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BY THE U.S. GENERAL ACCOUNTING OFFICE

**Report To The Chairman, Subcommittee On  
Fossil And Synthetic Fuels  
Committee On Energy And Commerce  
House Of Representatives**

**Removing Barriers To The Market  
Penetration Of Methanol Fuels**

This study examines some of the impediments confronting the development of methanol as a commercially viable transportation fuel. The primary barriers confronting methanol commercialization are economic, and they are largely dependent on the price of competing fuels.

There is little the Federal Government can do to influence these economic factors short of providing financial incentives. However, certain Federal regulations may present additional, though less substantial, impediments. Unlike the economic barriers, regulatory factors are within the control of the Federal Government. GAO believes that certain other measures might be effective at the margin--that is, they would not in themselves create widespread use of or demand for methanol, but they might help.

In the short term, the development of a market for methanol fuel may not reduce U.S. reliance on imported energy because low priced foreign methanol is becoming available. This factor is relevant to any decision to promote methanol for national security reasons.



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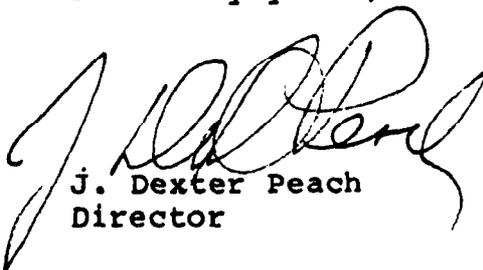
The Honorable Philip R. Sharp  
Chairman, Subcommittee on Fossil  
and Synthetic Fuels  
Committee on Energy and Commerce  
House of Representatives

Dear Mr. Chairman:

In your letter of April 28, 1982, you asked that we identify and assess infrastructural and institutional barriers to methanol's market penetration as a transportation fuel and examine policy options available to the U.S. Government to overcome these barriers. This report responds to your request.

As arranged with your office, we are sending copies of this report to the Senate Committee on Energy and Natural Resources, the House Committee on Energy and Commerce, and other interested parties. We are also sending copies to the Departments of the Treasury, Transportation, and Energy; General Services Administration; and the Environmental Protection Agency. It will also be available to others upon request.

Sincerely yours,



J. Dexter Peach  
Director

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GENERAL ACCOUNTING OFFICE  
REPORT TO THE CHAIRMAN,  
SUBCOMMITTEE ON FOSSIL AND  
SYNTHETIC FUELS, COMMITTEE  
ON ENERGY AND COMMERCE  
HOUSE OF REPRESENTATIVES

REMOVING BARRIERS TO THE  
MARKET PENETRATION OF  
METHANOL FUELS

D I G E S T

Methanol (or methyl alcohol) is a liquid that can be used as a fuel in itself or blended with gasoline or diesel fuel to run an automobile or other vehicle. It can be derived from natural gas, coal, wood, and other renewable sources. Some authorities expect methanol to become the preferred alternative fuel of the future because it offers the prospect of decreasing U.S. dependence on imported oil; others point to methanol's inherent energy efficiency. Use of methanol as a transportation fuel seems to be technically feasible although some uncertainties remain. Nevertheless, methanol has not emerged as a major transportation fuel because large investments are necessary to bring sufficient fuel and vehicles to the national retail level, while prospective return on investment has, to date, been inadequate to convince fuel producers and auto manufacturers to enter the market.

The Chairman of the Subcommittee on Fossil and Synthetic Fuels, House Committee on Energy and Commerce, asked GAO to identify and assess the barriers to methanol's market penetration as a transportation fuel and suggest possible Government actions, short of expensive subsidies, which might eliminate or diminish market impediments. This report suggests several actions that the Federal Government could take to accomplish that objective.

ECONOMIC BARRIERS TO WIDESPREAD  
USE OF METHANOL

Using methanol as a fuel in itself or as a substantial portion of a blend to power automobiles and other vehicles requires two conditions--the production and availability of methanol itself and the existence of vehicles designed to use it. The principal barrier is the economics of producing and distributing both the fuel and the vehicles. Such an undertaking involves complex and costly operations; it raises the "chicken or the egg" question of which comes first.

Auto manufacturers are unwilling to produce cars designed to run on methanol fuels until the fuel is widely available at the retail level. Methanol producers and marketers are unwilling to invest in a fuel that has as yet few customers. In the absence of a clear demand for the products, neither side is likely to invest significant amounts of capital to develop this alternative-fuel source. (See p. 7.)

#### FEDERAL STANDARDS AND REGULATIONS AFFECTING METHANOL

Besides economic considerations, various Federal standards and regulations affect methanol fuels and vehicles that use them. To promote the use of methanol as an alternative transportation fuel, the Government could take several steps to overcome or diminish administrative impediments. Keeping in mind the fundamental economic barriers which must be overcome, GAO considers that these steps might be effective at the margin--that is, they themselves would not create widespread use of or demand for methanol fuels or vehicles, but they might help. (See p. 10.)

#### Emissions standards

Currently, the Environmental Protection Agency (EPA) regulates methanol's use in blends with unleaded gasoline. In order to be approved, blends must be tested to assure that they will not cause vehicles to violate established emission standards. Some fuel manufacturers have complained about the need to test each individual blend because this process is costly and time consuming. If possible, EPA could provide a blanket waiver for blends within certain limits, which would eliminate the need for individual testing in many cases. This may require the manufacturers to make public more information about the formulation of their blends. (See p. 10.)

Methanol when used as a fuel emits significantly higher levels of aldehydes (suspected carcinogens) than gasoline or diesel fuels. It also results in emission of unburned methanol. EPA could help in reducing some of the market uncertainty by developing appropriate emission standards in anticipation of market development--that is, before widespread methanol use makes their need apparent.

## Fuel economy standards

GAO found that there is no officially accepted method of comparing the fuel economy of methanol fuels with that of gasoline or diesel fuels under the Corporate Average Fuel Economy Standards. This comparison is not straight forward because methanol and gasoline contain different amounts of energy per unit of volume. The inability to compare the economy of the two types of fuels would probably have a negative effect on both the production and sale of vehicles using methanol. However, EPA, with the cooperation of the Department of Transportation, may be able to establish an equivalency factor to compensate for methanol's lower volumetric energy content compared to established fuels. Both the mechanism and the precedent have been set to take this action. (See p. 17.)

## Methanol in commerce

Although methanol has been safely handled for many years as a chemical commodity, no standards or regulations exist for the orderly commerce--production, storage, and use--of methanol as a fuel. The absence of these standards may add to investors' uncertainty and cause delays in market development. To encourage orderly commerce in methanol, the Government may be able to cooperate with the American Society for Testing and Materials and similar organizations to develop appropriate criteria. In dealing with similar materials, the General Services Administration and the Department of the Army have established precedents for setting standards which have subsequently been adapted for private industry. (See p. 20.)

## Antitrust considerations

GAO's study revealed that antitrust considerations may limit some specific cooperative activities considered desirable by methanol fuel producers and vehicle manufacturers. Vehicle manufacturers and methanol producers would like to agree on standards and production schedules to assure simultaneous availability of both vehicles and fuel. The scope, extent, and duration of vehicle and fuel producers' cooperation could be defined in consultation with the Department of Justice to minimize the chance of formal antitrust actions. Procedures for such consultations are well established. (See p. 22.)

PUBLIC AND PRIVATE FLEET  
USE OF METHANOL VEHICLES

GAO examined the potential for using methanol in large public and private fleets as a market catalyst. This potential is limited by technical constraints and the driving requirements of many fleets. Under favorable conditions and assuming some motivation on the part of fleet operators to convert, captive fleet use of methanol could potentially lead to a wider market for methanol fuel and vehicles. This development would be further encouraged if fleet operators were to contract for their fuel needs with gas stations open to the general public rather than service their vehicles in private facilities.

Converting the Federal fleet to methanol fuels might have a positive psychological effect by indicating a Government endorsement of methanol. GAO believes, however, that such action by itself would not provide a sufficient market to promote general availability of methanol fuel and vehicles. (See p. 26.)

METHANOL IMPORTS MAY  
PENETRATE DOMESTIC MARKET

If a market for methanol develops in the transportation sector, fuel supplies beyond current production capacity may not come from new domestic sources but may be imported. Producing methanol from domestic coal is unlikely in the near- to mid-term because of the large front-end capital investment required for this type of production facility and the likelihood of price competition from imported sources. Domestic methanol from natural gas may also be vulnerable to some extent to price competition from imports, especially as natural gas prices in the United States increase. The quantity of methanol currently imported is increasing, but it is still small compared to domestic production. For the future, however, foreign producers of methanol apparently may enjoy a significant price advantage. Their natural gas feedstock, essentially a by-product of crude oil production, is often flared or reinjected. It can therefore serve as the basis for low cost methanol production. (See p. 44.)

AGENCY COMMENTS

The Departments of Energy, Justice, and Transportation; the Environmental Protection Agency;

and the General Services Administration commented upon a draft of this report. These comments are included in appendix III. In general, they agreed with the findings of this report. GAO made certain observations on steps that the Government could take to remove barriers to methanol's commercialization. Agency comments broadly supported these. Editorial suggestions have been incorporated in the report, where appropriate.

The Department of Energy (DOE) made the relevant point that a volumetric tax on methanol as a fuel constitutes a potential barrier to increased methanol use because methanol contains less energy by volume.

DOE gives greater emphasis to potential anti-trust problems than does the report. GAO believes that until existing antitrust remedies available through the Department of Justice have been tried, it is too early to conclude that they are inadequate. DOE also took issue with GAO's view that imported methanol may help to meet increased domestic demand from the transportation sector in the near- to mid-term on the grounds that foreign demand may also increase. Potential foreign demand might well increase; GAO did not examine this subject in detail. However, large quantities of natural gas continue to be flared in major foreign oil producing countries. This fact suggests that the potential for natural gas-based methanol production overseas is high. Therefore, increased U.S. demand for methanol fuel may result in larger methanol imports because foreign producers are likely to have access to low cost feedstock and to produce methanol less expensively. Domestic coal-to-methanol production could develop in the longer term.

The Department of Transportation suggested that GAO more extensively address possible safety hazards of methanol fuel use. Methanol fuel use presents several safety related trade-offs compared to gasoline. In the open air, neat methanol (above 85 percent pure) is considered less dangerous than gasoline. On the other hand, as Department of Transportation points out, methanol vapor in a vehicle tank may be an increased fire hazard. Low percentage methanol blends seem to present no special safety hazards. Chapter 2 discusses this issue in greater detail.

The General Services Administration recommended a more extensive discussion of engine and fuel compatibility problems. Chapter 1 of this report notes that methanol fuel may require substantial modifications to existing gasoline vehicle engines and fuel systems. Furthermore, differences in combustion characteristics between methanol and gasoline prevent the use of one of these fuels in a vehicle designed or modified to use the other.

The comments of the Department of Justice and the Environmental Protection Agency are clarifying and have been incorporated.

Information contained in this report was gathered between May and July 1, 1982. It was updated during the spring of 1983.

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#### ABBREVIATIONS

DOE	Department of Energy
DOT	Department of Transportation
EPA	Environmental Protection Agency
GAO	General Accounting Office
GSA	General Services Administration

## CHAPTER 1

### INTRODUCTION AND BACKGROUND

#### METHANOL PRODUCTION AND USE

##### Methanol production

Methanol (or methyl alcohol) is a liquid which can be derived from natural gas, coal, wood, and other biomass sources. Currently, it is produced primarily from natural gas and is used mainly as a chemical in manufacturing products such as building materials, plastics, and synthetic fibers. The United States produces approximately 1 billion gallons of chemical methanol annually, with 1981 domestic production totaling around 1.3 billion gallons or 85,000 barrels per day. Table 1 presents U.S. domestic methanol production, imports, and end-uses for recent years.

Table 1

#### U.S. Methanol Production, Imports, and End Uses

(millions of gallons)

	<u>1979</u>	<u>1980</u>	<u>1981</u>
U.S. methanol production	971.8	1077.0	1266.0
Total imports	58.7	35.6	26.5
Imports for fuel purposes	-	.03	.4
End-Uses			
Chemical	1090	980	*
Fuel uses (total)	10	50	*
Octane enhancers	5	30	*
Direct fuel	5	20	*

\*not available

Sources: U.S. Census Bureau, U.S. Trade Information Office  
1982 Commodity Yearbook  
E.I. duPont De Nemours & Co.

Most of the Government and industry analysts we interviewed agree that natural gas is likely to continue to be the major source of methanol in the short term. In the longer term, coal will become the likely domestic source of supply because of its relative abundance in the United States. Evidence indicates that sufficient economically recoverable reserves of coal exist to produce enough methanol to totally replace gasoline for about 100 years and still meet a doubling of current demand for coal for other uses. The technology for producing methanol from coal is proven, plants for converting coal to methanol have been demonstrated, but commercial-sized fuel plants are not yet in

operation in the United States. This is due, at least partially, to their higher capital and operating costs relative to natural gas-based methanol facilities. Despite the higher capital and operating costs, many analysts believe that in the future methanol fuel from coal can also be competitive with gasoline, depending on the future price of oil and other factors.

Methanol production from wood, biomass, and municipal wastes has also been demonstrated, but the cost estimates for commercial-scale production are even more speculative than those for coal-based methanol, and the technology is not so well developed at this time. As a result, the magnitude of the contribution of biomass technologies to methanol fuel supply in the future is uncertain.

#### Current transportation uses of methanol

Vehicles specially designed or converted to burn "neat"<sup>1</sup> methanol are now used in the United States by a limited number of vehicle fleets and experimental projects. Methanol fuel has also been used for years in certain high-performance racing cars. Methanol blended with gasoline is currently being used both experimentally and commercially in conventional gasoline engines either with or without minor carburetor, engine, or fuel system modifications.

The recent growth of methanol fuel use in the U.S. transportation sector can be attributed to several factors. Since 1979, several fuel companies have obtained waivers from the Environmental Protection Agency (EPA) which permit them to use small percentages of methanol as an octane enhancer in gasoline. Methanol is also being used to produce other chemicals that improve engine performance. Increasing experimentation with higher percentage methanol/gasoline blends and neat methanol is also contributing to the growth of methanol fuel use. Among those conducting experimental fleet test programs are the U.S. Postal Service, the California Energy Commission, the State of Florida, the Los Angeles County Government, the City of Baltimore, Bank of America, and the Fireman's Fund Insurance Company.

Several foreign countries, including Canada, West Germany, Sweden, and New Zealand, are also experimenting with methanol and methanol blends. The motivation for this work comes from the dual objectives of enhancing energy security and finding more environmentally benign fuels.

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<sup>1</sup>Neat methanol, as used here, is actually a blend of 85 percent or greater methanol and additives for lubricity and stability to avoid vapor lock and improve ignition to facilitate engine use.