United States General Accounting Office

GAO

Report to the Chairman, Committee on Ways and Means, House of Representatives

March 1997

TAX POLICY

Effects of the Alcohol Fuels Tax Incentives

GAO/GGD-97-41

GAO

United States
General Accounting Office
Washington, D.C. 20548

General Government Division

B-271977

March 6, 1997

The Honorable Bill Archer
Chairman, Committee on Ways and Means
House of Representatives

Dear Mr. Chairman:

In the late 1970s and early 1980s, Congress enacted tax incentives for biomass-derived alcohol fuels.[1] Proponents maintained that the incentives would reduce U.S. dependence on petroleum imports and provide an additional market for U.S. agricultural products. Subsequent environmental legislation has increased the demand for alcohol fuels. These alcohol fuels currently are blended with gasoline to increase its oxygen content in certain areas of the country that have mandatory minimum oxygen requirements for transportation fuel.[2]

In recent months, Congress has debated the need for continuing to provide tax incentives for alcohol fuels. In this context, you asked the following questions relating to tax incentives for alcohol fuels, which we address in this report:

- Whom do the incentives benefit and disadvantage economically?
- What environmental benefits, if any, have the incentives produced?
- Have the incentives increased the nation's energy independence?
- To what extent has the partial exemption from the excise tax for alcohol fuels reduced the flow of revenue into the Highway Trust Fund?

Background

In the 1970s and 1980s, the federal government adopted numerous policies to encourage the use of alternatives to imported fossil fuels.[3] Among these policies were tax incentives that were specifically targeted at the use of alcohol fuels derived from biomass materials. Supporters claimed that the tax incentives would not only reduce U.S. reliance on imported petroleum but would also help support farm incomes by finding another market for the agricultural products from which alcohol can be produced, such as corn. In the late 1980s, Congress' attention turned to the possible benefits of using alcohol fuels as additives to fossil-based fuels to reduce urban air

[1]Biomass-derived alcohol fuels are chemical compounds made from nonfossil material of biological origin and constitute a renewable energy source.

[2]Ethanol, which is an alcohol fuel, has been used traditionally as a gasoline extender and octane enhancer mainly in those areas of the Midwest where it is produced.

[3]See appendix I for a chronology of events and federal legislation relating to alcohol fuel use.

pollution. The Clean Air Act Amendments of 1990 required that transportation fuel used in some urban areas have a minimum oxygen content to reduce these areas' levels of carbon monoxide and ground-level ozone. In the early 1990s, congressional attention turned to the possible benefits of using renewable energy sources, including alcohol fuels, to reduce emissions of greenhouse gases that may contribute to global warming.[4]

Tax Incentives for Alcohol Fuels[5]

The federal tax incentives that are specifically targeted for motor fuels containing biomass alcohol are (1) a partial exemption from the federal motor fuel excise taxes that are earmarked for the Highway Trust Fund[6] and (2) a set of three credits against the income tax. The partial excise tax exemption has been much more important than the income tax credits in terms of the amount of tax benefits claimed.

The size of the partial exemption depends on how much and what type of alcohol is contained in each gallon of fuel. Virtually all of the excise tax exemptions for alcohol fuels claimed in 1995 were for fuel mixtures of gasoline and ethanol. The partial exemption lowers the after-tax cost of the gasoline that fuel blenders mix with ethanol. Each of the three income tax credits is directed at a distinct line of business. The "alcohol mixtures credit" allows blenders to reduce their income taxes by 54 cents for each gallon of biomass ethanol that they use in their blended fuel. The "alcohol credit" allows businesses to reduce their income taxes by 54 cents for each gallon of "qualified" biomass ethanol fuel (which must contain at least 85-percent alcohol) that they sell at the retail level or use themselves.[7] Finally, the "small ethanol producers credit" allows businesses that produce less than 15 million gallons of ethanol for fuel each year to reduce their income taxes by 10 cents for each gallon produced. Taxpayers who

[4]The preponderant greenhouse gas is water vapor. Other greenhouse gases are carbon dioxide, methane, and nitrous oxide. Greenhouse gases are emitted when a fossil fuel, such as gasoline, natural gas, or coal, or a renewable fuel is combusted. There are also substantial natural sources of greenhouse gases in addition to human-made sources. Greenhouse gases collect in the earth's atmosphere, trapping heat and, some believe, raising the earth's surface temperature. (See Energy Information Administration, Emissions of Greenhouse Gases in the United States 1995, DOE/EIA-0573(95), October 1996, for more information.)

[5]This section provides only a summary description of the tax incentives. Details and estimates are provided in appendix II.

[6]The Highway Trust Fund was established in 1956 as an accounting mechanism to finance the federal-aid highway program.

[7]"Qualified" biomass ethanol fuel is often referred to as "neat" alcohol fuel. Blenders or producers of neat alcohol fuel that use biomass alcohols other than ethanol can earn income tax credits or excise tax exemptions equal to 60 cents for each gallon of alcohol used.

claim the alcohol mixtures credit or the alcohol credit must reduce their credits by the amount of the partial excise tax exemption that is associated with the same fuel.

Current Alcohol Fuel Use

According to U.S. Department of Energy (DOE) data, almost all of the alcohol that was used as transportation fuel in the United States in 1995 was either ethanol or alcohol that was used to make methyl tertiary butyl ether (MTBE), which is a fuel additive derived from methanol. In 1995, MTBE accounted for about 3 percent of the total transportation fuels consumed and ethanol accounted for less than 1 percent.[8] Alcohol fuels usually are blended with gasoline, where they serve as oxygenates, octane enhancers, and/or fuel extenders.[9]

Currently, 95 percent of the U.S. production of ethanol fuel is derived from corn. In contrast, the methanol used to produce MTBE is currently derived from natural gas because that is how it can be produced most cost-effectively. Despite the fact that nonbiomass MTBE does not qualify for the tax incentives, according to DOE, it is more widely used than ethanol. This is, in part, because MTBE's lower volatility, compared with ethanol, makes it a more acceptable ingredient to blenders of reformulated gasoline (RFG)[10] in summer months. MTBE's lower volatility permits the gasoline fraction of RFG to have a higher volatility than otherwise would be permitted in achieving the RFG standard. In addition, ethanol has transportation problems that MTBE does not have (see app. IV), and MTBE may be a cheaper oxygenate than ethanol.

Results in Brief

The value of the ethanol tax incentives is shared among different groups in the economy, including alcohol fuel blenders, ethanol producers, and corn farmers. The tax incentives effectively lower the blenders' after-tax cost of using ethanol when they mix ethanol with gasoline. However, the blenders' increased demand for ethanol raises the market price of ethanol above what it would have been without the incentives. For this reason, the after-tax cost to the blenders is not lowered by the full value of the

[8]Table III.1 in appendix III shows the composition of U.S. transportation fuel consumption from 1992 to 1996. Table III.2 shows the percentage share of each fuel, by air quality area.

[9]In addition, a negligible amount of alcohol fuel is used as a fuel in alternative-fuel vehicles.

[10]RFG, which is a subset of oxygenated fuel, is gasoline whose composition has been changed (from that of conventional gasoline sold in 1990) to (1) include combustion-enhancing oxygenates and (2) reduce emissions of the ozone precursors, volatile organic compounds and nitrogen oxides, and toxic components. (Toxic components of fuel include benzene, butadiene, and other harmful substances.)

incentives. Other groups in the economy, such as ethanol producers and corn farmers, share in the value of the incentives because the blenders' increased demand for ethanol increases the prices and sales of the products of these groups.

According to the analysts we contacted or whose work we read, the tax incentives allow ethanol to be priced to compete with substitute fuels, such as gasoline and MTBE; thus, without the incentives, ethanol fuel production would largely discontinue. This information implies that ethanol producers benefit from the tax incentives because the blenders' demand for ethanol raises its price at least high enough to cover production costs. However, we did not estimate how much of the value of the incentives is shifted to ethanol producers. According to economic theory, the extent to which the benefits of the tax incentives are shifted depends on (1) the responsiveness of ethanol supply and demand to price changes and (2) whether producers control prices and, if so, how much control they have over prices that they charge. We could not obtain sufficient information on these factors to quantify the shift in value.

The tax incentives benefit farmers who grow corn and may benefit farmers who grow crops such as soybeans by increasing the prices that they receive for these products. According to analysts at the U.S. Department of Agriculture (USDA) and Congressional Budget Office (CBO), corn farmers benefit because the tax incentives create a demand for ethanol by the blenders, which in turn creates a demand for corn by the ethanol producers. Corn prices and incomes are higher as a result, providing incentives to farmers to plant corn on idle land and switch other crop acreage (mainly soybean acreage) into corn production. Soybean farmers may also benefit because lower soybean production is likely to raise the price of soybeans. However, by raising the prices of corn and soybeans, the tax incentives may cause farmers who raise livestock to pay higher prices for feed. We have not estimated the size of these effects on prices and income or the net effect on aggregate farm income because recent changes in government farm policy, which allow more flexibility in farmers' planting decisions, have not been in place long enough to provide information on how farmers respond to price changes under the new policy. The recent changes in government farm policy may cause farmers' responses to price changes to differ from historical experience because farmers' planting decisions will now be based more on market forces than on government programs.

The tax incentives may affect producers and consumers of fuels that substitute for ethanol and the consumers of some food products. The producers of some fuels, such as gasoline and MTBE, may be adversely affected because increased competition from ethanol may cause the producers of these fuels to lower their prices. However, the available evidence indicates that the decrease in the price of a gallon of fuel is likely to be small. Furthermore, the price decrease that adversely affects producers will benefit the consumers of these fuels. Although the producers receive slightly less revenue from each gallon they sell because of the price decrease, consumers pay slightly less for each gallon that they purchase. Similarly, the price increases that benefit farmers may adversely affect the consumers of some food products. As previously noted, the tax incentives may benefit farmers by causing the prices of some crops to be higher, which could mean that consumers would have to pay slightly higher prices for some food products. Thus, if the prices of some food products are slightly higher due to the incentives, the benefit to consumers from slightly lower gasoline prices might be partly offset.

Available evidence, including the views of analysts we interviewed, indicates that the ethanol tax incentives have had little effect on the environment. The substitution of other fuels for ethanol, if the tax incentives were removed, would likely have little effect on air quality given current technologies for ethanol production. In areas where gasoline containing oxygenates is mandated to help meet existing air quality standards, the likely substitute for ethanol would be MTBE. Both ethanol and MTBE meet existing standards for gasoline containing oxygenates, and gasoline oxygenated with MTBE already has more than a 50-percent share of the market for gasoline containing oxygenates in areas where its use is required.[11]

In areas that already meet existing air quality standards, ethanol has been used mainly as a gasoline extender and octane enhancer. According to the analysts we interviewed, the elimination of ethanol use in these areas would be expected to result in little reduction in overall air quality. Because ethanol is difficult to transport, it traditionally has been used mainly where it is produced, in midwestern corn-farming states. In these areas, which generally meet existing air quality standards, the likely substitute for ethanol-blended gasoline would be conventional

[11]Ethanol also is used as an octane enhancer in gasoline. Refiners have other alternatives than using an oxygenate to increase the octane level of gasoline. However, in the absence of ethanol, at the current time, the oxygenate MTBE would likely supply almost the entire market for octane enhancers with no likely effect on air quality, according to officials at DOE and the Environmental Protection Agency with whom we spoke.

(unblended) gasoline. According to the best available data, if gasoline entirely replaced ethanol, gasoline use would likely increase by no more than 4 percent in the most ethanol-intensive state. According to the Environmental Protection Agency (EPA), even if ethanol use were eliminated, these areas would most likely continue to meet national ambient air quality standards.[12] However, according to analysts we interviewed, if ethanol use were eliminated there would likely be small changes in emissions in these areas that would have both positive and negative effects on air quality. A negative effect would likely be slightly increased carbon monoxide emissions. A positive effect would likely be slightly decreased emissions of ozone precursors.[13]

The effect on global environmental quality (i.e., global warming) through changes in greenhouse gas emissions that would occur if ethanol fuel were not subsidized is likely to be minimal. The net effect on the quantity and quality of greenhouse gas emissions from the ethanol fuel cycle versus from the conventional gasoline fuel cycle is not precisely known. However, according to the EPA analyst we interviewed, the global-warming effects of using ethanol are likely to be no better than, and could be worse than, those of using conventional gasoline. Furthermore, even if current ethanol use were to contribute to lowered greenhouse gas emissions, ethanol is such a small part of total U.S. fuel use that global environmental quality should not be significantly affected if ethanol use were discontinued.

Although available evidence suggests that the tax incentives for alcohol fuels increase ethanol fuel use, it also indicates that these incentives do not significantly reduce petroleum imports. Therefore, the tax incentives do not significantly contribute to U.S. energy independence. Today's petroleum imports account for about 20 percent of the total U.S. energy consumption and about 50 percent of the U.S. petroleum consumption. This consumption is about the same as the petroleum imports accounted for in 1978, before ethanol incentives were offered (see table III.3 in app. III). By comparison, ethanol currently accounts for less than 1 percent of U.S. motor vehicle fuel consumption.

In addition, ethanol tax incentives have not significantly enhanced U.S. energy security. This lack of increased energy security is because the tax

[12]EPA has developed the national ambient air quality standards based on all of the known health effects from air pollutants.

[13]The most commonly used ethanol-gasoline blends release more ozone precursor compounds than does conventional gasoline. These precursors combine to produce ozone in the presence of sunlight. Ozone concentrations most often exceed the ozone standard during summer months.

incentives have not created enough usage to reduce the likelihood of oil price shocks and their consequences, which are increased U.S. fuel prices and reduced economic output and employment. As we recently reported, oil consumption, not oil imports, creates vulnerability to oil price shocks.[14] If technological breakthroughs were to occur and the resulting increased ethanol production lowered oil's share of total U.S. fuel consumption significantly, then energy security could be improved. The impact of an increase in the worldwide price of oil on U.S. fuel prices depends chiefly (1) on the share of oil in total U.S. fuel consumption and (2) on whether fuel production from alternative sources could be expanded rapidly in the event of an oil price shock. However, ethanol currently constitutes less than 1 percent of the total U.S. fuel consumption and, according to DOE, cannot be rapidly expanded with existing technologies.

We estimate that the partial exemption for alcohol fuels reduced motor fuels excise tax revenues by about $7.1 billion from fiscal years 1979 to 1995.[15] We estimate that about 108 billion gallons of alcohol fuel mixtures were sold over that period and that about $7.5 billion of motor fuels excise tax revenues were collected on the sales of this fuel. Without the partial exemption, the amount of tax paid on an equivalent gallonage of gasoline would have been about $14.6 billion. Virtually all of the revenue forgone due to the exemption is money that otherwise would have been earmarked for the Highway Trust Fund. In fiscal year 1995, the gross federal highway user tax receipts for the Highway Trust Fund were $23.1 billion. We estimate that without the partial exemption for alcohol fuels, an additional $617 million of revenue would have been allocated to the Highway Trust Fund for fiscal year 1995.

Objectives, Scope, and Methodology

To meet our first objective of determining whom the ethanol tax incentives benefit and disadvantage economically, we relied on economic theory and the empirical literature to describe the factors that determine how the reduced demand for ethanol would likely affect (1) the prices of various goods and (2) the incomes and profits derived from the production

[14]Energy Security: Evaluating U.S. Vulnerability to Oil Supply Disruptions and Options for Mitigating Their Effects (GAO/RCED-97-6, Dec. 12, 1996).

[15]These estimates are based on excise tax data compiled by the Internal Revenue Service and published data on ethanol fuel production. Unless otherwise noted, all revenue figures presented in this report are stated in constant 1996 dollars. Appendix II contains a discussion of our estimating methodology in which we note some reasons why this estimate may slightly overstate the revenue loss.

of those goods. We used our prior work,[16] studies of the ethanol industry, and estimates of consumer demand for ethanol to provide, where possible, an indication of the direction and broad magnitude of changes in prices, incomes, and profits that would likely occur if the incentives were removed. We did not try to determine who may have paid for the tax incentives in the form of higher taxes, less federal spending on other programs, or increased government borrowing. Nor did we look at any economywide efficiency losses resulting from the resource reallocations that have been made in response to the tax incentives.

To meet our second objective of determining what, if any, environmental benefits the incentives have produced, we relied on the empirical literature on fuel characteristics and emissions and air quality and also on interviews with energy and air quality analysts. Our major sources of information were DOE and EPA. We relied on fuel usage data and on expert opinion from DOE, EPA, and the U.S. Department of Transportation to determine what percentage of total fuel consumption ethanol represents and what fuels would likely have been used in place of ethanol if tax incentives had not existed. We used these sources to describe the differences in vehicle emissions with and without ethanol fuels and the likely effects of these differences on environmental quality.

To meet our third objective of determining whether the incentives have increased the nation's energy independence, we examined DOE data on U.S. energy consumption and petroleum imports to determine if the incentives had reduced U.S. reliance on imported petroleum. Concern over this reliance had been one of the reasons Congress originally adopted the incentives. We also relied on the energy economics literature, including work by DOE and Resources for the Future, and on data on fuel supply and fuel prices, mainly by DOE, to determine if U.S. vulnerability to oil price shocks were likely to be different if tax incentives for ethanol use had not existed.

To meet our fourth objective of determining to what extent the partial exemption from the excise tax for alcohol fuel reduced the flow of revenue into the Highway Trust Fund, we used Internal Revenue Service (IRS) excise tax data and published data on alcohol fuel production to estimate the amounts of excise tax exemptions that have been claimed for alcohol fuels for fiscal years 1979 to 1995. We also compiled estimates made by the Department of the Treasury and the Joint Committee on

[16]GAO/RCED-97-6; Motor Fuels: Issues Related to Reformulated Gasoline, Oxygenated Fuels, and Biofuels (GAO/RCED-96-121, June 27, 1996); and Ethanol Tax Exemption (GAO/RCED-95-273R, Sept. 14, 1995).

Taxation of the projected future revenue costs of both the partial excise tax exemptions for alcohol fuels and the alcohol fuels tax credits. We restated all of these estimates in terms of constant 1996 dollars. We spoke with analysts from Treasury and CBO to ensure that we correctly characterized the estimates presented in this report.

We conducted our review from March 1996 through November 1996 in accordance with generally accepted government auditing standards. We obtained written comments on a draft of this report from IRS and EPA, oral comments from Treasury and DOE, and both written and oral comments from USDA. Treasury's oral comments were provided by the Director of the Office of Tax Analysis and by economists from that office and from a tax legislative counsel at a meeting on November 22, 1996. USDA's oral comments were provided by the Deputy Director, Office of Energy and New Uses, Economic Research Service, and by policy analysts from that office and the Office of the Chief Economist at a meeting on November 21, 1996. DOE's oral comments were provided by policy analysts from the Offices of Energy Efficiency, Alternative Fuels, and Oil Policy; Fuels Development; and Technology Utilization on November 20, 1996. The written and oral comments are summarized and discussed at the end of this report.

The Ethanol Tax Incentives May Benefit or Disadvantage Certain Groups in the Economy

The groups that are legally required to pay a tax do not always enjoy the entire benefit of a tax incentive. The alcohol fuels tax incentives affect prices and incomes of other groups in the economy because they lower the after-tax cost of using ethanol, thereby increasing the demand for ethanol and causing changes in the price and production level of ethanol, as well as changes in the price and production level of other products. Some groups that do not claim the tax incentives would benefit if they paid lower prices or received higher incomes because of the tax incentives, while other groups would be adversely affected if they paid higher prices and received lower incomes. The positive and negative impacts of the tax incentives are shifted among groups in the economy through these price and income changes.

Although the tax incentives lower the after-tax cost of gasoline to ethanol blenders, the blenders do not enjoy the full benefit of the tax incentives. The analysts that we contacted, or whose work we read, agreed that the blenders' demand for ethanol raises the price of ethanol above what it would have been without the incentives, and that this price increase offsets part of the benefit that the blenders receive from the tax reduction.

As explained in the following sections of this report, the available data indicate that the incentives are shifted, in part, back to the ethanol producers as higher ethanol prices and back to farmers as higher corn prices. The incentives may also be shifted forward to consumers because an increase in the supply of ethanol-blended gasoline is likely to cause a small decrease in the price that consumers paid for motor fuels.

Ethanol Tax Incentives Benefit Ethanol Producers

Without the tax incentives, ethanol-blended gasoline currently cannot be priced to compete with the substitute fuels, and ethanol fuel production would largely discontinue. The ethanol producers benefit because the incentives create a demand for ethanol by the blenders that raises the price of ethanol at least high enough to cover production costs. This conclusion is based on recent estimates of ethanol production costs by USDA and on the opinions of analysts on the ethanol industry. This conclusion is also based on the results from simulation models of DOE's Energy Information Administration (EIA) that estimate the effect of removing the ethanol tax incentives.[17]

The incentives permit ethanol blends to be priced competitively with substitute fuels, such as gasoline and MTBE, even though the cost of producing ethanol with the current technology and corn prices exceeds the prices of these fuels. Because the incentives generally are equivalent to 54 cents per gallon of ethanol, the effective, or after-tax, price to the ethanol blenders is 54 cents per gallon less than the price charged by the ethanol producers. The ethanol producers can charge a price high enough to cover their costs, while blenders buy ethanol at an effective price that is competitive with substitute fuels.

If the ethanol tax incentives were eliminated, the effective cost of ethanol to the blenders would increase because they would not get a tax benefit from using the fuel. In this case, the blenders would be expected to purchase less expensive substitute products. As the blenders demand less ethanol, the price that ethanol producers can charge would decrease. If the price declined below production costs, some ethanol producers would likely stop producing ethanol. The large-scale ethanol producers with the lowest production costs might continue to produce ethanol over the short term, but, over the long term, the ethanol-fuel industry would largely discontinue. Some ethanol production for export might continue for a while without the federal tax incentives.

[17]See appendix IV for further discussion of the effect of the incentives on the ethanol industry.

We were unable to estimate the size of the benefit that ethanol producers receive. We could not make this estimate because we did not have information (1) on the responsiveness of ethanol supply and demand to price changes or (2) on whether ethanol producers control their prices, and, if so, how much control they have over their prices. The ethanol industry is dominated by a few large firms. Sixty-five percent of capacity is owned by the three largest firms, and the largest firm, Archer Daniels Midland, owns 50 percent of capacity. We did not have information on how prices are determined in an industry with this level of concentration. Consequently, we could not estimate how much of the value of the incentives is shifted from the blenders to the producers. We also did not have information on economies of scale or technological, managerial, or marketing advantages that individual ethanol producers may possess. Without any of this information, we did not know the extent, if any, to which the prices these producers were able to charge exceeded their production costs.

Ethanol Tax Incentives Are Likely to Benefit Farmers Who Grow Corn and Soybeans

The tax incentives benefit farmers who grow corn and likely benefit farmers who produce other crops, such as soybeans, by increasing the prices that they receive for these products. Conversely, the tax benefits may cause farmers who raise livestock to pay higher feed prices. The new farm policy, established in the Federal Agricultural Improvement and Reform (FAIR) Act of 1996, has not been in effect long enough to provide the information needed to make reliable quantitative estimates of the size of the tax incentives' effect on farm prices and income.

Corn farmers benefit from the tax incentives, according to analysts at USDA and CBO, because the tax incentives create a demand for corn by ethanol producers that raises the price of corn and the income derived from corn sales. In 1995, the industry used approximately 500 million bushels of corn to produce 1.3 billion gallons of ethanol. This usage represented about 6 percent of the total corn crop. Soybean farmers also likely benefit because the higher corn prices due to the incentives make growing corn more attractive than it would have been without the incentives, thereby reducing the acreage planted with soybeans, which is likely to raise soybean prices. However, livestock farmers may be adversely affected by the incentives because the higher corn and soybean prices may increase the cost of feeding their livestock.

In 1995, before the significant changes in farm policy introduced by the FAIR Act, we estimated, using various assumptions about ethanol use and

how the old farm policy would be implemented, that corn prices would decline by 6 to 9 percent and soybean prices by 3 to 5 percent if the incentives were removed.[18] We also estimated that net farm income, which combines the effect on crop and livestock farmers, would decline by 1 to 2 percent under the old policy.[19] The size of these price declines and the effect on net income is likely to be different under the FAIR Act. We have not estimated the effect of the tax incentives on farm income and prices because the FAIR Act has not been in place long enough to provide the information on how farmers respond to prices under the new policy. This information would be needed to make reliable estimates.

The FAIR Act affects (1) farm incomes by removing the link between income support payments and farm prices and (2) farm prices by giving farmers greater flexibility in making planting decisions. Before the FAIR Act, farmers received payments that depended on farm prices. That is, as prices dropped below a legislated level, farm payments increased. In addition, farmers were required to plant corn if they wanted to participate fully in the federal corn program. Under the FAIR Act, farmers receive annual, fixed but declining, payments regardless of farm prices. The FAIR Act gives farmers greater flexibility to make planting decisions because the act eliminates the requirement that farmers must plant corn to qualify for full payments under the federal corn program. The remaining farm program linked to prices under the FAIR Act is a program of government loans that may moderate the decline in farm incomes if market price declines are severe.

If the tax incentives were removed under the FAIR Act, corn prices would fall. However, the effect of removing the tax incentives on the size of the price decline may differ from the effect under the old farm policy. The increased planting flexibility under the FAIR Act makes it difficult to predict the size of the price decline. In addition, under the FAIR Act, farm support payments cannot increase in response to price declines to mitigate the effect on farm incomes. If the price falls far enough, farmers may offset some of the effect of the price decline through government loans. However, USDA believes that the price of corn is unlikely to fall far enough for the loans to be used to mitigate the effect of the price decline on farm incomes. USDA projects no outlays under the loan program in its current long-term budget projections.

[18]GAO/RCED-95-273R. We noted in this report that our assumptions about how farm policy would be implemented did not include the full range of policy alternatives that were available at that time. Under some of these alternatives, the decline in corn and soybean prices may have been smaller.

[19]See appendix IV for a description of how prices and incomes were estimated under the old farm policy.

Ethanol Tax Incentives May Benefit Consumers and Disadvantage Producers of Substitute Fuels

The tax incentives may benefit consumers of substitute fuels, such as gasoline and MTBE, and disadvantage producers of these fuels because the incentives increase the production of ethanol, which may cause a small decrease in the price of a gallon of the substitute fuels. This benefit to consumers from lower fuel costs may be partially offset by small increases in the prices of some food products due to the incentives.

If there were no tax incentives for ethanol, the fuel would no longer be used and other fuels would be used as substitutes. According to analysts at DOE, the oxygenate MTBE is likely to serve as a substitute for ethanol that is used as an oxygenate—i.e., mixed with gasoline to help meet air quality standards. According to these analysts, MTBE also may substitute for ethanol used as an octane enhancer in gasoline.[20] For ethanol that is used as a gasoline extender, the analysts said that more gasoline and less ethanol are likely to be used[21]

The effect of the tax incentives on the price of a gallon of MTBE is likely to be small. We have not estimated this effect, but the available evidence suggests that, if the incentives were removed, the increased demand for MTBE would cause only a slight increase in price. EIA estimates that, over the long term, removing the tax incentives would increase the difference in price between RFG, which would be made only with MTBE, and conventional gasoline by about 1 cent per gallon.

The effect of the tax incentives on the price of a gallon of gasoline also is likely to be small. Because most consumers consider ethanol blends close substitutes for gasoline, removing tax incentives would increase demand for gasoline by causing consumers to switch from ethanol blends to gasoline. Since ethanol currently makes up less than 1 percent of the total U.S. motor fuel consumption, removing the ethanol tax incentives is unlikely to have a large impact on prices. In 1988, the American Petroleum Institute estimated that the tax incentives for ethanol reduced the price of conventional gasoline by 0.27 percent.

The benefit to consumers from lower gasoline prices could be offset by any higher food prices due to the incentives. As previously discussed, the tax incentives may cause the prices of certain crops to be higher, which

[20]However, refiners have alternatives other than the addition of an oxygenate to increase the octane level of gasoline. The route chosen by each refiner will depend on the most cost-effective option that fits with their refinery's specific configuration, product slate, environmental requirements, and numerous other variables.

[21]Table III.3 in appendix III shows the amounts of gasoline, MTBE, and ethanol that are consumed within and outside of air quality nonattainment areas.

could lead to slightly higher prices to consumers for some food products. However, the effect on food prices is likely to be small. For example, the increased price that farmers receive for their corn may represent a much smaller price increase for consumers because, in many cases, the corn is only a part of the product purchased by the consumer and the farmer's price is only a part of the product's retail cost to the consumer. Furthermore, the effect of the increased corn price on the consumer's total food costs is likely to be small because spending on corn and products derived from corn represents only a part of the consumer's food budget.

Tax Incentives for Ethanol Fuel Are Likely to Have Had Little Effect on Environmental Quality

The tax incentives for biomass alcohol fuels are likely to have had little effect on the environment. If there were no tax incentives for these fuels, the price of ethanol would be higher compared with substitute fuels. Analysts we contacted or whose work we read believe little, if any, ethanol fuel would likely be used in the United States without these incentives. As previously mentioned, the fuels that would likely replace ethanol differ according to which ethanol use one is considering. Replacing ethanol with other fuels would result in differences in the emissions from fuel production, combustion, and evaporation. However, on the basis of our analysis of the data as well as on discussions with analysts at DOE and EPA, it seems that, with current technologies, there would likely be only slight changes in emissions. Consequently, little change in air quality or global environmental quality would be expected.

The net emissions changes from replacing ethanol with other fuels are likely to be small for several reasons provided us by environmental and energy analysts. These reasons are that (1) ethanol represents only a small portion of the total fuel used; (2) the production of ethanol creates emissions that are not much less polluting than those created by the production of other oxygenates; (3) likely ethanol substitutes such as MTBE are as clean-burning as ethanol; and (4) in certain areas of the United States at certain times of the year, ethanol has greater emissions than conventional gasoline because of its higher volatility.

No Effect Likely Where Gasoline Containing Oxygenates Is Required

Because tax incentives are only likely to cause substitution among equally clean fuels in areas where the use of gasoline containing oxygenates is mandated, it is unlikely that eliminating the tax incentives would affect air quality in these locations. In areas that do not meet existing air quality standards for the pollutants associated with transportation fuels, the use of gasoline containing oxygenates is required during part or all of the year.

Because the use of clean-burning fuel is mandated in these areas, without the ethanol incentives, the next cheapest clean-burning fuel, most likely MTBE, would have been used instead of ethanol. In 1995, in areas where the use of gasoline containing oxygenates was required, gasoline oxygenated with MTBE, which does not receive tax incentives, had more than a 50-percent share of the market for gasoline containing oxygenates. Because they have similar effects on air quality—they both meet existing standards for clean fuels—little change in the composition of emissions and no change in overall air quality in these locations would be expected from a substitution between ethanol and MTBE.

Little Effect Likely Where Gasoline Containing Oxygenates Is Not Required

If eliminating the tax incentives for ethanol fuel caused its replacement by gasoline in the areas where the use of gasoline containing oxygenates is not required, there likely would be little effect on air quality. According to the best available estimate, if ethanol were entirely replaced with gasoline, the average increase in gasoline use would be about 0.5 percent in these areas. In the state with the greatest percentage increase, gasoline use would increase by less than 4 percent.

As previously noted, ethanol traditionally has been used in midwestern corn-producing states, where it is produced for use as a gasoline extender and octane enhancer. These areas generally meet existing air quality standards for the pollutants associated with transportation fuels, and the use of gasoline containing oxygenates is not required. Because there generally is no mandate to use a clean-burning fuel in these areas, analysts believe that if there were no tax incentives, ethanol's use as a gasoline extender would disappear. Consumers would then use the next cheapest fuel, which would most likely be conventional gasoline. Ethanol's use as an octane enhancer also would likely disappear if there were no tax incentives and substitute octane enhancers would be used, mainly MTBE.[22]

According to DOE, conventional gasoline generally has more carbon monoxide and toxic components emissions than ethanol-blended gasoline. Therefore, switching from using an ethanol blend to using conventional

[22]Ethanol's disappearance as a gasoline octane enhancer may lead to the increased use of methylcyclopentadienyl manganese tricarbonyl (MMT) as a substitute. EPA has found the use of MMT to be a cause for concern because of possible adverse effects on human health. However, even if MMT were to entirely replace ethanol as an octane enhancer, the growth in MMT use would likely not be large for these reasons. First, MMT cannot be used in reformulated gasoline. Second, even in states where reformulated gasoline use is not required, MMT use would be limited to its role as an octane enhancer. If MMT were to entirely replace ethanol in these states, its share in total fuel use would not be large. As previously noted, in the most ethanol-intensive state, ethanol currently represents only 4 percent of all gasoline plus gasoline blended with ethanol fuel used.

gasoline would likely increase these emissions. However, environmental analysts believe air quality would be unlikely to decline to the point that these areas would not meet existing air quality standards for these pollutants. The areas in which ethanol traditionally has been sold as a gasoline extender generally are not areas where gasoline containing oxygenates is required. In these areas, motor vehicle emissions are not concentrated enough to create air quality problems. Furthermore, under certain conditions,[23] ethanol-blended fuel has a higher volatility than conventional gasoline and its use releases more ozone-precursor compounds than the use of conventional gasoline.[24] In these circumstances, switching from an ethanol blend to conventional gasoline would be expected to decrease emissions of volatile organic compounds.[25]

No Significant Effect Likely Through the Use of Alternative-Fuel Vehicles

Eliminating the use of ethanol in alternative-fuel vehicles would likely not significantly affect air quality because, to date, ethanol has been little-used as an alternative fuel. In 1995, the share of total alternative fuel (gasoline-equivalent gallons of fuel used in alternative-fuel vehicles) represented by ethanol was less than 0.08 percent. EIA has projected that ethanol used in alternative-fuel vehicles will account for only 0.28 percent of the total transportation fuel market by 2015.

The number of alternative-fuel motor vehicles, particularly those fueled by ethanol, is small and expected to remain so, even if tax incentives for ethanol remain in place. In 1995, fewer than 1,000 alternative-fuel vehicles were fueled by neat ethanol. Fuel used in these special vehicles represented only 0.0002 percent of the total transportation fuel consumption and only 0.02 percent of the total ethanol fuel consumption. Energy analysts expect ethanol's use as an alternative motor fuel to increase. However, even with anticipated improvements in technology during the next two decades and retention of the tax incentives, EIA projects that ethanol use in alternative-fuel vehicles will represent a negligible amount of the total fuel used.

[23]When ethanol is simply blended with gasoline in a 10-percent, 90-percent ratio rather than used as an ingredient in specially reformulated gasohol or used as a gasoline alternative in 85- to 100-percent ethanol-gasoline blends, the resulting blend can have higher volatility than conventional gasoline under conditions of high ambient air temperature, such as in the summer.

[24]For example, ethanol-blended fuel does not meet the stringent summertime fuel volatility restrictions in ozone nonattainment areas without adjustments to the gasoline fraction.

[25]However, some ethanol-producing states have suggested that ethanol's higher volatility is offset by its lower reactivity with sunlight in producing ozone, compared with conventional gasoline. Currently, the National Academy of Sciences is studying this issue at EPA's request.

No Significant Effect Is Likely on Global Environmental Quality

The production, evaporation, and combustion of different fuels produce different levels and types of greenhouse gas emissions, depending on whether the fuels are derived from biomass or from fossil fuel materials.[26] On the basis of a review of the scientific literature and discussions with EPA and other energy and environmental analysts, we conclude that ethanol fuel use likely has had no significant net effect on greenhouse gas emissions or on global environmental quality. According to the EPA analyst we interviewed, the net effect on greenhouse gas emissions from the corn-based ethanol fuel cycle is such that the possible global-warming effects of using ethanol are likely no better than those of conventional gasoline.[27] Moreover, even if ethanol did reduce greenhouse gas emissions, relative to gasoline, ethanol is such a small part of worldwide fuel use that global environmental quality is not likely to be significantly affected.

The EPA analyst's assessment is based on inferences from studies comparing the net energy use and, in some cases, the greenhouse gas emissions of different fuels. The exact net effect on the quantity of greenhouse gases from using ethanol made with current corn-based technologies instead of conventional gasoline is difficult to determine, and we are not aware of any direct estimate of this net effect. In addition, the results of the studies that provide indirect evidence are sensitive to assumptions made by the researchers. The EPA analyst also noted that the greenhouse gases emitted during the ethanol fuel cycle have so much greater global-warming potential than those emitted during the conventional gasoline fuel cycle that the global-warming picture may be worsened by using ethanol. The greenhouse gases released during the ethanol fuel cycle contain relatively more nitrous oxide and other potent greenhouse gases. In contrast, the greenhouse gases released during the conventional gasoline fuel cycle contain relatively more of the less potent type, namely, carbon dioxide.

[26]For example, when a fossil fuel such as gasoline is burned, the greenhouse gases that would have lain buried in oil fields are released into the atmosphere, possibly contributing to global warming. In contrast, when a fuel derived from biomass is burned, only the greenhouse gases that were taken up by the plant material as it grew are released—the emissions from combustion, net of the carbon dioxide absorbed during growing, are zero. Of course, some greenhouse gases are released during the production of both the fossil fuel and the biomass-derived fuel. However, in contrast to the fossil fuel, if the biomass fuel had no production emissions, the effect of its use on greenhouse gases would be zero.

[27]To completely evaluate the emission effects of alternative transportation technologies, one must consider emissions and energy use from upstream fuel production processes as well as from vehicle operations. This "full fuel cycle" approach is especially important when comparing technologies that employ fuels with distinctly different primary energy sources and fuel production processes—such as corn-based ethanol and conventional gasoline—for which upstream emissions and energy use are significantly different. In the case of corn-based ethanol, one must also assume the share of emissions from ethanol plants and upstream corn production that will be allocated to ethanol's byproducts.

EPA has not yet evaluated the most recent DOE study of ethanol's greenhouse gas emissions.[28] USDA infers from this new study that replacing corn-based ethanol fuel with gasoline would increase the quantity of greenhouse gases emitted over the entire fuel cycle. However, the study focused on the net greenhouse gas effect of using neat and near-neat ethanol (in alternative-fuel vehicles) in place of gasoline oxygenated with MTBE. The study did not estimate the net greenhouse gas effect of eliminating the ethanol in use today, which is almost always ethanol and gasoline mixtures that are mainly gasoline and are used in conventional vehicles. Furthermore, because of the different assumptions made by modelers regarding upstream energy conversion efficiencies, technology pathways, emission control intensities, and vehicular emissions, different studies of the same technology may generate significantly different emissions results.

If sufficient breakthroughs in the technologies used to make ethanol from biomass other than corn were to occur, then the use of ethanol instead of fossil fuels possibly could cause a net reduction in greenhouse gas emissions.[29] DOE believes that, if the technological breakthroughs in ethanol production over the next 20 years were significant enough, ethanol produced from cellulosic biomass feedstocks could conceivably achieve a market share of 10 to 15 percent of all U.S. transportation fuel.[30] In that event, the environmental benefits could far exceed those of the current corn ethanol industry. However, neither EIA, nor anyone else to our knowledge, has forecasted future levels of production of ethanol from cellulosic biomass.

[28]M. Q. Wang, GREET 1.0 — Transportation Fuel Cycles Model: Methodology and Use, Argonne National Laboratory, U.S. Department of Energy, ANL/ESD-33, June 1996.

[29]Ethanol can be derived from plant materials other than corn, such as wood, wood and other crop waste, weeds, and municipal solid waste. Because crop and municipal waste have very low-valued alternative uses compared with the alternative uses for corn, ethanol from these materials is expected to be considerably cheaper to produce than corn-based ethanol, when (and if) manufacturing breakthroughs occur.

[30]The constraints of engine- and fueling-system design limit the use of ethanol in conventional motor vehicles to no more than about 15 percent of the total fuel used.

Tax Incentives for Ethanol Fuel Are Unlikely to Have Significantly Affected U.S. Energy Independence or Energy Security

Tax incentives for alcohol fuels are unlikely to have significantly increased U.S. energy independence because, despite the tax incentives, ethanol use has not significantly reduced the United States' reliance on imported energy. Nor is it likely that ethanol tax incentives have significantly lessened U.S. susceptibility to oil price shocks. Vulnerability to oil price shocks depends on the nation's level of oil consumption as a proportion of total fuel consumed, on the oil dependence of the transportation sector, and on the difficulty of substituting other fuels for oil in case of a crisis. Many energy analysts believe that the percentage of the nation's oil that is imported is not a major cause of vulnerability to oil price shocks. The alcohol-fuel tax incentives could only have been successful at enhancing energy security if they had decreased oil's proportion of total fuel consumed or if the tax incentives had caused the supply of ethanol fuel to be capable of rapid expansion in case of a crisis. According to DOE, it is possible that with continuing tax subsidies for ethanol, future technological breakthroughs may permit ethanol production at costs so low that ethanol use would become more widespread.

Despite the tax incentives available since the late 1970s for ethanol, which is produced almost entirely from domestically grown corn, U.S. fuel imports as a percent of total energy consumption have not declined. Imports today account for about 20 percent of the total U.S. energy consumption, and about 48 percent of the oil consumption. In contrast, ethanol[31] currently accounts for less than 1 percent of U.S. motor vehicle fuel consumption. Oil imports account for the same share of domestic energy consumption that the imports did in 1978, before the ethanol fuel tax incentives were implemented.[32] EIA projections indicate that oil imports, as a percentage of U.S. consumption, will continue to rise through 2015,[33] even if the ethanol tax incentives remain in place.

In addition, tax incentives for alcohol fuel use have not been a factor in deterring or moderating potential price shocks in the energy sector. For this reason, the tax incentives do not increase the United States' energy

[31]This includes the ethanol used in gasoline blends as well as the ethanol used to make the gasoline oxygenate, ethyl tertiary butyl ether (ETBE). ETBE is an ether produced from ethanol and used in making oxygenated gasoline.

[32]Appendix I contains more details about the events and legislation that have encouraged ethanol fuel use.

[33]Oil imports are projected to grow through 2015 in EIA's reference case, as well as under most of the alternative scenarios that they model. (EIA's reference case represents the midlevel of EIA's alternative assumptions about the growth of the domestic economy and world oil market conditions.) However, under the special case assumption of more rapid technology improvement, projected oil imports begin to decline after 2005.

security. As we recently reported,[34] vulnerability to oil price shocks depends on the nation's level of oil consumption, including the oil dependence of the transportation sector. The economic effects of oil price disruptions are largely the same, regardless of the level of oil imports. The rapid oil price increases of 1973 and 1979 disturbed U.S. economic stability because there were (and are) few good substitutes for oil. Following these crises, legislation encouraging alcohol fuel use was enacted in part to diversify the sources of fuel beyond the consumption of petroleum to guard against the potential impact of future shocks.

The greater the share of nonpetroleum-based fuels in total U.S. fuel consumption, the smaller would be the impact of any oil price increase. To the extent that ethanol is substituted for petroleum-based fuels, it can mitigate the effects of any oil supply disruption or rapid increase in oil prices, which could threaten U.S. economic stability. However, ethanol currently comprises less than 1 percent of total U.S. fuel consumption and, according to EIA projections, even if tax incentives for ethanol remain in place, will still comprise less than 1 percent in 2015. Therefore, ethanol use would not significantly mitigate the effects of oil price increases. Alternatively, if ethanol's supply were capable of rapid expansion, it could mitigate the effects of any oil supply disruption or rapid increase in oil prices. However, given existing technologies of production, the U.S. ethanol-fuel supply cannot be greatly and cheaply expanded whenever necessary. If a sufficient future breakthrough were to occur in the technology used to make ethanol from biomass other than corn, then ethanol/gasoline blends could become more widely used.

The Partial Exemption Reduced Highway Trust Fund Revenues From Fiscal Years 1979 to 1995

We estimated that the partial exemption for alcohol fuels reduced motor fuels excise tax revenues by about $7.1 billion from fiscal years 1979 to 1995 (see table II.2 in app. II).[35] We also estimated that about 108 billion gallons of alcohol-fuel mixtures were sold over that same period and that about $7.5 billion of motor fuels excise tax revenues were collected on the sales of this fuel. The amount of tax that would have been paid on an equivalent gallonage of gasoline is about $14.6 billion. In 1995, Treasury projected that the partial exemption for alcohol fuels would reduce excise tax receipts by $3.3 billion from fiscal years 1996 to 2000 (see table II.3 in app. II).

[34]GAO/RCED-97-6.

[35]Unless otherwise noted, all revenue figures presented in this report are stated in constant 1996 dollars.

Virtually all of the motor fuels excise tax revenue that has been forgone due to the partial exemption would otherwise have been earmarked for the Highway Trust Fund. Only a negligible amount of that forgone revenue would have been earmarked for the Leaking Underground Storage Tanks Trust Fund. In 1995, the gross federal highway user tax receipts for the Highway Trust Fund were $23.1 billion.[36] We estimated that, without the partial exemption for alcohol fuels, an additional $617 million of revenue would have been allocated to the fund for fiscal year 1995.

The income tax credits for alcohol, alcohol mixtures, and small ethanol producers are offset against the Treasury's General Fund and, therefore, do not affect the amount of revenue allocated to the Highway Trust Fund. Past estimates by Treasury indicate that these tax credits have reduced general fund revenues by less than $0.2 billion from fiscal year 1981, when the credits were first introduced, to fiscal year 1995. Although both the partial exemption and the income tax credit for alcohol mixtures provide a subsidy of 54 cents per gallon of alcohol blended as a fuel, there are several reasons why the exemption may be preferable to taxpayers. First, the benefit of the exemption can be realized immediately, while the benefit of the credit is realized no earlier than when the taxpayer files a quarterly estimated income tax return.[37] Second, a blender must have a positive precredit income tax liability to use the credit. Third, the benefit of the income tax credits can be constrained by the general business tax credit limitation and by the alternative minimum tax.[38] Treasury projects that about $50 million of alcohol fuels tax credits will be claimed against the income tax from fiscal years 1996 to 2000.

The net effect that the partial excise tax exemption has had on total federal revenues may be less than the $7.1 billion previously cited because the excise tax exemption may increase the amount of real income that is subject to the federal income tax. By convention, when the Joint Committee estimates the amount of revenue that is attributable to an excise tax, it reduces the estimated gross revenue gain from the tax by 25 percent to account for offsetting declines in income tax revenue.[39]

[36]This amount includes receipts from excise taxes on highway motor fuels, vehicles, and tires.

[37]Credits for overpayments of excise taxes are distinct from the income tax credit. See appendix II for details.

[38]The general business tax credit is the combination of the alcohol fuels credits and 11 other tax credits. The amount of general business credit that a taxpayer may claim cannot exceed the taxpayer's net regular income tax liability minus the greater of (1) the taxpayer's tentative alternative minimum tax liability or (2) 25 percent of the net regular tax liability above $25,000.

[39]See appendix II for the rationale behind this 25-percent offset.

Conversely, when the Joint Committee estimates the amount of revenue forgone due to an excise tax exemption, it reduces the gross revenue forgone by 25 percent to account for offsetting increases in income tax revenue. The Joint Committee projected that the net revenue cost of the partial exemption will be $2.6 billion from fiscal years 1996 to 2000.

Agency Comments and Our Evaluation

At our request, officials representing the heads of the Department of Energy, the Department of Agriculture, the Environmental Protection Agency, the Department of the Treasury, and the Internal Revenue Service provided comments on a draft of this report. Generally, their concerns centered on (1) the benefits and costs of the tax incentives, (2) the potential future benefits from an expanded ethanol industry, (3) the short-term economic effects of eliminating the incentives, (4) the effects of unstable government subsidy policies, (5) oxygenate security, (6) the energy balance[40] of ethanol compared with other fuels, and (7) the effect of the incentives on federal outlays. The following is a summary of the agencies' principal comments, accompanied by our responses.

Benefits and Costs of the Tax Incentives

Both USDA and DOE officials expressed concern that the draft report would be viewed by some readers as an assessment of the costs and benefits of the ethanol tax incentives. In their view, the draft report did not provide a balanced cost-benefit analysis because it quantified the excise tax revenue loss due to the incentives but did not quantify the benefits received by farmers, consumers, and others. The USDA and DOE officials were concerned that readers would think that the benefits of the tax incentives are small relative to their cost because the draft report described the benefits that various groups receive in terms of small percentage changes in prices or incomes. For example, the draft report suggested that the effect of the tax incentives on gasoline consumers is likely to be small because the incentives lower the price of a gallon of gasoline by an estimated 0.27 percent. Both USDA and DOE officials pointed out that this price decline, when multiplied by total gallons of gasoline consumed, represents a yearly saving of over $200 million in consumer spending on gasoline. USDA officials also commented that a balanced presentation of the costs and benefits of the tax incentives for ethanol would include a discussion of the tax benefits provided to petroleum and other energy industries.

[40]The energy balance of ethanol compares its energy contribution as a motor fuel component with the net energy consumed in the production of ethanol, including the energy consumed in the production of feedstocks.

Our response to the agencies' comments involves several parts. First, we agree that our report should not be viewed as an overall cost-benefit analysis of the incentives. It was not intended to provide such an analysis, and we have added statements to this report clarifying this point.

Second, we did not make dollar estimates of the benefits and costs to particular groups because, in most cases, we did not have sufficient information to make reliable estimates.[41] Moreover, if we had quantified the benefits to various groups, as USDA and DOE officials suggested, it would not be appropriate to include either those estimates or our revenue cost estimate in a cost-benefit analysis of the tax incentives. Inclusion would not have been appropriate because benefits to specific groups in society do not represent a net benefit to society. A benefit to one group—higher incomes for farmers—is typically a cost to another group—higher prices for consumers of certain foods. Similarly, the tax revenue forgone due to the incentives does not represent a net cost to society; it is a transfer from one group to another.

Third, in preparing an overall cost and benefit analysis, the real benefits of a government program should be measured in terms of the extent to which the program expands the total production potential of society.[42] Similarly, the cost of a program should be measured in terms of the lost opportunity to increase production under an alternative allocation of resources. A program would have a net benefit if it leads to a resource allocation that increases production and consumption above what they would have been under the best alternative resource allocation.

Fourth, sufficient information for completing a reliable, overall cost-benefit analysis of the tax incentives is not available at this time. For example, given the uncertainties regarding how farmers would respond to a decline in the demand for corn under the new farm policy, we would be unable to determine how the allocation of resources without the incentives would differ from the current allocation of resources.

Finally, regarding the USDA and DOE officials' point about the benefits provided to petroleum and other energy industries, we agree that a proper cost-benefit analysis of the alcohol fuels tax incentives should take

[41]We presented a dollar estimate of the excise tax revenues forgone because the requester is interested in the effect that the incentives have had on the amount of revenue available to the Highway Trust Fund. We did not present the estimate as part of a cost-benefit comparison.

[42]Total production includes the production of intangibles, such as energy security, and improvements in environmental quality.

account of pre-existing distortions in resource allocation, such as those caused by other tax provisions.

Potential Future Benefits From Cellulosic Biomass Ethanol

USDA and DOE officials also said that a balanced assessment of the tax incentives requires consideration of (1) the potential economic and environmental benefits of the much larger and cost-effective ethanol industry, based on cellulosic biomass, that may emerge in the future and (2) the role the existing ethanol industry would play as a launching platform for this new technology. They said that our draft report did not discuss these potential benefits. Representatives of both departments said that government incentives would play an important role in the future development of the ethanol industry. The officials expressed the opinion that, if ethanol use can be increased significantly over time by using new technologies and biomass feedstocks other than corn, then fossil energy use and emissions of greenhouse gases, ozone, and particulates could be reduced substantially. USDA officials pointed out that U.S. energy security would be enhanced if the nation could reduce its heavy reliance on a single transportation fuel, fossil-based gasoline.

In response to the agencies' assertion that the existing ethanol industry could play a significant role as a launching platform for the new technology, we note that cellulose-based ethanol remains an experimental rather than an economically viable technology. We clarified our report to acknowledge that, if sufficient breakthroughs in the technologies used to make ethanol from biomass other than corn were to occur, then the use of ethanol in place of fossil fuels could possibly cause a net reduction in greenhouse gas emissions. However, we also added that neither EIA, nor anyone else to our knowledge, has forecasted future levels of production of ethanol from cellulosic biomass.

Short-Term Economic Effects of Eliminating the Tax Incentives

The USDA and DOE officials noted that the draft report did not discuss the economic effects that would occur under various scenarios for eliminating the incentives. For example, the draft report did not include the effect on prices of near-term market disruptions that would occur if the incentives were eliminated quickly. The officials said that the short-term increase in the price of MTBE would likely be significantly larger than the estimate of the long-term increase that we report.

We agree; however, we chose not to discuss the short-term effects of eliminating the incentives because such effects would depend on the

specific scenario. Such short-term effects would be important for computing the costs of different proposals for eliminating the incentives.

Effects of Unstable Government Subsidy Policies

DOE officials said that unstable government subsidy policies could be devastating to the ethanol industry. They noted that investors need to plan several years ahead when investing in plants that are based on new technologies or when bringing production on-line for plants that take a long time to build. If investors cannot count on a stable government policy, they are unlikely to invest in new technologies. DOE officials noted that one of our previous reports found this to be true in the alternative fuels industries in several other countries.[43]

We agree that frequently changing levels of government support can cause uncertainty that can negatively affect any industry. Our previously mentioned report stated that "wavering government subsidies and support" can discourage private investors from investing in an unproved technology. However, the alcohol fuels tax incentives were enacted in the late 1970s and early 1980s. Furthermore, we would not characterize the history of the incentives to date as being one of "wavering government subsidies and support."

Oxygenate Security

DOE officials commented that the draft report did not note that if MTBE were to replace ethanol as an oxygenate, the additional MTBE would likely come almost entirely from foreign sources. They said that this could reduce U.S. energy security by increasing the percentage of oxygenates that is imported. DOE officials noted that the use of replacement fuels was encouraged in the 1992 Energy Policy Act and that another of our recent reports stressed that oxygenates are an important part of the whole replacement fuel picture.[44]

We agree that we are on record in saying that oxygenates displace some petroleum. However, as we explained above, ethanol's potential for substituting for petroleum is so small that it is unlikely to significantly affect overall energy security. Furthermore, the United States' vulnerability to disruptions in MTBE supply is not comparable to its vulnerability to disruptions in oil supply. A disruption of MTBE supply is probably less likely than an oil supply disruption because MTBE has more

[43]Alternative Fuels: Experiences of Brazil, Canada, and New Zealand in Using Alternative Motor Fuels (GAO/RCED-92-119, May 7, 1992).

[44]GAO/RCED-96-121.

widely varied sources of supply. Moreover, in the event of a disruption of MTBE imports, oxygenate regulations could be relaxed or suspended until the disruption ended or until domestic production increased to fill the shortage.

Energy Balance of Ethanol Compared With Other Fuels

USDA officials said that the draft report understated the energy balance from ethanol made with current technology and did not mention the even better energy balance that might be achieved if a cellulosic biomass ethanol industry emerges in the future. The officials also noted that the report failed to mention the large amounts of fossil fuel used in making fossil-fuel products, such as gasoline and diesel fuel.

We agree that there is some evidence that ethanol use may have some energy balance advantages relative to gasoline, in that the former may involve lower levels of fossil energy and petroleum consumption.[45] We also acknowledge that, if sufficient breakthroughs in the technologies used to make ethanol from biomass other than corn were to occur in the future, then even better fossil energy and petroleum consumption balances might be achieved through using ethanol in place of gasoline. However, because so little ethanol fuel is used, our evaluation of energy security benefits would not change even if no petroleum or other fossil fuels were consumed in the production of ethanol. For this reason, we did not compare the energy balance of ethanol with the energy balance of gasoline. Our evaluation of the effects of ethanol use on greenhouse gas emissions takes into account the latest research on full fuel-cycle emissions.

Effect of the Tax Incentives on Federal Outlays

USDA officials noted that in a 1990 report, we estimated the savings in federal outlays for deficiency payments to corn farmers that result from the partial exemption for ethanol.[46] They said that we should include these effects when discussing federal outlays before passage of the FAIR Act.

We disagree for several reasons. First, our 1990 report did not estimate the impact of the partial exemption for ethanol on federal farm payments; it simulated what would happen if ethanol production increased by a range of assumed growth rates.

[45]For example, see Wang, GREET 1.0 — Transportation Fuel Cycles Model: Methodology and Use, pages 40 to 43 and 46.

[46]Alcohol Fuels: Impact From Increased Use of Ethanol Blended Fuels (GAO/RCED-90-156, July 1990).

Second, as we noted in the "objectives, scope, and methodology" section of this report, our objective relating to fiscal impact was limited to estimating the effect that the tax incentives have had on the flow of revenue into the Highway Trust Fund.

Third, while federal farm payments before the passage of the FAIR Act may have been lower than they would have been in the absence of the tax incentives, it is not possible to determine with certainty the size of any federal outlay savings that may have occurred. Such savings would depend on the unknown extent to which the Secretary of Agriculture would have used the acreage reduction program to restrict corn supply in the absence of the incentives. A sufficient restriction of corn acreage could have mitigated or eliminated the effect of the reduced demand for corn on corn prices. Therefore, such a restriction, if brought to bear, could also have mitigated or eliminated any effect on federal outlays.

Finally, since the FAIR Act has now removed the link between income support payments and farm prices, the tax incentives are not likely to have any future effect on federal farm outlays.

Other Comments

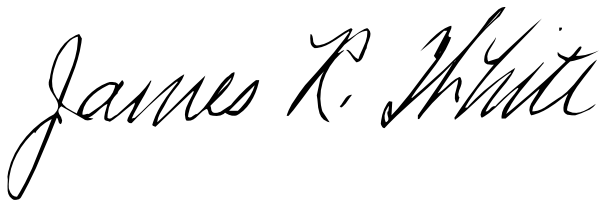
USDA, DOE, EPA, Treasury, and IRS officials provided a number of suggestions for rewording our discussion of technical details in the draft. We made corrections and clarifications where appropriate. As a result of our discussions with Treasury officials, we determined that the excise tax data we used to make our revenue loss estimates did not reflect claims for refunds or credits for excise tax overpayments on gasoline used to make alcohol fuel mixtures. We obtained additional data from Treasury and IRS and made the proper adjustments to our estimates.

Unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days from the date of this letter. At that time, we will send copies of this report to the Ranking Minority Member of your committee, the Chairman and Ranking Minority Member of the Senate Finance Committee, other appropriate congressional committees, and other interested parties. Copies will also be made available to others upon request.

This work was performed under the direction of James Wozny, Assistant Director, Tax Policy and Administration Issues. Major contributors to this

report are listed in appendix V. If you have any questions, please contact me on (202) 512-9110.

Sincerely yours,



James R. White
Associate Director, Tax Policy
and Administration Issues

Contents

Abbreviations

API	American Petroleum Institute
CBO	Congressional Budget Office
DOE	U.S. Department of Energy
EIA	Energy Information Administration
EPA	Environmental Protection Agency
ERS	Economic Research Service
ETBE	ethyl tertiary butyl ether
FAIR	Federal Agricultural Improvement and Reform Act of 1996
FAPRI	Food and Agriculture Policy Research Institute
GDP	gross domestic product
IRS	Internal Revenue Service
MMT	methylcyclopentadienyl manganese tricarbonyl
MTBE	methyl tertiary butyl ether
OPEC	Organization of Petroleum Exporting Countries
RFG	reformulated gasoline
USDA	U. S. Department of Agriculture

Chronology of the Legislation and Events Affecting Ethanol Fuel Use

Year	Legislation/Event	Ethanol summary
1967	Air Quality Act of 1967 (P.L. 90-148)	Regulated ambient air quality. Established emissions standards and a basic fuel and fuel additive registration program.
1970	U.S. production of crude oil peaked	Increased U.S. dependence on foreign sources of crude oil, primarily from OPEC.
	Clean Air Amendments of 1970 (P.L. 91-604)	Established the National Ambient Air Quality Standards and began regulating fuel additives for air pollution reduction. Section 211 gave EPA the authority to regulate fuel and fuel additives, which included the authority to control or prohibit the sale of any fuel or fuel additive that it determined would endanger the public health or welfare.
1973	1973 Arab Oil Embargo	Disrupted petroleum supply and escalated price. Was the beginning of consumer efforts to conserve energy and reduce petroleum consumption.
	Emergency Petroleum Allocation Act of 1973 (P.L. 93-159)	Established government controls on domestic petroleum price and supply, replacing market forces.
1974	Supplier-Purchaser Rule, Buy-Sell Program, and Crude Oil Entitlement Program	Below-market petroleum prices and allocated supplies caused lowered incentives for oil exploration and production, increased incentives to import oil, and greater domestic oil demand.
	Unleaded motor gasoline was introduced at gasoline stations	Began the transition to unleaded gasoline. Transition was enhanced by the compatibility of unleaded gasoline with the catalytic converter, which was developed to reduce tailpipe emissions.
1975	Energy Policy and Conservation Act of 1975 (P.L. 94-163)	Established the Strategic Petroleum Reserve to deter and mitigate effects of future oil supply disruptions.
1978	U.S. demand for petroleum peaked	Subsequent decline in demand contributed to lower oil imports.
	Powerplant and Industrial Fuel Use Act of 1978 (P.L. 95-620)	Restricted construction of electric powerplants with petroleum or natural gas as their primary fuel.
	Energy Tax Act of 1978 (P.L. 95-618)	Established a 4 cents per gallon (then the entire amount of the federal gasoline excise tax) exemption from excise taxes for motor fuels blended with biomass-derived alcohols (minimum of 10-percent alcohol).[a]
	1978 Iranian Revolution	Declines in Iran's crude oil production began a series of OPEC price escalations between 1979 and 1981. A worldwide recession occurred and oil consumption was depressed.
1980	Energy Security Act of 1980 (P.L. 96-294)	Authorized funds for building alcohol fuel production plants.
	Crude Oil Windfall Profit Tax Act of 1980 (P.L. 96-223)	Extended the 4-cent exemption for gasohol to December 1, 1992, and established a blender's tax credit of 40 cents per gallon of alcohol used in the production of gasoline/alcohol mixtures.
	Omnibus Reconciliation Tax Act of 1980 (P.L. 96-499)	Placed a tariff on imported ethyl alcohol to be used in the production of gasoline/alcohol mixtures.
1981	Petroleum Price and Allocation Decontrol (E.O. 12287)	Reinstated market forces for petroleum prices. Domestic crude oil production was revitalized. Deregulation of oil prices and the development of futures markets reduced the economic cost of an oil price shock. During an oil market shock, producers had the incentive to bring forth additional energy supplies and consumers had an incentive to reduce energy consumption because prices could adjust quickly and completely to changing information about potential future oil supplies.

(continued)

Year	Legislation/Event	Ethanol summary
1982	Surface Transportation Assistance Act of 1982 (P.L. 97-424)	Raised the gasoline tax rate from 4 to 9 cents per gallon and increased the exemption for gasohol from 4 to 5 cents per gallon. Set a 9 cents per gallon exemption for fuels containing 85 percent or more alcohol.
1984	Tax Reform Act of 1984 (P.L. 98-369)	Raised the exemption for gasohol from 5 to 6 cents per gallon. Increased the blender's tax credit from 40 to 60 cents per gallon of blend for 190-proof alcohol.
1986	Price of crude oil collapsed	Domestic crude oil production declined, dependence on OPEC crude oil increased, and lower petroleum prices stimulated economic growth.
	Tax Reform Act of 1986 (P.L. 99-514)	Reduced the exemption for 85-percent alcohol fuels from 9 to 6 cents per gallon.
	Superfund Revenue Act of 1986 (P.L. 99-499)	Raised the gasoline excise tax rate from 9.0 to 9.1 cents per gallon.
1988	Alternative Motor Fuels Act of 1988 (P.L. 100-494)	Addressed national energy policy concerns and created a program of financial support for research, development, and demonstration of alternative motor vehicles and alternative fuels.
	Technical and Miscellaneous Revenue Act of 1988 (P.L. 100-647)	Permitted gasohol blenders to purchase gasoline and alcohol at different locations and still get the 6 cent per gallon exemption without having to file a claim for an excise tax refund.
1989	Reid Vapor Pressure Regulations	Reduced evaporative emissions of smog-producing compounds in gasoline.
1990	Persian Gulf Crisis of 1990-91	Unlike with previous oil supply disruptions, the impact from the sudden oil price increase and supply cutoff was reduced. Reduction was attributable to the deregulation of oil prices, to the development of futures markets, to the achievement of greater efficiency and fuel-switching capabilities by oil users, and to greater worldwide cooperation. Cooperation included the use of worldwide strategic reserves, an OPEC increase in production, and non-OPEC producer supply shifts.
	Omnibus Budget Reconciliation Act of 1990 (P.L. 101-508)	Raised the gasoline excise tax rate from 9.1 to 14.1 cents per gallon, reduced the gasohol exemption from 6.0 to 5.4 cents per gallon, and reduced the blender's tax credit from 60 to 54 cents per gallon. Retained the exemption for 85-percent alcohol fuels at 6 cents per gallon. Extended these incentives to the year 2000. Provided an income tax credit of 10 cents per gallon for the first 15 million gallons of ethanol manufactured by qualified small producers with annual outputs of less than 30 million gallons.
	Clean Air Act Amendments of 1990 (P.L. 101-549)	Initiated a mandated phaseout in the use of lead as a gasoline octane enhancer. Established the requirement that areas with the worst ground-level air pollution should use the following cleaner-burning motor fuels: oxygenated gasoline in carbon monoxide nonattainment areas during winter months and reformulated gasoline in ozone nonattainment areas. Reduced the sulfur content of diesel fuel.
1992	Energy Policy Act of 1992 (P.L. 102-486)	Extended gasohol excise tax exemption to blends containing less than 10-percent (7.7 and 5.7 percent) alcohol. To encourage the use of alternatives to petroleum-based transportation fuels, set guidelines and established incentives for (1) purchasing clean-fuel vehicles for federal, state, and private fleets and (2) arranging refueling facilities for these fleets.
	Oxygenated fuels program began	Required oxygenated gasoline use in wintertime in air quality nonattainment areas for carbon monoxide.

(continued)

Year	Legislation/Event	Ethanol summary
1993	Omnibus Budget Reconciliation Act of 1993 (P.L. 103-66)	Raised gasoline excise tax rate from 14.1 to 18.4 cents per gallon.
1994	EPA mandated 30-percent minimum renewable oxygenate content for reformulated gasoline	Issued a ruling that at least 30 percent of each refinery's annual production of reformulated gasoline in 1996 and for each year thereafter should be derived from renewable oxygenates.
1995	Courts struck down 30-percent renewable oxygenate mandate	Struck down EPA's ruling of June 1994 mandating the use of at least 30-percent renewable alcohol in reformulated gasoline, which would have significantly expanded demand for ethanol.
	Reformulated gasoline program began	Required reformulated gasoline use in the worst air quality nonattainment areas for ozone.

[a]Although under the Internal Revenue Code, blends of gasoline with any biomass-derived alcohol receive the exemption, the only economically feasible biomass-derived alcohol has been ethanol.

Sources: U.S. Department of Energy, Energy Information Administration, The Energy Information Administration's Assessment of Reformulated Gasoline, Volume 1, SR/OOG/94-02/1, October 1994, pages 5 and 6; Volume 2, SR/OOG/94-02/2, October 1994, pages 132-134; U.S. Department of Energy, Energy Information Administration, The U.S. Petroleum Industry: Past as Prologue, 1970-1992, DOE/EIA-0572, September 1993, pages 2 and 3; U.S. Department of Energy, Energy Information Administration, Renewable Energy Annual 1995, DOE/EIA-0603(95), December 1995, pages 68-70; U.S. Department of Energy, Energy Information Administration, Estimates of U.S. Biomass Energy Consumption 1992, DOE/EIA-0548(92), May 1994, page 29; U.S. Department of Energy, Energy Information Administration, Alternatives to Traditional Transportation Fuels: An Overview, DOE/EIA-0585/O, June 1994, pages 33-38; U.S. Department of Energy, Energy Information Administration, Alternatives to Traditional Transportation Fuels 1994, Volume 1, DOE/EIA-0585(94)/1, February 1996, pages 5-7; U.S. Senate, Committee on the Budget, Tax Expenditures: Compendium of Background Material on Individual Provisions, S.Prt. 103-101, December 1994, pages 80-82; Congressional Research Service, Alcohol Fuels Tax Incentives and EPA's Renewable Oxygenate Requirement, 94-785 E, October 7, 1994, pages 6 and 7; Congressional Research Service, Federal Excise Taxes on Gasoline and the Highway Trust Fund: A Short History, 96-394 E, May 3, 1996, pages 5-8; Congressional Research Service, Alternative Transportation Fuels: Oil Import, Highway Tax, and Implementation Issues, IB93009, March 28, 1996, pages 3 and 4; Congressional Research Service, Alcohol Fuels Tax Incentives: Current Law and Proposed Options to Expand Current Law, 89-343 E, June 2, 1989, pages 4-7 and 11-12.

Details and Estimates Relating to the Tax Incentives for Alcohol Fuels

Federal Tax Incentives for Alcohol Fuels

The partial exemptions from motor fuels excise taxes were adopted in the Energy Tax Act of 1978 and first became effective in 1979. Currently, motor fuels consisting of at least 10-percent biomass-derived ethanol are exempt from 5.4 cents of the per-gallon federal excise taxes on gasoline, diesel fuel, and other motor fuels that are earmarked for the Highway Trust Fund. Table II.1 shows that the exemption is also available, at lower rates per gallon of fuel, for blends that are at least 7.7- or 5.7-percent ethanol.[1] For all of these fuel blends, the exemptions provide a subsidy of 54 cents per gallon of ethanol used (i.e., if the lowest alcohol content within a given range is used). Exemptions for alcohol fuel blends that contain biomass methanol or other biomass alcohols, instead of ethanol, provide a subsidy worth 60 cents per gallon of alcohol used.[2] The alcohol contained in any of these blends must be at least 190 proof. The Internal Revenue Code refers to these blends collectively as "gasohol."

[1]The 5.7- and 7.7-percent blends correspond to oxygen content standards for gasoline sold in ozone nonattainment areas and carbon-monoxide nonattainment areas under the Clean Air Act. The tax incentives were extended to these additional blends by the Energy Policy Act of 1992.

[2]In the Internal Revenue Code sections relating to motor fuels, the term "methanol" refers to any alcohol other than ethanol.

Table II.1: Rates of Excise Taxes, Excise Tax Exemptions, and Income Tax Credits for Selected Highway Motor Fuels

Motor fuel	Combined motor fuels excise tax rates (cents per gallon of fuel)[a]	Rates of exemption (cents per gallon of fuel)	Rates of exemption (cents per gallon of alcohol)[b]	Rates of alcohol fuels tax credits (cents per gallon of alcohol)[b,c]
Gasoline	18.3	0.0	N/A	N/A
Diesel fuel[d]	24.3	0.0	N/A	N/A
Gasohol from ethanol:				
At least 10-percent ethanol	12.9	5.4	54.0	54.0
At least 7.7-percent but less than 10-percent ethanol	14.14	4.16	54.0	54.0
At least 5.7-percent but less than 7.7-percent ethanol	15.22	3.08	54.0	54.0
Gasohol from methanol:				
At least 10-percent methanol	12.3	6.0	60.0	60.0
At least 7.7-percent but less than 10-percent methanol	13.68	4.62	60.0	60.0
At least 5.7-percent but less than 7.7-percent methanol	14.88	3.42	60.0	60.0
10-percent dieselhol from ethanol	18.9	5.4	54.0	54.0
10-percent dieselhol from methanol	18.3	6.0	60.0	60.0
Qualified ethanol fuels from other than petroleum or natural gas	12.9	5.4	6.35	54.0
Qualified methanol fuels (other than ethanol) from other than petroleum or natural gas	12.3	6.0	7.06	60.0
Special motor fuels	18.3	0.0	0.0	[e]
Partially exempt methanol and ethanol fuels from natural gas	11.3	7.0	8.24	N/A

(Table notes on next page)

Legend: N/A = not applicable.

[a]The combined tax rates encompass the Highway Trust Fund taxes and the General Fund tax.

[b]The rates of exemptions and credits per gallon of alcohol as shown in the table are for blends that meet the minimum alcohol content percentage. Blends that have higher contents than the minimum for a given range receive a lower subsidy per gallon. For example, gasohol that is 6-percent ethanol receives a subsidy of 51.3 cents per gallon of alcohol.

[c]The credit rates shown are for alcohol fuels in which the alcohol is at least 190 proof; credit rates for proofs between 150 and 190 are lower. No credit is given for alcohol that is less than 150 proof. The credit rates shown do not include the credit for small ethanol producers.

[d]There is a lower rate of tax for diesel fuel used for intercity buses.

[e]Alcohol fuels that qualify as special fuels are eligible for the separate "alternative fuels production tax credit."

Sources: Internal Revenue Code and GAO computations.

Neat alcohol fuels—those that contain at least 85-percent alcohol—also qualify for partial excise tax exemptions, but the subsidies per gallon of alcohol are less than 10 cents. These fuels are referred to in the tax code and in table II.1 as "qualified" ethanol and methanol fuels. A lower-rate exemption is also available for "partially exempt methanol or ethanol fuel," which, in the tax code, means any liquid fuel that is at least 85-percent alcohol produced from natural gas.

In fiscal year 1995, over 99.9 percent of the alcohol fuel reported in Internal Revenue Service (IRS) excise tax summaries was gasohol that contained ethanol. All of the other alcohol fuels were aggregated into a single line in the IRS summaries and, together, these fuels accounted for less than 0.1 percent of the alcohol fuel reported.

The partial excise tax exemption may be claimed by the blenders of gasohol or by the distributors that sell them the gasoline used to make gasohol. The partial exemption may be claimed when the blenders or distributors file their quarterly federal excise tax returns,[3] when blenders file their annual income tax returns, or, if certain conditions are met, when

[3]According to IRS regulations, the "position holder," with respect to the taxable fuel at a distribution terminal, is the one liable for paying the excise tax. In some cases, this may be the blender; in other cases, it may be the terminal operator.

blenders file quarterly claims for refunds of excise taxes.[4] Most of the exemptions are scheduled to expire after September 30, 2000, which is 1 year after the scheduled expiration of the Highway Trust Fund motor fuel excise taxes. The exemption for partially exempt methanol and ethanol fuels expires after September 30, 1999.

In addition to the excise tax exemptions, the tax code provides income tax credits for alcohol used or sold as a fuel, whether the alcohol is blended with another motor fuel or used neat. These income tax credits were enacted as part of the Crude Oil Windfall Profit Tax Act of 1980, and they are scheduled to expire after December 31, 2000. The "alcohol mixture credit" is available to "blenders"—businesses that mix alcohol with other motor fuels and use the mixtures in a trade or business or sell it for use as a fuel. The credit provides a subsidy of 54 cents per gallon of ethanol used, if it is at least 190 proof, or 40 cents, if the ethanol is between 150 and 190 proof. The subsidy per gallon of alcohol other than ethanol is 60 cents, if it is at least 190 proof, or 45 cents, if the alcohol is between 150 and 190 proof. No credit is available for alcohols that are less than 150 proof. The "alcohol credit" is available to businesses that either use neat alcohol fuels or sell them at the retail level. This credit provides the same subsidy per gallon of alcohol as the alcohol mixtures credit.

The tax code also provides for an income tax credit for small ethanol producers—those that produce no more than 15 million gallons of qualified ethanol fuel per year. Qualified ethanol fuel is ethanol that is produced by a small producer and used or sold for use as a motor fuel. The credit is equal to 10 cents per gallon of qualified ethanol.

For the most part, to qualify for an excise tax exemption or an income tax credit, alcohol used in a motor fuel cannot be produced from petroleum, natural gas, coal, or peat. One exception is the partially exempt methanol or ethanol fuel previously mentioned. The other exception is that certain alcohol fuels that are derived from coal or lignite (falling under the heading "special motor fuels" in table II.1) could qualify for the alternative fuels production tax credit. Little, if any, alcohol fuel is produced from coal or lignite.

[4]The credit that a gasohol blender may claim for excise taxes previously paid on gasoline is distinct from the income tax credits described in the following paragraph. Even though this claim for previously paid tax is filed with the annual income tax return, it is an offset against excise tax receipts, not income tax receipts, and Treasury subtracts the claims from the Highway Trust Fund rather than from the General Fund. Blenders may claim credits for, or refunds of, excess excise taxes paid on the gasoline they blend with ethanol, even if they are not the ones who originally made the tax payments, as long as the original taxpayer did not claim the partial exemption.

Taxpayers who claim the alcohol mixtures credit or the alcohol credit must reduce their credits by the amount of the partial excise tax exemption associated with the same fuel. The taxpayers must choose between the exemptions and the credits. One of the reasons why Congress supplemented the exemption with the alcohol fuels credits was to provide incentives for the production and use of alcohol fuels in mixtures that contained less than 10-percent alcohol. At the time the credits were introduced, the excise tax exemption applied only to mixtures that were at least 10-percent alcohol. Congress also wanted to give users who were exempt from all fuel excise taxes, such as farmers, an incentive to use alcohol-fuel blends instead of gasoline and diesel.

Final regulations promulgated by IRS in 1990 interpreted section 40 of the tax code to say that blends of gasoline and ethyl tertiary butyl ether (ETBE) could qualify for the alcohol mixtures credit.[5] This interpretation was made retroactive to sales or uses of the fuel blends after September 30, 1980. In 1994, IRS published proposed regulations saying that blends of gasoline and ETBE could qualify for the partial exemption from excise tax, effective January 1, 1993.[6] This ruling was confirmed by final regulations that became effective October 1, 1995.[7] The final regulations also contained a ruling that enables gasoline refiners to claim the partial exemption for mixtures of gasoline and ETBE that are blended at a refinery and then distributed through pipelines, even if the ETBE content of this fuel becomes diluted as it passes through the pipelines.

Allocation of Excise Tax Revenues to the Highway Trust Fund

The second column of table II.1 shows the current combined rates (per gallon of fuel) of federal excise taxes on highway motor fuels. Most of the tax on these fuels is allocated to the Highway Trust Fund. In the case of 10-percent gasohol and dieselhol, 7.5 cents of the tax per gallon of fuel remains in the Treasury's General Fund. In the case of the other gasohol blends, 6.9 cents of the tax per gallon remains in the General Fund and 4.3 cents of the tax per gallon of the remaining fuels shown in the table is left in the General Fund. The remainder of the taxes collected on these fuels is transferred to the Highway Trust Fund. The partial exemptions for alcohol fuels reduce the excise tax revenues that are allocated to the trust fund;

[5]T.D. 8291, RIN 1545-AN72, Alcohol Fuels Credit; Definition of Mixture, March 9, 1990, 55 Fed. Reg. 8946. ETBE is an ether produced from ethanol.

[6]PS-66-93, RIN 1545-AS10, Gasoline and Diesel Fuel Excise Tax; Rules Relating to Gasohol, 59 Fed. Reg. 52735; Tax on Compressed Natural Gas, October 19, 1994.

[7]T.D. 8609, RIN 1545-AS10, Gasohol; Compressed Natural Gas, July 25, 1995, 60 Fed. Reg. 40079, Aug. 7, 1995.

they do not affect the portion of the tax that is allocated to the general fund.

The federal Highway Trust Fund was established by the Highway Revenue Act of 1956 as an accounting mechanism to finance anticipated expenditures under the federal-aid highway program for the 16-year period from fiscal years 1957 to 1972. Congress has subsequently passed laws extending the fund and the excise taxes that are earmarked to it.[8] The trust fund excise taxes are currently scheduled to expire after September 30, 1999. The 4.3-percent general fund tax rate is permanent.[9]

During fiscal year 1995, the Highway Trust Fund excise taxes generated about $23.1 billion for the fund, with 60 percent of these revenues coming from the gasoline tax. However, the total tax collections were subject to certain tax refunds, credits, and transfers, such as a tax rebate for diesel-powered vehicles, totaling about $.7 billion. Therefore, the net taxes generated amounted to about $22.4 billion in fiscal year 1995.

Revenue Estimates for the Tax Incentives

Table II.2 shows our estimates of the amounts of excise tax revenue forgone from fiscal years 1979 to 1995 due to the exemptions for alcohol fuels. We estimated that approximately $7.1 billion of excise tax revenue, in constant 1996 dollars, was forgone over that period due to the exemptions.

[8]In addition to excise taxes on motor fuels, excise taxes on certain tires, a use tax on heavy vehicles, and a retail tax on heavy trucks are also earmarked for the fund.

[9]Before expiring on January 1, 1996, there was also a small excise tax on motor fuels that was allocated to the Leaking Underground Storage Tanks Trust Fund. This fund was established to help finance the cost of cleaning up leaking, underground storage tanks for petroleum products. The rates of the tax were 0.1 cent per gallon of fuel for all of the fuels shown in table II.1, except for the qualified ethanol and methanol fuels. The rate for qualified ethanol and methanol fuels was 0.05 cent per gallon of fuel.

Table II.2: Estimates of the Amounts of Excise Tax Revenues Forgone Due to the Partial Exemptions for Alcohol Fuels, 1979-95

Fiscal year	Excise tax revenues forgone (in millions of current dollars)	Excise tax revenues forgone (in millions of constant 1996 dollars)
1979-86	$1,436	$2,049
1987	489	642
1988	483	612
1989	465	564
1990	467	543
1991	510	569
1992	420	455
1993	518	549
1994	504	524
1995	605	617
Total	**N/A**	**$7,124**

Legend: N/A = not applicable.

Sources: GAO estimates on the basis of excise tax collection data from IRS (for fiscal years 1987-95) and gasohol production data from a publication entitled The Economics of Gasoline Ethanol Blends (for calendar years 1979-86).

The data sources and methodologies used to estimate the revenues forgone for the period 1979 through 1986 in table II.2 differed from those used for the period 1987 through 1995 because of differences in the data available for each period. For fiscal years 1987 through 1995, IRS' quarterly reports on excise tax receipts contained sufficient detail for us to determine the amount of tax receipts collected from sales of gasohol and from sales of gasoline that would later be used to produce gasohol. This information on tax receipts for each quarter, combined with information on tax rates in effect for each quarter, enabled us to estimate the number of gallons of gasohol that were sold in each fiscal year.[10] Once we had estimated the number of gallons of gasohol sold, we multiplied the tax rate for gasoline by the number of gallons of gasohol to compute the amount of revenue that would have been collected if the gasohol had been taxed at the full rate. To obtain our estimate of the amount of excise tax revenue forgone, we subtracted the amount of revenue actually collected on gasohol from the amount that would have been collected if it had been subject to the full rate.

[10]In the case of gasohol that was taxed directly, the gallonage of gasohol could be computed as: gallons = tax receipts / rate of tax per gallon of gasohol. In the case of gasoline sold for later use in gasohol, the gallonage of gasohol could be computed as: gallons = (tax receipts / rate of tax per gallon of gasoline used for gasohol) / gasoline content as a fraction of each gasohol gallon.

IRS' excise tax reports before 1987 do not contain sufficient detail to allow us to estimate the gallons of gasohol sold each year. Instead, we relied on published estimates of the amounts of gasohol produced in calendar years 1979 through 1986.[11] We used the published estimates of gasohol production and the applicable tax rates to estimate the amount of tax that was collected on the sale of gasohol from 1979 to 1986 and the amount that would have been collected if the gasohol had been taxed at the full excise tax rate. By subtracting the former from the latter, we obtained our estimate of the revenue excise tax revenue forgone each year.[12]

We also obtained data from the Department of the Treasury and IRS relating to the amount of revenue subtracted from the Highway Trust Fund when taxpayers claim refunds or credits for overpayments of excise tax on gasohol. We included these revenue losses in our totals for each year.

In the absence of the exemption, the amount of excise tax forgone would not necessarily have been exactly equal to the $7.1 billion shown in table II.2. Without the exemption, the 108 billion gallons of gasohol that we estimated were consumed from 1979 to 1995 might have been replaced by a slightly smaller gallonage of other motor fuels that had been subject to the full motor fuel excise tax rates. Since ethanol has less energy content than gasoline or methyl tertiary butyl ether (MTBE), if these other fuels had been used instead of ethanol, then less total gallonage of fuel would have been needed to support a given mileage total. Another reason why less motor fuel might have been consumed is that, without the exemption, the price of motor fuels might have been slightly higher than it was with the exemption, which might have caused the demand for motor fuels to be slightly lower than it was.

The estimates that we present in table II.2 are "static" estimates in that they do not take into account the potential changes in motor fuel consumption in response to the elimination of the exemptions. In this respect, our estimates are similar in concept to the projections that Treasury and the Joint Committee on Taxation make each year for the amounts by which excise tax receipts are reduced due to the existence of

[11]These estimates were published in Anderson, Robert C., Thomas J. Lareau and Roger D. Wollstadt, The Economics of Gasoline Ethanol Blends, Research Study #045, (American Petroleum Institute, Washington, D.C., 1988).

[12]We were not able to present our results for individual fiscal years in this period because the data were available for complete calendar years only. However, we did make an adjustment to our 1986 data which, when combined with the fact that the exemption became effective at the beginning of 1979, makes our estimate for the 1979 through 1995 period equivalent to the sum for the fiscal years during that period.

the exemption.[13] These projections do not represent the amount of revenue that would be saved if the exemption were eliminated because they do not account for the potential behavioral responses that might alter the total gallonage of motor fuels consumed in the future.

When Treasury or the Joint Committee make revenue-savings projections or revenue-cost projections for policy changes, they do take potential behavioral responses into account. The Joint Committee has made projections of the amount of revenue that would be saved if the exemption were eliminated. These projections are virtually identical (after the assumed effective date for the tax law change) to the Joint Committee's static projections of the amount of revenue that will be forgone, due to the exemption, if it is not eliminated. This equality indicates that the estimators believe behavioral responses to the elimination of the exemption would be negligible. Treasury has not made public any revenue-savings estimate for the elimination of the alcohol fuels exemptions in recent years.

The estimates that we have made and the projections that Treasury has made are of the reduction in excise tax revenues due to the exemptions. In contrast, the projections that the Joint Committee has made are of the reduction in total federal revenues due to the exemptions, net of income tax effects. By convention, when the Joint Committee estimates the amount of revenue that is attributable to an excise tax, it reduces the estimated gross revenue gain from the tax by 25 percent to account for offsetting declines in income tax revenue.[14] Conversely, when the Joint Committee estimates the amount of revenue forgone due to an excise tax exemption, it reduces the gross revenue forgone by 25 percent to account for offsetting increases in income tax revenue.

[13]Treasury's projections are published each year in the "Tax Expenditure" section of the President's Budget. The Joint Committee's projections are published each year in its "Estimates of Federal Tax Expenditures."

[14]When the Joint Committee produces revenue estimates for an existing or proposed tax law provision, it assumes that the adoption or elimination of the provision will not affect aggregate economic variables, such as the gross domestic product (GDP), total employment, and the overall price index. The Joint Committee expects that the imposition of an excise tax would raise the prices of the taxed goods and, thereby, increase nominal GDP by the amount of tax collected. However, to maintain its assumption that GDP remains fixed, the Joint Committee assumes that aggregate income would fall by an amount equal to the excise tax collected so as to offset the tax-induced increase in GDP. This decline in income would reduce income tax receipts by an amount equal to the excise tax collected multiplied by the average marginal income and payroll tax rate on all income. The average marginal income tax rate is assumed to be about 25 percent. Therefore, the Joint Committee estimates that the excise tax's net effect on federal revenues would be equal to only 75 percent of the amount of excise tax collected. (See Congressional Budget Office, Budget Estimates: Current Practices and Alternative Approaches, Jan. 1995 and Bruce F. Davie, "Tax Expenditure in the Federal Excise Tax System," National Tax Journal, Vol. XLVII, No. 1, Mar. 1994, pp. 39-62), and Joint Committee on Taxation, Discussion of Revenue Estimation Methodology and Process (JCS-14-92), August 13, 1992.

The projections made by Treasury and the Joint Committee are presented in table III.3. The Joint Committee's projection of total federal revenues that will be forgone due to the partial tax exemption in fiscal years 1996 through 2000—about $2.6 billion—is significantly lower than Treasury's projections of excise tax revenues forgone—about $3.3 billion.

Treasury projects that the alcohol fuels income tax credits will cost a total of about $50 million in forgone income tax revenue from fiscal years 1996 to 2000. The Joint Committee has not made precise projections of the revenue costs of the credits; they simply project that the cost will be less than $50 million in each of the fiscal years from 1996 to 2000.

Table II.3: Department of the Treasury and Joint Committee on Taxation Projections of Revenue Losses Attributable to the Excise Tax Exemptions for Alcohol Fuels, Fiscal Years 1996-2000

Fiscal year	Treasury projections of excise tax revenue losses (in millions of current dollars)	Treasury projections of excise tax revenue losses (in millions of constant 1996 dollars)	Joint Committee projections of total net tax revenue losses (in millions of current dollars)	Joint Committee projections of total net tax revenue losses (in millions of constant 1996 dollars)
1996	$645	$645	$600	$600
1997	665	651	600	587
1998	685	656	500	479
1999	705	660	500	468
2000	730	668	500	458
Total	**$3,430**	**$3,280**	**$2,700**	**$2,592**

Sources: Treasury projections are published in Analytical Perspectives: Budget of the United States Government for Fiscal Year 1997, Table 5-1, "Total Revenue Loss Estimates for Tax Expenditures in the Income Tax," pages 62-64. The Joint Committee's projections are from the Committee's print Joint Committee on Taxation Staff Estimates of Federal Tax Expenditures for Fiscal Years 1996-2000, issued September 5, 1995, Table 1, "Tax Expenditure Estimates By Budget Function, Fiscal Years 1996-2000," pages 12-19. We put the projections into constant dollars using the GDP deflator published in the fiscal year 1997 budget.

Data on U.S. Fuel Consumption and Imports

Table III.1: U.S. Transportation Fuel Consumed, 1992-96

	Fuel consumption (millions of gasoline-equivalent gallons)				
Fuel type	**1992**	**1993**	**1994**	**1995**	**1996**
Traditional:					
Gasoline	108,259	108,494	110,279	111,716	113,673
Diesel	23,866	24,297	26,422	26,740	27,316
Total	**132,125**	**132,791**	**136,701**	**138,456**	**140,989**
Oxygenates:					
Ethanol[b]	701	760	846	919	914
MTBE[c]	1,175	2,069	2,019	2,973	3,330
TAME[d] + ETBE[e]	N/A	N/A	N/A	201	N/A
Total	**1,876**	**2,829**	**2,865**	**4,093**	**4,244**
Alternative fuels:					
E-85[f]	0.021	0.048	0.080	0.105	1
E-95[g]	0.085	0.080	0.140	0.140	0.140
M-85[h]	1	2	2	2	4
M-100[i]	3	3	3	3	3
Liquified Petroleum Gases (propane)	208	265	249	260	263
Compressed Natural Gas (CNG)	17	22	24	44	48
Liquified Natural Gas (LNG)	1	2	2	3	3
Electricity	0.374	0.309	0.430	1	1
Total	**230**	**294**	**281**	**313**	**323**

Legend: N/A = not available.

[a]Projected.

[b]Represents the ethanol used in all fuel blends that are 10-percent or less ethanol and 90-percent or more gasoline.

[c]MTBE is methyl tertiary butyl ether, derived from fossil materials.

[d]TAME is tertiary amyl methyl ether, derived from fossil materials.

[e]ETBE is ethyl tertiary butyl ether, derived from biomass.

[f]E-85 is a fuel mixture of 85-percent ethanol and 15-percent gasoline.

[g]E-95 is a fuel mixture of 95-percent ethanol and 5-percent gasoline.

[h]M-85 is a fuel mixture of 85-percent methanol and 15-percent gasoline.

[i]M-100 is a fuel consisting of 100-percent methanol.

Source: U.S. Department of Energy, Alternatives to Traditional Transportation Fuels, Vol. 1, DOE/EIA-0585(94)/1, February 1996, page 37.

Table III.2: Gasoline, MTBE, TAME, Ethanol, and ETBE Used in the United States in 1995, by Air Quality Area

Fuel/Source material	Percent of that fuel type used in area (percent)	Quantity of fuel used (millions of gallons)	Gasoline energy equivalent (percent)	Quantity of gasoline-equivalent fuel (millions of gasoline-equivalent gallons)	Percent of total gasoline-equivalent fuel used (percent)
All areas meeting air quality standards:					
Gasoline[a]	58%	63,802	100%	63,802	55.0%
MTBE	0	0	82	0	0
TAME	0	0	88	0	0
Ethanol	38	495	67	332	0.3
All air quality nonattainment areas:					
Gasoline[a]	42	47,057	100	47,057	40.7
MTBE	100	4,745	82	3,891	3.4
TAME	100	123	88	108	0.1
Ethanol	62[b]	742	67	497	0.4
ETBE	N/A	63	85	54	0.05
All areas:					
Gasoline[a]/Fossil	100	110,859	100	110,859	95.8
MTBE/Fossil	100	4,745	82	3,891	3.4
TAME/Fossil	100	123	88	108	0.1
Ethanol/Biomass	100	1,237	67	829	0.7
ETBE/Biomass	100	63	85	54	0.05

Legend: N/A = not applicable.

[a]Gasoline category does not include MTBE, TAME, ethanol, or ETBE.

[b]Includes the ethanol used to make ETBE.

Sources: Urbanchuk, John M., Ethanol: Fueling An Economic Engine: Macroeconomic and Fiscal Impacts of Ethanol Production Under the 1996 Farm Bill, April 19, 1996, AUS Consultants, page 10; U.S. Department of Energy; and GAO.

Table III.3: U.S. Energy and Petroleum, Consumed and Imported (Actual and Projected), 1973-2015

	Energy[b] consumed			Petroleum[c] consumed		
	(quadrillion Btu)		(percent)	(quadrillion Btu)		(percent)
Year[a]	Total	Imported	Imported	Total	Imported	Imported
1973	74.28	12.68	17	34.84	12.98	37
1974	72.54	12.19	17	33.46	12.66	38
1975	70.55	11.75	17	32.73	12.51	38
1976	74.36	14.65	20	35.18	15.20	43
1977	76.29	18.02	24	37.12	18.24	49
1978	78.10	17.32	22	37.97	17.06	45
1979	78.90	16.75	21	37.12	16.93	46
1980	75.96	12.25	16	34.20	13.50	39
1981	73.99	9.65	13	31.93	11.38	36
1982	70.85	7.46	11	30.23	9.05	30
1983	70.52	8.31	12	30.05	9.08	30
1984	74.14	8.96	12	31.05	9.89	32
1985	73.98	7.87	11	30.92	8.95	29
1986	74.30	10.38	14	32.20	11.53	36
1987	76.89	11.91	15	32.87	12.53	38
1988	80.22	13.15	16	34.22	14.01	41
1989	81.33	14.18	17	34.21	15.33	45
1990	81.27	14.08	17	33.55	15.29	46
1991	81.12	13.36	16	32.85	14.22	43
1992	82.14	14.63	18	33.53	14.96	45
1993	83.86	17.18	20	33.84	16.40	48
1994	88.74	18.59	21	34.77	17.28	50
1995	90.93	17.93	20	34.92	16.87	48
2000	97.85	24.18	25	37.92	22.41	59
2005	103.36	27.43	27	40.46	25.59	63
2010	107.89	29.33	27	42.24	27.48	65
2015	110.67	30.53	28	43.26	28.60	66

(Table notes on next page)

Note: Imports are net of exports.

[a]Figures for 2000 and later years are Energy Information Administration (EIA) projections. Ethanol preferences expire after 2000; however, EIA projections assume the preferences will be renewed and continue at current levels through 2015.

[b]Energy includes natural gas, coal, nuclear, and renewable, in addition to petroleum.

[c]Petroleum includes crude oil, lease condensate, petroleum products, unfinished oils, pentanes plus, and gasoline-blending components.

Sources: 1973-1993: U.S. Department of Energy, Monthly Energy Review, DOE/EIA-0035(96/06), June 1996, pages 7 and 9. 1994-2015: U.S. Department of Energy, Annual Energy Outlook 1997: With Projections to 2015, DOE/EIA-0383(97), December 1996, page 96.

Description of Groups in the Economy That the Ethanol Tax Incentives Affect

The ethanol tax incentives benefit or disadvantage different groups in the economy by changing the prices these groups pay and the income they receive. By lowering the after-tax price of ethanol, the tax incentives change the price of ethanol relative to the prices of other goods and, thereby, change the supply and demand for these goods. The incentives may cause the groups that buy and sell these goods to pay different prices and receive different incomes than they would receive in the absence of the incentives.

Determining the groups that the tax incentives benefit or disadvantage—what economists call the "incidence" of the incentives—requires analyzing how prices and incomes would be different in the absence of the incentives. The groups that benefit from the incentives are those that would pay higher prices or receive lower incomes in the absence of the incentives. This appendix explains the factors that determine the incidence of the incentives and describes the economic groups that may be affected by the incentives.

The Factors Determining the Incidence of the Tax Incentives

The groups that bear the burden of a tax or receive the benefit of a tax incentive are not necessarily those who legally must pay the tax. Levying a tax may change the price of one good relative to another and, thereby, may change prices and the allocation of resources. In this way, the tax may be shifted to other households and firms in the economy through price changes.

The groups that legally must pay the excise tax on gasoline do not receive the full benefit of the ethanol tax incentives. In some cases, those who legally must pay the tax may be the blenders; in other cases, they may be the gasoline distributors. In either case, the tax incentives reduce the blenders' after-tax cost of using ethanol because they are the ones who undertake the activity of blending ethanol and gasoline that gives rise to the tax reduction. If the blenders pay the tax, they can also claim the tax reduction. If gasoline distributors pay the tax and claim the tax reduction, they will reduce the price that they charge the blenders by virtually the full amount of the tax benefit. The reasons for this are: (1) the gasoline distributors are just as well off selling gasoline to be blended with ethanol at the lower price and receiving the tax reduction as they are selling gasoline for other uses at the higher price and receiving no tax reduction and (2) the blenders have the option of not telling the distributors that the gasoline will be blended with ethanol, in which case the distributors would

not claim the tax reduction, and the blenders could later claim refunds of the overpayment of tax.

However, the blender does not receive the full benefit of the incentives because the reduction in the after-tax cost of ethanol increases the blenders demand for ethanol, and thereby raises its price. Therefore, a part of the benefit that the blenders could receive is offset due to the increase in the pre-tax cost of ethanol. A part of the benefit is shifted back to ethanol producers and may be shifted to other groups in the economy through price and income changes.

How prices and incomes are altered by the shifting of the incentives among groups depends on how responsive market supply and demand are to price changes and on market conditions that affect a firm's ability to control prices. The responsiveness of supply and demand to price changes is called the "price elasticity." Determining the incidence of the incentives requires (1) information on price elasticities for all of the markets potentially affected by the incentives and (2) information on the conditions in the markets that determine whether firms control prices and, if so, how much control firms have over the prices they can charge to consumers.

In competitive markets where firms do not control the prices they charge, the incidence of the incentives depends on the elasticity of supply and demand. In general, the less elastic is supply and the more elastic is demand, the more suppliers benefit from the incentives. For example, if the supply of corn by farmers is less responsive to price changes than the demand for corn by ethanol producers, more of the value of the incentives would be shifted back to farmers as higher corn prices. These elasticities also make it likely that the short-term effect on prices of removing tax incentives will be greater than the long-term effect because the supply of products and resources is less elastic over shorter periods of time. For example, fuel producers may need time to adjust their production levels when a tax is removed, and, therefore, the short-term effect on their prices is likely to be greater than the long-term effect.

Except in the case of a monopoly, the factors governing the incidence of the tax incentives in noncompetitive markets are more difficult to determine. The incidence of the tax incentives in a market with a few firms that can influence market price depends on the behavior of these firms. Whether a firm shifts the tax incentives forward to consumers will depend on whether it believes other firms in the industry will also lower prices.

The incidence of the tax incentives may also depend on whether firms are maximizing profits, total revenues, or market share.

Description of the Markets and Consumers of Ethanol and Related Products

The tax incentives, by altering supply and demand conditions in the ethanol market, can affect prices in markets throughout the economy. For example, the increased demand for ethanol increases demand and price in the corn market, while it lowers demand and price in markets for substitute fuels. In this section, we describe the groups for whom the incentives have a nonnegligible effect on prices. We do not describe the groups such as workers for whom the effect is likely to be negligible. Although the tax incentives increase the demand for workers in the ethanol industry, this increased demand merely shifts labor from other sectors in the economy and does not produce a net increase in employment. Furthermore, the ethanol industry is relatively small and increased demand in this industry is unlikely to have any net effect on wage rates in the economy.

Ethanol Blenders and Distributors

The blending and distribution of the ethanol blends usually are not integrated with ethanol production. Ethanol and gasoline usually have been blended by businesses that purchase gasoline at wholesale from refiners and purchase ethanol at wholesale from ethanol producers. Most fuel ethanol is sold in the open market rather than through integrated distribution channels. The ethanol is sold primarily to wholesalers beyond the refinery gate so that ethanol competes directly with wholesale gasoline and other blending agents. Most petroleum pipelines will not carry ethanol because the ethanol can suffer water contamination or cross contamination with other petroleum products, and because of ethanol's corrosive properties. Therefore, ethanol is usually transported by truck or rail and blended with gasoline, which arrives by pipeline at the distribution points.

However, in the future, gasoline refiners may begin to account for a larger share of alcohol fuel-blending than they have in the past. New IRS regulations (effective Oct. 1, 1995) allow ETBE, which is an ether derived from ethanol, to qualify for both the partial excise tax exemption and the income tax credits. ETBE (like the ether MTBE) can be blended with gasoline and transported via pipelines without serious problem.

Ethanol Producers

The ethanol industry is dominated by a few firms. Sixty-five percent of capacity is owned by the three largest firms, and the largest firm, Archer Daniels Midland, owns 50 percent. In 1994, total capacity of the industry was about 1.6 billion gallons per year, and total output was about 1.3 billion gallons. A few large plants account for the bulk of capacity, with 50 percent of industry capacity accounted for by four large plants owned by Archer Daniels Midland. The average capacity of these plants was about 215 million gallons per year.

Economies of scale are difficult to quantify because of diverse plant configurations in the industry. However, some estimates are that plants need an annual capacity of 50 to 100 million gallons per year to take advantage of economies of scale. In 1995, the four large plants owned by Archer Daniels Midland accounted for about 70 percent of the capacity of plants in the industry that can produce more than 50 million gallons per year.

The ethanol is produced using dry-milling and wet-milling technologies. Both processes convert a bushel of corn into approximately 2.5 gallons of ethanol. The technologies differ in the byproducts produced and capital costs. Generally, wet milling has higher capital costs but produces more valuable byproducts than dry milling. The byproducts of the wet-milling process include corn gluten meal, corn gluten feed, corn oil, and carbon dioxide. The principal byproduct of dry milling is direct distillers grains, which is a high protein livestock feed. Wet milling accounts for about 60 percent of the total ethanol production.

The net cost of producing ethanol depends on the price of corn; the value of the byproducts generated in the production process; the costs of energy, chemicals, and labor; the size of the plant; and the technology used to produce the ethanol. The estimates of total costs can vary significantly depending on variations in these components of costs. A 1988 report[15] by the American Petroleum Institute (API) estimated the total cost of ethanol production in a wet-milling plant with a capacity of about 50 million gallons per year at $1.14 per gallon with corn prices at $1.80 per bushel and at $1.38 per gallon with corn prices at $2.75 per bushel. API estimated dry-milling costs in a plant with the same capacity at $1.25 and $1.48 using the same variation in corn prices. A 1992 analysis by the U.S. Department

[15]Anderson, Lareau, and Wollstadt, The Economics of Gasoline Ethanol Blends.

of Agriculture's (USDA) Economic Research Service (ERS)[16] estimated the total cost, in 1992, for a wet-milling plant with 100-million gallon capacity at $1.24 per gallon of ethanol produced. This estimate was based on average corn prices and byproduct prices from 1981 to 1991. ERS reported estimates by other researchers that range from $1.08 to $1.95 per gallon.

The Effect on the Ethanol Industry of Removing the Tax Incentives

Without the tax incentive, fuel ethanol production would largely discontinue. This conclusion is based on estimates of ethanol production costs, the opinions of industry analysts, and the results of simulation models estimating the effect of removing the exemptions.

The cost of producing ethanol exceeds the price of the alternatives, given the current technology and recent prices of substitute fuels. The wholesale price of gulf coast regular gasoline at the rack averaged about $0.55 per gallon in the second half of 1995, and the price of the methanol-based additive, MTBE, averaged about $0.81 per gallon. The estimates of ethanol production costs reported above all exceed the prices of these alternative products. On the basis of these cost estimates, ethanol could not be priced to match the prices of the alternative products and cover the cost of producing ethanol and the additional costs of distributing ethanol to blenders.

The economic viability of the ethanol industry depends on the size of state subsidies as well as the federal incentives. States provide incentives for ethanol in the form of tax exemptions and production subsidies. As of December 1995, according to one industry survey, eight states had production subsidies that ranged from 20 to 40 cents per gallon of ethanol, and nine states had a sales tax or motor fuels tax exemption for ethanol. These exemptions range from 10 cents per gallon of ethanol in Connecticut and Iowa to 80 cents per gallon in Alaska. These state tax incentives, combined with the federal exemption of 54 cents per gallon, allow ethanol to compete profitably with substitute fuels.

However, ethanol producers may be able to price ethanol competitively without the incentives if the price of corn were lower and the price of the substitute fuels were higher, or if significant cost savings were made through technological improvements. In 1988, API estimated that corn would need to cost as little as $1.80 per bushel and wholesale gasoline would have to sell for as much as $1.25 per gallon for producers to price ethanol competitively with gasoline and cover their production cost.

[16]Hohman, Neil and C. Matthew Rendleman, "Emerging Technology in Ethanol Production," Agriculture Information Bulletin, No. 663, (Economic Research Service, U.S. Department of Agriculture, January 1993), pages 1 to 17.

Estimates made in 1993 of cost savings from improvements in technology show short-term gains (in the next 2 to 5 years) of 5 to 7 cents per gallon and long-term gains (in the next 5 to 10 years) of an additional 4 to 8 cents per gallon.

In addition to the cost analysis, the views of analysts of the ethanol industry also lead us to conclude that the ethanol production would largely discontinue if the incentives were removed. For our 1995 report, we interviewed ethanol and gasoline industry trade groups, ethanol producers, and government officials.[17] We concluded from the interviews that, without the incentives, large-scale ethanol producers having the lowest production costs may continue to produce ethanol, at least in the short term, but that the amount of ethanol used would decline dramatically. Some ethanol production for export may continue for a while, although the amount of U.S. exports of ethanol varies a great deal from year to year.[18] In our 1995 report, we used declines of 50 and 90 percent with no expected future growth in ethanol use in the simulations used to assess the effect of eliminating the exemption on farm prices and incomes.

Simulations by the Energy Information Agency (EIA) also led to the conclusion that the ethanol fuel production would largely discontinue if the incentives were removed. According to EIA, ethanol would represent about 21 to 33 percent of the oxygenate content of gasoline through 2015 if the exemption were continued at current levels, while the rest of the oxygenate content would be MTBE and other ethers. The EIA model projects that ethanol-blending would discontinue if the exemptions actually were to expire after 2000, but it would recover slightly by 2015 to cover about 2 percent of the oxygenate market. The recovery would occur because the prices of other blending components would rise more rapidly than the price of ethanol throughout the forecast period.

Producers of Alternative Gasoline Additives

Substitutes for ethanol as an octane enhancer are hydrocarbon aromatics, such as benzene, toluene, and xylene. The chief substitute for ethanol as an oxygenate is MTBE, which is produced using methanol. MTBE also enhances octane but to a smaller extent than ethanol. MTBE is a less costly source of oxygen in blended fuels than ethanol. MTBE is currently derived

[17]GAO/RCED-95-273R.

[18]The export market for ethanol is volatile because the foreign demand for U.S. ethanol depends on the price of sugar. Because ethanol production involves the fermentation of sugar, when sugar prices are low, more ethanol is produced abroad and demand for U.S. ethanol is less.

from natural gas and, therefore, it does not benefit from the federal tax preferences. These preferences are sufficient to make ethanol competitive with MTBE as an oxygenate. Ethanol and ethanol-based additives had 35 percent of the oxygenate market in 1994, while MTBE had about 65 percent.

If the tax incentives were removed, MTBE is likely to supply nearly all of the oxygenate and octane enhancer markets. According to EIA simulations, MTBE would almost entirely replace ethanol if the incentives were removed. EIA also measured the impact of eliminating the incentives on the price of reformulated gasoline. The differential between the price of reformulated gas and conventional gasoline would increase from about 4 cents per gallon to 5 cents per gallon after 2000 if the exemption is eliminated.

Farmers

Corn is the principal feedstock used for ethanol production. About 95 percent of the ethanol sold for gasoline in the United States is made from corn; the rest is made from wheat, barley, and potato waste. In 1995, approximately 500 million bushels of corn were used to produce about 1.3 billion gallons of ethanol. Corn used in ethanol production represented about 6 percent of the total corn output in 1995. Most ethanol production is in corn-growing states.

Ethanol production increases the supply of high-protein animal feed and corn oil byproducts from the conversion of corn into ethanol. The dry-milling process generates distilled dried grains, while the wet-milling process produces gluten meal, gluten feed, corn oil and carbon dioxide. The increased supply of these byproducts may reduce the demand for and price of oil seeds, such as soybeans, cottonseed, and sunflower seeds. The increased supply of byproducts may reduce demand for soybeans because the byproducts compete with soybean meal in the high protein meal markets and with soybean oil in the vegetable oil markets. However, the effect of reduced demand on soybean prices may be offset by a reduction in supply as farmers switch to more profitable corn production following an increase in the price of corn. Corn is a primary competitor for soybean acreage, and as farmers substitute corn for soybean acreage, soybean supply may fall and its price increase, offsetting the effect on soybean prices of the drop in soybean demand due to increased production of ethanol byproducts.

Farmers use corn and other feed grains for their livestock. The higher corn prices due to the ethanol tax incentives may increase the feed costs of some livestock producers, such as those who raise cattle. However, to the extent that the increased supply of ethanol byproducts lowers the price of high protein animal feed, other producers, such as those who raise poultry, may face lower costs. Although, as a group, grain producers may increase their income, the total effect on farmers' incomes depends on the net effect of the price changes on grain, oilseed, and livestock producers.[19]

The Effect of the Ethanol Tax Incentives on Farm Prices and Incomes

In our 1995 report, we estimated the effect of removing the tax incentives on farm prices and income assuming that all agricultural policies set forth in the 1990 farm bill would be maintained. We used an econometric model developed by the Food and Agriculture Policy Research Institute (FAPRI) to estimate the effect of the removing the incentives, assuming that the demand for ethanol would decline by 50 percent and 90 percent.[20] Each of these scenarios was estimated for the period 1995 through 2000, assuming alternatively no corn acreage reduction and that corn acreage would be reduced as modeled in the 1995 FAPRI baseline.[21] Under both sets of assumptions, we concluded that corn prices, soybean prices, and net farm income would decline if the tax incentives were removed. We found that the average decline in the price of corn over the period 1995 through 2000 would range from 5.9 to 9.3 percent for a 50- and 90-percent decline in ethanol use. We also found that, for a 50-and 90-percent decline in ethanol use, the average decline in the price of soybeans would range from 3.0 to 4.8 percent, and the average decline in net income for all farmers would range from 1.4 to 2.4 percent.

We did not estimate the effect on prices and incomes of removing the incentives under the new policies introduced by the Federal Agricultural Improvement and Reform (FAIR) Act of 1996. According to analysts at USDA

[19]In cases where farmers do not own the land they work, in theory, the benefit of higher farm prices could be shifted back to the owners in terms of higher land prices or rents. In these cases, the effect of the incentives on farm incomes would include the effect on the income of land owners as well as the farmers who work the land.

[20]FAPRI uses a set of integrated models to determine the consequences of policies and programs that affect U.S. and world agriculture. The FAPRI modelling system consists of U.S. domestic crop models; U.S. livestock models; world trade models for feed grains, wheat and soybeans; a model that estimates the cost of domestic government agricultural programs; and a model that estimates net farm income.

[21]The FAPRI baseline assumes that the acreage that farmers can plant with corn and still be eligible for federal farm payments would be reduced by 7.5 percent in the first year and 5 percent thereafter. CBO suggested that a reasonable alternative is to assume that the Secretary of Agriculture would have reduced the acreage that farmers were allowed to plant with corn to remain eligible for federal payments sufficiently to offset the effect of the reduced demand for corn on corn prices.

and the Congressional Budget Office (CBO), corn and net farm income would decline under the FAIR Act if the incentives are removed. The FAIR Act, by eliminating the barriers to shifting acreage among crops, also increased the likelihood that the drop in ethanol production would result in a decrease in soybean prices if the incentives were removed. However, our estimates of the size of these price and income declines would be different because the estimates would reflect these new policies and changed market conditions since our report. For example, the decline in farm incomes may be different under the FAIR Act because the act removed the link between farm payments and farm prices so that lower market incomes from corn would not be offset by increasing deficiency payments. Our 1995 analysis assumed that government deficiency, or income support, payments would be made as corn prices declined, somewhat compensating corn farmers for lower market receipts from corn. The FAIR Act retained a program of government loans, which may moderate the decline in farm incomes if market price declines are severe.[22] However, USDA believes that the price of corn is unlikely to fall far enough for the loans to be used to mitigate the effect of the price declines on farm income.

Consumers

Consumer demand for ethanol is based on its characteristics as a motor fuel and on environmental regulations. Ethanol is used in gasohol in unregulated markets as a gasoline extender and octane enhancer. Over 76 percent of all gasohol is sold in midwestern states where it is competitive in price with gasoline because of the states' proximity to ethanol producers and because of state tax incentives for gasohol. Ethanol is also used as an oxygenate to meet environmental regulations. According to estimates that are based on ethanol industry data, in 1995, ethanol represented 28 percent of the oxygenates used in the oxygenated fuels market and 7 percent of the oxygenates used in the reformulated gasoline market. By 2002, these ethanol shares are estimated to increase to 38 percent and 13 percent of the respective markets, if the tax incentives are continued at the current levels.

[22]Farmers may receive a loan from the government at a designated rate per unit of production (loan rate) by pledging and storing a crop as collateral. The farmers have the option either to repay their loans with interest at any time or, at the end of the loan period, to forfeit their crop to the government and have their interest payments forgiven. Farmers who raise certain crops, such as oilseeds, wheat, and feedgrains, may repay the loans at alternative repayment rates that are based on price data from USDA when these rates are lower than the loan rates. Because the farmers keep the difference between the loan rate and the alternative payment rate, they can sell their crops at market prices without reducing their returns. Farmers who do not take out loans may also receive amounts called loan deficiency payments that are equal to this difference between the loan rate and the alternative payment rate.

Consumers benefit if the tax incentives are passed on in the form of lower motor fuel prices. Price-shifting depends on the price elasticity of demand for ethanol-blended fuels. The more inelastic is demand, the more the consumer would benefit from the incentives. The price elasticity for ethanol blends is affected by the availability of substitute fuels with similar characteristics and by environmental regulations requiring the use of additives, such as ethanol. Demand would be less responsive to price changes to the extent that the use of ethanol is required to meet environmental standards and to the extent the ethanol blend is perceived to have characteristics different from other motor fuels.

Consumers are not likely to benefit much from the tax incentives in the regulated markets because the regulations do not require the use of ethanol. The environmental regulations have increased demand for ethanol for use as an oxygenate. Since the Clean Air Act Amendments of 1990, demand for ethanol and MTBE has more than doubled. However, these regulations do not specify that ethanol be used as the oxygenate. MTBE, which is less costly to produce than ethanol, already has about 65 percent of these regulated markets. The demand for ethanol blends in these markets is likely to be highly elastic because consumers will respond to any price differences by purchasing the lower-priced fuel.

Consumers also are not likely to benefit much from the tax incentives in unregulated markets because the fuel characteristics of ethanol blends make them a close substitute for gasoline. Ethanol blends have higher octane levels than gasoline, which improves driveability by reducing engine knock. However, the blends also have higher volatility than gasoline, which reduces driveability by causing vapor lock in hot weather, and the blends get fewer miles per gallon because ethanol has about two-thirds the energy content of gasoline. API concluded from its review of driveability studies that the octane, volatility, and mileage tradeoffs turn out to be about equal, and that most consumers view ethanol blends as close substitutes for gasoline.

Because the ethanol blends are viewed as close substitutes for gasoline by most consumers, the effect of the incentives on gasoline prices would be limited by the size of ethanol production relative to the total market for motor fuels. Since ethanol makes up only 1 percent of the motor fuel supply, removing the incentives is unlikely to have a large impact on price. In 1988, API estimated that the tax incentives lowered the price of motor fuels by 0.27 percent.

MTBE blends are also close substitutes for ethanol blends for use as an octane enhancer and gasoline extender in the unregulated markets. Ethanol blends have a higher octane level but have lower mileage and higher volatility. Removing the ethanol tax incentives would increase demand for MTBE both as an oxygenate and as an octane enhancer. The consumers are likely to respond to any difference in price by purchasing the lower-priced fuel. As previously described, EIA has estimated that removing the tax incentives would produce a small increase in the price of reformulated gasoline produced with MTBE.

The ethanol tax incentives may also affect consumers as buyers of food. As previously discussed, the incentives may cause the prices of some crops to be higher, which could then lead to slightly higher prices to consumers for some food products. The benefit to consumers from lower gasoline prices could be reduced by the higher food prices due to the incentives. However, like the effect on gasoline prices, the effect on food prices is likely to be very small. For example, the increased price that farmers receive for their corn may represent a much smaller price increase for consumers because, in many cases, the corn is only a part of the product purchased by the consumer, and the farmer's price is only part of the product's retail cost to the consumer. Furthermore, the effect of the increased corn price on the consumer's total food costs is small because spending on corn and products derived from corn represents only a part of the consumer's food budget.

Major Contributors to This Report

General Government Division, Washington, D.C.	James A. Wozny, Assistant Director, Tax Policy and Administration Issues Anne O. Stevens, Economist-in-Charge Kevin E. Daly, Senior Economist Charles C. Tuck, Senior Economist
Resources, Community and Economic Development Division, Washington, D.C.	Mary C. Kenney, Senior Economist

Ordering Information

The first copy of each GAO report and testimony is free. Additional copies are $2 each. Orders should be sent to the following address, accompanied by a check or money order made out to the Superintendent of Documents, when necessary. VISA and MasterCard credit cards are accepted, also. Orders for 100 or more copies to be mailed to a single address are discounted 25 percent.

Orders by mail:

U.S. General Accounting Office
P.O. Box 6015
Gaithersburg, MD 20884-6015

or visit:

Room 1100
700 4th St. NW (corner of 4th and G Sts. NW)
U.S. General Accounting Office
Washington, DC

Orders may also be placed by calling (202) 512-6000 or by using fax number (301) 258-4066, or TDD (301) 413-0006.

Each day, GAO issues a list of newly available reports and testimony. To receive facsimile copies of the daily list or any list from the past 30 days, please call (202) 512-6000 using a touchtone phone. A recorded menu will provide information on how to obtain these lists.

For information on how to access GAO reports on the INTERNET, send an e-mail message with "info" in the body to:

info@www.gao.gov

or visit GAO's World Wide Web Home Page at:

http://www.gao.gov

United States
General Accounting Office
Washington, D.C. 20548-0001

Bulk Rate
Postage & Fees Paid
GAO
Permit No. G100

Official Business
Penalty for Private Use $300

Address Correction Requested