refiner has begun using ethanol as an octane enhancer, and others are apparently considering either using ethanol as their refinery octane source or adjusting their operations to produce a lower cost, lower octane blending stock which when mixed with ethanol at the terminal will be boosted to regular unleaded octane quality.

Finally, oil industry representatives told us that many refiners have a built-in reluctance to using fuel components with which they are not familiar and over which they have no production control. One representative told us that refineries operate 24 hours a day and are reluctant to risk a shutdown because ethanol supplies were unavailable. Another said that many refiners have invested large sums of capital in equipment to raise gasoline octane through increased processing and, accordingly, have little desire to take steps that would reduce the use of this equipment.

If ethanol could overcome these impediments and become used and valued for its high octane properties at the refinery, its price competitiveness would be significantly enhanced even if oil and corn prices remained the same. For example, one of the most widely used octane enhancers in unleaded gasoline today is toluene. Compared to gasoline's wholesale price of $.88 a gallon, toluene currently sells for about $1.12 a gallon, or about $.24 higher. Ethanol selling for $1.65 a gallon is therefore $.24 closer to being competitive with toluene than it is with unleaded gasoline. In addition, since ethanol has a higher blending octane value than toluene, its competitive position can be further improved because less ethanol is needed to achieve a given octane boost. If ethanol came to be marketed as a refinery octane component, it would represent a major step toward closing the price gap with conventional fuels and reduce the importance of the federal incentives.

It is likely that there will be an increasing demand for alternative high octane components in the future. Available

projections from automotive fuel analysts suggest that premium (high octane) unleaded gasoline will make up an increasing proportion of total gasoline sales. In 1982, premium unleaded accounted for about 11 percent of total gasoline sales, up from only about 5 percent in 1980. Industry analysts suggest this proportion will increase to about 30 percent or more by 1990 as more cars demanding higher octane fuel enter the nation's vehicle fleet. To produce this increased volume of higher octane gasoline, gasoline producers will need a greater volume of higher octane components.

The government's policy of phasing down lead use in gasoline will further contribute to the demand for alternative octane enhancers. Tetraethyl lead has long been used as a relatively inexpensive octane component in gasoline. Despite its cost-effectiveness, lead use is being phased out in response to Environmental Protection Agency regulations (40 CFR 80.20) promulgated in 1977 under the Clean Air Act. In October 1982, the Agency revised its regulations to further reduce the amount of lead that refineries can use in gasoline. The primary effect of these latest regulations was on small refiners who on July 1, 1983, were forced to comply with the same lead levels as large refiners. Previously, small refiners were allowed to use higher lead levels. Since losing this special dispensation, small refiners have sought and will continue to seek alternative octane sources.

Ability to expand coproduct markets

The future economic viability of existing and prospective ethanol plants also may depend in large measure on expanding markets for the high protein animal feed supplement that remains from the corn feedstock when ethanol is produced. Sales of these coproducts have recently enabled producers to recover sometimes as much as one-half of the initial corn costs. As ethanol production expands, markets for the additional coproduct will have to be found to maintain coproduct revenues. Whether such markets can be found is uncertain at this time.

The largest volume animal feed coproduct of the ethanol industry as currently configured is corn gluten feed. The vast majority of corn gluten feed is now being exported to European countries where it commands a higher price than in the United States. This has enabled U.S. wet corn milling ethanol producers to generate relatively high revenues from their coproduct and thereby lower their net ethanol costs. Although a difference of opinion exists, the European market may be nearing saturation. If this is true, alternative markets will have to be found for the animal feed generated from appreciably larger ethanol production.

Possible markets for the expanded coproduct production include U.S. livestock feeders, other overseas markets such as the Soviet Union or Japan, and human consumption. If the additional

prices, net corn costs would have risen about $.07 a gallon, thereby reducing profits a corresponding amount according to the financial service company analyses. If corn prices continue to rise, profits would be further squeezed.

FUTURE NEED FOR INCENTIVES UNCERTAIN

At this time it is difficult to determine whether the fuel ethanol industry will eventually be able to operate without special federal incentives. This is true because future ethanol price competitiveness depends so heavily on future oil prices and other factors which cannot now be reliably predicted. It is clear, however, that for the ethanol industry to ultimately stand on its own feet, oil prices will have to rise faster than corn prices. In addition, the ethanol industry will likely have to be successful in bringing production costs down through technological advances and in breaking into new ethanol and coproduct markets.

The most critical factor in the future competitiveness of fuel ethanol is the relative price of oil and corn. Currently, refiners pay an average of about $29 for a barrel of oil, and unleaded gasoline sells for about $.88 a gallon wholesale. If this same price ratio was maintained, oil prices would have to rise to about $49 a barrel for gasoline to cost $1.50 a gallon and to $54 a barrel to result in gasoline costing $1.65 a gallon--the current ethanol selling price. Increases in corn prices over currently prevailing levels could lead to ethanol price increases, making it necessary that oil prices rise even higher before ethanol would become competitive with gasoline. While these calculations are obviously simplistic and do not reflect the many market and nonmarket factors that affect gasoline pricing, they do serve to provide a rough indication of how far oil prices have to rise before unsubsidized ethanol will be competitive with unleaded gasoline in the marketplace. If and when oil prices will rise to the levels necessary is impossible to predict.

Several other factors, in addition to future oil price increases, may be crucial to ethanol's ultimate competitiveness. The ethanol industry's success in achieving lower operating costs through advanced technology, breaking into the refinery octane market, and developing expanded coproduct markets may all prove vital to ethanol's future. Each of these factors is addressed below.

Technological advances could lower production costs

If oil prices do not rise sharply, ethanol's ability to compete as an automotive fuel without subsidy may depend on the industry's ability to lower prices with improved technology. In this connection, industry representatives told us that developments in the fields of plant genetics as well as yeast and enzyme

technology in particular could increase the ethanol yield per bushel of corn above the current 2.5 gallon industry standard. Considering corn costs represent the single largest element of ethanol costs, such advances would obviously improve ethanol production economics. However, according to industry officials, the maximum possible yield from a bushel of corn is about 2.7 gallons per bushel so that such advances will improve ethanol economics only marginally. One producer estimated that potential ethanol from corn cost reductions from improved technology were in the range of 10 cents a gallon.

Another possibility for lowering future costs could be the use of lower cost cellulosic feedstocks such as agricultural residues, trees, or municipal solid waste. Officials from one project seeking funds from DOE told us that their proposed plant, using available enzymatic hydrolysis technology, would be able to produce ethanol using municipal solid waste as a feedstock for $1.06 a gallon in 1983 prices. The planned ethanol plant would be operated jointly with a resource recovery facility which would separate and sell the metal and glass portions of the waste. DOE officials recognized the potential of the technology involved but disputed the technological readiness claimed by these project officials. DOE is conducting research to develop ethanol from cellulose technology, and officials believe the technology could be available by the late 1980's or early 1990's. Once commercially ready, the officials project production costs in the range of $1 a gallon in 1983 prices. If achieved, ethanol's commercial potential would be obviously enhanced.

Marketing ethanol as an octane enhancer

Ethanol's long-term fuel competitiveness could be aided substantially if its pricing becomes pegged to higher value, high octane gasoline components rather than unleaded gasoline itself. Gasoline sold at the pump is a composite product--a blend of many fuel elements having varying costs. High octane gasoline components have a higher value and cost than the composite product. When blended with gasoline, ethanol provides a substantial octane boost much like conventional petroleum-derived octane components and could be valued accordingly. However, as currently marketed, most ethanol is sold to fuel distributors who simply mix it with gasoline at a terminal or at the service station and are normally willing to pay a net (after subsidy) ethanol price no more than they paid for the gasoline with which it is to be mixed. In this manner, ethanol producers are not deriving full economic benefit from ethanol's octane boosting value and are essentially giving the octane away.

Several factors are impeding ethanol's integration into refineries as an octane component of finished gasoline. Of primary significance is ethanol's relative price compared to alternative octane options and the ethanol industry's limited production capacity. Concerning price competitiveness, ethanol must compete on the basis of a cost per unit of octane increase at each

CURRENT INCENTIVES POSSIBLY LARGER THAN NECESSARY FOR SOME EXISTING PRODUCERS

While federal incentives are undoubtedly needed to make ethanol competitive with unleaded gasoline and attract new producers to the business, some evidence indicates that the existing incentives may be more than sufficient to enable profitable operations by some existing producers. Based on available ethanol production cost analyses, it seems likely that at the time of our analysis these existing fuel ethanol producers could and would have sold ethanol at a lower price if the available subsidies were lower. By enabling producers to obtain higher than necessary prices, the existing incentive level may have enabled some to achieve additional profits at the expense of federal revenues.

Ethanol producers set their prices so that ethanol prices, less available federal and state subsidies, will equal unleaded gasoline prices. Accordingly, because it is the after-subsidy price that is crucial, if subsidy levels increase, producers raise ethanol prices and when subsidy levels decrease producers lower prices. This relationship was clearly demonstrated in April 1983 when the federal ethanol subsidy was increased $.10 a gallon. When the subsidy increase became effective, two leading ethanol producers announced a $.10 a gallon increase, and four others increased prices between $.05 and $.09 a gallon. The relationship can also be seen when producers charge different prices in different states depending on the relative state subsidy levels.

While production costs are not paramount in establishing ethanol prices, determining whether the current federal exemption is providing additional profits to existing producers or simply generating enough sales revenue to make ethanol production possible requires an assessment of ethanol production costs. Existing ethanol producers do not normally reveal information about their costs. Moreover, most ethanol is currently being produced by wet corn millers who make a variety of products at the same facility, thereby making cost allocations among their various products difficult to assess. Consequently, precise cost estimates are not possible. However, studies issued by financial services companies as well as cost information available from prospective new producers applying for DOE loan guarantees provide a reasonable basis for estimating these costs.

Because corn costs are the single most important aspect of total production costs, any cost estimate must vary according to the price of corn. At corn prices of $3 a bushel (the rough prevailing price at the time the tax exemption was increased to $.50 a gallon), several financial service company reports suggest that production costs, prior to allowance for various investment tax incentives, would be in the range of $1.40 a gallon. At a selling price of $1.70, this allows for a $.30 pretax profit per gallon. For a 60 million gallon a year facility, this would mean profits of $18 million a year.

Such profits may understate the profitability of some existing ethanol producers for several reasons. First, according to the most detailed available study, the capital cost component of the $1.40 per gallon total cost estimate is probably overstated. This cost, estimated to be $.30 a gallon, is based on constructing a new, multiproduct corn wet-milling plant at current construction costs and includes an incremental allocation of the plant's front-end corn processing capacity to the ethanol output.

According to the study, capital costs for older plants (such as those operated by some existing producers) would be lower. Moreover, the most expensive component of plant costs is the front-end corn grinding equipment. Plants that were able to use corn grinding capacity which was not fully utilized in producing sweeteners and other products, and hence did not have to add additional grinding capacity, would experience even lower capital costs.

Second, the cost estimates assumed no production cost credit for the value of ethanol coproducts other than high protein animal feed supplements. For example, the estimates include no value for the carbon dioxide released during the ethanol production process. When captured, carbon dioxide sales could reduce net ethanol costs by about $.04 a gallon.

Finally, the cost estimates apparently do not take into account the value of the regular 10-percent investment tax credit and the additional 10-percent energy investment tax credit to the producer's income stream. Such credits can have an important impact on the profitability of ethanol production. In fact, according to projected cash flow streams for plants applying for DOE loan guarantees, these credits help provide investors in such plants with a positive return in the early years of the project's operation when the project itself is operating at a substantial loss. These credits could contribute to increased plant profitability on the part of existing producers.

We discussed these costs estimates and the associated profit margins with two large fuel ethanol producers. For proprietary reasons, neither would share their actual costs of production. One producer told us, however, that the $1.40 per gallon estimate was somewhat low, while the other said that the estimate was reasonable. This latter producer recognized that his company was making a profit but that such profits were the natural reward for being the first to risk entering the fuel ethanol business on a large scale. This producer also believed that such profits were necessary to expand production capacity and to develop innovative technology necessary for making ethanol more competitive in the future. The producer also suggested that profits would likely be cyclical, with high profits during certain periods offsetting periods of much lower profits. In this connection, because of the last year's drought conditions along with government-induced acreage reductions, corn prices have risen from roughly $3 a bushel in March 1983 to about $3.35 in March 1984. At such

coproduct is sold in dry form to U.S. livestock feeders, per unit revenues will fall from those obtained in Europe because of lower prevailing prices here. For example, the going price for a ton of corn gluten feed is $170 in Rotterdam and only $115 in Chicago. Ethanol producer representatives told us that even after deducting transportation costs, they can obtain higher revenues from overseas markets than domestic markets. If, on the other hand, the coproduct can be sold wet to farmers near the plants, producers can save the considerable drying expense and thereby increase their net coproduct revenues.

If coproduct revenues are to be sustained, other markets may also have to be found. Possible markets cited by the ethanol producers are the Soviet Union, Japan, and the domestic food industry. There are no signs that large scale marketing here is imminent. However, if any of the new markets could be significantly penetrated, the ethanol industry's chances of at least maintaining coproduct revenues, and accordingly ethanol production economics, would be improved.

CHAPTER 3

DOMESTIC ECONOMIC EFFECTS OF FUEL ETHANOL PRODUCTION

Ethanol production, like the product of any domestic industry, has a variety of impacts on economic output and employment. In addition, since ethanol production uses agricultural commodities as the primary production feedstock, it also impacts on agricultural prices. Finally, because of its dependence on government tax incentives, ethanol production and use has special impacts on the federal Treasury. At current production levels and those currently projected for 1990, all these impacts are modest from a national perspective although they could be more substantial on a local level. While some localities will undoubtedly benefit from fuel ethanol production, conventional economic theory suggests doubts as to whether ethanol production represents a net gain to the economy as a whole.

OUTPUT AND EMPLOYMENT ASSOCIATED WITH ETHANOL PRODUCTION

No analytical tools exist that enable a precise calculation of the net national output and employment impacts of fuel ethanol production. Using input-output and associated employment tables prepared by BEA and BLS, we estimated the domestic output and employment in related industries associated with present and projected ethanol production levels. This analysis suggests that even at ethanol production levels five times greater than 1982 production, ethanol-related output and employment represents a tiny fraction of U.S. economic output and the labor force. While these tables reveal the output and employment in related industries associated with ethanol production, they provide no information on the economic activity displaced by ethanol production and accordingly no basis for estimating the net total economic effects. Conventional economic theory, however, indicates that when a higher cost good (ethanol) is substituted for a lower-cost good of equal utility (gasoline), total national output is reduced.

Output

Because industry members do not release information about their production activities, precise statistics on the fuel ethanol industry's current output are difficult to obtain. The most widely cited industry analyst has estimated that in 1982 the fuel ethanol industry produced about 210 million gallons of ethanol. At an average 1982 price of $1.65 a gallon, the ethanol would be valued at about $350 million. Based on information obtained from this analyst, we further estimated that the industry produced about $100 million worth of high protein animal feed supplements, most of which was exported. Finally, based on conversations with industry representatives we estimated that the industry spent about $300 million in 1982 on investments in plant and equipment to expand production capacity. (The total value of industry

plant and equipment currently in place exceeds $1 billion.) The portion of this industry output contributing to final demand rather than intermediate products is considered to be the industry's direct output. We estimate that the direct output of the fuel ethanol industry in 1982 totaled about $700 million.

The output associated with fuel ethanol production is larger than the value of this direct output itself. This is true because other industries must produce varying levels of output to make the ethanol production possible. To estimate the output from other industries associated with ethanol production, we used the Detailed Input-Output Structure of the U.S. Economy: 1972 published by BEA in 1979. Provided in table form, this model shows the volume and type of resources used in actual practice to domestically produce 496 commodities. Since the model reflects the structure of the economy in 1972 not 1984, it probably does not strictly reflect current industry structures or production techniques. Further, because fuel ethanol was not being produced in 1972 it is not included among the 496 commodities included in the tables. We therefore used the data presented for wet corn milling production to represent fuel ethanol production. We chose the wet corn milling industry because most fuel ethanol is currently being produced as part of the wet corn milling process. Despite the weaknesses in the BEA model, we believe that it is suitable for the purpose of assessing the output of industries related to ethanol production.

These tables show that to produce and deliver a dollar's worth of ethanol to the fuel consumer, corn producers must grow $.38 worth of corn, railroads must provide $.04 worth of services, and the petroleum and coal industries must provide $.03 worth of their product, etc. This supporting production is known as indirect output. When the direct and indirect output from all 496 industries is totaled, producing an additional $1 in delivered ethanol involves a total of about $2.23 in additional direct and indirect output.

Using the input-output tables, we estimated that the total output and investment of the ethanol and related industries was about $1.6 billion in 1982. This was computed as follows:

Direct and Indirect Output Associated With 1982 Ethanol Production

	(millions)
Direct ethanol and coproduct output	$ 408
Indirect output associated with ethanol production	501
Direct investment in plant and equipment	300
Indirect output associated with investment	356
Total	$1,565

This output associated with ethanol production represents only about 0.05 percent of the over $3 trillion gross national output in 1982. Assuming production requirements remained constant, at a production level of 1 billion gallons--roughly five times greater than 1982 production--expected to be achieved by 1990, the ethanol industry's output will still amount to only a small fraction of total output.

Even this relatively insignificant output suggested by input-output analysis may overstate the ethanol industry's total net economic impact. This is true because input-output analysis cannot predict, with any precision, the level of economic output displaced by ethanol production. Ethanol use immediately displaces a certain volume of gasoline production, thereby reducing output in that sector. In addition, investment in ethanol plants may simply displace investment in some other industry. Further, since ethanol costs more than the gasoline it displaced, the economy must spend more money on ethanol, leaving less money to purchase other goods, implying reduced output in other sectors. Only a complete macroeconomic model, including the ethanol industry, could capture all these effects and calculate a net impact of ethanol production on the U.S. economy. No models exist that can calculate these displacement effects.

While undoubtedly very small, it is therefore not possible with currently available quantitative tools to precisely predict the net impact of ethanol production on the U.S. economy. Conventional economic theory suggests that national economic welfare will be reduced when a higher cost product is substituted for a lower cost product that provides the same service. Since gasoline costs about one-half as much as ethanol and is as good an automotive fuel, the theory suggests that on strictly economic grounds ethanol should not be substituted. To do otherwise will reduce overall economic efficiency and thereby most likely lead to a contraction in output rather than economic expansion.

Employment

To calculate the employment associated with 1982 ethanol production and investment, we used employment tables prepared by BLS. These tables were prepared and are structured much like the BEA input-output tables. They set forth the typical number of employees needed to produce a given value of final output from each of the major U.S. industries. Accordingly, with the assistance of BLS staff, we translated our estimates of output associated with ethanol production into employment estimates. The same cautions must be used with these tables as with the input-output tables in that they only indicate employment in industries associated with ethanol production not the net aggregate employment effects on the overall economy.

The BLS employment tables indicate that about 19,600 jobs were associated with the ethanol industry's direct and indirect output in 1982. This includes employment involved with growing

the feedstock, producing the ethanol and accompanying coproducts, constructing ethanol plants, as well as producing the indirect output associated with these activities. The employment effects are broken out by the source of employment in the following table.

Source of employment	Number of jobs
Ethanol and coproduct output	
-Growing corn feedstock	1,856
-Other agricultural sector	1,011
-Nonagricultural sector	7,520
Total	10,387
Plant building construction	1,990
Equipment manufacture	7,207
Total	19,584

The BLS data does not distinguish between type of employment. Accordingly, the figures in the "number of jobs" column represents either full- or part-time jobs, not full-time equivalent employment or employee years. Nonetheless, this employment level represents only a tiny fraction of the 110 million member U.S. civilian labor force. BLS tables suggest that producing 1 billion gallons of ethanol (not considering any investment in new ethanol plants) would involve about 49,000 jobs in both direct and indirect output or less than one-tenth of 1 percent of the current labor force.

Indications show that even the relatively small employment impacts suggested by the BLS tables may be overstated. Based on our talks with producers as well as our plant visits, it is apparent that ethanol plants are becoming increasingly automated. Modern computer control systems enable 50 million gallon a year or larger plants to operate with only a few operating personnel. Managers at one of the largest U.S. plants, in fact, told us that the computer system at their plant has helped them reduce their plant personnel requirements by about one-half. They said that if they had designed their plant from scratch, instead of remodeling an older plant, they could have reduced employment needs even further. BLS tables, compiled with 1981 employment statistics, may not reflect this level of automation.

Further, about 2,000 of the approximately 20,000 jobs indicated in our 1982 employment computations are associated with growing the corn feedstock. It can be reasonably suggested that the agricultural sector would have produced this corn even if the ethanol industry did not exist. Accordingly, associating the effects of growing this corn to the ethanol industry might not be appropriate.

We compared our employment findings with those developed as a part of a detailed ethanol industry employment requirements study performed by Oak Ridge Associated Universities for DOE. This study found lower employment effects than those suggested by the BLS tables. The Oak Ridge study concluded that between 20,000 and 38,000 employee years would be required to operate the plants, grow the corn, and generate the supporting output necessary to produce 1 billion gallons of fuel ethanol. This employment level is considerably less than the 49,000 jobs indicated by the BLS tables. The BLS tables represent a number of jobs not employee years. Nonetheless, it is possible that the employment effects indicated by the BLS tables, while negligible on a national scale, may be on the high side.

As with our output computations, the job estimates discussed above do not represent net additional employment. To obtain such net aggregate employment effects, these estimates would have to be adjusted by the number of jobs lost in the gasoline refinery industry due to ethanol's displacement of gasoline production and any other jobs lost in other sectors through economic substitution effects. No tools exist, however, to estimate the full extent of these job losses and hence no way to estimate net aggregate employment effects.

While insignificant at the national level, fuel ethanol production could have more major impacts on those states and localities where ethanol and its feedstocks are produced. For example, a large portion of currently operating U.S. ethanol production capacity is concentrated in a small area of Illinois. Combined with the use of locally grown corn as a feedstock and Illinois coal as a process fuel, the impact of fuel ethanol production on the local and Illinois economy could be substantial. In this connection, a study performed by the University of Illinois at Urbana-Champaign estimated that ethanol production increased state income by $150 million in 1982 and $190 million in 1983.

AGRICULTURAL SECTOR IMPACTS

Ethanol is currently produced in the U.S. almost exclusively from corn. Accordingly, the ethanol industry impacts the domestic agricultural sector in several ways. Initially, the increased demand for corn associated with ethanol production helps boost corn prices. Because of the extensive web of interdependencies in the agricultural sector, these corn price increases affect the demand for, and prices of, other feed grains as well as livestock and ultimately the consumer's food bill. Other impacts are generated because the high protein coproduct from ethanol production competes with soybean meal in animal feed rations.

Sorting out the complex short- and long-term agricultural sector impacts that result from a change in demand like that generated by the fuel ethanol industry's demand for corn is a very difficult process. To estimate such impacts, USDA and other organizations have developed a number of computer models. The

models developed to date have varying capabilities and levels of complexity. One of the most detailed and comprehensive models available is USDA's Food and Agriculture Policy Simulator (FAPSIM).

FAPSIM is an annual econometric model containing over 600 variables. It estimates prices and production for a variety of agricultural commodities in addition to estimating net farm income, various government agricultural price support program costs, and consumer food prices. According to USDA, since FAPSIM became operational in 1981, it has been routinely used by USDA to estimate the effect of various agricultural policy changes on production, prices, and government costs.

Following a review of several other available models, we decided to use FAPSIM to estimate the effect of fuel ethanol production on agricultural prices. We used the model to estimate the impact of actual 1982 ethanol production as well as assumed production levels through 1990. Some of the agricultural impacts projected by the model are shown in the table below.

Selected Agricultural Impacts of Fuel Ethanol Production

	Year								
	1982	1983	1984	1985	1986	1987	1988	1989	1990
GAO production assumptions									
Ethanol (million gals)	210	400	500	600	700	800	900	950	1,000
Associated corn demand (millions bu)	78	152	190	228	266	304	342	361	380
Price and income effects									
Corn (¢ per bu)	+4	+4	+6	+8	+8	+11	+12	+14	+15
-1981 baseline = $2.45/bu									
Soybeans (¢ per bu)	-6	-7	-9	-10	-12	-14	-14	-14	-21
-1981 baseline = $6.01/bu									
Consumer food prices (% change)	0	+0.04	+0.03	+0.05	+0.10	+0.15	+0.24	+0.30	+0.35
Net farm income (billion dollars)	-.049	+.393	+.714	+.689	+1.096	+1.630	+2.252	+3.221	+3.597
-1981 baseline level = $17 billion.									

As shown in the table, FAPSIM projects that fuel ethanol production, up to at least 1 billion gallons, will have only

minor impact on agricultural commodity prices and the consumer food bill. Several factors contribute to the limited impact of ethanol production on agricultural prices. Even at a 1 billion gallon a year production level, such a demand would represent less than 5 percent of the 1982-83 corn crop estimated at 8.4 billion bushels and only slightly more than 5 percent of the average 7.7 billion bushel annual corn production since 1978.

The impact of fuel ethanol production on the agricultural sector is further mitigated by the self-adjusting and interdependent nature of U.S. agricultural prices and production. Corn price increases generated by increased demand from one source in turn cause other corn users to shift to other alternatives, resulting in a partially compensating demand reduction and thereby a moderation in the initial price increase. Further, the increased corn prices induce farmers to grow more corn the next season, leading to a nominal corn supply increase in future seasons further dampening the long-run price increase effect from the initial demand increase.

Coincident with the adjustments in the corn marketplace, similar and interdependent adjustments also occur in the wheat, sorghum, and the soybean markets. The soybean market is particularly affected because the high protein coproduct of ethanol production competes with soybean meal in animal feed rations. The increased availability of competing high protein feed supplement supply has a depressing impact on soybean and soybean meal prices. Once again, however, such price changes in the long term tend to be moderated by farmer decisions to reduce soybean planting in favor of other crops commanding a better price thereby reducing overall supply and generating a countering upward price pressure.

Historically, more than 80 percent of domestic corn consumption has occurred as animal feed. Similarly, all the high protein ethanol coproduct and much of the soybean crop has been used as animal feed, either domestically or overseas. Accordingly, any changes in the market prices of these commodities are felt by the consumer primarily in the meat and dairy product markets. Considering meat and dairy products comprise only a part of the typical consumer market basket, minor price impacts here have a barely recognizable effect on the total consumer food bill.

After analyzing the price impacts of ethanol production projected by FAPSIM, we compared these results with the projections of other models and sought independent viewpoints from other experts in the field. Most of the other studies we identified projected similarly small price impacts. For example, in 1980 the Solar Energy Research Institute estimated that a 1 billion gallon ethanol production level would generate a $.12 increase in corn prices compared to $.15 projected by FAPSIM. In 1982, the University of Illinois at Urbana-Champaign estimated that, in the long term, corn prices would increase $.05 per bushel, with 430 million gallons of ethanol production and $.13 per bushel at a

1.1 billion gallon a year production level. Several other estimates prepared by USDA staff using models other than FAPSIM also show relatively minor price changes resulting from ethanol production up to about 1 billion gallons. In addition, several university experts interviewed said that the FAPSIM results generally agreed with their projections.

While relative price effects are small, the absolute effect of ethanol production on corn farmer income should not be discounted. Because of the large crop volumes involved, even small price increases result in significantly increased corn farmer receipts. For example, the projected $.04 increase in 1982 corn prices over the 5-year average 7.7 billion bushel crop would result in about a $300 million increase in annual corn farmer receipts. FAPSIM also projects that ethanol production reduces total farm expenses from the level that would otherwise have been experienced. Increased corn farmer receipts combined with the reduced total farm expenses contributed to FAPSIM's projected gain in net farm income.

Further, while national scale price impacts are relatively small, ethanol projection can have a much more significant impact on local grain markets. In this connection, representatives from two major fuel ethanol producers told us that their corn purchases on a given day can have significant impacts on local corn prices. One of the representatives told us in fact that his company has been forced to substantially enlarge the area of corn purchases around the plant because of the impact his purchases have had on local prices.

Reports prepared by the Office of Technology Assessment and USDA indicate that national agricultural sector impacts will not become major until annual production reaches 2 to 4 billion gallons. For example, an Office of Technology Assessment study[1] states that caution should be exercised when expanding ethanol production from grains and sugars beyond 2 billion gallons a year, the level at which it estimates competition between food and fuel production would begin. The study estimated that once food-fuel competition became severe, domestic food consumers could pay $3 to $4 per year in higher food prices for each additional gallon of ethanol produced. USDA staff analyses confirm that beyond about 2 billion gallons a year, price effects would be more significant. One analysis concluded that 4.6 billion gallons a year ethanol production would increase corn prices by $.27 a bushel and 9.2 billion gallon production would result in a $.55 a bushel price increase. Price increases of this magnitude could have more significant impacts throughout the food chain and ultimately on the food consumer.

Price impacts could be somewhat mitigated by substantially increasing land in production. In this connection, the federal

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[1]Energy from Biological Processes, July 1980.

government has for many years conducted programs to remove land from production by either paying farmers not to grow crops or by requiring farmers to leave part of their land fallow as a prerequisite to participating in government support programs. Further, in 1983 the government conducted a special acreage reduction program to reduce massive and growing crop surpluses. Known as payment-in-kind, this program essentially paid farmers to idle acreage with surplus commodities. The payment-in-kind program removed roughly 40 million corn and sorghum acres from production. At an average yield of 100 bushels of corn per acre, this land alone could have produced enough corn to produce about 10 billion gallons of ethanol. This much land would obviously not be be available every year. Accordingly, as we and others have pointed out in previous work, ethanol production from all feedstock sources, including cellulose, should not be counted on for much more than 10 billion gallons, or about 10 percent of current gasoline consumption.

IMPACTS ON FEDERAL REVENUES

Fuel ethanol production has a variety of conflicting impacts on federal revenues. The federal tax incentives, necessary to make fuel ethanol sales possible, cost the Treasury tax revenue. This lost revenue is offset to some extent by projected reductions in government agricultural support program outlays and additional revenue generated by the collection of special duties on fuel ethanol imports. Any change in total domestic output resulting from fuel ethanol production would generate changes in personal and corporate income tax revenue. Without the ability to quantify this output effect, however, it is not possible to quantify the income tax revenue effect. Consequently, we were not able to conclusively determine whether the fuel ethanol industry was a net contributor to, or drain on, total federal revenues.

The U.S. fuel ethanol industry came into existence mainly because of the availability of various special federal tax incentives. These incentives include (1) the exemption of gasohol from $.05 of the $.09 Federal gasoline exise tax, (2) an equivalent income tax credit for ethanol blenders not obtaining the excise tax exemption, and (3) a 10-percent investment tax credit for renewable energy production investments. These incentives cost the Treasury a certain amount of income and excise tax revenues.

In 1982 domestic ethanol production totaled about 210 million gallons. For our analysis, we assumed that all 1982 production was sold in 1982. In addition, while much more imported ethanol entered the United States in 1982, we estimated that only about 13.5 million gallons entered the United States before the

last few days of the year.[2] Since ethanol entering the United States during these last few days could not possibly reach the fuel consumer before year end, we assumed that only 13.5 million gallons of the imported ethanol was sold in 1982. Consequently, we estimated that about 224 million gallons of fuel ethanol was sold in 1982. Each gallon of ethanol sold in 1982 received a $.40 a gallon tax subsidy, resulting in a revenue loss of about $90 million.

Industry sources estimate that fuel ethanol producers invested about $300 million in ethanol plant and related equipment in 1982. Much of these expenditures--80 percent according to a standard rule of thumb--qualified for a special 10-percent investment tax credit. Applying this 80-percent rate, about $240 million of the $300 million 1982 ethanol plant investment would qualify for the special investment tax credit, resulting in about $24 million in reduced federal tax revenues. Combined with the $90 million in lost gasoline excise taxes, we estimate special ethanol tax incentives in 1982 cost the Treasury about $114 million.

The ethanol industry, like all industries, receives benefits from the standard 10-percent investment tax credit and accelerated depreciation provisions of the tax code. However, because these provisions are not unique to the ethanol industry, we did not include their costs in our revenue loss computations. We also did not include in our computations any costs associated with the government's loan guarantee, cooperative agreement, or grant programs.

On the other hand, fuel ethanol production and use contributed to improving the 1982 federal revenue balance in two ways. First, through its impact on agricultural commodity prices, ethanol production helps hold down government agricultural support program outlays. In an effort to stabilize and protect farm prices and income, the federal government administers numerous farmer support programs. These programs have historically included commodity loans, production controls through acreage reduction, and various forms of direct payments. Commodity loan programs for corn include regular 9-month loans and 3-year farmer-owned reserve loans in which farmers receive larger loans for their crops in return for removing their crops from the market for at least 3 years. Both loan programs are nonrecourse in that farmers can default the crop under loan as full repayment of their debt. Among the direct payments are so called deficiency payments and storage payments. Deficiency payments are made to

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[2]On January 1, 1983, the fuel ethanol duty increased from $.20 to $.40 a gallon. Based on data obtained from the Census Bureau and the Customs Service, it appears that importers expecting to sell ethanol in 1983, arranged to have about 31 million gallons enter the United States just prior to January 1, 1983, to take advantage of the lower duty level.

farmers when the price for their respective products drops below a prescribed level. The payments essentially equal the difference between market prices and a prescribed minimum price times the amount of the commodity produced. Storage payments are made to farmers who put their crops in storage under the farmer-owned loan program. In addition, the government conducts a dairy price support program in which it establishes minimum dairy prices and supports those prices through bulk dairy commodity purchases. Data from USDA suggests that 1982 ethanol production had a modest but beneficial impact on each of these government program cost elements.

In addition to helping reduce 1982 government agricultural support program costs, fuel ethanol use contributed to a more positive federal revenue balance by generating fuel ethanol import duties. These duties helped offset federal gasoline tax revenue losses resulting from the use of imported ethanol in gasohol. In 1982 the duty on fuel ethanol was $.20 per gallon plus 3 percent of the declared value.

Precisely quantifying either the reduction in agricultural support program costs or the amount of increased customs duties that are attributable to alcohol fuel production is not possible. Moreover, because of the uncertainty surrounding the industry's impact on total output, we could not compute the industry's net effect on income tax revenue. Consequently, we could not determine whether the ultimate revenue impact from the ethanol subsidies was positive or negative. In relationship to the 1982 federal deficit of over $110 billion, it is clear, however, that the impact was very small.

CHAPTER 4

INTERNATIONAL TRADE IMPACTS AND IMPLICATIONS

As with its impact on government revenues, domestic fuel ethanol production and use impacts on the U.S. international trade balance in several ways. By substituting for gasoline made from imported oil, domestically produced fuel ethanol helps reduce total imports thereby improving the U.S. trade balance. Our analysis also suggests fuel ethanol production contributed to a net increase in the total value of agricultural exports thereby further improving the trade balance. On the other hand, fuel ethanol imports worsen the trade balance. Considering these factors alone, fuel ethanol production and use resulted in a fractional improvement in the 1982 U.S. trade balance. However, because it is not possible to trace the full impact of fuel ethanol production on every economic sector, there may be other trade-related impacts which we could not identify that would change this assessment.

ETHANOL PRODUCTION HAD SMALL IMPACT ON TRADE BALANCE

Based on the limited impacts we could identify, it appears that the domestic production and use of 210 million gallons of fuel ethanol resulted in a slight improvement in the nation's 1982 trade balance. The improvement was attributable primarily to the substitution of ethanol for gasoline produced from imported oil. Also contributing to the improvement was a net increase in agricultural exports. Increased exports of corn gluten feed and distillers dried grains along with projected increases in the value of corn and other commodity exports more than made up for projected decreases in the values of soybean and soybean meal exports in our analysis. The trade balance gains were partially offset by fuel ethanol imports necessary in 1982 to fill the gap between ethanol demand and domestic production capacity. While a small net trade balance improvment is indicated by the factors we could identify, it is possible that other trade impacts we could not quantify could alter this result. Moreover, there is no certainty that the factors contributing to a positive trade balance in 1982 will continue to generate similar improvements in the future.

The fuel ethanol industry's most significant impact on the nation's trade balance results from its substitution for gasoline made from imported oil. Based on available data, we estimate that the United States used about 224 million gallons of fuel ethanol in 1982 or 5.3 million barrels.[1] We further estimate that each gallon of ethanol can replace about 1.2 gallons of

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[1]A barrel contains 42 gallons.

oil.[2] In this manner, 1982 fuel ethanol replaced about 6.4 million barrels of oil. We assumed that the oil displaced by ethanol was imported because in 1982 imported oil cost more than domestic oil. Accordingly, at an average 1982 imported oil refinery acquisition price of $33.55 a barrel, fuel ethanol production and use reduced oil imports by about $213 million.

The nation's trade balance was also improved by the export of animal feed produced as coproducts of ethanol production as well as a projected net increase in the value of other agricultural exports. As discussed in chapter 1, when ethanol is produced by wet corn milling, about 12.8 pounds of corn gluten feed and 2.6 pounds of corn gluten meal is produced from each bushel of corn processed. When the dry milling process is used, the coproduct is about 18 pounds of distillers dried grains. For many years, export markets have existed for corn gluten feed and distillers dried grains yielded during the production of corn sweeteners and other corn products. Assuming production of ethanol did not displace additional sweetener production, the extra volume of these coproducts yielded during ethanol production adds to these exports. Corn gluten meal is consumed almost entirely in domestic markets and therefore has little impact on the trade balance.

Over the last 3 years, about 90 percent of all corn gluten feed produced was exported with virtually all of these exports going to European markets. Wet corn millers export their corn gluten feed because it commands a higher price in certain European countries than in the United States even after deducting transportation expenses. The European price is higher because of high internal European price supports and high import duties on some competing animal feed components. Even at a premium price, U.S. corn gluten feed is still a relative bargain to certain European livestock feeders. According to USDA statistics, in 1982 the United States produced about 3.2 million metric tons of corn gluten feed and exported about 2.7 million metric tons, or about 87 percent. Of the total production, USDA estimates that 390,000 metric tons (about 12 percent) was attributable to fuel ethanol production. Assuming this production was exported in the same proportion as overall production, the export value totaled $53 million at an average price of $155 a metric ton.

A much lesser percentage of distillers dried grains has historically been exported. In 1980, the latest year in which data was available, about 28 percent of total U.S. distillers dried grain production was exported. In 1982, official U.S. export statistics compiled by the Census Bureau indicated that U.S. producers exported about 170,000 metric tons of distillers dried grains valued at about $24 million. Based on corn-use data obtained from USDA, we estimate that only about 3 percent of this production was attributable to fuel ethanol production. The

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[2]The basis for this estimate is discussed on p. 38.

remainder of distillers dried grain exports were a coproduct of beer and food product production. Accordingly, we etimated that distillers dried grain exports derived from fuel ethanol production totaled about 4,500 metric tons valued at about $644,000. Thus, we estimate that the combined exports of corn gluten feed and distillers dried grains attributable to fuel ethanol production totaled slightly more than $53 million.

Based on FAPSIM projections, we estimate that 1982 fuel ethanol production also contributed to a small net addition to the value of other agricultural exports. FAPSIM projects increased export values for corn, wheat, sorghum, and soybean oil and decreased export values for soybeans and soybean meal. On balance, FAPSIM projects about a $2.8 million increase in these agricultural exports resulting from 1982 ethanol production. Together with the reduced oil imports and increased ethanol coproduct exports, we estimate that fuel ethanol production and use contributed to an initial $269 million improvement in the 1982 U.S. balance of trade.

This improvement was partially offset by fuel ethanol imports. Despite vastly increased U.S. ethanol production in 1982, the United States imported substantial quantities of ethanol to meet burgeoning demand. There is considerable confusion, however, over the quantity and value of these imports. According to official Census Bureau trade statistics, in 1982 the United States imported about 13.5 million gallons of fuel ethanol with a total value of about $14.2 million. In addition, the Census Bureau reported that about 30.6 million gallons were imported during the first three months of 1983. Based on comments from officials in the U.S. Customs Service and the ethanol industry, these imports probably entered the United States during the last few days of 1982 and that associated paperwork was not completed in time to be included in 1982 statistics. If combined, this would mean that ethanol imports totaled 44 million gallons valued about $45.4 million, or about $1.03 a gallon. Virtually all of these imports came from Brazil.

Other sources, however, suggest that even this combined import volume is low. An official with the Brazilian trading company selling fuel ethanol to the United States told us that based on company sales records, Brazilian sales to the United States totaled 57.6 million gallons. We confirmed this figure with the U.S. commercial agent representing Brazilian interests in the United States. If this figure was accurate, at the same $1.03 per gallon price shown in Census Bureau statistics, the Brazilian imports would be worth over $59 million or about $14 million more than in U.S. statistics.

In attempting to reconcile the difference in reported fuel ethanol import statistics, we held numerous discussions with Census Bureau and Customs Service officials and reviewed applicable regulations. We found that some of the fuel ethanol sold by Brazil could have been reported by U.S. importers as being for

nonfuel use and thereby not be included in fuel ethanol import statistics. Importers classifying their fuel ethanol imports in this manner would also avoid the additional duty placed on ethanol to be used for fuel purposes. Customs officials told us that they had no evidence of importers misclassifying ethanol imports but that from a practical standpoint it could be occurring. After we brought this matter to their attention, the Custom Service's Commercial Fraud Investigation Center began a review of the matter.

For our analysis, we assumed that the fuel ethanol import volume based on Brazilian sales records was closer to being accurate. Accordingly, we reduced the initial $269 million improvement in the trade balance attributable to oil import reductions and agricultural export increases by $59 million, leaving a balance of about $210 million or about $1 for each gallon of ethanol produced. As of April 1, 1983, the United States placed a 50 cent per gallon special tariff on fuel ethanol imports, up from 20 cents a gallon in 1982 and 40 cents a gallon during the first 3 months of 1983. This additional duty will tend to hold down future fuel ethanol imports.

In 1982 the United States ran a deficit in the merchandise trade account[3] totaling $42.7 billion. The 1982 deficit followed annual deficits from 1976 through 1981 as shown in the table below.

Year	Trade deficit
	(billions)
1976	$17.3
1977	39.2
1978	42.4
1979	40.4
1980	36.4
1981	39.7

In this context, it is clear that the $210 million identifiable improvement in the trade balance resulting from 1982 fuel ethanol production and use had only a very small impact on the nation's trade balance. Even at a production level of 1 billion gallons, it is likely that the impact would remain relatively small. Further, it is possible that there may be other trade balance impacts we could not quantify that would further alter the impact of fuel ethanol production on the trade balance improvement.

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[3]This account represents the value of goods sold among nations. It does not include flows of capital, military assistance grants, or exchanges of services.

FUEL ETHANOL PRODUCTION AT HEART OF TWO TRADE DISPUTES

In addition to impacting the current trade balance, the fuel ethanol industry and government efforts to support that industry are central elements in two international trade disputes. Both these disputes involve the primary international agreement governing trade among nations. In one case--the U.S. tariff on imported ethanol--the United States has entered into consultations with nations claiming rights under the agreement. In the other case--a potential duty on U.S. corn gluten feed exports to the European Economic Community (EEC)--the United States would be the affected nation under the agreement. Each dispute could have significant implications for the future of the domestic fuel ethanol industry.

U.S. tariff on imported fuel ethanol

As part of the Omnibus Reconciliation Act of 1980 (Public Law 96-499 Dec. 5, 1980), the Congress enacted a special duty on fuel ethanol imports. In addition to the 3-percent ad valorem duty applied to all nonbeverage ethanol imports, the act added a $.10 per gallon duty to ethanol imported for fuel purposes in 1981. It raised the extra duty to $.20 per gallon during 1982 and to $.40 a gallon from 1983 through 1992. Subsequently, the Highway Revenue Act of 1982 increased the duty to $.50 a gallon for fuel ethanol imports entering between April 1, 1983, and December 31, 1992. The duty level has been set to exactly offset the value of the federal tax exemption so that foreign ethanol producers do not benefit from the exemption.

Despite the recent action to increase and extend the duty, officials in the State Department and the Office of the United States Trade Representtive agreed that the duty increase impairs a previously negotiated tariff agreement under the General Agreement on Tariffs and Trade (GATT)--the primary agreement governing international trade for most of the world's trading nations. A primary GATT function is to obligate member nations to maintain a set of tariff levels for various items agreed to as part of an overall tariff negotiating process. To change a duty bound under GATT, the nation making the change is normally required to compensate those nations affected by the change. In most cases the compensation involves reducing duty levels on some other commodity acceptable to the affected nations.

The nation primarily affected by the U.S. fuel ethanol tariff is Brazil. Since the late 1970's, Brazil has been conducting an aggressive program to expand its production and use of fuel ethanol. As a result of this program, Brazil has become the leading world producer and user of fuel ethanol. Consequently, Brazil was in a good position to produce relatively inexpensive ethanol for export to the U.S. market as that market began its expansion. The desire to prevent Brazilian ethanol from receiving the tax benefits provided to encourage U.S. ethanol production and use led U.S. law makers to enact the tariff.

The United States and Brazil have discussed the issue of compensation under GATT and have reached a tentative accord. State Department and Office of the U.S. Trade Representative officials pointed out, however, that any agreement must be approved in the form of specific legislation. While this legislation has not been approved, the officials told us that Brazil has agreed to suspend its claim pending legislative action. Depending on how the dispute is ultimately resolved, there could be important future implications for the fuel ethanol industry's impact on the trade balance.

Potential restrictions on corn gluten feed

A second trade issue linked closely to the fuel ethanol industry is the debate with the EEC over potential trade restrictions on corn gluten feed. Most U.S. corn gluten feed production is exported to the ECC with approximately 12 percent coming from the coproducts of ethanol production. The United States exports corn gluten feed because the artificially high prices for grain and other animal feed components supported within the EEC make corn gluten feed a competitive feed ingredigent particularly to certain European dairy farmers. Because of this price competitiveness, U.S. corn gluten feed exports to Europe have expanded rapidly from 700,000 metric tons in 1972 to about 2.7 million metric tons in 1982.

In reaction to this growing volume of corn gluten exports and fears of even larger exports in the future, certain EEC interest groups began seeking ways to limit these exports. After much discussion over a 4-year period, in April 1984, the European Commission--the principal administrative body of the EEC--formally proposed installing a levy on corn gluten feed imports over 3 million tons a year. The United States is strongly opposing this proposal, as it opposed previous informal proposals to this end, noting that such a levy clearly violates a GATT binding. Under terms of the GATT, member nations proposing changes to GATT tariff bindings must enter into consultations with those nations affected by the change. Such consultations are the next step for the corn gluten feed proposal. If an agreement is not reached resulting in either EEC withdrawing its proposal or arriving at suitable compensation, affected nations such as the United States can retaliate with duty changes of their own.

Steps, such as the levy proposed by the EEC, which restrict corn gluten feed exports to Europe would lower corn gluten feed prices and thereby affect the U.S. ethanol industry. Revenues from corn gluten feed sales are important to viable fuel ethanol economics based on wet corn milling. Sales of corn gluten feed and related coproducts to Europe enable fuel ethanol producers to reduce their net corn feedstock costs, sometimes by as much as 50 percent. If the European corn gluten feed market was limited, revenues could fall thereby raising the net cost of producing ethanol via wet milling.

CHAPTER 5

FUEL ETHANOL'S IMPACT ON NATIONAL ENERGY SECURITY

Substituting domestic, renewable fuel such as ethanol for gasoline enhances national energy security by reducing U.S. dependence on imported oil from the Middle East and other politically unstable regions. Further, during a petroleum supply disruption, the ethanol industry would be able to put some additional capacity on line fairly quickly, further reducing U.S. vulnerability. However, ethanol's impact on national energy security is small because the industry's current and projected output represents only a tiny fraction of gasoline demand. Although small on a national level, there is some indication that ethanol's contribution to energy security in certain areas of the country could potentially be more pronounced. In addition, stockpiling ethanol as a supplement to the Strategic Petroleum Reserve (SPR) could further reduce U.S. vulnerability to petroleum supply disruptions. However, while our analysis indicates that ethanol stockpiling could be feasible, its cost effectiveness is questionable.

CURRENT AND PROJECTED ETHANOL PRODUCTION MINIMALLY ENHANCES NATIONAL ENERGY SECURITY

Blending ethanol into gasoline can enhance national energy security by making the nation less dependent on imported oil and by giving refiners an additional octane enhancer for the gasoline they produce. Currently, however, ethanol's contribution to national security is small because little ethanol is produced relative to total gasoline use. Ethanol's future contribution to national security depends on how much ethanol is produced and how that ethanol is used. The amount of additional ethanol supply capacity above current use, or surge capacity, is important when considering how extensive a contribution ethanol can make during a supply disruption. Further, ethanol availability could have a more significant impact in certain localities if local production was actually used in the area. Finally, ethanol could make a contribution toward making the farm sector more energy secure during an emergency; however, because most farm machinery runs on diesel, ethanol's use here would probably not be optimal.

Current contribution to national energy security is modest

In 1982 the domestic fuel ethanol industry produced about 210 million gallons of ethanol for mixing with gasoline to extend automotive fuel supplies and increase gasoline octane. By helping to reduce dependence on imported oil, this ethanol enhanced national energy security. However, because 1982 domestic ethanol production amounted to only about one-fifth of 1 percent of gasoline consumption, this contribution was modest.

Several factors must be considered in measuring fuel ethanol's impact on reducing imported oil dependency. Initially, any fuel ethanol used displaces an equal volume of gasoline. In this manner, 1982 fuel ethanol production would have helped reduce petroleum requirements by about 5 million barrels,[1] or less than one-half of 1 percent of total 1982 oil imports.

Assessing the value of ethanol in displacing oil imports is more complicated than simply determining the volume of gasoline displaced by ethanol, however. Other factors such as reduced petroleum use at the refinery for gasoline processing and the amount of petroleum used to produce the ethanol have to be considered. Because refinery energy savings is a key factor in ethanol's oil savings potential, how ethanol is used is a critical consideration in determining how much oil is saved. If ethanol was simply mixed with finished gasoline and used to displace regular unleaded gasoline without taking advantage of the octane increase, we estimate that each gallon of ethanol would save about 0.9 gallons of petroleum.[2] Currently, however, most ethanol is mixed with regular unleaded gasoline to make an unleaded fuel about 3 octane points above regular unleaded. When this fuel is used to displace a super unleaded grade of gasoline that would have been produced entirely from petroleum, we estimate that each gallon of ethanol would save about 1.2 gallons of petroleum.[3] Assuming all ethanol was used to displace super unleaded gasoline in this manner, 1982 ethanol production saved an additional 1 million barrels of imported oil, or about 6 million barrels in total. At a production level of 1 billion gallons a year which could be achieved by 1990, ethanol could save nearly 29 million barrels of petroleum per year.

Somewhat less petroleum is consumed to raise gasoline octane from subregular to regular grade. Accordingly, sliqhtly less than 1.2 gallons of petroleum would be saved if refiners produced a subregular unleaded gasoline and used ethanol to boost the fuel's octane to a regular unleaded grade. At least one Midwest refiner is now beginning to produce unleaded regular octane gasoline with ethanol.

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[1]This assumes all 1982 production was used in 1982 and that gasohol provides the same mileage as gasoline.

[2]This computation assumes that gasohol provides mileage equal to gasoline and that ethanol is produced in a coal-fired distillery. It includes a credit for the petroleum required to produce the soybean meal displaced by ethanol coproduct and for the refinery energy losses associated with producing the gasoline physically displaced by the ethanol.

[3]This computation is identical to the previous calculation except that it adds about .3 additional gallons of petroleum saved per gallon of ethanol to reflect ethanol's ability to eliminate the need to raise gasoline octane by 3 points through more intensive petroleum processing.

Surge production could provide some additional fuel ethanol in emergencies

In the event of a petroleum supply disruption, only additional ethanol supply above normal production levels could help reduce the shortfall. Any additional ethanol supply will be the result of surge production. In 1982 some surge capacity was available. Some fuel ethanol plants were shut down while other plants produced below their rated capacity. In an emergency, such as a petroleum supply shortfall, it should be possible to bring some of this capacity on line to increase production.

Precise data on industry surge production capacity is difficult to obtain because producers keep such information confidential for competitive reasons. One industry analyst estimated, however, that as of March 1983 there was about 112 million gallons of ethanol production capacity that was operable but not available for current production. Much of this capacity was at wet corn milling plants that was being devoted to sweetener production. In a fuel emergency, this capacity could potentially be brought on line. In addition, the analyst estimated that about 15 percent of operating ethanol capacity in 1983--or about 62 million gallons--would be idle for various reasons. Once again, during an emergency, it is possible these plants could run at full capacity. In total, therefore, the estimates indicate about 175 million gallons of surge production capacity was available for surge production.

The analyst estimated that there was an additional 73 million gallons of inoperable capacity at various plants which would require some overhauling to bring into production. He estimated that the overhauling process could take a year or more. As a result, these plants would probably be useful only during a lengthy petroleum supply disruption. If faced with such a disruption, a better course of action might be to build new plants. New plants can be built in about 2 years and would likely be more efficient than older plants that have been out of operation.

Effects of ethanol use could be more substantial in certain areas

Although the fuel ethanol industry's output appears small in relation to national gasoline use, ethanol could provide more substantial assistance in areas around ethanol production facilities, particularly in the Midwest. In this connection, the Renewable Fuels Association (the primary ethanol industry trade association) reports that nationwide there are over 100 ethanol plants in operation ranging in size from less than 500,000 gallons a year to more than 50 million gallons a year. These plants, located in 31 states, could supplement local fuel supplies during a fuel emergency.

While ethanol facilities are spread across the country, most production capacity is concentrated in a relatively small area.

Almost 70 percent of the ethanol industry's total estimated operational production capacity in early 1983 was located within a 100 mile radius covering northwestern Illinois and northeast Iowa. With four of the nation's largest ethanol plants, this area could benefit most from localized retention of the ethanol it produced. If these plants, plus the approximately 5 million gallons of capacity in the rest of Iowa and Illinois ran at 100 percent of capacity during a fuel supply emergency, they could supply about 4.8 percent of the two states' total gasoline requirement, or roughly 9.7 percent of unleaded gasoline requirements.

Such calculations are purely theoretical, however, because ownership of the ethanol depends on contractual arrangements, not the location of the production facilities. Therefore, even though the ethanol might be produced in Illinois, contractual arrangements could result in ethanol being used elsewhere. As a result, it is not certain that areas near ethanol production plants will in reality experience any enhancement of local fuel supplies during an emergency.

Ethanol/diesel blends have potential but practical value is currently limited

Ethanol could potentially be used to extend diesel fuel supplies. Such use could be particularly helpful to the nation's increasingly diesel dependent agricultural sector. However, because of inherent difficulties in mixing ethanol and diesel for use in current diesel engines as well as diesel's cost, such ethanol use on a large scale is currently neither practical nor economically viable. Several approaches under investigation could help overcome the technical difficulties, but because ethanol's fuel properties are better suited for use with gasoline than diesel, it will probably be more beneficial to mix available ethanol with gasoline than diesel.

Ethanol does not have particularly good properties for use in diesel engines. Ethanol's high octane make it a good fuel for gasoline engines, but its low cetane rating[4] makes it a less valuable diesel fuel supplement. Diesel engines would require a much higher compression ratio than is presently common in order to ignite straight ethanol without additional mechanical or chemical assistance. Further, ethanol in combination with diesel fuel is difficult to use because they do not mix well. Unlike blends of gasoline and ethanol, when diesel and ethanol are combined they will not form a solution, but instead separate in a manner akin to trying to mix oil and water.

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[4]Cetane rating is a measure of how easily a fuel will ignite under compression. The higher the cetane rating, the more easily the fuel will ignite. Current diesel engines require a cetane rating of at least 40, while ethanol has a cetane rating of essentially zero.

These problems do not entirely preclude the use of ethanol/diesel blends in diesel engines. Currently, four basic approaches are under investigation to resolve the problems impeding the use of ethanol/diesel blends. These are:

(1) Fumigation - adding ethanol to intake air, and using diesel injection to ignite the fuel. This method requires engine modifications.

(2) Direct Cylinder Injection - injecting the ethanol into the cylinder using the fuel injection system. This method requires some type of ignition initiator such as spark ignition, pilot injection of a high cetane fuel, or the use of chemicals to promote ignition. Major engine modifications are required.

(3) Emulsions - mechanically mixing alcohol and diesel fuel immediately prior to injection into the cylinder. Dual fuel systems and emulsifier components are required.

(4) Solutions - using stabilizing chemicals to keep ethanol and diesel together in solution, so that an existing fuel injecion system could be used. Little or no engine modification is required.

Work on these various methods of using ethanol in diesel engines is still in the research stage. It is not clear which, if any, of these approaches might be commercially acceptable.

One researcher we talked to believed that some type of ethanol/diesel combination could provide a means of extending diesel fuel supplies during a petroleum supply emergency. At this time, stabilized solutions appear to provide the most convenient system for rapid use of ethanol as a diesel fuel extender in an emergency because extensive engine and fuel system modifications would not be required. With appropriate stabilizers, as much as 15-percent ethanol/85-percent diesel fuel could be used in existing diesel engines without greatly affecting the power, efficiency, and emissions of these engines. However, the availability of stabilizing agents could limit such usage.

Ethanol/diesel combinations could potentially be especially helpful to U.S. agriculture during a petroleum supply disruption because the vast majority of tractors and associated farm equipment have diesel engines. As a result of this diesel dependence, a petroleum supply disruption could have immense consequences for the U.S. agricultural sector, especially if it occurred during planting or harvesting time. Ethanol/diesel blends could help extend diesel supplies and during times of emergency help keep farm machinery operating.

While ethanol could potentially be used to extend diesel supplies during disruptions, the best use of ethanol during a fuel supply disruption would probably be in a blend with gasoline

where ethanol's high octane can be used effectively. If used in this manner, ethanol could maximize its petroleum saving potential thereby freeing up more petroleum for diesel production. In a situation of limited ethanol supply, the nation would be better served by using it in a manner consistent with its fuel properties rather than forcing it into an application where its use would be difficult at best.

FUEL ETHANOL RESERVE PROBABLY FEASIBLE BUT COST EFFECTIVENESS IS QUESTIONABLE

Stockpiling fuel ethanol could enhance ethanol's contribution to national energy security. Fuel ethanol made in privately owned plants from surplus government-owned corn could be stockpiled in a Strategic Alcohol Fuel Reserve (SAFURE) as a substitute for a portion of the SPR. Such a system could both reduce SPR oil purchase requirements and the amount of corn in government stockpiles. Our analysis shows that while under certain conditions a SAFURE could be feasible, its cost effectiveness is questionable.

Bulging corn stockpiles and the nation's continuing vulnerability to petroleum supply disruptions spawned congressional interest in converting some surplus corn into ethanol to be stored in a SAFURE for use during a fuel emergency. Such a reserve--commonly projected at a level of about 25 million barrels or about 1 billion gallons--would serve a dual purpose. First, it would help control the quantity of corn in storage. Second, the stockpiled ethanol could substitute for a portion of the SPR that has yet to be filled with a domestic alternative to buying foreign oil for the SPR.

We conducted an exploratory assessment of the SAFURE concept to determine if it was feasible and, if feasible, whether it would be cost effective for the federal government. The practicability of the SAFURE concept depends on four main conditions. First, sufficient quantities of government-owned corn must be available to provide feedstock for SAFURE ethanol production. Second, there must be enough privately owned ethanol production capacity available without interfering with supplying private sector demand. Third, there must be sufficient means of safely storing the ethanol over an extended period of time. Finally, SAFURE should be cost effective in terms of federal outlays; SAFURE costs should not be higher than the combined costs of that portion of SPR and federal corn price support programs it would displace.

Government-owned corn stocks may not always be adequate to provide for SAFURE production

Corn availability for SAFURE will always be subject to uncertainty because unfavorable weather conditions and government programs can dramatically impact corn output and prices. A one billion gallon ethanol reserve produced entirely from corn and

filled over an 8- to 10-year period would require between 40 and 50 million bushels a year. In recent years with bumper harvests and low prices, more than enough government corn was available to meet this requirement.

The United States has amassed a corn stockpile which reached about 3.1 billion bushels by the end of the 1983 crop year. Of this amount, about 1.2 billion bushels was government-owned. Because of this huge stockpile, the government instituted its payment-in-kind program in 1983. This program removed approximately 40 million acres of corn and sorghum land from production during 1983. Coupled with the extremely dry summer that reduced the harvest on the land remaining in production, the PIK program resulted in significant reductions in projected 1984 corn stockpiles. As of April 1984, USDA projected corn stocks will total about 1.5 billion bushels in September 1984, with about 175 million bushels of that being government-owned. This government-owned stock level is about two-thirds the average stock 1979 through 1982.

Sufficient government-owned corn has, therefore, been available every year since 1979 to accommodate SAFURE demand. This has not always been the case, however. Between 1972 and 1979 there was essentially no surplus government-owned corn available. Consequently, while government corn stocks are currently adequate for SAFURE and have been for several years, there is no assurance that such stocks would always be available.

Some ethanol production capacity could be available for SAFURE

SAFURE feasibility also depends on the amount of available ethanol production capacity. In our assessment, we did not envision constructing ethanol production capacity specifically for the purpose of filling SAFURE. Instead, production for the reserve would be flexible, depending on the availability of excess production capacity in the private sector. The lack of data on industry capacity utilization makes it impossible to conclude with certainty that sufficient excess capacity would be available to produce ethanol for SAFURE without hindering private supplies. However, there are indications that at least some capacity would be available for this purpose.

The 1982 capacity estimates included in the DOE SAFURE report[5] provides one indication. These estimates indicate that in 1982 the ethanol industry had operable capacity to produce perhaps 100 million gallons more than it did to meet private market demand. As discussed earlier, much of this capacity was wet milling swing capacity that was devoted to sweetener production. Whether this capacity would be diverted to SAFURE ethanol production is not certain.

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[5]A Report to the Congress: Strategic Alcohol Fuel Reserve, Dec. 31, 1982.

A pilot corn conversion program conducted by USDA also suggests that ethanol producers may have some capacity available for SAFURE production. Under this program begun in May 1982, USDA contracted with nine fuel ethanol producers to convert 2 million bushels of low-grade corn to ethanol. As of July 1983, about 1.2 million bushels had been delivered to producers and slightly more than 2 million gallons of ethanol had been produced. Of this 2 million gallons, the government had sold about 1.9 million gallons. Several of the contractors were having problems meeting their contractual obligations, making it questionable whether the 2 million bushel program would be completed. Despite the implementation problems, the USDA pilot program provides a further indication that some capacity might be available to produce ethanol for a SAFURE.

Finally, an official with the Renewable Fuels Association told us that he expects much more excess capacity will be available in the future. This official told us that in the next few years there should be 600 million gallons of fully operable capacity, with 10 to 20 percent (60 to 120 million gallons) idle at any point in time because of demand shortfalls in particular markets. If this estimate turns out to be accurate, such capacity could be sufficient to meet the annual SAFURE requirements.

Sufficient ethanol storage capacity can probably be obtained

After the ethanol is produced, our analysis envisions it being stored in either new or reconditioned above-ground steel tanks, located at or near gasoline distribution terminals or oil refineries. The ultimate choice between new storage facilities and reconditioned petroleum storage capacity will depend on the availability, applicability, and cost of existing versus new storage. While the details of idle petroleum storage capacity remain sketchy, our informal survey of several oil companies and industry associations revealed that a substantial amount of excess storage capacity could be purchased at costs between $2 and $20 a barrel depending on tank condition and location. This availability is due primarily to the ongoing reduction in demand for petroleum products. The oil industry considers a substantial amount of this demand reduction to be long term, and as a result, many companies are pulling out of less profitable markets. Refinery shutdowns and capacity reductions, also a result of the market contraction, are also freeing up storage capacity.

One petroleum industry representative that we spoke with expressed reservations regarding the adaptability of unused petroleum storage capacity for long-term ethanol storage. He said that the majority of the available surplus capacity is not appropriate for storing ethanol on a long-term basis without inordinate expenditures for modifications. Ethanol should be stored in a closed steel tank with an internal float in order to control fumes and prevent moisture problems. The representative believed that much of the available petroleum storage capacity consists of

open tanks with an external float which are inappropriate for long-term fuel ethanol storage because they cannot prevent water contamination. Even if closed roof tanks originally built for petroleum storage are available, many might not be useful for ethanol storage because they either lack an internal float to control the accumulation of potentially explosive ethanol vapors or have roofs made of aluminum. He said that aluminum components would not be suitable for long-term ethanol storage because they could deteriorate in the presence of ethanol. Finally, this representative believed that some of the storage capacity that oil companies will be selling will be the older type of riveted steel tank, which have seams usually sealed with epoxy. He said that most types of epoxy are ethanol soluble, making these tanks inappropriate for ethanol storage. If accurate, these statements would deflate the potential for ethanol storage in surplus petroleum storage capacity.

If existing tanks are not usable or prove too costly, a more suitable alternative for SAFURE storage might be newly constructed tanks. In this connection, one storage tank industry representative told us that it would be possible to construct ethanol storage in locations with existing ancillary support facilities for about $6.50 per barrel. Other industry officials provided cost estimates up to about $14 a barrel, well within the $2 to $20 cost per barrel quoted to us for existing excess petroleum capacity.

SAFURE cost effectiveness questionable

While potentially feasible, our limited analysis indicates that a SAFURE program may be costlier than existing alternatives. For SAFURE to be cost effective, its costs would have to be no more than the combined costs of that portion of current SPR and corn price support programs it would displace. Our cost analysis indicates that as long as the government recoups a moderate portion of its corn loan default costs through subsequent corn sales, existing programs will be less expensive than SAFURE.

The results of our analysis are shown in the following table. All costs are presented in terms of government costs per bushel of corn. Further, we considered only actual government expenditures in our analysis and as such excluded potential expenses such as interest on government debt and certain opportunity costs from our analysis. Because the available data in many of the cost elements has not been precisely determined, the information presented in the table illustrates the cost comparison under one set of assumptions and should not be viewed as definitive.

Illustrative Government Costs
(Not including subsequent corn sales)
($ per bushel)

Cost category	Existing programs	SAFURE
Corn acquisition (defaulted loan value)	$2.65	$2.65
Interest lost through loan default	.20	.20
Corn handling (in and out charges)	.14	.14
Corn storage (4 years)	1.32	-
Corn transportation	.20	.20
Total	4.71	3.19
Conversion to ethanol	-	1.83[a]
Ethanol transport to storage	-	.16
Ethanol storage	-	.39 to .83
Total	4.71	5.57 to 6.01
Oil acquisition for SPR	2.09 ($30)[b]	-
Oil transport for SPR	.05 ($.70)[b]	-
Oil storage for SPR	.32 ($4.54)[b]	-
Total gross cost (excluding corn sale credit)	$7.17	$5.57 to $6.01

[a]We did not include the value of the ethanol coproduct received by the distiller within our computations because it was not an out-of-pocket government expense but rather a foregone opportunity for revenues.

[b]Prices in parenthesis are per barrel of oil.

As the table demonstrates, we estimate SAFURE would be between $1.16 and $1.60 cheaper than existing program costs when the revenue from government corn sales is not considered. Alternatively, if the government could be expected to obtain more than $1.60 a bushel for the corn it obtains from loan defaults and later sells, conducting existing programs would be less expensive than using that corn to conduct a SAFURE program.

It is not possible to predict with any precision the revenue the government will obtain when it sells corn out of its inventory. The government cannot sell corn unless (1) the market price reaches a predetermined level well above the government support price or (2) the corn has deteriorated below standard market grades. USDA officials told us that under these restrictions no historical average price could be set forth as a guide for estimating future government sales prices. For example, in fiscal year 1982, the government sold about 6.3 million bushels of corn from its inventories at an average price of $2.51 a bushel. The previous year it sold about 13.7 million bushels at an average price of $3.10 a bushel.

Further complicating the issue, the government does not always obtain any revenue from its corn dispositions. Each year it gives away varying quantities to foreign countries and needy domestic users. Moreover, as part of the payment-in-kind program, the government gave 1.76 billion bushels to farmers in return for idling acreage. Thus, the government gets no revenue for much of the corn it releases. In light of these complications, assigning any specific value to corn sales is very chancy. Accordingly, we chose not to assign a specific value but instead pointed out the range of corn sales prices that would suggest whether SAFURE was either less costly or more costly.

In using or interpreting the results of our exploratory analysis, it is also important to realize that precise data was not available on other crucial elements of the analysis. For example, USDA officials told us that it is not possible to identify an historically valid average length of time corn could be expected to stay in government storage after the government acquired it from loan default. Nor is it possible to predict with certainty the relative proportions of corn that would come to government inventories from regular loan program defaults versus farmer-owned reserve loan defaults. In these instances, we made simplifying assumptions that (1) corn stays in government storage 4 years before being disposed of and (2) all corn comes to government ownership through defaults of regular corn program loans. A complete listing of assumptions and explanations behind the numbers in the table are presented in appendix II.

The uncertainties involved with estimating the cost of the existing corn programs make it impossible to conclusively establish whether SAFURE is or is not cost effective. Conclusions can vary depending on the assumptions chosen. It does seem likely, however, that as long as the government obtains some modest level of revenue from selling the corn that would otherwise be used for a SAFURE, existing programs will be less expensive than SAFURE.

DOE and the Congressional Budget Office recently completed cost analyses of the SAFURE concept as well. These studies, which used different analytical approaches than we used, concluded that a SAFURE program would not be cost effective. Unlike our analysis which considered only federal government costs, DOE

examined SAFURE in terms of net national economic costs and benefits and thereby incorporated economic elements not directly bearing on the federal budget. Regarding the Congressional Budget Office study,[7] while we compared SAFURE costs to the combined cost of corn storage and SPR oil purchases displaced by SPR, the Congressional Budget Office examined the programs separately. It first compared the costs of producing ethanol from government corn stocks with the cost of storing the corn and ultimately disposing of it in accordance with the existing price support system. It then compared the cost of producing gasoline from SPR oil with producing ethanol from government corn. Looking at SAFURE in these ways, both studies concluded that conducting existing programs would be less costly than SAFURE.

While both DOE and the Congressional Budget Office concluded that SAFURE is not cost effective, we believe that cost elements on either existing programs or the SAFURE option are not sufficiently developed to be conclusive. Because crucial data in the analysis cannot be precisely established, assumptions have been made which can have a major impact on the conclusions reached. Recognizing this situation, DOE's Deputy Assistant Secretary for Energy Emergencies told us that its report reflected DOE's limited state of knowledge and that more specific conclusions would evolve over time. Since much of the Congressional Budget Office analysis was based on information presented in the DOE study, the same limitations would apply to this analysis as well. Given the limitations surrounding the studies performed to date, we believe that it would not be appropriate to either accept or reject the SAFURE concept based on the results of these studies. More precise data on the costs of the existing corn program will be needed before a sufficiently conclusive study can be performed.

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[7]Possibility of a Strategic Alcohol Reserve as a Supplement to the Strategic Petroleum Reserve, Mar. 1983.

CHAPTER 6

TAX EXPENDITURES BENEFITING OTHER ENERGY INDUSTRIES

In addition to assessing the federal tax incentives offered to the fuel ethanol industry, we assembled information on the incentives offered to other energy industries. We found that while structured much differently from the gasohol tax exemption, the budgetary cost of incentives received by conventional energy industries such as oil and gas dwarf that received by the fuel ethanol industry. Conventional energy technology incentives have been in place for decades and have cost the U.S. Treasury about $100 billion since 1950 in foregone tax receipts, sometimes known as tax expenditures. The administration sought repeal of the fuel ethanol incentives because the incentives distort the energy marketplace and thereby lead consumers and investors to make uneconomic decisions. In light of the extensive incentives long provided to the conventional energy industries, it is not clear that the fuel ethanol subsidy unduly distorts the market. Because of the array of tax incentives in place, the energy marketplace is not now, nor perhaps has it ever been, free from government intervention.

ENERGY TAX INCENTIVES AND ASSOCIATED REVENUE LOSSES

The federal government has offered special tax treatment to conventional energy industries since at least 1916. While in recent years a spate of tax provisions have been enacted promoting conservation and new energy technologies, including fuel ethanol, conventional energy technologies continue to receive the majority of government energy-related tax expenditures. Moreover, according to available projections, conventional energy technologies will continue to receive the majority of federal energy tax expenditures over the next 5 years.

A study made by Battelle Memorial Institute for DOE entitled, An Analysis of the Results of Federal Incentives Used To Stimulate Energy Production, pointed out that the oil and gas industry received nearly $70 billion in tax subsidies between 1950 and 1977. This amount represents two-thirds of federal energy tax expenditures during the period. Tax expenditures provided the oil and gas industry have come primarily through special expensing provisions for exploration and development costs (known as intangible drilling costs) and the percentage depletion allowance.

According to reports published by the Joint Committee on Taxation, the most expensive energy tax incentive is the provision for preferential expensing of exploration and development costs. In most industries, businesses can deduct the cost of capital investments (such as machinery or equipment) from their taxable income only by depreciating the value of the asset as it loses value. Firms producing oil and gas, and some other

extractive industries, however, are permitted to expense the entire amounts paid for exploration and development investment costs in the same year they are incurred. As a result, taxes on income are effectively deferred. Oil and gas industry investment costs that qualify for this special treatment include amounts paid for (1) constructing derricks, tanks, pipelines, and other structures necessary for drilling operations, (2) clearing ground for drilling, and (3) fuel, labor, repairs, hauling, and supplies used for drilling and preparing a well for initial production. Typically, these costs comprise between 75 and 90 percent of the total investment costs associated with bringing a well into initial production.

Oil and gas companies are also able to deduct a depletion allowance against their income each year to reflect the physical and economic depletion of their reserves as they are removed. Depletion may be calculated on either a cost basis or a percentage basis. The cost basis is comparable to depreciation claimed by other businesses in that it allows only for recovery of the actual expenses associated with purchasing and developing the oil or gas deposit. Each year the original portion of the investment that can be deducted from income is determined by the portion of the deposit removed that year. As with normal depreciation, once the cumulative deduction equals the cost of the original investment no further deductions can be claimed.

The special tax treatment to the oil and gas industry (and other extractive industries) comes through the provision known as percentage depletion. Under this method, a company can deduct an established fixed percentage of gross income from the property regardless of the amount of original investment, so long as the amount deducted in any one year does not exceed 50 percent of taxable income from the property for that year. Since there are no limits on the cumulative amount that can be deducted using percentage depletion, the value of this incentive is, therefore, the amount of tax savings derived from percentage depletion above that which would be achieved on a cost depletion basis.

Joint Committee on Taxation reports demonstrate that in recent years, both the maximum percentage that can be deducted for oil and gas depletion as well as the number of firms eligible to use percentage depletion has declined. Over the past few years, the Congress has lowered the percentage deduction for oil and gas depletion from 27.5 percent of gross income applicable between 1926 and 1969 down to 15 percent in 1984. Moreover, beginning in 1975, percentage depletion was repealed for major oil and gas companies. As a result, only an estimated one-quarter of the oil and gas being produced has remained eligible for percentage depletion.

The predominance of tax expenditures associated with intangible drilling cost and percentage depletion provisions among total energy incentives has continued since 1977, the last year covered in the Battelle study. While other energy industries

such as coal and geothermal can take advantage of these incentives, the vast majority of these tax expenditures are attributable to the oil and gas industry. The following table prepared from data published by the Joint Committee on Taxation shows the estimated costs of specific federal energy incentives from 1978 through 1982.

Energy Tax Expenditures Estimate - 1978 thru 1982[a]

(Millions of Dollars)

	1978	1979	1980	1981	1982	Total 1978-82
Expensing of exploration and development costs	1185	1490	2190	2760	4095	11,720
Excess of percentage over cost depletion	1460	1625	2130	2675	2350	10,240
Capital gains treatment of royalties from coal	65	75	85	90	105	420
Alternative fuel production credit	-	-	-	25	95	120
Alcohol fuel tax exemption	-	-	-	-	50	50
Alcohol fuel blender credit	-	-	-	(b)	20	20
Exclusion of interest on state and local government industrial development bonds for energy production facilities	-	-	-	(b)	5	5
Residential energy supply and conservation credits	-	715	460	540	620	2,335
Alternative, conservation, and new technology credits	-	220	390	520	515	1,645
Energy credits for intercity buses	-	-	-	5	5	10

[a]Excludes tax incentives aiding electric utility construction which are grouped with water, sewage, and gas utility construction incentives in the Joint Committee on Taxation data.

[b]Less than $2.5 million.

The table shows that while seven new tax incentives for conservation and renewable energy technologies have been added since 1978, the dominance of incentives to the oil and gas industry has continued. Tax expenditures associated with special expensing of exploration and development costs along with percentage depletion allowances primarily for oil and gas companies made up the majority of total federal energy tax expenditures during the period.

Joint Committee on Taxation estimates for the period 1983 through 1988 suggest the dominance of oil and gas industry incentives will continue. The Committee estimates that special exploration and development cost expensing provisions will cost the Treasury about $9.6 billion. It further estimates the percentage depletion allowance provisions will cost another $13.7 billion. Together, these costs continue to represent the majority of projected federal energy tax expenditures.

In addition to simply measuring the absolute cost of various energy tax expenditures, it would be helpful to compare their relative costs in terms of energy produced. In this manner, an incentive that cost the Treasury $1 million but led to the production of 100 million barrels of oil or equivalent would be more effective than an incentive that cost $1,000 but only leads to the production of 500 barrels of oil or equivalent. Unfortunately, it is practically impossible to compare energy incentive costs in this way. The major difficulty comes in calculating the amount of energy produced that is attributable to the incentive. For example, how much oil would have been produced domestically if the energy marketplace were free of government tax incentives? It is extremely difficult to identify this quantity with any precision. Without such data, reliable calculations concerning the relative cost effectiveness of various incentives cannot be made.

ADMINISTRATION VIEWPOINT ON ETHANOL INCENTIVES SEEMS INCONSISTENT

As part of its fiscal year 1983 budget submission, the administration proposed repealing business energy tax incentives for energy conservation and the development of alternative energy sources, including fuel ethanol. The administration argued that with oil decontrol such incentives were no longer needed. It further argued that such subsidies interfered with business decisions by preempting free market resource allocations. The administration's proposal was overwhelmingly rejected by the Congress, and in January 1983 the Highway Revenue Act of 1982 increased the ethanol incentives.

Although the President signed this act into law, a Treasury official told us that the administration remains philosophically opposed to the ethanol incentives. He said that the administration continues to believe that the marketplace is the most efficient mechanism for determining energy use patterns and allocating resources efficiently. Commenting on a previous

report, other Treasury officials told us that the administration believes that tax subsidies which are targeted to specific industries (such as the ethanol industry) distort proper resource allocation by encouraging firms to undertake investments that are less economic at current market prices and by inducing customers to purchase higher cost fuels where a lower cost substitute is available. As a result of these tax incentives, the administration contends that workers, capital, and initiative are diverted from more productive uses elsewhere in the economy thereby lowering overall productivity. Moreover, by reducing the cost of certain specific energy alternatives, the administration believes these credits discourage other potentially more efficient alternatives. New inventions and refinements in technologies not covered by the credits are at a disadvantage in the marketplace when the government interferes by subsidizing the competition.

Philosophical opposition to fuel ethanol incentives because they distort the energy marketplace does not take into account the potential public good associated with a fuel produced from domestic, renewable resources or the potential value of helping a new industry develop into a self-sustaining component of the economy. Nor does it recognize the billions of dollars in tax incentives offered conventional energy industries over the past decades and the fact that the alcohol fuel industry must deal with an additional element of government intervention in the marketplace which tends to increase the price of its feedstock. Through various agricultural price support programs, the government has reduced production and maintained an artificial floor under the price of corn, the ethanol industry's primary feedstock and highest production cost element. Without government intervention, it is likely that the ethanol industry's feedstock costs would currently be appreciably lower.

In a broad context, therefore, fuel ethanol tax incentives are but an additional distortion to a marketplace already affected by significant government intervention. This is not to suggest that because conventional energy industries receive special tax benefits, the ethanol industry should receive compensating benefits, only to point out that ethanol is not competing in a free energy marketplace. Accordingly, fuel ethanol incentives should be addressed in this context rather than being dismissed solely because they represent government intervention in the marketplace.

CHAPTER 7

CONCLUSIONS, OBSERVATIONS, AND AGENCY COMMENTS

CONCLUSIONS AND OBSERVATIONS

The federal fuel ethanol tax incentives in general and the gasohol tax exemption in particular have been successful in achieving their intended objective--expanding the production of alcohol fuels as an alternative to petroleum fuels in automobile transportation. The incentives have been largely responsible for establishing and developing a fuel ethanol industry that has grown from essentially no production in 1978 to over 200 million gallons of output in 1982. Because ethanol costs substantially more than gasoline, the new fuel ethanol industry has been and continues to be dependent on federal tax incentives for its survival.

At this point it is not possible to conclusively determine whether the fuel ethanol industry will ever be able to operate profitably without federal incentives. Such a determination hinges most importantly on the future price of oil which no one can predict with any certainty. If oil prices do not rise sharply, it is likely that ethanol will continue to be more expensive than gasoline. If, on the other hand, the nation has another major oil price run-up, ethanol could become competitive with gasoline. In addition, future advances in ethanol production technology, particularly involving the use of cheaper cellulosic feedstock, could help narrow the price gap.

While undoubtedly successful in achieving their objective, the more important question concerning the incentives is whether their result is worthwhile. Answering this question depends on an assessment of the incentives' relative costs and benefits in comparison to other alternative uses of government energy funding. All things considered, we believe that the federal fuel ethanol incentives should be maintained until currently scheduled expiration dates. By offering the incentives, the government has foregone a certain level of tax receipts. On the other hand, the fuel ethanol industry created by the incentives has helped lower government agricultural support programs costs and raised other government revenue. Further, the industry has modestly enhanced national energy security and contributed to the public good by expanding alcohol fuel production as an alternative to petroleum based automobile fuels.

The ethanol industry has the potential to increase its contributions to the nation as its production expands. It is important to realize, however, that the fuel ethanol industry is not ever likely to be a panacea for the nation's problems. Unless agricultural programs are reconfigured to encourage rather than discourage production, feedstock limitations will likely limit ethanol production from grain to less than 5 percent of current gasoline demand. Ethanol production from all feedstock sources should not be counted on for more than 10 percent of current gasoline demand. Accordingly, ethanol by itself is not likely

to transform either the transportation or agricultural sectors of the economy. It will also not free the nation from foreign oil dependence, substantially increase total employment, or close the federal deficit. Moreover, it is not clear that ethanol is the best alternative fuel option for the nation.

Nonetheless, the ethanol industry has responded effectively to the offer of federal tax incentives and is making a growing contribution to the national automotive fuel supply. Considerable private investment has been lured to the industry by the promise of a market created by the tax incentives. While small by national standards, fuel ethanol has achieved public acceptance and has begun making a tangible contribution toward several areas of national interest.

Accordingly, we believe that it would not be appropriate to prematurely terminate the federal incentives. In good faith, the private sector has taken the action desired by the government in establishing the incentives. Investment decisions were made with the understanding that the incentives would be in place for several years. Removing the incentives at a time when ethanol remains uncompetitive with gasoline could be viewed as a break in faith that would not be justified by any expectation of major budget savings or economic efficiency gains and could damage private sector response to future government initiatives.

We do not believe, however, that the benefits provided the nation by the fuel ethanol industry warrant an increase in the incentives beyond that already available. The contributions made by the ethanol industry are now limited and are likely to remain so in the future. Further, combined federal and state subsidies ar ufficient to make ethanol competitive.

While we believe a reduction or termination of the incentives would not represent good policy at this time, we believe that the need for the incentives should be periodically reviewed. If relative production costs between gasoline and ethanol narrow appreciably, federal incentives would no longer be essential to ethanol marketing. At such time, the role of the federal incentives would be completed and the ethanol industry should be expected to stand on its own. If the industry is still not competitive by 1992 when the incentives' are scheduled to expire, continuation of the incentives will have to be seriously questioned. Among the factors which would have to be considered at that time would be the incentives' cost to the government, the volume of outstanding government loan guarantees to alcohol plants, and the industry's national energy security value.

AGENCY COMMENTS

We provided a draft copy of this report to the Departments of Agriculture, Energy, and Treasury for official comment. Agriculture chose not to provide official comments. The Department of Energy agreed with our findings and conclusions,

suggesting only editorial changes. The changes are reflected in the report. Treasury, on the other hand, disagreed with our conclusion that the tax incentives should continue through 1992 as currently scheduled. It also suggested that a number of our findings were misleading. The Departments of Energy's and Treasury's comments are incorporated as appendices III and IV.

Treasury's position that the incentives should not be continued through 1992 is based on its view that oil and gasoline decontrol completed in January 1981 made the alcohol fuel tax incentives obsolete. Treasury believes that the principal rationale for the incentives was to enable alcohol fuels to compete with the artificially low gasoline prices that resulted from price controls on crude oil. Treasury believes that the need for the special alcohol fuel incentives was eliminated, once the price controls were removed and overall business investment incentives, such as accelerated depreciation, were put in place. In this context, Treasury believes that continuing the incentives diverts capital resources to less productive uses thereby making the nation poorer.

We believe that Treasury's disagreement, which is based on one area of economic theory, ignores several important points. First, a strict application of economic theory does not consider the national security benefits that accrue to building an alternative fuels industry that could help protect the nation against future imported oil supply disruptions. In this context, while it may not be economically efficient to develop an alcohol fuels industry in the short term, having such an industry in place could ultimately be important to the nation if an emergency occurs.

Second, Treasury ignores the economic doctrine of infant industries. We agree that the marketplace is the most efficient allocator of resources in the short term and that incentives distort this allocation. However, we believe that to initiate and develop an industry that may ultimately be a valuable, self-sustaining component of the economy, it may be necessary to provide special incentives over a relatively short period of time. The alcohol fuels industry is in this category and is attempting to develop as a competitor to the well established gasoline industry. In enacting the alcohol fuels tax exemption legislation, the Congress gave the alcohol fuels industry a reasonable period to develop as a viable competitor in the marketplace. We agree that after the period ends continuing the subsidy should be seriously questioned. Contrary to Treasury's view, we believe that a short-term disturbance to the marketplace is justified to give the industry a chance to develop.

Finally, we also believe that Treasury's view ignores the fact that businesses and individuals have invested large sums of money in alcohol fuel plants with the expectation that the government would provide the incentives until 1992. As we

said earlier, terminating the incentives before the scheduled expiration date could be viewed as a break in faith.

Treasury made a number of other comments on specific aspects of the report and we have made changes where appropriate.

ORGANIZATIONS CONTACTED DURING REVIEW

FUEL ALCOHOL PRODUCERS AND DISTRIBUTORS

Archer Daniels Midland Company
Pekin Energy Company
A.E. Staley Manufacturing Company
Publicker Industries, Inc.
New England Ethanol Products
South Point Ethanol
Grain Power, Inc.
American Gasohol Refiners, Inc.
Kentucky Agri Energy
Midwest Solvents, Inc.

ASSOCIATIONS

Renewable Fuels Association
National Alcohol Fuel Producers Association
American Automobile Association
American Petroleum Institute
National Petroleum Refiners Association
National Corn Growers Association
Society of Independent Gasoline Marketers of America
Service Station Dealers of America
Coordinating Research Council
Corn Refiners Association
Independent Liquid Terminals Association
Highway Users Federation for Safety and Mobility
American Association of State Highway and Transportation Officials
Steel Tank Institute

FEDERAL AGENCIES AND LABORATORIES

Department of Energy
Department of Agriculture
Department of the Treasury
- -Bureau of Alcohol, Tobacco, and Firearms
- -Internal Revenue Service
- -U.S. Customs Service

Department of Transportation - Federal Highway Administration
Department of Commerce
- -Bureau of Economic Analysis
- -Bureau of the Census

Department of Labor - Bureau of Labor Statistics
Department of State
Office of the United States Trade Representative
Oak Ridge Associated Universities
Battelle Memorial Institute
Congressional Research Service
Congressional Budget Office
National Petroleum Council

STATE GOVERNMENTS, ORGANIZATIONS, AND UNIVERSITIES

National Governors Conference
Midwest Governors Conference

Arizona
Arkansas
California
Colorado
Florida
Illinois
Indiana
Iowa
Kansas
Kentucky
Michigan
Minnesota
Mississippi
Montana
Nebraska
New Hampshire
New Mexico
North Dakota
Ohio
Oklahoma
South Carolina
Texas
Utah
Virginia
Washington
Wyoming
University of Illinois
University of Missouri

FINANCIAL SERVICE COMPANIES
Merrill Lynch Capital Markets
Strud Nash Associates
Piper, Jaffray and Hopwood, Inc.
Drexel Burnham Lambert, Inc.

COMPANIES INVOLVED WITH FUEL AND CHEMICAL STORAGE
Paktank Corp
Chicago Bridge & Iron Company
Halliburton Company
Eaton Metal Products Company
Owens-Corning Fiberglass Corporation
Mobil Corporation
Gulf Refining & Marketing Company
Texaco, Inc.

OTHER ORGANIZATIONS
Energy Ventures Analysis, Inc.
Energy and Environmental Analysis, Inc.
Interbras
Davis and McLeod
Ethyl Corporation
Information Resources, Inc.
Leva, Hawes, Symington, Martin and Oppenheimer
Rock Island Refining Corporation

APPENDIX I

Pincas Jawetz - Consultant
United Bio-Fuel Industries, Inc.
Mack Trucks, Inc.
Cummins Corporation

ASSUMPTIONS AND ANALYTICAL APPROACH USED IN PREPARING SAFURE COST COMPARISON

As we discussed in chapter 5, assumptions and analytical approach are crucial to any SAFURE cost analysis. In preparing our cost analysis, we considered only actual government costs. We compared estimated marginal costs for existing corn storage and SPR programs with an alternative SAFURE scenario. Because precise and reliable data was not available in all cost categories, we made estimates based on the best available information. We also made a number of general assumptions to simplify our analysis as listed below.

--The cost of converting corn to ethanol would be in line with those costs experienced during the USDA pilot corn conversion program.

--Corn for ethanol conversion would likely come from the short-term nonrecourse loan program. We assumed that once corn was obtained by the government through loan default, it was converted to ethanol immediately without being sent to corn storage.

--In the absence of precise estimates regarding the average time corn spends in storage under existing programs, we assumed that corn was disposed of after 4 years in government storage.

--SAFURE ethanol would be used to make regular unleaded gasoline during a petroleum supply disruption. Therefore, based on our calculations, it displaces 1.17 gallons of petroleum per gallon of ethanol used. This considers petroleum displacement only. Any natural gas, coal, and electricity that might have been used in ethanol production were not included in this calculation since they are not substitutes for petroleum in the transportation sector.

In addition to these general assumptions, we made a number of other specific assumptions relating to individual cost elements in our cost comparison. These specific assumptions are provided as explanatory footnotes to the cost comparison table which is shown on the next page.

Illustrative Government Costs

Cost category	Existing programs	SAFURE
Corn acquisition (defaulted loan value)	$2.65[a]	$2.65
Interest lost through loan default	.20[b]	.20
Corn handling (in and out charges)	.14[c]	.14
Corn storage (4 years)	1.32[d]	-
Corn transportation	.20[e]	.20
Total	4.71	3.19
Conversion to ethanol	-	1.83[f]
Ethanol transport to storage	-	.16[g]
Ethanol storage	-	.39 to .83[h]
Total	4.71	5.57 to 6.01
Oil acquisition	2.09[i]	-
Oil transport	.05[j]	-
Oil storage	.32[k]	-
Total gross cost (excluding corn sale credit)	$7.17	$5.57 to $6.01

[a]The 1983 federal loan rate for corn was $2.65 per bushel. The government acquires corn when the loan is defaulted; therefore, the cost of the corn to the government would be $2.65.

[b]The interest rate USDA charged on crop loans was 10-percent simple interest per year. The amount of interest lost on a 9-month (the standard loan period) loan of $2.65 would therefore be $.20.

[c]Estimate by USDA officials.

[d]We assumed that after corn is defaulted to the government it spends 4 years in government storage. Current expenses for government storage are about $.33 per year. Over 4 years, storage costs would reach $1.32.

[e]Estimate by USDA officials.

[f]This cost element is based on the experience during USDA's pilot corn to ethanol conversion program. USDA paid an average of $.70 a gallon to convert off-grade corn to ethanol. We normalized this cost to reflect the greater volume of ethanol that could be expected from higher quality corn and established a projected cost of $.73 a gallon. Multiplied by the expected yield of 2.5 gallons of ethanol per bushel of corn, the cost per bushel is $1.83. This value does not reflect the value of co-product which USDA allowed the distillers to keep as part of the conversion agreements.

[g]In establishing this cost element, we used DOE's estimated transport cost of $.064 per gallon to get the ethanol from the distillery to storage. Again, multiplied by an average yield of 2.5 gallons per bushel, the cost per bushel is $.16.

[h]This ethanol storage cost figure uses an estimated total cost of storage acquisition of between $6.50 and $14 per barrel of ethanol. Accordingly, we calculated this cost as being the cost of storage acquisition ($6.50 to $14 per barrel) divided by 42 gallons per barrel times 2.5 gallons per bushel, or between $.39 and $.83.

[i]This cost element assumes that SPR oil is acquired at $30/barrel. Further, we calculated that each gallon of ethanol can displace 1.17 gallons of oil when used to produce regular grade unleaded gasoline at the refinery. Accordingly, we calculated that it would cost $2.09 to buy enough SPR oil to make the same amount of gasoline displaced by ethanol produced from a bushel of corn.

[j]DOE estimated oil transportation costs at $.017 per gallon. We normalized this cost to reflect the costs of transporting the amount of gasoline displaced by ethanol produced from a bushel of corn or $.017 per gallon of oil times 1.17 gallons of oil per gallon of ethanol times 2.5 gallons of ethanol per bushel of corn, or $.05.

[k]This SPR storage cost figure uses an estimated average total cost of storage acquisition of $4.54 per barrel of oil. We once again normalized this cost to reflect ethanol's full oil saving potential. Accordingly, we calculated this cost as being $4.54 per barrel divided by 42 gallons per barrel times 2.5 gallons per bushel times 1.17 gallons of oil displaced per gallon of ethanol, or $.32.

APPENDIX III

Department of Energy
Washington, D.C. 20585

FEB 8 1984

Mr. J. Dexter Peach
Director, Resources, Community and
Economic Development Division
U.S. General Accounting Office
Washington, D.C. 20548

Dear Mr. Peach:

The Department of Energy (DOE) appreciates the opportunity to review and comment on the GAO draft report entitled "Importance and Impact of Federal Alcohol Fuel Tax Incentives." DOE believes that the Alcohol Fuels Program is a sound Federal effort to provide the Nation an alternative which displaces petroleum and its derivatives for use in automotive transportation.

The draft GAO report documents, in a conservative and fair approach, that this belief is well founded and finds that the Federal tax incentives have been and will continue to be vital to the alcohol fuel industry's growth. The impact of these Federal subsidies on the overall economy has been small and the net revenue impact on the Government is not large. DOE further agrees with this report's conclusion that sufficient justification exists to continue the incentives until the expiration in 1992.

Comments of an editorial nature have been provided directly to members of the GAO audit staff. DOE appreciates the opportunity to comment on this draft and trusts that GAO will consider the comments in preparing the final report.

Sincerely,

Martha O. Hesse
Assistant Secretary for
Management and Administration

APPENDIX IV

DEPARTMENT OF THE TREASURY
WASHINGTON, D.C. 20220

ASSISTANT SECRETARY

FEB 06 1984

Dear Mr. Anderson:

Enclosed are the Treasury Department's comments on the GAO draft report entitled "Importance and Impact of Federal Alcohol Fuel Tax Incentives."

The Treasury Department finds no basis for the GAO's conclusion that there is sufficient economic justification to continue the tax subsidies to the alcohol fuel industry until their currently scheduled expiration date. When these provisions were enacted, Congress believed that it was important to encourage the development of energy sources other than petroleum products for use in motor fuel. At that time, price controls were in effect on crude oil, and alternative fuels had difficulty competing with oil at its artificially low price.

The decontrol of oil and gasoline prices, completed in January, 1981, and the business investment incentives enacted in the 1981 Economic Recovery Tax Act, in particular, the Accelerated Cost Recovery System, have removed barriers to investment in the alcohol fuels industry. These changes have removed the principal rationale for providing targeted tax subsidies to particular industries.

If subsidies to alcohol fuels are obsolete and merely divert capital to less productive uses, then the finding that they are "effective" in increasing investment in the alcohol fuel industry does not justify their continuance. As the GAO draft report notes, the substitution of higher cost ethanol for gasoline "... will reduce overall economic efficiency and thereby most likely lead to a contraction in output rather than an expansion."

The GAO draft report is also misleading in other respects. The enclosed comments provide details and suggest changes that should be incorporated into the final report.

Sincerely,

John E. Chapoton
Assistant Secretary
(Tax Policy)

Mr. William J. Anderson
Director
General Government Division
General Accounting Office
Washington, D.C. 20542

Enclosure

Comments on Draft GAO Report: "Importance and Impact of Federal Alcohol Fuel Tax Incentives"

The draft GAO report concludes that "Based on its assessment of presently identifiable costs and benefits surrounding the federal fuel ethanol tax incentives, GAO believes it would be appropriate to continue these incentives until their currently scheduled expiration date." By "costs" GAO means the tax revenue lost from the subsidy. By "benefits" GAO means the lower outlays for agricultural support programs that occur from the ethanol industry's increased demand for corn. Other benefits identified in the report include a "modestly enhanced national energy security" and the contribution "to the public good by providing an alternative to the petroleum based automobile fuels.

Because of certain problems with GAO's analysis, we believe that their conclusion is unfounded. If the report is intended to be an assessment of the benefits and costs of tax subsidies to alcohol fuels, it is seriously deficient. GAO did not correctly identify either the benefits or the costs of the subsidies. Thus, GAO risks misleading the Congress when it states that its conclusions are based on such an assessment.

GAO's report attempts to answer a set of questions posed to it by Congress. Its assessment includes an accounting of some of the budget effects of subsidies to ethanol. If this accounting had been done correctly, it would have provided Congress with valuable information on the magnitude of the subsidies to this industry. Unfortunately, GAO has included the budget effects of some of the subsidies to the alcohol fuel industry and ignored others.

GAO briefly mentions, but then fails to develop, the main issues in the discussion of selective subsidies to particular industries--whether the resources diverted by the subsidies have a lower or higher value to the society in their new use than in their old one. If the value in the new use is lower, as it appears to be in the alcohol fuels case, then workers, capital and initiative are diverted from other more productive uses elsewhere in the economy. As a result, the economy as a whole is worse off as a result of the subsidy.

GAO points out that ethanol is not competing in a free marketplace and that subsidies to ethanol should be addressed in the context of subsidies to other industries. Apparently, GAO believes that it has viewed subsidies to ethanol in this context. Thus, we find it odd that GAO, as the watchdog of government waste, did not conclude that Congress take steps to review subsidies to all industries and to remove those that are no longer necessary. Instead, GAO concluded that subsidies to the ethanol industry should be continued.

In addition to these general comments on the report's conclusions, there are other inaccurate or misleading statements which are worth correcting.

cover summary. GAO states that " the net revenue impact on the government is not large." This statement is misleading, because it is not clear what GAO is comparing the revenue loss with. If GAO believes that the revenue loss is small in the absolute sense, then it should then try to determine whether it is large in a relative sense. For example, the revenue loss per barrel ($21) may be considered to be high compared to the current price of oil.

[GAO COMMENT: A change was made to clarify our views.]

cover summary: GAO states that "The cost of the subsidy is offset by savings in agricultural price support programs due to the added demand for corn for ethanol production." On page iii, GAO adds that "...the ethanol industry's demand for corn reduced federal agricultural support outlays by a projected $129 million while the incentives cost $114 million in lost-tax revenue. These factors alone would suggest that fuel ethanol production resulted in about a $15 million gain in 1982 Federal revenues." These statements and similar statements made elsewhere in the report are misleading. The problem is that these factors cannot be considered alone. The true cost of the subsidy is the efficiency loss, not the budget effect.

Further, if GAO wishes to compare the budget effects of subsidies to alcohol fuels, then it should include the costs of all federal subsidies to ethanol production, including those it mentions on page 1 (loan guarantees, cooperative agreements, project feasibility study grants, and research and development grants). In addition, if GAO includes the reduction in agricultural oulays due to the increase in corn prices, it should also include the increase in outlays for other programs tied to the cost-of-living. Further, GAO notes but does not account for the fact that the Federal government's acquisition of corn is an outlay in 1 year, but its sale increases receipts in another year.

[GAO COMMENT: A change was made both in the cover summary and in the body of the report to clarify our views.]

cover summary: GAO states "Balancing the incentives' costs and benefits, GAO believes there is sufficient justification to continue the incentives until their currently scheduled 1992 expiration date." This statement is incorrect and the conclusion is unfounded. GAO has addressed a specific set of questions posed to by Congress. The answers to the questions do not constitute an assessment of costs and benefits. Without such an assessment, their conclusion is unwarranted and may mislead the Congress.

[GAO COMMENT: As discussed in the agency comments section of the report, we disagree with Treasury's views.]

p. v. GAO states that " the tax subsidies received by conventional energy industries such as oil and gas dwarf those received

by the fuel ethanol industry and other conservation and alternative energy sources." This comparison and similar comparisons made in Chapter 6 are faulty. The price of oil is determined in the world market. Thus, U.S. production incentives have very little effect on the price of oil, and on ethanol's ability to compete with gasoline.

The comparison of absolute revenue losses is also irrelevant because it neglects the fact that the oil and gas industry is much larger than the fuel ethanol industry and other conservation and alaternative energy sources industries. GAO has also failed to mention that the oil industry is subject to a special tax--the crude oil windfall profit tax--which reduces the benefits it receives from other provisions of the tax code. Thus, if GAO compared the net tax benefits per dollar of investment or sales, their conclusion would be reversed.

[GAO COMMENT: Changes were made to this section to clarify our views.]

p. 45. GAO states that "...fuel ethanol contributed to a more positive Federal revenue balance by generating fuel ethanol import duties." Although import duties are a source of revenue, it is incorrect to attribute these revenues to domestic ethanol production.

[GAO COMMENT: We included this item in our consideration of net federal revenues only to offset the tax loss associated with using gasohol made with imported ethanol. This was the duty's purpose and hence is properly included in our analysis.]

p. 67. GAO states that "...because of the floor effectively placed under corn prices by agricultural support programs, the fuel ethanol industry has dealt with Government intervention not faced by conventional industries." This statement is incorrect. Conventional energy industries have been and some still are subject to government regulation. For example, the petroleum industry was subject to price and allocation regulations for many years; the gas industry is only partially decontrolled; and the coal industry is subject to pollution regulations.

[GAO COMMENT: Changes were made to this section to clarify our views.]

p. 83. GAO states that the government has reduced the price of feedstock for gasoline through production tax incentives, it has kept the price of feedstock for ethanol high by maintaining a floor under the price of corn. This statement is misleading. The price of oil is determined in the world market. Subsidies to domestic energy production have virtually no effect on the world price of oil.

[GAO COMMENT: This section of the report was modified to improve the clarity of our views.]

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