Methyl *Tertiary*-Butyl Ether (MTBE): Conditions Affecting the Domestic Industry

Investigation No. 332-404

Publication 3231 **September 1999**

U.S. International Trade Commission

Washington, DC 20436

U.S. International Trade Commission

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[1] Chairman Lynn M. Bragg did not participate in this investigation.

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U.S. International Trade Commission

Washington, DC 20436

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ABSTRACT

The U.S. International Trade Commission[1] instituted investigation No. 332-404, Methyl *Tertiary*-Butyl Ether (MTBE): Conditions Affecting the Domestic Industry, under section 332(g) of the Tariff Act of 1930 (19 U.S.C. 1332(g)) on January 27, 1999, following receipt of a request from the United States Trade Representative on December 23, 1998. Public notice of this investigation was posted in the Office of the Secretary, U.S. International Trade Commission, Washington, DC 20436, and published in the *Federal Register* (64 F.R. 5312) of February 3, 1999. A public hearing was held on April 1, 1999, in Washington, DC.

MTBE, formerly used primarily as an octane enhancer to replace the tetraethyllead phased out of gasoline in the late 1970s and early 1980s, is now used mainly as an oxygenate blended with gasoline to add sufficient oxygen to meet the oxygen requirements of the Clean Air Act Amendments of 1990. MTBE is used in about 84 percent of U.S. reformulated gasoline (RFG); fuel ethanol is used in much of the remainder.

The United States is the world's largest producer of MTBE, producing about 3.5 times more in 1998 than Saudi Arabia, the second largest producer. U.S. MTBE production, trade, and consumption all increased during 1994-98. After increasing during 1994, U.S. production capacity remained constant during 1995-98; U.S. capacity utilization rose steadily during 1994-97 to 86 percent before declining to 81 percent in 1998. The United States is both the world's largest importer and consumer of MTBE. Saudi Arabia, the world's largest exporter of MTBE, was the largest source of U.S. imports during 1994-98. The next three largest sources in terms of quantity during those years were Canada, the United Arab Emirates, and Venezuela (by 1998 ranking).

Government policies in the United States and Saudi Arabia are considered by many to have had a major impact on production, trade, and consumption of MTBE. For example, on the demand side, the U.S. RFG and the California Air Resources Board Phase 2 programs are widely recognized as the major factors influencing the increase in U.S. and global MTBE consumption. However, largely because of the presence of MTBE in California water supplies, the Governor of California issued an order on March 25, 1999, to phase out MTBE in that State by December 31, 2002. Additionally, the July 1999 report of the EPA's "Blue Ribbon Panel on Oxygenates in Gasoline" recommended reduced use of MTBE in the United States, with efforts to curtail use to begin immediately.

On the supply side, Resolution No. 68, issued by the Council of Ministers of the Kingdom of Saudi Arabia on November 25, 1992, implemented a 30-percent feedstock discount for domestic users on liquefied gases, including butane (an input in MTBE production), based on their export price. The butane discount, reportedly intended primarily to offset transportation costs incurred in exporting the product and to peg the price of butane for all Saudi consumers at 70 percent of Saudi Aramco's export price, is said to be available to all companies operating in Saudi Arabia regardless of geographical location or company ownership. The Saudi Basic Industries Corporation, a primarily state-held entity, is the main MTBE producer in Saudi Arabia, accounting for about 97 percent of total Saudi MTBE production capacity through three joint-venture operations. Saudi MTBE is said to be primarily intended for export.

The information and analysis in this report are for the purpose of this report only. Nothing in this report should be construed as indicating how the Commission would find in an investigation conducted under other statutory authority.

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[1] Chairman Lynn M. Bragg did not participate in this investigation.

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Executive Summary

The U.S. International Trade Commission (Commission) instituted this investigation on January 27, 1999, following receipt on December 23, 1998, of a letter from the United States Trade Representative (USTR) requesting that the Commission conduct an investigation under section 332 (g) of the Tariff Act of 1930 (19 U.S.C. 1332(g)) and provide a report concerning conditions affecting the U.S. methyl *tertiary*-butyl ether (MTBE) industry. The Commission was requested to provide the report within 9 months of receipt of the letter, or by September 23, 1999.

USTR requested that the Commission provide the following information in its report, to the extent that such information is available:

> (1) An overview of the global market for MTBE, including consumption, production, capacity, and trade trends during 1994-98, emphasizing the United States and Saudi Arabia.
>
> (2) A description of the domestic MTBE market, and the major factors affecting it, including imports of MTBE, especially from Saudi Arabia.
>
> (3) An overview of the current MTBE production processes, with information on costs of production, including those of its major raw material components, and the principal sources of these feedstocks in the United States, as well as in Saudi Arabia.
>
> (4) Profiles of the U.S. and Saudi Arabian MTBE industries and importers, including information on their patterns of ownership and investment, as well as Government policies affecting production, investment, and trade of MTBE. Examples of such policies would be industrial policies, trade policies, and other governmental measures that may affect the cost of raw materials, transportation, and other relevant competitive factors.

In the request letter, USTR noted that the United States is a significant producer and consumer of MTBE, a chemical used primarily as an oxygenate for gasoline. USTR stated that U.S. producers of MTBE have expressed concerns about competitive conditions affecting their industry, including increased MTBE imports from Saudi Arabia, and that the "producers believe that these increased imports are the indirect result of the Saudi Arabian Government's provision of butane feedstock to Saudi MTBE producers at a substantial discount to world market prices."

Product Coverage

- ❑ MTBE is a synthetic organic chemical used primarily as an oxygenate. Oxygenates are generally defined as any substances (usually ethers, such as MTBE, or alcohols, such as fuel ethanol) which, when added to gasoline, increase the amount of oxygen in that gasoline blend. The use of oxygenates in the United States increased during the early 1990s largely as a result of the Clean Air Act Amendments of 1990 (CAAA), which, among other things, called for the addition of oxygen to gasoline to reduce carbon monoxide emissions and other air pollutants. MTBE is used in over 85 percent of reformulated gasoline (RFG); ethanol is used in much of the remainder. In turn, RFG accounts for about 30 percent of U.S. gasoline demand.[2]

World Overview

- Major MTBE net exporters all have large production capacities, including, with one exception, chemical plant production. Levels of domestic consumption in these countries vary, but in all cases is relatively small. Saudi Arabia is the world's largest net exporter of MTBE. Other major net exporting nations for 1994-98 included Venezuela, the United Arab Emirates, Malaysia, Canada, the Netherlands, France, and China.

- Nations with nearly balanced MTBE trade have production limited to refineries and generally do not have domestic oxygenate requirements. The majority of countries which trade MTBE are in this group. These countries have a wide variety of profiles in terms of domestic production and use, but they share two common attributes: a lack of large-scale chemical plant MTBE production and relatively minor petroleum and natural gas resources. This group of 21 countries includes Argentina, Brazil, most of both Eastern and Western Europe, Japan, and Korea.

- Major MTBE importing countries vary, but all use MTBE domestically to address air-quality concerns. The United States is the world's largest importer of MTBE. Other major net importers include Finland, Italy, Taiwan, Thailand, Mexico, Denmark, Norway, and Switzerland. In the larger countries, domestic production is substantial, although domestic demand, resulting from high levels of gasoline use and strict clean-air regulation, has outpaced domestic supply.

U.S. MTBE Industry, Market, and Factors Affecting the Market

- The U.S. MTBE industry is the largest in the world. Its production of 186,400 barrels per day in 1998 was about 3.5 times more than the production volume of Saudi Arabia, the next largest producer. Construction of new domestic production facilities in the United States, however, has been discouraged by uncertainty concerning future U.S. consumption and recent increases in global production capacity.

- The U.S. MTBE market is also the largest in the world, primarily because of the U.S. position as the world's largest gasoline market and U.S. regulations mandating a minimum oxygen content for much of this gasoline. The oxygenated gasoline and RFG programs, implemented under the CAAA, and the California Air Resources Board (CARB) Phase 2 gasoline program were largely responsible for the significant growth in U.S. consumption of MTBE during much of the 1990s.

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[2] Reformulated gasoline must contain at least 2 percent oxygen by weight and no more than 1 percent benzene by volume.

- Prices varied greatly throughout 1994-98, depending on input costs, supply, and use. U.S. prices for MTBE rose substantially during 1994, largely because of an independent increase in methanol prices, but also because they were supported by strong MTBE demand. During 1997-98, however, they declined by 23 percent because of a number of factors, most notably the 37 percent decline in the price of crude petroleum.

Transportation Costs

- Practically all of the MTBE both produced and consumed domestically is transported between U.S. coasts by ships;[3] imported MTBE is transported similarly to either coast. U.S. shippers generally pay higher freight rates on a per-mile basis than foreign shippers. U.S. producers must use U.S.-flag Jones Act [4] vessels for cargo shipped between U.S. ports. U.S. industry representatives have indicated that they believe the Jones Act makes it less profitable for them to compete in the U.S. west coast market (the destination for most imported Arabian Gulf MTBE). Moreover, total shipping costs for U.S. MTBE shipped from the gulf coast to the west coast are higher than costs for MTBE shipped to the east coast because of the distance involved.

Government Policies

- The majority of respondents to the Commission's questionnaire, as well as industry officials interviewed, cited U.S. and Saudi Arabian government policies as having the greatest effect on both the current and future competitive conditions in the global market; policies specifically cited by industry representatives were the CAAA, the Jones Act, and the ethanol tax credit, and Saudi Arabian feedstock pricing policies. Other factors considered by the respondents to have a significant impact on current and future competitiveness were U.S. imports of MTBE and health/environmental concerns.

- Widespread use of MTBE as an oxygenate in gasoline largely resulted from new air-quality standards mandated by amendments enacted in 1990 to the Clean Air Act. The Clean Air Act, initially enacted in 1963 and significantly amended in 1990 by the CAAA, addresses air quality, defines certain pollutants, and sets air-quality standards. The Clean Air Act is administered principally by the Environmental Protection Agency (EPA) in conjunction with the States. The CAAA represented a major amendment of the Clean Air Act, and imposed considerable new standards on motor vehicle emissions designed to meet air quality objectives. The CAAA's goals with respect to motor vehicle emissions included: (1) the removal of lead from gasoline; (2) the reduction of carbon monoxide emissions from the burning of gasoline by cars and light trucks; and (3) the reduction of

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[3] USITC fieldwork in the United States; telephone interviews with industry sources, Aug. 18, 1999. Barges are generally used when the distance to be shipped is short (i.e., in the local area).

[4] Section 27 of the Merchant Marine Act of 1920, commonly referred to as the Jones Act, prohibits merchandise from being transported by water between U.S. ports "in any other vessel than a vessel built in and documented under the laws of the United States and owned by persons who are citizens of the United States."

volatile organic compound emissions and toxic air pollutants from the burning of gasoline.

- The Clean Air Act also permits a State to receive a waiver from the Federal fuel requirements if the State adopts its own standards that are at least as strict as the Federal standards. California received such a waiver in 1994 and established its own emission standards, introducing CARB Phase 2 RFG in 1996. This waiver affords California the authority to control or prohibit the use of any fuel additive.

- Two late-breaking events may presage a major change in government policy in the United States concerning MTBE: (1) the issuance of an executive order on March 25, 1999, by the Governor of California requiring the phaseout of MTBE in California by the end of the year 2002, largely because of concerns about ground water contamination; and (2) the July 1999 report of the EPA's "Blue Ribbon Panel on Oxygenates in Gasoline" recommending the reduced use of MTBE in the United States, with efforts to curtail use to begin immediately.

Health and Environmental Concerns

- MTBE was discovered in California drinking wells in the mid-1990s. The contamination reportedly occurred as a result of the migration of MTBE from leaking underground gasoline storage tanks to nearby ground water. In 1997, the City of Santa Monica, CA, closed over half of its public drinking wells owing to contamination by MTBE. That same year, MTBE was found in several California lakes and reservoirs, where the chemical was said to be leaking from two-stroke engines on motorboats and jet skis. In addition to California, MTBE has been detected in the public water systems of at least 10 east coast States.

- In November 1998, the EPA assembled a panel of outside experts, the Blue Ribbon Panel on Oxygenates in Gasoline, to review the health concerns associated with MTBE contamination of water and evaluate the efficacy of available oxygenates in maintaining clean-air standards in the United States. On July 27, 1999, the Panel presented its recommendations on domestic oxygenate use to EPA. In its recommendations, the Panel requested that EPA work with Congress and individual States to implement a four-part reform package, which would "simultaneously maintain air quality benefits while enhancing water quality protection and assuring a stable fuel supply at reasonable cost." Among other things, the Panel recommended that use of MTBE in the United States be reduced "substantially" and that Congress act to remove the current Clean Air Act requirement –i.e., that 2 percent of RFG, by weight, consist of oxygen.

- Companies are already researching possible options as to alternative products or alternative uses for existing equipment. Some options reportedly under consideration include the production of alternative blending components such as isooctane or, in some cases, the production of altogether different products. One industry source suggested that if MTBE were to be banned, refiners would add more aromatic blending components, often considered undesirable and currently reduced in volume and effect by the use of MTBE, to offset any octane reduction.

Substitute Products

- ❑ Alternatives for MTBE as an oxygenate and as an octane enhancer include fuel ethanol, ETBE, TAME, and other chemical compounds such as TBA. Ethanol is considered to be the most likely alternative oxygenate, especially if an oxygenate waiver is not granted, because it is environmentally friendly, achieves an octane rating desired by most consumers, and is a renewable energy source. However, ethanol absorbs water in the normally used petroleum products distribution and storage systems, keeping the water trapped in the fuel mixture and, thus, requires a different transportation and blending infrastructure than MTBE. ETBE could also be a replacement for MTBE because of its low Reid Vapor Pressure, excellent octane enhancement properties, reduced sulfur content, handling advantages, and high renewable component.

The Saudi Arabian Industry and Market

Production Capacity

- ❑ The Saudi Basic Industries Corporation (SABIC) is the main producer of MTBE in Saudi Arabia, with total MTBE production capacity of about 63,000 barrels per day as of 1997 through three joint-venture operations. SABIC is primarily a state-held entity, with the Government of Saudi Arabia holding 70 percent of the company's stock and the remaining shares owned by "citizens of Saudi Arabia and other Gulf Cooperation States."

- ❑ Alujain Corp. a private-sector company in Saudi Arabia, announced plans in 1997 for bringing another MTBE plant onstream in Saudi Arabia by the year 2000 in conjunction with Ecofuel (a subsidiary of ENI of Italy) and Neste Oy (Finland). However, these plans have been put on hold indefinitely because of the high level of current production capacity for MTBE worldwide and the decision in California to ban the use of MTBE.

Production, Trade, and Consumption of MTBE

- ❑ Annual MTBE production during 1994-96 averaged about 47,000 barrels per day, approaching about 63,000 barrels per day in 1998 as a result of the startup of the latest production facility in 1997. According to SABIC, Saudi Arabia imported no MTBE during 1994-98 and "levels of exports on average were roughly comparable to levels of production" in those years. SABIC states that annual consumption of MTBE in Saudi Arabia during 1994-95 was "negligible," growing to between 349 and 1,047 barrels per day during 1996-97 and then to around 2,327 barrels per day in 1998.

Government Policies

Feedstocks and Pricing

- ❑ Resolution No. 68, issued by the Council of Ministers of the Kingdom of Saudi Arabia on November 25, 1992, states that "granting national industries using liquid gases (butane-propane-natural gasoline) a 30 percent discount of the lowest international price obtained by the exporting party in any quarterly period from any overseas consumer is hereby approved." SABIC notes in its submission that the price is an "adjusted price, based on the export price of the applicable liquid gas" that is available to all consumers of liquefied gases in Saudi Arabia regardless of their geographical location or company ownership. The resolution was reportedly prompted by several reasons, including efforts to allow for the offset of transportation costs typically incurred in exporting the butane and efforts to "uniformly peg" the price at a particular level for all users in Saudi Arabia.

- Feedstock costs represent a significant portion of MTBE production costs and, hence, feedstock prices can be one of the deciding factors as to whether a project is considered to be competitive. A representative of SABIC noted in 1997 that SABIC "derives a 'clear feedstock advantage' from the access it has to low-priced raw materials in Saudi Arabia," allowing the company to be "more flexible with its profit margin for petrochemicals," but he added that "this is only a limited cushion against the effects of the petrochemical industry cycle" and that "SABIC is not immune to market forces."

Investment climate

- Industry representatives operating in Saudi Arabia interviewed by the Commission did not identify any Government policies in Saudi Arabia that would prevent a company from establishing operations in the Kingdom. Investment incentives offered (e.g., tax holidays and interest-free loans) are said to accrue only to firms "with at least 25 percent Saudi ownership," thereby favoring the formation of joint ventures. When the high incidence of joint ventures in the Saudi Arabian MTBE industry was discussed among industry representatives of some of the joint-venture partners and others, the primary reason stated for the joint ventures was a reduction in risk, especially financial risk, by the shareholders. Other reasons cited by industry sources include assistance with local regulations and access to an established infrastructure.

WTO Accession

- Saudi Arabia has been seeking accession to the WTO since 1995, in continuation of its efforts begun in 1993 to join the General Agreement on Tariffs and Trade, and, according to USTR, one of the issues raised in the context of the accession negotiations has been dual pricing. Under dual pricing, the domestic price of a product is set by the government at a level lower than the export price. Some sources consider the Saudi 30-percent feedstock discount to be a form of dual pricing, which under some circumstances or conditions may be considered a subsidy. USTR indicates that the issue of whether this pricing program constitutes a subsidy is being considered in the context of the accession negotiations. It is unclear whether investment incentive programs and feedstock discounts will continue if Saudi Arabia accedes to the WTO. In the meantime, Saudi Arabia is reportedly addressing some of the issues raised, including the investment issues.

CHAPTER I
INTRODUCTION

Purpose and Scope of Study

On December 23, 1998, the Commission received a letter from the United States Trade Representative (USTR) requesting that the Commission institute a factfinding investigation under section 332(g) of the Tariff Act of 1930 of conditions affecting the U.S. methyl *tertiary*-butyl ether (MTBE) industry.[1] The Commission was requested to provide the study within 9 months of receipt of the letter, or by September 23, 1999.

In the letter, the Commission was asked to provide the following information, to the extent that such information is available:

(1) An overview of the global market for MTBE, including consumption, production, capacity, and trade trends during 1994-98, emphasizing the United States and Saudi Arabia.

(2) A description of the domestic MTBE market, and the major factors affecting it, including imports of MTBE, especially from Saudi Arabia.

(3) An overview of the current MTBE production processes, with information on costs of production, including those of its major raw material components, and the principal sources of these feedstocks in the United States, as well as in Saudi Arabia.

(4) Profiles of the U.S. and Saudi Arabian MTBE industries and importers, including information on their patterns of ownership and investment, as well as government policies affecting production, investment, and trade of MTBE. Examples of such policies would be industrial policies, trade policies, and other governmental measures that may affect the cost of raw materials, transportation, and other relevant competitive factors.

In the request letter, USTR noted that the United States is a significant producer and consumer of MTBE, a chemical used primarily as an oxygenate for gasoline. USTR stated that U.S. producers of MTBE have expressed concerns about competitive conditions affecting their industry, including increased MTBE imports from Saudi Arabia, and that "these producers believe that these increased imports are the indirect result of the Saudi Arabian government's provision of butane feedstock to domestic MTBE producers at a substantial discount to world market prices."

Public notice of this investigation was posted in the Office of the Secretary, U.S. International Trade Commission, Washington, DC 20436, and published in the *Federal*

[1] The request from USTR is reproduced in full in appendix A.

Register (64 F.R. 5312) of February 3, 1999.[2] A public hearing, at which all interested parties were permitted to present testimony regarding this investigation, was held on April 1, 1999, in Washington, DC.[3]

Product Coverage

MTBE, a colorless, flammable liquid with a strong odor, is a synthetic organic chemical used primarily as an oxygenate. Oxygenates are generally defined as any substances (usually ethers, such as MTBE, or alcohols, such as fuel ethanol) which, when added to gasoline, increase the amount of oxygen in the gasoline.[4] The Clean Air Act Amendments of 1990 (CAAA) called for, among other things, the addition of oxygen to gasoline to reduce carbon monoxide emissions and other air pollutants.[5] Oxygenates are blended with gasoline to produce the desired oxygen concentration required by the CAAA.

MTBE was formerly used mainly as an octane enhancer[6] to replace the tetraethyllead that was phased out of gasoline in the late 1970s and early 1980s.[7] Although MTBE still has octane-enhancing properties, its main use now is as an oxygenate in gasoline blending in the United States, accounting for about 80 percent of U.S. oxygenate use (fuel ethanol accounts for much of the remaining 20 percent).

MTBE's properties also lead to secondary effects. For example, MTBE acts as a diluent in the gasoline, reducing the absolute amount of certain gasoline components–for example, aromatics such as benzene[8]– that are considered toxic air pollutants and, in some cases, are carcinogenic.[9] MTBE also acts as a marker for gasoline spills (i.e., those searching for gasoline

[2] The notice is included in appendix B.

[3] A list of witnesses who testified at the hearing is presented in appendix C.

[4] U.S. Department of Energy (U.S. DOE), Energy Information Administration, "Glossary," found at *http://www.eia.doe.gov/emeu/perfpro/glossary.html*, retrieved May 31, 1999.

[5] The CAAA will be discussed in more detail in chapter III in the section entitled ***Government Policies***.

[6] Octane enhancers, as defined by the U.S. DOE, are added to gasolines to control engine preignition or "knocking" by slowing combustion rates. "Glossary," dated 1994, found at *http://www.eia.doe.gov/emeu/rtecs/ glossary.html*, retrieved July 23, 1999.

[7] California Energy Commission, *Supply and Cost of Alternatives to MTBE in Gasoline*, Feb. 1999, Staff Report, p. 1, and California Air Resources Board, *An Overview of the Use of Oxygenates in Gasoline*, Sept. 1998, p. 1.

[8] The U.S. Department of Energy defines aromatics as "very reactive hydrocarbons that tend to be relatively uncommon in crude oil (typically 10 percent or less). However, light aromatics increase octane number in gasoline, and consequently are deliberately created by steam reforming of naphtha." U.S. DOE, "GG Appendix A on Emissions Coefficients/rev 10/12," undated; found at *http://www.eia.doe.gov/oiaf/1605/87-92rpt/*, retrieved on June 4, 1999.

[9] DeWitt & Co., Inc., *MTBE and Oxygenates, 1998 Annual*, p. 45; *Reformulated Gasoline Complex Model*, dated Aug. 21, 1998, found at *http://www.eia.doe.gov/*

(continued...)

spills will often test for MTBE).[10]

Other oxygenates currently used in the United States include fuel ethanol, and ethers such as ethyl *tertiary*-butyl ether (ETBE) and *tertiary*-amyl methyl ether (TAME). The advantages and disadvantages of each as substitutes for MTBE in the United States are discussed in more detail in chapter III of the report.

Study Approach and Organization

The Commission obtained information from a variety of sources. In addition to conducting a literature search of industry and Government publications, the Commission also conducted telephone and field interviews to obtain firsthand information about the MTBE industry. These interviews were with representatives of (1) domestic and foreign companies that produce and/or purchase MTBE and/or its feedstocks; (2) domestic companies that produce and/or purchase fuel ethanol, ETBE, TAME, or other substitutes for MTBE; (3) principal trade associations; (4) U.S. and foreign governments; and (5) major private and governmental research groups. The Commission also obtained information from submissions from interested parties and from a public hearing held at the Commission on April 1, 1999. Information was also obtained from independent consulting firms. In some cases, especially when official statistics are not available, data from several sources are presented for purposes of comparison. The data and information collected were compiled so as to present a qualitative assessment of the conditions affecting MTBE producers in the U.S. and global markets.

Data were also obtained from questionnaires sent to 21 producers and 11 purchasers of MTBE in the United States. These firms accounted for about 95 percent of U.S. MTBE production during 1994-98 and about 90 percent of U.S. imports (several U.S. producers also

[9] (...continued)

emeu/steo/pub/special/rfg1.html, retrieved May 31, 1999; "Achieving Clean Air and Clean Water: The Report of the Blue Ribbon Panel on Oxygenates in Gasoline," dated July 27, 1999, slide number 12; U.S. DOE, *Demand and Price Outlook for Phase 2 Reformulated Gasoline, 2000*, dated Apr. 8, 1999, found at *http://www.eia.doe.gov/emeu/steo/pub/special/rfg4.html,* retrieved May 31, 1999. The last source presents the following example of the dilution effect: "Adding 11 gallons of MTBE to 89 gallons of conventional gasoline with 32 volume percent aromatics will result in a blend with 28.5 volume percent aromatics (or 30 volume percent aromatics when diluted with 6 volume percent fuel ethanol)." Efforts to reduce toxic air pollutants include efforts to reduce the concentration of aromatics in gasoline.

[10] USITC fieldwork in the United States, Feb. 8-12, 1999; Roland Blassnig, "Canadian Company Seeks $970 Million in Damages for California Ban on MTBE," *International Environment Reporter*, June 23, 1999, pp. 524-525. The article states that "the detection of MTBE in water is often the first and sometimes the only evidence of gasoline contamination." It also states that "for every gallon of MTBE found in the environment, another eight gallons of other gasoline components are released into the environment."

reportedly purchased imported MTBE during this time period). All 32 firms responded to the questionnaires.

The remainder of this chapter consists of an overview of the production processes used to manufacture MTBE. Chapter II provides an overview of the world market for MTBE, presenting information on major world producers and consumers. Chapters III and IV present industry and market profiles for the U.S. and Saudi Arabian MTBE industries, respectively, including information on average MTBE production costs for each country. MTBE production, trade, and consumption trends for each industry are presented and reasons for the trends are discussed. Moreover, information regarding potential substitutes for MTBE in the United States, including sources of the products, their availability, and their substitutability is presented. Country- or regional-specific Government policies affecting the production, consumption, and trade of MTBE and its inputs, including butane, are also discussed in chapters III and IV.

A glossary is presented in appendix D, and a more detailed discussion of MTBE production processes appears in appendix E. Appendix F consists of a discussion of production and consumption trends for the major MTBE inputs. Appendix G contains information regarding U.S. tariff treatment and trade investigations and, expanding the discussion in the Government policies section, a summary of events related to MTBE use in the United States is presented in appendix H. Following the copy of the official submission to the Commission on behalf of the Saudi Basic Industries Corporation (SABIC) and SABIC Americas, in appendix I, is information regarding recent legislation introduced in the United States regarding MTBE, in appendix J.

MTBE Production Processes

MTBE is produced worldwide by reacting methanol with isobutylene.[11] Several companies license MTBE reaction technology worldwide.[12]

There are different sources of the isobutylene feedstock, often depending on the type of MTBE producer. Unlike methanol, isobutylene is generally not available commercially and thus must be either obtained from process streams available in-house or manufactured separately, generally starting from butane.[13]

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[11] The reaction is exothermic and generally run at about 40^{0}-100^{O}C. The chemical reaction is $(CH_3)_2CCH_2 + CH_3OH \Rightarrow (CH_2)_3C(CH_3)O$. The acidic cation exchange resin catalyst used needs to be regenerated approximately every 2 years.

[12] *Process Evaluation Research Planning Report: MTBE, 94/95-4*, June 1996, prepared by Chem Systems, Inc., p. 49; DeWitt & Co., *MTBE and Oxygenates,* appendix C. Such companies include Arco, CDTECH, Snamprogetti, Phillips Petroleum, and Huels/UOP.

Chem Systems is a U.S. management consulting firm that assists businesses in the global energy, chemicals, plastics, and process industries with technology/economic evaluation, market research and forecasting, and strategic planning. DeWitt & Co., founded in 1973, is an independent consulting firm that, among other things, provides information and advice regarding current and future trends in the world petrochemical industry.

[13] DeWitt & Co., *MTBE and Oxygenates,* appendix C. Butane is a liquefied petroleum

(continued...)

There are four primary MTBE processes, depending on the source of the isobutylene. Brief descriptions of the different sources of isobutylene and of each process are presented below in table 1-1; more detail is presented in appendix E. Each of the four processes is used to varying degrees in the United States. In Saudi Arabia, the primary production process used is butane dehydrogenation.

[13] (...continued)
gas, with the molecular formula C_4H_{10}, that includes the individual isomers *n*-butane and isobutane.

Table 1-1.
The four main sources of isobutylene and their associated MTBE processes

Process	Source of isobutylene	Average production capacity	Typical consumer of the MTBE produced	Share of total U.S. MTBE production capacity, 1998[1]	Share of Saudi MTBE production capacity, 1998
		Barrels per day		*Percent*	*Percent*
Steam crackers . .	Isobutylene obtained directly from C_4 streams[2] generated by steam crackers during the manufacture of ethylene. Butadiene is usually extracted from the steam cracker stream before use; the resulting stream can be called raffinate 1. Refineries generally consume the isobutylene produced.	1,000 to 8,000	Generally consumed captively in the producing refinery.	4	4
Fluid catalytic cracker units (FCCUs)	Isobutylene obtained directly from C_4 streams generated by FCCUs in refineries. The refineries that produce these streams consume them captively.	1,000 to 8,000[3]	Generally consumed captively in the producing refinery.	31	4
Tertiary-butyl alcohol (TBA)	Isobutylene produced from TBA, a coproduct of propylene oxide (PO), that is itself derived from isobutane. The isobutylene produced is then used captively to manufacture MTBE.	14,000 to 33,000[4]	Generally sold on the merchant market, largely to refiners, with some to gasoline blenders	20	Not used
Butane dehydrogenation[5] .	Isobutylene produced from the dehydrogenation of isobutane. The isobutylene produced is consumed captively. An isomer of isobutane, *n*-butane, can also be used as a starting material for this process but must be converted, or isomerized, into isobutane before the dehydrogenation step. Whereas many U.S. production facilities start with either *n*-butane or isobutane, some facilities, generally those in Europe and Saudi Arabia, start with a feed of mixed butanes (also called "field butanes").	12,000 to 25,000[4]	Generally sold on the merchant market, largely to refiners, with some to gasoline blenders; most of the production in Saudi Arabia is exported.	35	92

[1] The total percentage of production capacity in the United States accounted for by each source of isobutylene does not total 100 percent because some facilities use combined feeds (e.g., those from steam crackers and from FCCUs or from steam crackers and butane dehydrogenation).
[2] C_4 streams, regardless of their source, primarily contain hydrocarbons with 4 carbon atoms–e.g., mixed butylenes, including isobutylene and *n*-butylene.
[3] The capacity is limited by the volume of the C_4 streams produced. In many cases, the MTBE production unit was added to add value to the isobutylene produced internally.
[4] These facilities are generally large scale in terms of production capacity.
[5] Facilities producing MTBE using this process are often called "on-purpose" plants.

Source: Derived from information presented in appendix E.

CHAPTER II
WORLD MTBE MARKET FACTORS

This chapter examines global MTBE market trends and the production, consumption, and trade factors which affect them. Nations trading MTBE are described both in terms of production and consumption and in terms of MTBE trade flows. Special attention is given to nations with either a large MTBE trade surplus or a large trade deficit.

Global Production

The United States is the largest producer among the 38 nations producing MTBE. In each year during 1994-98, U.S. MTBE production was more than four times that of the second largest MTBE- producing nation, Saudi Arabia; it was also more than the combined annual production of the next eight leading producer nations.

Production increased in all of the leading producer nations during 1994-98. U.S. production increased by the largest amount (42.7 thousand barrels per day); Saudi Arabian production increased by the largest percentage (96 percent). Another leading producer, the United Arab Emirates (UAE), produced no MTBE in 1994, but increased production during 1995-98 by 80 percent. Table 2-1 provides data on MTBE production levels of major producing nations.

MTBE can be produced at petroleum refineries, along with other petroleum products, or at small- and large-scale chemical plants, which produce MTBE either alone or along with other chemicals. Refineries and chemical plants use several production processes; however, large-scale plants are limited to two: PO/TBA and butane dehydrogenation.[1] In addition to MTBE, refineries produce MTBE isobutylene feedstock (although many purchase the second feedstock, methanol) and the gasoline end products in which MTBE is used. These refinery-based MTBE facilities are globally widespread, although limited in capacity by the refinery's isobutylene output,[2] and generally consume all their production captively.[3] Conversely, chemical plants producing MTBE generally buy all feedstocks, are less common than refineries (the large-scale plants are present in only 8 of the 38 countries which produce MTBE), have capacities of up to 33,000 barrels per day, and sell their product in the merchant market.[4] While many countries

[1] MTBE production processes are discussed in more detail in chapter I and appendix E.
[2] Most have a capacity of less than 4,000 barrels of MTBE per calendar day (hereinafter called barrels per day unless otherwise specified), although the largest has a capacity of 9,400 barrels per day.
[3] DeWitt & Co., *MTBE and Oxygenates, 1998 Annual*, pp. 49, 83, 126-8, 148, and 163-4.
[4] Ibid.

Table 2-1
MTBE production levels of major producing nations, 1994-98

(1,000 barrels/day)

Country	1994	1995	1996	1997	1998
United States	143.7	163.3	185.2	197.0	186.4
Saudi Arabia	20.7	23.9	26.1	47.3	40.6
Netherlands	17.5	18.0	19.4	20.9	19.6
Venezuela	11.7	17.0	18.0	18.0	15.0
Canada	11.8	12.4	12.0	12.8	13.8
France	10.0	10.4	11.7	12.6	11.8
United Arab Emirates	0.0	5.8	10.8	12.0	10.4
Republic of Korea	7.7	6.2	8.3	10.9	10.3
China	8.5	7.4	8.8	10.4	10.6

Source: U.S. DOE, Energy Information Administration, *Petroleum Supply Monthly*, February, 1999; DeWitt & Co., *MTBE and Oxygenates*; Ministry of Commerce, Industry, and Energy, Republic of Korea.

have MTBE production of some kind, the factor most likely to distinguish major producing nations is the presence of large-scale chemical plants using the PO/TBA or butane dehydrogenation process.

Global Consumption

The United States accounted for approximately one-half of global MTBE consumption throughout the 1990s.[5] In each year during 1994-98, U.S. consumption was more than six times the total consumption of the next three leading nations: Mexico, the Republic of Korea, and Italy (see table 2-2). During 1994-98, U.S. consumption increased by the largest volume (77 thousand barrels per day), and Venezuelan consumption increased by the largest percentage (200 percent). Consumption was stable in Taiwan and decreased in Japan, but increased in all other major consuming nations. Worldwide consumption, estimated at 224 thousand barrels per day in 1992, increased to an estimated 419 thousand barrels per day in 1997.[6] However, worldwide consumption growth has slowed since 1996. A plateau in U.S. consumption, due to an end in reformulated gasoline (RFG) program expansion, and an economic slowdown in the major East Asian markets have combined to reduce global demand growth.[7]

These consumption patterns are influenced by the type of MTBE use. One use for MTBE is as an octane enhancer to improve gasoline combustion and engine performance, often as a replacement for lead. Consumption is higher in countries that also use it as an oxygenate to reduce harmful automobile emissions. In many countries gasoline producers use MTBE as a

[5] Janet Link, "MTBE Market Matures and Stabilizes," *Chemical Market Reporter*, Nov. 23, 1998, p. 16. The *Chemical Market Reporter* was previously named the *Chemical Marketing Reporter*. Depending on the date of the article referenced, either title will be used in this paper.

[6] Link, "MTBE Market Matures," p. 16.

[7] USITC fieldwork in the United States.

Table 2-2
MTBE consumption levels of major consuming nations, 1994-98

(1,000 barrels/day)

Country	1994	1995	1996	1997	1998
United States	174.9	221.2	247.4	266.3	251.9
Mexico	10.5	10.0	11.9	13.9	14.0
Italy	8.0	10.2	10.9	11.8	11.1
Republic of Korea	9.5	7.0	10.8	13.2	10.5
Taiwan	9.0	8.8	9.0	9.7	9.0
Germany	5.4	7.0	7.5	8.1	7.6
Spain	5.1	6.9	7.4	8.1	7.5
Japan	8.0	7.0	7.0	7.0	6.5
Venezuela	2.0	6.0	5.5	6.0	6.0

Source: Compiled from official statistics of the U.S. Department of Commerce; DeWitt & Co., *MTBE and Oxygenates.*

diluent to reduce the amount of toxic substances such as sulfur and benzene in their product. In the United States and Finland, for example, gasoline is required to have a specific amount of oxygen, and gasoline producers use MTBE, among other chemicals, to meet this stricter standard. In the U.S. RFG program, gasoline must contain 2 percent oxygen by weight; when MTBE is used as the oxygenate, this translates into approximately 11 percent MTBE by volume.[8]

Some industry analysts expect MTBE demand to grow outside the United States.[9] Although health concerns raised in the United States have the potential to slow MTBE consumption in other countries,[10] European producers, for example, believe that tank leakage is less prevalent in their domestic markets, rendering an MTBE ban in that region unlikely.[11] Production facilities continue to come onstream in some countries (e.g., Qatar).[12]

Major Trade Flows

The balance between MTBE production and consumption separates MTBE trading nations into three groups: major net exporting countries, countries with neither substantial net exports nor net imports, and major net importing countries. Major net MTBE exporting nations (those which export at least 50 percent of domestic production) tend to have at least one of two basic characteristics: abundant supplies of the appropriate natural resources–crude petroleum or natural gas–and either PO/TBA or butane dehydrogenation production. In 1994-98, this category included

[8] DeWitt & Co., *MTBE and Oxygenates*, p. 45. Reformulated gasoline (RFG) must contain at least 2 percent oxygen by weight and no more than 1 percent benzene by volume.
[9] Link, "MTBE Market Matures," p. 16.
[10] USITC fieldwork in the United States.
[11] USITC fieldwork in Europe, Apr. 16-22, 1999.
[12] USITC fieldwork in the United States.

Saudi Arabia,[13] Venezuela, the UAE, Malaysia, Canada, the Netherlands, France, and China. In France and the Netherlands, the butane dehydrogenation production method is not economical, so large-scale production plants use only the PO/TBA process.[14] China is unusual in that it has emerged as a large exporter of MTBE without large-scale production plants; Chinese MTBE is produced by numerous refineries. The other major exporters all use butane dehydrogenation plants to produce MTBE, either alone or in conjunction with other plants and refineries (see table 2-3).

In terms of domestic demand, there is substantial variation among these major exporting nations. Saudi Arabia, Malaysia, and the UAE are not known to have significant domestic demand. In 1998, the share of production in other major exporting countries that was consumed domestically ranged from approximately 15 percent in Canada[15] to 48 percent in China.[16] In Canada, Venezuela, the Netherlands, France, and China, MTBE is used domestically both to boost octane and to improve air quality.[17] In these countries there are currently no oxygenate requirements, but MTBE is used to reduce other harmful gasoline components whose proportions are regulated. Canada, Venezuela, the Netherlands, France, and the UAE all use some MTBE domestically to produce RFG for export.[18] France also uses some ETBE for the same reasons. Venezuelan producers use TAME, and Canadian producers use some methylcyclopentadienyl manganese tricarbonyl (also known as MMT) and ethanol in blending gasoline.[19] For more on MTBE substitutes, refer to the section entitled ***Substitutes for MTBE in the U.S. Market*** in chapter III.

The second group of countries neither export nor import more than 15 percent of their domestic MTBE production or consumption. The majority of countries which trade MTBE are in this group. These countries have a wide variety of profiles in terms of domestic production and consumption, but they share two common attributes: a lack of large-scale chemical plant MTBE production and relatively minor petroleum and natural gas resources. This group of 21 countries includes Argentina, Brazil, most of both Eastern and Western Europe, Japan, and Korea. In Germany, Spain, Japan, and, for most of 1994-98, Korea, among others, MTBE consumption was relatively high, driven by both high levels of gasoline consumption and air-quality concerns.[20] In other countries, including Brazil (which uses a large amount of ethanol), most of Eastern Europe, and Turkey, gasoline consumption was relatively low. Most of these countries have been increasingly using MTBE to replace lead as an octane enhancer. A few of these countries, including Spain, Belgium, and Brazil, use some MTBE in making RFG for export.

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[13] The Saudi Arabian MTBE market will be discussed in more detail in chapter IV.

[14] DeWitt & Co., *MTBE and Oxygenates*, p. 125. There are 33 MTBE production facilities in Western Europe. Two of these, one in France and one in the Netherlands, together produce approximately one-third of Western European MTBE.

[15] Ibid., p. 85.

[16] Ibid., p.169.

[17] USITC fieldwork in the United States; DeWitt &Co., *MTBE and Oxygenates*, p. 11.

[18] Ibid.; official trade statistics of the U.S. Department of Commerce.

[19] DeWitt & Co., *MTBE and Oxygenates*, pp. 76-77, 100, 123.

[20] Ibid.; Hyung-Jin Kim, “Korean Oxygenates Rule Sparks MTBE Capacity Plans,” *Chemical Week*, June 15, 1994, p. 26.

Table 2-3
MTBE trade balances of major exporting nations, 1994-98

(1,000 barrels/day)

Item	1994	1995	1996	1997	1998
Saudi Arabia:					
Exports	20.7	23.9	26.1	47.3	40.6
Imports	([1])	([1])	([1])	([1])	([1])
Balance	20.7	23.9	26.1	47.3	40.6
Canada:					
Exports	([2])	([2])	12.0	10.8	11.8
Imports	2.7	0.1	0.1	0.1	0.3
Balance	([2])	([2])	11.9	10.7	11.5
Venezuela:[3]					
Exports	11.7	14.0	13.9	13.6	10.8
Imports	.6	1.3	2.8	1.6	11.2
Balance	11.1	12.7	11.1	12.0	-0.4
United Arab Emirates:					
Exports	([1])	5.8	10.8	12.0	10.4
Imports	([1])	([1])	([1])	([1])	([1])
Balance	-	5.8	10.8	12.0	10.4
Netherlands:					
Exports	([2])	([2])	([2])	7.7	([2])
Imports	([2])	([2])	([2])	([1])	([2])
Balance	([2])	([2])	([2])	7.7	([2])
China:					
Exports	2.8	2.9	4.0	5.4	7.3
Imports	([1])	([1])	([1])	([1])	([1])
Balance	2.8	2.9	4.0	5.4	7.3
France:					
Exports	([2])	([2])	([2])	2.4	([2])
Imports	([2])	([2])	([2])	([1])	([2])
Balance	([2])	([2])	([2])	2.4	([2])

[1] Less than 50 barrels/day.
[2] Not available.
[3] In 1998, Venezuelan imports of MTBE reached a temporary high attributed to a production shortfall.

Source: Compiled from official statistics of the U.S. Department of Commerce; DeWitt & Co., *MTBE and Oxygenates;* a May 18, 1999, fax from Pequiven Petroquimica de Venezuela.

The third group of countries, the major net importers, must import MTBE to satisfy domestic demand, importing more than 15 percent of their domestic consumption. This group includes the United States,[21] Finland, Italy, Taiwan, Thailand, Mexico, Denmark, Norway, and Switzerland (see table 2-4). In the larger countries, domestic production is in fact substantial, although domestic demand, resulting from high levels of gasoline usage and strict clean-air regulation, has outpaced domestic supply. Of this group, only the United States has large-scale chemical plant production facilities for MTBE. Companies headquartered in at least three of these countries–the United States, Finland, and Italy–have part or full ownership in MTBE production facilities abroad, in part to satisfy domestic demand.[22] Whereas some of these countries, including Taiwan, Thailand, and Mexico, have some level of domestic production, a smaller group, including Denmark, have no domestic production of MTBE and import small amounts.

Table 2-4.
MTBE trade balances of major importing nations, 1994-98

(1,000 barrels/day)

Item	1994	1995	1996	1997	1998
United States:					
Imports	40.6	62.8	69.2	76.3	88.2
Exports	9.4	5.1	7.0	8.7	22.7
Balance	-31.2	-57.7	-62.2	-67.6	-65.5
Mexico:					
Imports	9.3	5.2	7.1	9.1	10.5
Exports	([1])	([1])	([1])	([1])	([1])
Balance	-9.3	-5.2	-7.1	-9.1	-10.5
Taiwan:					
Imports	5.4	6.2	6.4	6.8	6.1
Exports	0.1	0.1	0.1	0.2	0.1
Balance	-5.3	-6.1	-6.3	-6.6	-6.0
Thailand:					
Imports	4.0	2.4	5.4	5.4	3.3
Exports	([1])	([1])	([1])	([1])	([1])
Balance	-4.0	-2.4	-5.4	-5.4	-3.3
Italy:					
Imports	([2])	([2])	([2])	5.2	([2])
Exports	([2])	([2])	([2])	([1])	([2])
Balance	([2])	([2])	([2])	-5.2	([2])
Finland:					
Imports	([2])	([2])	([2])	2.8	([2])
Exports	([2])	([2])	([2])	([1])	([2])
Balance	([2])	([2])	([2])	-2.8	([2])

[1] Less than 50 barrels/day.
[2] Not available.

Source: Compiled from official statistics of the U.S. Department of Commerce; DeWitt & Co., *MTBE and Oxygenates.*

[21] The U.S. MTBE industry will be profiled in more detail in chapter III.
[22] USITC fieldwork in the United States and in Europe.

CHAPTER III
U.S. INDUSTRY PROFILE, MARKET, AND MARKET CONDITIONS

This chapter focuses on the production, trade, and consumption of MTBE in the United States. The chapter has three main sections: (1) A profile of the U.S. MTBE industry; (2) a section addressing U.S. production costs for MTBE and a presentation of market data trends during 1994-98; and (3) a discussion of factors that affected the market data trends during those years.

Industry Profile

The U.S. MTBE industry is the largest in the world. In 1994, 19 companies reported production totaling 143.7 thousand barrels of MTBE per day in the United States.[1] The industry expanded steadily as U.S. consumption increased with the establishment of minimum oxygen requirements in some gasoline. By 1998, there were 26 producers utilizing 44 production facilities[2] to produce 186.4 thousand barrels per day,[3] or about 3.5 times more than the volume of Saudi Arabia, the next largest producer.

Although the number of MTBE producers increased during this period, there was some consolidation. Huntsman purchased Texaco's 15,000-barrel-per-day MTBE production facility in 1997,[4] and in 1998 Lyondell acquired Arco Chemical Co., including its 58,500-barrel-per-day MTBE production facility, in a $5.6 billion transaction.[5] Both of these purchases included production capacity of other commercially important chemicals. These transactions added to the industry's concentration and, at the end of 1998, the top four U.S. producers–Lyondell, Huntsman, Texas Petrochemical, and Valero–together were producing approximately 49 percent of domestic production.[6]

As discussed in chapter I, the process for producing MTBE involves reacting methanol and isobutylene. The isobutylene needed is obtained from different sources. The type of producer will often determine the source of the isobutylene and vice versa. For example, MTBE can be produced

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[1] U.S. International Trade Commission, *Synthetic Organic Chemicals, 1994,* USITC publication 2933, Nov. 1995, p. 3-41.
[2] DeWitt & Co., *MTBE and Oxygenates,* p. 49.
[3] U.S. DOE, *Petroleum Supply Monthly*, Feb. 1999, p. 138.
[4] "Huntsman Finetuning Its Petrochemical Empire," *Chemical Marketing Reporter*, Mar. 31, 1997, p. 20.
[5] Alex Tullo, "Lyondell Acquires Arco for $5.6 Billion, Deal Strengthens Company in Petrochems," *Chemical Marketing Reporter*, June 22, 1998, p. 49.
[6] DeWitt & Co., *MTBE and Oxygenates,* p. 49.

(1) in refineries using either their in-house FCCU C_4 streams or C_4 streams obtained from steam crackers during the production of ethylene; the refineries then use the resultant MTBE captively, blending it into gasoline;[7] (2) in large-scale petrochemical plants that convert *tertiary*-butyl alcohol (TBA), obtained as a coproduct in the production of propylene oxide (PO), into MTBE and then generally sell the product on the merchant market; and (3) in "on-purpose" plants that are built specifically to produce MTBE and that generally sell the MTBE produced on the merchant market.[8] In total, there are four main sources of isobutylene and, therefore, four main production processes. Each of these production processes is used in the United States.

There are 33 MTBE-producing refineries in the United States.[9] These are owned by gasoline producers which produce at least one MTBE feedstock, MTBE itself, and the final blended gasoline product. They tend to be located near sources of petroleum or near major gasoline markets; there are 12 in Texas, 7 in Louisiana, and 5 in California, with the rest distributed in 9 other States.[10] Twenty-eight of these refineries use the FCCU production method.[11]

The eight producers using the butane dehydrogenation and TBA production processes account for virtually all of the MTBE produced for the merchant market in the United States.[12] These plants are mostly chemical plants, owned by a variety of petrochemical and gasoline producers. Most of them purchase their feedstocks and then sell their production on the merchant market. All but one of these plants are in Texas, with its availability of feedstocks, purchasers, and shipping facilities (the exception is in Wyoming).[13] Although there are relatively few plants producing for the merchant market, their capacities are large enough that they account for roughly one-half of total U.S. production.[14]

Foreign ownership levels within the industry vary depending largely on the type of producer. Although several refinery production facilities are owned by multinational petroleum companies which have some foreign ownership, all but one of the chemical production facilities are U.S. owned.

Total U.S. MTBE production capacity for 1997 was 229.5 thousand barrels per day (see table 3-1), with an average capacity utilization level of about 81 percent. Most U.S. MTBE

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[7] Most refineries built MTBE units to add value to existing C_4 streams generated by refinery operations.

[8] Approximately half of the MTBE produced in the United States is sold on the merchant market; the remainder is consumed captively by producing refineries.

[9] DeWitt & Co., *MTBE and Oxygenates*, p. 49.

[10] Ibid.

[11] Ibid.

[12] Refiners represent the majority of purchasers on the merchant market. Some sales are also made to gasoline blenders.

[13] DeWitt & Co., *MTBE and Oxygenates*, p. 49.

[14] U.S. DOE, *Petroleum Supply Monthly*, Feb. 1999, p. 138. During 1994-98, the ratio of merchant production to captive production varied widely each month. However, annual ratios for 1994-98 were 1.0:1.0 for each year except 1996 (1.2:1.0).

Table 3-1
U.S. MTBE production facilities, 1997

Production Method	Year built	Company	State	Capacity *(barrels/ day)*
Butane dehydrogenation	1990	Texas Petrochemical	Texas	23,300
	1992	Coastal	Wyoming	4,300
	1992	Enron	Texas	14,000
	1992	Global Octanes	Texas	11,600
	1993	Valero	Texas	13,000
	1994	Enterprise/Sun/Mitchell[1]	Texas	14,900
Subtotal	–	–	–	81,100
FCCU gas	1983	Valero	Texas	2,300
	1985	Amoco	Indiana	500
	1986	Huntsman	Texas	9,300
	1986	Amoco	Virginia	700
	1986	Diamond Shamrock	Texas	1,900
	1986	Phillips	Texas	3,000
	1986	Valero	Texas	1,400
	1987	Sun	Pennsylvania	2,300
	1988	Citgo	Louisiana	2,500
	1988	Lyondell	Texas	1,900
	1989	Marathon[2]	Michigan	1,000
	1990	Conoco	Louisiana	1,900
	1990	Chevron	California	1,900
	1990	Ashland[2]	Kentucky	3,000
	1990	Atlantic Richfield	California	2,300
	1991	Hess	New Jersey	1,400
	1992	Valero	Louisiana	2,000
	1992	Valero	Texas	1,400
	1992	Koch	Texas	2,600
	1992	Chevron	California	1,900
	1992	Star	Louisiana	2,300
	1992	Exxon	Louisiana	6,500
	1993	Tosco	California	2,000
	1993	Chevron	Mississippi	2,200
	1993	Star	Delaware	1,900
	1993	Exxon	Texas	6,500
	1994	Exxon	Texas	3,700
	1994	Koch	Minnesota	1,400
Subtotal	–	–	–	71,700
Steam cracker (raffinate 1[3])	1986	Exxon	Texas	2,800
	1986	Citgo	Texas	4,200
	1992	Oxychem[4]	Texas	1,900
Subtotal	–	–	–	8,900
TBA/PO	1986	ARCO Chemical[5]	Texas	32,600
	1994	Huntsman	Texas	14,000
Subtotal	–	–	–	46,600
Mixed[6]	1986	Lyondell	Texas	7,000
	1988	Mobil	Texas	2,500
	1990	Exxon	Louisiana	1,400
	1993	Shell	Louisiana	5,600
	1994	Deer Park	Texas	4,700
Subtotal	–	–	–	21,200
Total	–	–	–	229,500

[1] This partnership is also known as Belvieu Environmental Fuels.
[2] Facilities now owned by a joint venture, Marathon Ashland LLC.
[3] Raffinate 1 is defined as a steam cracker-derived C_4 stream from which butadiene has been extracted.
[4] Now owned by Equistar.
[5] Now owned by Lyondell.
[6] These facilities use feedstock mixtures (e.g., raffinate 1 and FCCU isobutylene).

Source: DeWitt & Co., *MTBE and Oxygenates,* p. 49. Reprinted with permission from DeWitt & Co. Capacities have been altered by the Commission to reflect barrels per calendar day.

production capacity is fairly recent, with over two-thirds built during 1990-94. During 1992-94 alone, 21 facilities came onstream with a capacity of 118,000 barrels per day. No new production capacity came onstream after 1994.[15] Because of uncertainty concerning future U.S. consumption and recent increases in global production capacity, there are no known plans for building new domestic production facilities.[16]

Sales are made either directly from MTBE producers or through traders,[17] with most being direct sales between MTBE producers and consumers.[18] Producers often act as traders, however, when they are unable to meet their sales obligations, reselling product purchased from traders and other producers.[19] Contract and spot sales are both common, with prices for both determined by spot market prices.[20] Imported MTBE, like the domestic product, is purchased by refiners, gasoline blenders, MTBE traders, and domestic MTBE producers.[21]

As most U.S. MTBE production is in the gulf coast region and more than 80 percent of demand is on the east and west coasts,[22] distribution is an important factor in the MTBE market. The responsibilities of storage and shipment are generally borne by the purchaser.[23] MTBE shipment and storage are comparable in complexity and cost to those of gasoline and do not require special handling by gasoline producers. Whether imported or domestically produced, MTBE is usually delivered by ship to coastal facilities,[24] with some moved inland by barge, rail, or truck.[25]

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[15] DeWitt & Co., *MTBE and Oxygenates*, p. 49.

[16] Don Richards, "RFG Downtrend May Signal End of the MTBE Buildup," *Chemical Marketing Reporter*, Oct. 23, 1995, p. 17.; USITC fieldwork in the United States.

[17] Based on responses to the Commission's questionnaire.

[18] USITC fieldwork in the United States.

[19] Based on responses to the Commission's questionnaire.

[20] USITC fieldwork in the United States. For much of the 1990s, when many analysts felt that demand growth would outpace supply growth, contract prices were based on a formula of input prices plus a guaranteed margin for producers. These contracts were regarded as favorable by producers. During 1996, however, supply increased to the point that prices came to be determined by the spot market.

[21] Based on responses to the Commission's questionnaire.

[22] DeWitt & Co., *MTBE and Oxygenates, 1998 Annual*, p. 61.

[23] USITC fieldwork in the United States.

[24] Ibid.

[25] The transportation of MTBE is covered more fully later in this chapter in the section entitled ***Transportation Costs***.

Production, Trade, and Consumption Trends for MTBE

MTBE Production Costs in the United States

The costs of the four primary MTBE production processes vary widely, largely depending on factors such as the type of plant and the source and relative cost of the feedstocks. For example, the type of plant determines initial capital investment levels and ongoing process costs. Butane dehydrogenation, or "on-purpose," plants are much larger than refinery-based plants and require higher capital investments. In the United States, when built from the ground up, they require about $200-$300 million in initial investment, compared with about $8-$15 million for an FCCU-based MTBE production facility. Moreover, the additional processing required by the butane dehydrogenation process (i.e., the isomerization of *n*-butane and the dehydrogenation of isobutane) adds "significant costs to the relatively inexpensive MTBE synthesis system."[26] The dehydrogenation unit is considered to be the "most expensive part of the plant," primarily because the process is very energy intensive.[27]

The source and cost of the feedstock are also important determinants of the cost of the production process. For example, the steam cracker process is less expensive than the FCCU process primarily because the C_4 streams obtained from steam crackers contain a higher concentration of isobutylene than those obtained from FCCUs and, therefore, their use results in reduced capital and operating costs.[28] Further, the ready availability of an in-house supply of finished isobutylene streams plays an important role in reducing the production costs of the FCCU process, compared with those of the butane dehydrogenation process, as does the low capital investment needed. Many refineries with available C_4 streams built MTBE units to utilize and add value to the streams.[29]

Although any direct comparison between the different MTBE production processes would be difficult, as they require different capital investments, have different economies of scale, and use different feedstock sources and valuations,[30] industry sources state that on a general basis the butane dehydrogenation process is the most expensive, followed by the FCCU process and then the steam cracker process. The difficulty in evaluating the relative costs of the FCCU and TBA processes is compounded by the fact that the valuation of the feedstocks will vary because they are internal streams and, as such, the values are generally allocated by the producer as proprietary transfer prices.[31] The valuations can also vary depending on the focus of the production process.

[26] Chem Systems, Inc., *Process Evaluation Research Planning Report*, p. 17. Also DeWitt & Co., *MTBE and Oxygenates*, appendix C.

[27] DeWitt & Co., *MTBE and Oxygenates*, appendix C, and USITC fieldwork in the United States.

[28] Chem Systems, Inc., *Process Evaluation Research Planning Report*, p. 9.

[29] USITC fieldwork in the United States; telephone discussion with a representative of DeWitt & Co., June 22, 1999.

[30] USITC fieldwork in Europe.

[31] Communication from DeWitt & Co., dated Apr. 29, 1999; communications with

(continued...)

In the PO/TBA process, for example, the valuation depends largely on the economics of producing the primary product (PO) and the valuation of the byproduct (TBA). An independent consulting company produced two evaluations of the cost of producing TBA in the United States in 1995 using different methods to value the TBA and the PO.[32] In one, the TBA process was ranked as the most expensive when compared with the butane dehydrogena-tion, FCCU, and steam cracker processes; in the second, it ranked as one of the least expensive.

Examples of cost breakouts for two prototypical production facilities in the United States using *n*-butane and FCCU isobutylene streams as raw materials in 1999 are provided in tables 3-2 and 3-3 for illustrative purposes. A publicly available cost breakout for the TBA/PO process in 1999 was not available because only two MTBE producers use the process and, hence, the data associated with the process are considered proprietary. A cost breakout for the steam cracker process would be similar to that of the FCCU process, but with reduced capital and operating costs. Valuation of the steam cracker process is also complicated by the highly variable market value of the input streams.[33]

The prototypical production facilities examined are considered representative of the general size of such facilities in the industry. For example, four of the six facilities using the butane dehydrogenation process in the United States have production capacities ranging between 11,000 and 15,000 barrels per day. Moreover, according to industry sources, some of the facilities using that process start with preseparated isobutane obtained from a fractionator and some start with preseparated *n*-butane that they then isomerize or pay a fractionator to isomerize. The cost breakout for the prototypical plant starting with *n*-butane is still considered representative of this segment of the industry despite the different starting materials used because the additional cost of using isobutane (priced about 1 to 2 cents per gallon higher than *n*-butane in the spring of 1999) is generally offset by the lower capital costs that result from its use. Industry sources have stated that producers without isomerization units are said to be favored when *n*-butane and isobutane are priced within 1 or 2 cents of each other, and producers with isomerization units are reportedly favored when the price spread between the two products increases to about 3 to 4 cents or more per gallon.[34]

The share of total cash costs accounted for by butane and methanol in the production of MTBE varies, depending on the cost of each.[35] Table 3-4 compiles these feedstock costs and their shares of total feedstock and total cash costs for 1996 and 1999 for the butane dehydrogenation process. The feedstock costs for the FCCU process presented in table 3-3

Table 3-2

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[31] (...continued)

industry representatives, Apr. 5-30, 1999. Transfer prices are generally defined as the monetary value assigned to products, services, or rights conveyed or exchanged between related parties, including those occurring between units of a consolidated entity.

[32] Chem Systems, Inc., *Process Evaluation Research Planning Report,* pp. 64 and 66; discussions with and fax from representatives of Chem Systems, Inc., May 3-21, 1999.

[33] Telephone discussion with a representative of DeWitt & Co., June 22, 1999.

[34] Telephone discussions with industry representatives, May 17-18, 1999.

[35] "Cheaper Saudi Butane Feedstock Could Boost MTBE Projects," *The Middle East Economic Survey*, Jan. 11, 1993, p. A2.

The cost of producing MTBE from *n*-butane in the United States, 1999

DeWitt & Co., Inc.					
500,000 Metric Tons/Year of MTBE from *n*-butane		(about 11635 barrels/day)			
U.S. gulf coast					
Capital Cost, $MM : 300					
1999 Conditions				Dollars	Dollars
(As of 04/26/99)		Unit		per metric	per barrel
Cost Element		Cost	$MM	ton MTBE	MTBE
FEED STOCKS					
Butanes	376,691 Metric Tons @	$163.50 /Metric Ton =	61.59	123.18	14.53
Methanol	186,518 Metric Tons @	$98.75 /Metric Ton =	18.42	36.84	4.35
TOTAL FEEDS			80.01	160.02	18.88
VARIABLE COSTS					
Electricity	34.23 MMKwh@	0.069 $/Kwh	2.36	4.72	0.56
Fuel Gas	5.5 MMMM	2.00 $/MM	11.00	22.00	2.60
Cooling Water	21.1 MM Gal	0.20 $/MMGal	4.22	8.44	1.00
Catalyst Repl.			1.25	2.50	0.29
			18.83	37.66	4.44
MARGINAL CASH COST			98.84	197.68	23.32
FIXED COSTS					
Labor/Overhead	8 /shift @	0.3 $MM	2.40	4.80	0.57
Maintenance	3.50 Pct of	300 $MM	10.50	21.00	2.48
Insurance, etc.	1.00 Pct of	300 $MM	3.00	6.00	0.71
TOTAL FIXED COSTS			15.90	31.80	3.75
TOTAL CASH COST			114.74	229.48	27.07
Depreciation[1]	10 Pct of	300 $MM	30.00	60.00	7.08
FULL COST			144.74	289.48	34.15

[1] In consultation with a representative of DeWitt & Co., the original valuation of a 15-percent return on investment was modified to reflect a 10-percent charge for depreciation.

Source: DeWitt & Co., Inc., except as noted. Reprinted with permission from DeWitt & Co., Inc.

Table 3-3
The cost of producing MTBE from FCCU isobutylene in the United States, 1999

DeWitt & Co., Inc.					
2,500 BBL/Stream Day	**from FCCU isobutylene**	**(about 2,329 barrels/ calendar day)**			
U.S. gulf coast					
Capital Cost, $MM :	**8.00**				
1999 Conditions				**Dollars**	**Dollars**
(As of 04/26/99)		**Unit**		**per metric**	**per barrel**
Cost Element		**Cost**	**$MM**	**ton MTBE**	**MTBE**
FEED STOCKS					
Isobutylene	**27,373,500 gallons @**	**$53.73 cts/gal =**	**14.71**	**151.10**	**17.83**
Methanol	**11,781,000 gallons @**	**$29.70 cts/gal=**	**3.50**	**35.95**	**4.24**
TOTAL FEEDS			**18.21**	**187.05**	**22.07**
VARIABLE COSTS		**1.5 cts/gal=**	**0.52**	**5.34**	**0.63**
MARGINAL CASH COST			**18.73**	**192.39**	**22.70**
FIXED COSTS					
Labor/Overhead		**1.0 cts/gal=**	**0.35**	**3.56**	**0.42**
Maintenance, etc.	**3.5 % of**	**8.00 $MM =**	**0.28**	**2.88**	**0.34**
TOTAL FIXED COSTS			**0.63**	**6.44**	**0.76**
TOTAL CASH COST			**19.35**	**198.83**	**23.46**
Depreciation[1]	**10 % of**	**8.00**	**0.80**	**8.22**	**0.97**
FULL COST			**20.15**	**207.05**	**24.43**

[1] In consultation with a representative of DeWitt & Co., the original valuation of a 15-percent return on investment was modified to reflect a 10-percent charge for depreciation.

Source: DeWitt & Co., Inc., except as noted. Reprinted with permission from DeWitt & Co., Inc.

Table 3-4
Butane dehydrogenation production process: Feedstock costs and shares of total feedstock and total cash costs, 1996 and 1999

Year	Unit input costs		Cost of feedstock		Input costs as a share of total feedstock costs		Total cash costs	Input costs as a share of total cash costs		Total feedstock costs as a share of total cash costs
	Methanol	Butane	Methanol	Butane	Methanol	Butane		Methanol	Butane	
	----Per metric ton-----		*Per metric ton MTBE*		*-------Percent----------*		*Per metric ton MTBE*	*------------------------Percent-----------------*		
1996	$245.00	$179.00	$91.54	$134.87	40	60	$147.90	31	46	77
1999	98.75	163.50	36.84	123.18	13	77	229.48	16	54	70

Source: Information presented in table 3-2; DeWitt & Co., *MTBE and Oxygenates*, appendix C.

accounted for approximately 94 percent of the total cash cost in 1999, with the isobutylene stream accounting for the majority of the feedstock cost (about 81 percent).

U.S. Production, Trade, and Consumption Data

During 1994-98, U.S. production of MTBE rose by 42.7 thousand barrels per day, and apparent U.S. consumption rose by 77.0 thousand barrels per day (see table 3-5). Both production and consumption reached their highest levels in 1997. Production capacity increased by 14.3 thousand barrels per day in 1995 and remained at that level for the rest of the period. Imports increased from 40.6 thousand barrels per day to 88.2 thousand barrels per day during 1994-98 (or by 117 percent), with their share of consumption increasing from 23 percent to 35 percent. Imports from all major sources increased during the period. U.S. exports changed little between 1994 and 1997, ranging from a low of 5,200 barrels per day in 1995 to a high of 9,400 barrels per day in 1994. In 1998, however, they increased to 23,800 barrels per day (or by 170 percent). This increase was accounted for by a rise in shipments to Venezuela and Mexico.

Table 3-5
U.S. production, trade, consumption, production capacity, and utilization for MTBE, 1994-98

Item	1994	1995	1996	1997	1998
Production *(1,000 barrels per day)*	143.7	163.3	185.2	197.0	186.4
Imports *(1,000 barrels per day)*	40.8	63.2	69.6	76.7	88.7
Exports *(1,000 barrels per day)*	9.4	5.2	7.1	8.8	23.8
Consumption *(1,000 barrels per day)*	175.1	221.3	247.7	264.9	251.3
Ratio of imports to consumption *(percent)*	23	29	28	29	35
Capacity*(1,000 barrels per day)*	214.8	229.1	229.1	229.1	229.1
Capacity utilization *(percent)*	67	71	80	86	81

Source: Compiled from data obtained from Energy Information Administration monthly surveys and official statistics of the U.S. Department of Commerce.

Factors Affecting MTBE Trends

Market Conditions

As has been noted, the U.S. MTBE market is the largest in the world, owing to the highest gasoline consumption of any country and environmental regulations which mandate oxygen content for much of this gasoline. In 1996, the latest year for which information is available, the United States accounted for 43 percent of the world's motor gasoline consumption. The next highest consuming nation was Japan, with 4.9 percent of world consumption.[36]

[36] U.S. DOE, *International Energy Annual, 1997*, pp. 55-59.

MTBE is mostly sold on the west coast, the gulf coast, or the east coast.[37] As most U.S. producers are located on the U.S. gulf coast and thus have easy access to the surrounding area, this region has relatively few imports.[38] Although imported MTBE enters on both coasts, the west coast market accounts for the majority of the total. Distribution channels for imported and domestic MTBE are similar on both coasts. U.S. producers suggest that even though the distance their product must travel is relatively short compared with that of the imported product, their shipping costs are high because of regulations covering domestic shipping under the Jones Act.[39]

The oxygenated gasoline and RFG[40] programs, implemented under the CAAA, and the California Air Resources Board (CARB) Phase 2 RFG gasoline program[41] are considered by industry analysts to have been largely responsible for the significant growth in U.S. and world consumption of MTBE during much of the 1990s.[42] MTBE demand initially had a highly seasonal character as a result of the CAAA requirements that oxygenated gasoline be sold in the winter months; this requirement resulted in oxygenates being blended with gasoline to ensure that the gasoline met the specified oxygen content.[43] Following the 1995 and 1996 introduction of the Federal RFG and CARB Phase 2 RFG programs, respectively, which required oxygenated gasoline to be used on a year-round basis, MTBE consumption increased (41.5 percent during 1994-96) and lost some of its seasonality.

The size of the U.S. MTBE market is still dependent on the RFG and CARB programs. In 1998, 31 percent of gasoline consumed in the United States was RFG.[44] However, U.S. consumption has plateaued as the Federal RFG program has ceased expansion. Further, according to industry sources, the executive order issued by the Governor of California on March 25, 1999, to phase out MTBE in that State by December 31, 2002, is likely to dramatically reduce the size of the U.S. market.[45] Even if no other State seeks to phase out MTBE, the termination of its usage in California would mean a reduction of 100 thousand barrels per day in U.S. consumption (or roughly 40 percent).[46] Companies are already said to be

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[37] USITC fieldwork in the United States.

[38] Ibid.

[39] Ibid. For more information, see the section later in this chapter entitled the ***Jones Act***.

[40] In this chapter, RFG is used to refer to both the gasoline product and the Federal RFG program. To avoid confusion, the latter will be called the RFG program or the Federal RFG program.

[41] The CARB Phase 2 RFG program is separate from the Federal RFG program. This program will be called either the CARB Phase 2 RFG program or CARB program.

[42] Don Richards, "MTBE Markets Could Require New Plants," *Chemical Marketing Reporter*, Nov. 11, 1996, p. 20. The CAAA, RFG, and CARB Phase 2 RFG programs are discussed more fully later in this chapter in the section entitled ***Government Policies***.

[43] DeWitt & Co., *MTBE and Oxygenates*, p. 26.

[44] Ibid., p. 1.

[45] The California phaseout is discussed further in the section entitled ***Health and Environmental Concerns and Related Legislation*** later in this chapter.

[46] "California Seeks MTBE Alternatives," *Oil & Gas Journal*, Oct. 5, 1998, p. 34.

exploring their options regarding alternatives to MTBE for use in gasoline blending and have reportedly contacted engineering contractors about alternative uses for the MTBE plants themselves.[47]

The large increase in U.S. domestic demand was met with increases in both domestic production and imports (see tables 3-6 and 3-7). During 1994-98, the United States was a net importer; domestic production never exceeded 77 percent of domestic consumption. Saudi Arabia was the leading source of U.S. MTBE imports throughout this period, with Canada, the UAE, and Venezuela as the next three leading suppliers. Although U.S. imports from Saudi Arabia more than doubled between 1994-98, their share of U.S. consumption increased from 7.4 percent to 11.2 percent. In terms of quantity, U.S. imports from Saudi Arabia increased more than those from any other country. However, in terms of percent of U.S. consumption, imports from the UAE increased the most (from zero to 4.2 percent).

During 1994-97, U.S. exports of MTBE changed very little in terms of quantity (see table 3-8). However, in 1998, owing to increased shipments to Mexico and Venezuela, exports increased by 170 percent. Both of these countries are close to the U.S. gulf coast production center. Mexico is a net importer of MTBE and was one of the largest foreign markets for the U.S. product throughout 1994-98. One U.S. producer likened increases in exports to Mexico to trade with other U.S. producers, which occasionally have sales obligations in excess of production and, on a temporary basis, purchase MTBE to meet contracts. U.S. exports to Venezuela, one of the world's leading MTBE-exporting nations, were relatively low until 1998, when they increased more than sixfold. A representative of the Venezuelan national petroleum company, Pequiven, indicated that Venezuela's export contractual obligations are significant and that a combination of refinery production problems, increased domestic consumption, and increased domestic blending of RFG for export to the United States necessitated the imports.[48]

Some MTBE also entered the United States already blended in RFG imports. During 1994-98, these imports increased from 9.9 thousand barrels per day to 158.4 thousand barrels per day (see table 3-9). Most of the import increase occurred between 1994 and 1995, coinciding with the implementation of the Federal RFG program. Although some U.S. producers suggest that these imports have had a significant impact on the U.S. MTBE market,[49] accurately calculating the amount of MTBE which enters the United States in RFG is difficult. For example, while some of these imports contain the same 11 percent of MTBE by volume as domestically produced RFG, some contain other oxygenates used to meet the Federal oxygen requirements.

In regard to choosing between domestic or imported MTBE, producers and purchasers both report that the most important factors are price and reliability of supply,[50] as differences in quality are small and generally not sufficient to alter purchasing patterns. Industry sources note

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[47] "Desperately Seeking Solutions," *European Chemical News*, Apr. 19-25, 1999, p. 17, and USITC fieldwork in the United States.

[48] Telephone discussion with a representative of Pequiven, Apr. 15, 1999.

[49] USITC fieldwork in the United States.

[50] Ibid.

Table 3-6
Major U.S. MTBE import sources, 1994-98

Source	1994	1995	1996	1997	1998
	Quantity (1,000 barrels per day)				
Saudi Arabia	12.9	23.0	24.3	25.8	28.3
Canada	11.8	12.5	7.7	12.6	15.3
UAE	0.0	5.7	10.8	9.7	10.7
Venezuela	8.5	10.2	13.1	12.1	10.7
Netherlands	2.3	5.9	3.6	3.6	6.5
France	1.7	2.3	2.9	4.1	4.5
Malaysia	2.3	2.1	4.5	3.7	3.8
Republic of Korea	0.0	0.1	0.8	1.1	3.8
Brazil	0.0	([1])	0.9	0.7	2.4
All other	1.1	1.2	0.9	3.2	2.6
Total imports	40.8	63.2	69.6	76.7	88.7
	Value (1,000 dollars per day)[2]				
Saudi Arabia	453.0	682.8	743.9	789.2	710.7
Canada	495.8	586.9	309.7	456.2	454.8
UAE	([3])	158.6	296.4	279.4	257.3
Venezuela	283.5	355.4	416.6	372.4	256.7
Netherlands	67.0	197.2	118.6	118.8	164.7
France	60.6	73.3	95.4	133.3	117.3
Malaysia	69.7	72.7	170.5	126.3	107.5
Republic of Korea	([3])	5.6	26.7	37.2	99.8
Brazil	([3])	2.1	28.2	22.7	64.3
All other	27.5	39.8	33.9	108.8	70.2
Total imports	1,457.1	2,174.7	2,239.9	2,444.3	2,303.3
	Unit value (per barrel)				
Saudi Arabia	$35.0	$29.6	$30.6	$30.6	$25.1
Canada	42.0	47.1	40.3	36.2	29.7
UAE	([3])	27.6	27.4	28.8	24.0
Venezuela	33.0	34.9	31.9	30.7	24.0
Netherlands	28.6	33.4	33.1	33.4	25.4
France	35.4	31.4	32.3	32.5	26.1
Malaysia	29.6	35.3	37.8	33.7	28.2
Republic of Korea	([3])	52.3	33.3	33.0	26.3
Brazil	([3])	29.0	31.0	33.7	26.5
All other	26.7	32.9	36.3	34.3	27.0
Total imports	35.7	34.4	32.2	31.2	26.0

[1] Less than 50 barrels/day.
[2] Data presented are imports for consumption, customs value.
[3] Not applicable.

Note.–Because of rounding, figures may not add to totals shown.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Table 3-7
U.S. MTBE import-to-consumption ratio, by source, 1994-98

(*Percent*)

Source	1994	1995	1996	1997	1998
Saudi Arabia	7	10	10	10	11
Canada	7	4	3	4	6
UAE	([1])	3	4	4	4
Venezuela	5	4	5	5	4
Netherlands	1	3	2	1	3
All other	3	3	4	5	7
Total	23	27	28	29	35

[1] Not applicable.

Note.–Because of rounding, figures may not add to totals shown.
Source: Compiled from official statistics of the U.S. Department of Commerce.

Table 3-8
Major U.S. MTBE export markets, 1994-98

Market	1994	1995	1996	1997	1998
	Quantity (1,000 barrels per day)				
Venezuela	0.6	1.6	1.4	1.5	11.2
Mexico	5.7	3.1	3.3	7.0	11.3
Canada	2.7	0.1	0.1	0.1	0.3
All other	0.4	0.4	2.3	0.3	0.9
Total	9.4	5.2	7.1	8.8	23.8
	Value (1,000 dollars per day)[1]				
Venezuela	27.3	56.2	48.8	52.1	345.4
Mexico	203.3	109.9	118.2	249.7	302.3
Canada	109.0	4.5	3.8	4.6	7.8
All other	13.3	13.7	82.2	12.2	26.6
Total	352.9	184.3	253.0	318.6	682.1
	Unit value (per barrel)				
Venezuela	$45.5	$35.1	$34.9	$34.7	$30.8
Mexico	36.3	35.5	35.8	36.2	29.3
Canada	40.3	44.7	47.2	63.9	27.1
All other	34.6	33.8	35.0	43.7	27.7
Total	37.5	35.7	35.4	36.0	28.7

[1] Data presented are domestic exports, f.a.s.

Note.–Because of rounding, figures may not add to totals shown.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Table 3-9
U.S. imports of reformulated gasoline, by sources, 1994-98
(*1,000 barrels per day*)

Source	1994	1995	1996	1997	1998
Canada	3.3	48.3	67.8	67.1	61.1
Venezuela	1.3	29.4	40.9	48.4	52.0
Netherlands	0	6.4	1.4	12.0	9.1
Saudi Arabia	0	4.9	12.2	14.7	8.1
All other	5.1	11.8	14.5	5.9	5.8
Total	9.9	106.6	154.3	164.5	158.4

Source: Compiled from official statistics of the U.S. Department of Commerce.

that purchasers do not distinguish between imported and domestic MTBE.[51] By design, purchasers tend to mix acquisitions by utilizing both the spot market and contracts of varying length, allowing them to switch suppliers depending on price.[52]

Price Trends

MTBE prices fluctuate substantially throughout the year (see table 3-10). However, two longer-term price shifts are worth noting. One is the increase from $25 to $45 per barrel during March-November 1994. This increase derived mainly from an independent rise in methanol prices, which was, in turn, the result of production problems that reduced supplies while methanol demand continued to grow. However, even after methanol prices declined, MTBE prices stayed high as MTBE demand remained strong, particularly given the implementation of the Federal RFG program in 1995.

The second major longer term shift in MTBE prices was the decline from $39 to $20 per barrel during August 1997-December 1998. Industry sources report that MTBE prices tend to be closely associated with crude petroleum prices,[53] and relate this particular decline to a parallel decrease in the price of crude petroleum following the onset of the Asian financial crisis in mid-1997.[54] The Asian countries most affected by the crisis represented significant markets for crude petroleum, and the zero to negative growth of the gross domestic product in some of these countries reduced the global demand for crude petroleum, contributing to a 37-percent decline in the price of crude petroleum during 1997-98.[55]

[51] Ibid.
[52] Ibid.
[53] DeWitt & Co., *MTBE and Oxygenates*, p. 6.
[54] Telephone discussions with industry sources, May 16, 1999.
[55] Domestic first purchase price. U.S. DOE, *Monthly Energy Review*, Apr.1999, p. 111.

Table 3-10
Average monthly and annual U.S. gulf coast MTBE spot prices, 1994-98

(per barrel)

Period	1994	1995	1996	1997	1998
January	$25.65	$40.13	$36.65	$36.09	$30.95
February	25.38	38.14	32.19	33.08	30.40
March	24.93	29.27	34.31	33.00	26.21
April	27.27	32.55	37.59	31.75	26.72
May	28.81	39.46	34.34	32.68	28.82
June	32.18	38.12	31.40	33.47	27.97
July	36.12	36.17	32.30	38.60	28.67
August	39.00	35.55	34.91	38.72	26.49
September	38.80	32.00	35.04	35.24	26.23
October	44.10	29.21	37.23	36.96	26.38
November	45.40	33.44	36.02	37.35	26.20
December	43.32	37.72	35.94	32.91	19.82
Average annual	34.08	35.15	34.82	34.99	27.07

Source: *Platt's Oilgram Price Report* and *Platt's Oilgram News.*

Several U.S. producers say that MTBE prices are still declining in 1999. Whereas some have stated that this trend has generally resulted in decreasing profit margins,[56] others reported "solid" profit margins in mid-1998.[57] One industry source notes that profit margins have declined since 1995, but states that they remain positive for the industry as a whole, although too low to encourage new capacity construction.[58]

Table 3-11 presents data on unit values of imports, on a landed duty-paid (LDP) basis,[59] from the top five sources during 1994-98. These sources accounted for over 80 percent of U.S. MTBE imports. The LDP unit values include a 5.5 percent tariff applied to imports from

[56] USITC fieldwork in the United States.

[57] "Stable Feedstock Prices Provide U.S. MTBE Producers With Solid Margins," *Platt's Oilgram Price Report*, July 21, 1998, p. 10.

[58] DeWitt &Co., *MTBE and Oxygenates*, p. 7. Profit margins are one of several factors discouraging the construction of new capacity.

[59] The LDP value of imports is calculated as follows:

LDP value = customs value + charges, insurance, and freight + calculated duties collected.

The United States assesses import duties on the customs value of imports, which is conceptually similar to the exporter's f.o.b. (free on board) value. "Calculated duties collected" are derived by applying the published duty rates to the customs value. LDP unit values and customs unit values are derived by dividing LDP values and customs values by the appropriate unit of quantity for a particular product, when available. In principle, the LDP unit value should be a reasonable proxy for prices paid by U.S. consumers of imports, since it includes insurance and freight costs and tariffs (but not shipping from the port of entry).

Table 3-11
Landed duty-paid unit value per barrel of U.S. MTBE imports, by country, 1994-98

Country	1994	1995	1996	1997	1998
Saudi Arabia	$41.89	$35.39	$37.02	$36.54	$30.51
Canada	43.72	49.27	42.43	38.09	32.83
UAE	([1])	33.41	33.51	36.05	29.42
Venezuela	36.20	37.67	35.81	33.66	26.87
Netherlands	32.31	37.46	36.58	36.74	27.77
Average for total imports from all sources	39.74	38.73	37.22	36.47	30.10

[1] Not applicable.
Note.–The average was derived from the trade data for all sources, not just the countries listed above.
Source: Compiled from official statistics of the U.S. Department of Commerce.

Saudi Arabia, the UAE, and the Netherlands, as well as the higher shipping costs for more distant sources such as Saudi Arabia and the UAE.[60] Table 3-12 shows these charges, as reported by the United States Customs Service, both in terms of dollars per barrel and as a share of LDP unit values. LDP unit values, customs unit values, and spot prices of MTBE tracked each other fairly closely during the period in question (see figure 3-1). For example, the decline in MTBE prices during 1998 shows up fairly clearly in all three series. Since tariffs, charges, freight, and insurance costs have been stable over time (table 3-12), the LDP unit values and customs values as reported by U.S. Customs are closely linked. Since 1996, these two values and the U.S. gulf coast spot price as reported in *Platt's Oilgram Price Report* have tracked more closely, and the dispersion among LDP unit values for various exporters has been reduced. Some of these changes appear to coincide with changes in industry pricing practices.

Until 1996, contracted U.S. gulf coast prices were determined by a three-variable "A+B+C" formula. In this formula, A was the price of butane, B was 0.34 times the price of methanol, and C was a combination of other costs of production and producer profit consistent with prevailing market factors.[61] The A and B variables changed in accordance with published feedstock prices, while the C variable was negotiated separately for each contract. As the "A+B+C" contracts expired in 1996, this pricing formula ended and spot prices published daily in *Platt's Oilgram Price Report* came to determine both spot and contract prices.[62]

[60] U.S. tariffs are discussed in more detail in ***appendix G***. Transportation costs are discussed later in the section entitled ***Transportation Costs*** later this chapter.
[61] DeWitt & Co. *MTBE and Oxygenates,* p. 189. This convention is derived from the proportions of feedstocks used to make MTBE.
[62] Based on responses to the Commission's questionnaire. In addition to *Platt's*, four other publications report spot prices for MTBE, although *Platt's* is the most widely referenced. One industry analyst estimated that over 90 percent of the MTBE sold in the United States was transacted at prices based on prices published in *Platt's*.

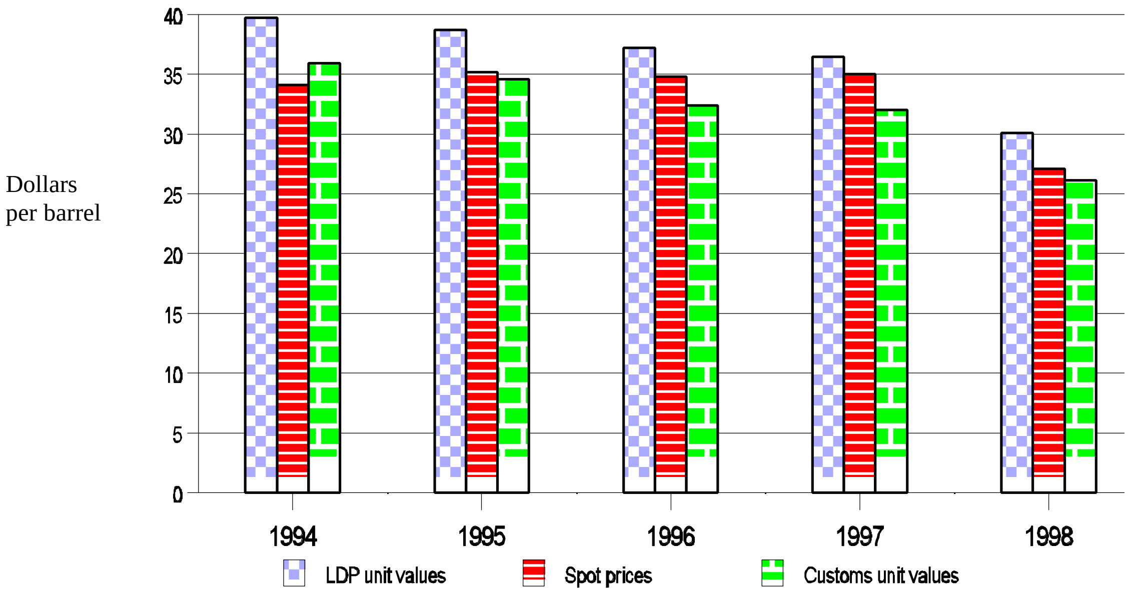
Table 3-12
Components of LDP unit values for U.S. MTBE imports by sources, by value, and by shares of LDP unit value, 1994-98

Item	1994	1995	1996	1997	1998
	Value (per barrel)				
Customs unit value per barrel:					
Saudi Arabia	$35.17	$29.78	$30.73	$30.73	$25.27
Canada	42.13	47.33	40.54	36.34	29.79
UAE	([1])	27.71	27.50	28.94	24.08
Venezuela	33.16	35.07	32.02	30.82	24.17
Netherlands	28.72	33.53	33.25	33.55	25.52
Charges, insurance, and freight per barrel:					
Saudi Arabia	4.74	3.94	4.57	4.11	3.85
Canada	1.59	1.93	1.89	1.74	3.04
UAE	([1])	4.15	4.47	5.51	4.01
Venezuela	2.98	2.60	3.73	2.84	2.68
Netherlands	1.98	2.05	1.46	1.35	0.85
Calculated duties per barrel:					
Saudi Arabia	1.97	1.67	1.72	1.69	1.39
Canada	([1])	([1])	([1])	([1])	.00
UAE	([1])	1.55	1.54	1.59	1.39
Venezuela	0.06	([1])	0.05	([1])	0.02
Netherlands	1.61	1.88	1.86	1.84	1.40
	Shares of LDP unit value (percent)				
Customs value:					
Saudi Arabia	84	84	83	84	83
Canada	96	96	96	95	91
UAE	([1])	83	82	80	82
Venezuela	92	93	89	92	90
Netherlands	89	90	91	91	92
Charges, insurance, and freight:					
Saudi Arabia	11	11	12	11	13
Canada	4	4	5	5	9
UAE	([1])	12	13	15	14
Venezuela	8	8	10	8	10
Netherlands	6	6	4	4	3
Duties:					
Saudi Arabia	5	5	5	5	5
Canada	([1])	([1])	([1])	([1])	([1])
UAE	([1])	5	5	4	5
Venezuela	([1])	([1])	([1])	([1])	([1])
Netherlands	5	5	5	5	5

[1]Not applicable.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Figure 3-1
MTBE: LDP unit values, spot prices, and Customs unit values, 1994-98



Source: Compiled from official statistics of the U.S. Department of Commerce and data from various issues of *Platt's Oilgram Price Report* and *Platt's Oilgram News*

According to one source, MTBE prices in 1997 and 1998 were about 20 to 30 cents per gallon lower than those with the pricing formula.[63] Typically, an average of the prices for several days around the day of either the delivery to purchaser facilities or pickup from supplier facilities is used to determine price.[64]

Almost all U.S. MTBE imports are delivered to ports outside of the U.S. gulf coast area, and LDP unit values for all supplier countries are generally slightly higher than the U.S. gulf coast price. Import unit values for Saudi Arabia tend to be close to the average for all imports and near the middle of the top five suppliers.

[63] DeWitt & Co. *MTBE and Oxygenates*, p. 189.
[64] Based on responses to the Commission's questionnaire.

Transportation Costs

Practically all of the MTBE both produced and consumed domestically is transported between U.S. coasts by ships;[65] imported MTBE is transported similarly. Transportation costs vary, depending on a number of factors, including prevailing freight rates, distance traveled, mode of transportation, flag-registry of shipping vessels, and amount of cargo shipped. This discussion compares total transportation costs with transportation costs on a per-mile basis to highlight geographically and nongeographically determined differences in costs.[66]

Jones Act [67]

Section 27 of the Merchant Marine Act of 1920, commonly referred to as the Jones Act,[68] prohibits merchandise from being transported by water between U.S. ports "in any other vessel than a vessel built in and documented under the laws of the United States and owned by persons who are citizens of the United States." In addition, other U.S. laws and regulations restrict the foreign ownership of, and the citizenship of crews on, U.S.-flag and U.S.-registered ships. Although they too affect the transportation of merchandise between U.S. ports, certain of these regulations operate separately from the Jones Act. [69] Shipping firms indicate that the Jones Act increases rates for U.S. coastal shipping for a number of reasons: (1) vessels built in U.S. yards cost more, (2) U.S. crewing requirements exceed those of most foreign-flag vessels, and (3) U.S. insurance, liability, and other requirements also raise the cost of operating a U.S.-flag vessel.[70] It should be noted, however, that the Jones Act applies to U.S.-flag transportation of all commodities in the United States between U.S. ports and is not specific to MTBE.

Determinants of Transportation Costs

Total transportation costs are largely a function of distance for both U.S. and foreign MTBE producers. The shipping distances from principal MTBE suppliers in the Arabian Gulf to either U.S. coast are roughly comparable and hence their transportation costs to either coast tend to be similar. For domestic suppliers of MTBE, the situation is somewhat different. Many domestic MTBE producers/merchants are located around the U.S. gulf coast and utilize ships to transport most, if not all, of the product they sell on either coast. However, it costs U.S. producers/merchants more to ship by vessel to the west coast than to the east coast because of

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[65] USITC fieldwork in the United States; telephone interviews with industry sources, Aug. 18, 1999. Barges are generally used when the distance to be shipped is short (i.e., in the local area). Shipments by barge, however, are limited by the size of the barge.

[66] Generally, shifting imports from a neighboring supplier to a distant supplier increases total transportation costs, but such a shift is not likely to independently determine changes in transport costs on a per-mile basis.

[67] More information about the Jones Act can be found in USITC, *The Economic Effects of Significant U.S. Import Restraints, Second Update*, USITC Publication 3201, May 1999, pp. 85-104.

[68] 46 U.S.C. 883; 19 CFR 4.80 and 4.80(b).

[69] *U.S. Import Restraints*, p. 86.

[70] Interviews with U.S. domestic shipping firms, Feb. 1999.

the distance involved.[71]

Although total shipping costs for imported MTBE from the Arabian Gulf generally exceed total shipping costs for domestic MTBE because distances are significantly greater, U.S. shippers generally pay higher freight rates on a per ton-mile[72] basis than foreign shippers (table 3-13 and figure 3-2). U.S. producers must use U.S.-flag Jones Act vessels for cargo shipped between U.S. ports. U.S. industry representatives stated that they believe the Jones Act makes it less profitable for them to compete in the west coast market (the destination for most imported Arabian Gulf MTBE).[73]

Table 3-13
Clean marine transportation, spot charter rates, 1996-98

	1996 Total cost	Rate	1997 Total cost	Rate	1998 Total cost	Rate
	Per ton	*Per ton-mile*	*Per ton*	*Per ton-mile*	*Per ton*	*Per ton-mile*
Type of voyage:						
Domestic (Jones Act):						
U.S. gulf-U.S. east coast	$11.36	$0.0059	$10.23	$0.0054	$9.73	$0.0051
U.S. gulf-California (LA)	24.75	0.0052	24.12	0.0051	21.92	0.0046
Foreign:						
Europe-U.S. east coast	13.63	0.0040	14.97	0.0044	10.78	0.0032
Caribbean-U.S. east coast	9.32	0.0050	10.51	0.0057	6.40	0.0035
Singapore-California	19.13	0.0020	16.31	0.0020	16.10	0.0020
Arabian Gulf-California	29.48[1]	0.0026	27.03[1]	0.0023	24.57	0.0024

[1] Estimated by the Commission using industry information.

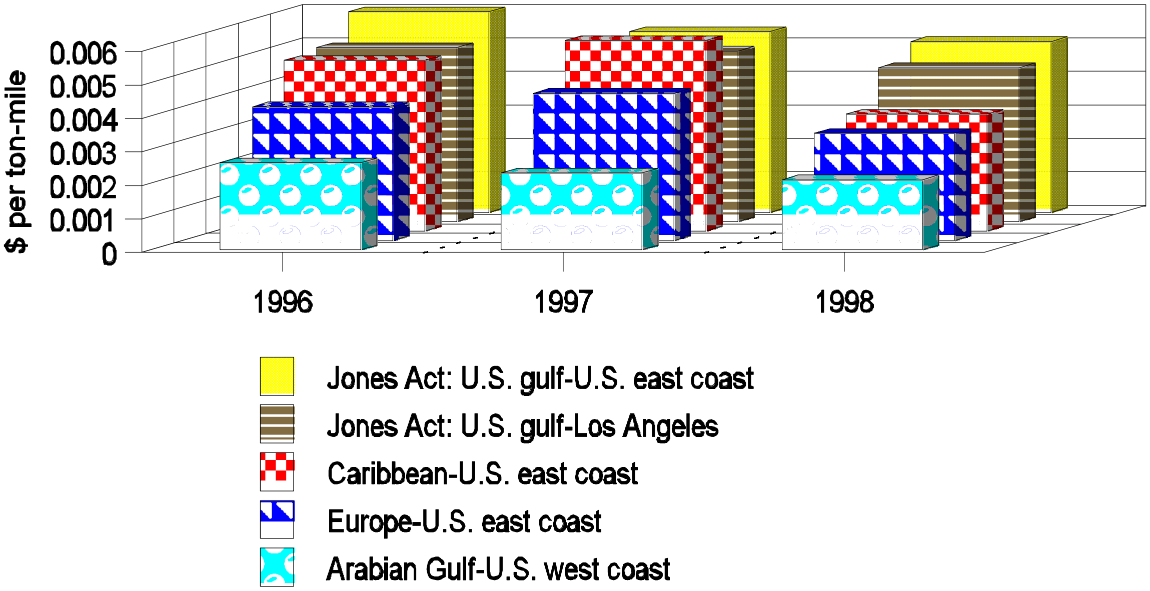
Source: Compiled by the Commission from information provided by U.S.-based shippers.

[71] As of February 1999, the freight costs for shipping MTBE from the U.S. gulf coast to the east coast and to the west coast amounted to approximately 3.5 cents per gallon and 7.5 cents per gallon, respectively. As it is difficult to cover transportation costs to the west coast through the market price, there is substantially less product shipped from the gulf coast to the west coast. USITC fieldwork in the United States.

[72] A ton-mile is a unit of measure reflecting the movement of 1 ton of freight 1 mile. The freight cost per ton-mile is the cost to move 1 ton this distance.

[73] USITC fieldwork in the United States.

Figure 3-2
MTBE: Shipping rates, per ton-mile, 1996-98



Source: Compiled by the Commission from information provided by U.S.-based shippers.

Government Policies

This section presents information on Government policies in the United States that affect production, investment, and trade of MTBE.[74] The majority of respondents to the Commission's questionnaire, as well as industry officials interviewed by the Commission, cited U.S. and Saudi Arabian government policies as having the greatest effect on both current and future competitive conditions of the global market; policies specifically cited by industry representatives were the CAAA, the Jones Act, and the ethanol tax credit, and Saudi Arabian feedstock pricing policies.[75] Other factors identified by the respondents to have a significant impact on current and future competitiveness of the U.S. industry were U.S. imports of MTBE and health/environmental concerns.

Two government policy-related events subsequent to most Commission fieldwork and the return of questionnaire responses may presage a major change in government policy in the United States concerning MTBE: the issuance of an executive order on March 25, 1999, by the Governor of California requiring the phaseout of MTBE in California by the end of the year 2002, largely because of concerns about ground water contamination, and the July 1999 report of the EPA's "Blue Ribbon Panel on Oxygenates in Gasoline" recommending the reduced use of MTBE in the United States, with efforts to curtail use to begin immediately.

The first part of this section discusses the Clean Air Act, as amended by the CAAA. The CAAA, among other things, mandated the phaseout of tetraethyllead in gasoline and required the use of gasoline with higher oxygen content in specified parts of the country to reduce carbon monoxide emissions and toxic air pollutants. MTBE is one of several oxygenates that can be blended with gasoline to meet these requirements. This part also discusses the waiver of the Federal fuel requirements granted to California and the California Air Resources Board (CARB) Phase 2 RFG program, as well as the Governor's executive order. California consumes more MTBE than any other State, accounting for 40 percent of U.S. consumption. The second part of

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[74] Neither industry sources nor the Commission identified any specific Federal laws or regulations that apply solely to MTBE. The chemical is generally subject to EPA and U.S. Department of Transportation (USDOT) regulations that apply to chemical products. For example, plants producing MTBE, like plants producing other chemical products, must meet EPA standards relating to the discharge of certain pollutants. The shipping and packaging of MTBE are subject to regulations issued by the USDOT. MTBE can be shipped "neat," that is, as an individual chemical, for later blending with gasoline, or it can be shipped already blended in gasoline. While USDOT indicates that there are no specific regulations governing the transportation of MTBE per se, it indicates that regulations applicable to the shipment of flammable liquids, including gasoline, are applicable to MTBE when it is shipped either neat or blended with gasoline. 42 U.S.C.§ 7412(f)(4). Also see e.g., 49 CFR §§ 173.150, 176.305-340.

[75] The Commission found no information that indicated that there are any Federal restrictions on investment. Market forces were mentioned as being the main restrictions on such investment.

the section describes health and environmental concerns raised by the use of MTBE, including the July 1999 report of the EPA Blue Ribbon Panel.[76]

The Clean Air Act

Widespread use of MTBE in the United States as an oxygenate in gasoline is largely the result of new air-quality standards mandated by amendments to the Clean Air Act enacted in 1990. The Clean Air Act, initially enacted in 1963 and significantly amended in 1990 by the CAAA, addresses air quality, defines certain pollutants, and sets air-quality standards. The Clean Air Act is administered principally by the EPA in conjunction with the States. The CAAA represented a major amendment of the Clean Air Act, and imposed considerable new standards on motor vehicle emissions designed to meet air-quality objectives. The CAAA's goals with respect to motor vehicle emissions included: (1) the removal of tetraethyllead from gasoline; (2) the reduction of carbon monoxide emissions from the burning of gasoline by cars and light trucks; and (3) the reduction of volatile organic compound (VOC)[77] emissions and toxic air pollutants from the burning of gasoline. One of the methods identified for accomplishing these goals was to add oxygenates to gasoline. Oxygenates boost octane (and, therefore, reduce engine "knock") and thus offset the loss of octane caused by the removal of tetraethyllead.[78] Also, oxygenates increase the oxygen content in the gasoline, resulting in cleaner burning gasoline. It was estimated that use of oxygenated fuels in pre-1981 vehicles would reduce carbon monoxide emissions by 24 percent or more.[79] MTBE was one of three oxygenates noted by the legislative history of the CAAA as then used in gasoline; also noted were ethanol and ETBE.[80]

To accomplish the goals related to motor vehicle emissions, the CAAA required that the composition of gasoline be changed in two steps. The first step was the oxygenated gasoline program, implemented in 1992, which required the use of oxygenates in gasoline in nonattainment areas during winter months.[81] The second step, implemented in 1995, required the production of RFG for use in designated metropolitan areas on a year-round basis. Implementation of the 1992

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[76] The ethanol tax credit is discussed in the section of this chapter entitled ***Substitutes for MTBE in the U.S. Market***; the Jones Act is discussed in the section of this chapter entitled ***Transportation Costs***; and the Saudi feedstock pricing policy is discussed in chapter IV.

[77] VOCs are organic compounds that participate in atmospheric photochemical reactions. They are said to contribute significantly to the formation of ground-level ozone (smog). "Glossary," undated, found at *http://www.eia.doe.gov/oiaf/1605/gg97rpt/glossary.html*, retrieved June 23, 1999; "OAR Policy and Guidance Metarecord," dated Nov. 17, 1998, found at *http://www.epa.gov/ttncaaa1/t3/meta/m20705.html*, retrieved June 23, 1999.

[78] 136 *Cong. Rec*. S 3510-12 (1990).

[79] S. Rept. 101-228, Clean Air Act, Amendments, at 118 (1990).

[80] Ibid. at 119; 3504.

[81] A nonattainment area does not meet, or contributes to another area's failure to meet, the standards for a particular pollutant. These areas include Baltimore, Chicago, Hartford, Houston, Los Angeles, Milwaukee, New York City, Philadelphia, and San Diego. Conversely, an attainment area meets such standards. Some attainment areas decided to opt in to the RFG program despite meeting the standards for particular pollutants. § 107(d)(1)(A) & 211(k)(6) of the Act, 42 U.S.C.A. § 7407(d)(1)(A) & 7545(k)(6); 40 CFR § 81.302.

and 1995 programs is considered to be largely responsible for the significant growth in U.S. consumption of MTBE during much of the 1990s.[82]

Major provisions regarding mobile sources of air pollution

The oxygenated gasoline program, which became effective on November 1, 1992, was intended to address carbon monoxide problems during the winter months in carbon monoxide nonattainment areas.[83] The program required that about 12 percent of all motor gasoline sold during the winter months contain at least 2.7 percent, by weight, blended oxygenate.[84] Oxygenated gasoline is still used in certain parts of the country, but since implementation of the RFG program, it accounts for a smaller percentage of the total gasoline used in the United States (about 3 percent of gasoline demand in 1997).[85]

The CAAA mandated the sale of RFG for use in motor vehicles as of January 1, 1995, to reduce VOC emissions and toxic air pollutants and, in turn, ozone production.[86] RFG was mandated for use on a year-round basis in nine metropolitan areas with the worst ozone smog.[87] The program calls for continued reductions in such emissions through two phases. Phase I, implemented in 1995 with an initial goal of, among other things, reducing toxic emissions relative to 1990 levels, was upgraded in 1998 to meet specified pollutant limits. Phase II, which calls for greater reductions in VOC emissions and toxic air pollutants, will be implemented in 2000.[88]

RFG has more stringent specifications than oxygenated gasoline.[89] To qualify as RFG, gasoline must contain at least 2 percent oxygen by weight and no more than 1 percent benzene by

[82] DeWitt & Co., *MTBE and Oxygenates*, p. 25; Richards, "MTBE Markets Could Require New Plants," p. 20; *Prehearing Brief of Saudi Basic Industries Corporation (SABIC) and SABIC Americas, Inc.*, submitted by Miller & Chevalier, Chartered, counsel for SABIC, dated Mar. 19, 1999, pp. 3-4.

[83] Carbon monoxide results from the incomplete engine combustion of gasoline. Increasing the oxygen content causes the gases to burn more completely and reduces carbon monoxide emissions. Carbon monoxide exceedances were found to occur most often in the winter months due to colder ambient temperatures , atmospheric temperature inversions, and, in some areas, the combined effects of high altitude and climatic conditions. S. Rep. 101-228 at 118-19; reprinted in 1990 *U.S. Code Congressional and Administrative News* (U.S.C.C.A.N.) at 3503-04.

[84] § 211(m)(2) of the Act, 42 U.S.C.A. § 7545(m)(2). The requirement is equivalent to 15.2 percent MTBE or 7.6 percent fuel ethanol by volume. These percentages may change plus or minus 0.5 percent absolute. For example, MTBE in oxygenated gasoline may range from 14.7 to 15.7 percent by volume, depending on the density of the motor gasoline, the purity of the oxygenate, and the assumed average oxygen content.

[85] DeWitt & Co., *MTBE and Oxygenates*, p. 28.

[86] H.R. Conf. Rep. 101-952, reprinted in 1990 U.S.C.C.A.N. at 3868.

[87] § 211(k) of the Act, 42 U.S.C.A. § 7545(k)(5).

[88] Discussions with representatives of the EPA, June 23, 1999.

[89] Oxygenated gasoline includes gasohol but excludes reformulated gasoline and certain other products. 40 CFR § 80.2.

volume,[90] and contain no lead or heavy metals.[91] The EPA must certify that any RFG meets these requirements.[92]

MTBE is one of four commercially available blending agents available to oxygenate gasoline;[93] the other three are fuel ethanol, ETBE, and TAME.[94] In the United States, MTBE and fuel ethanol account for over 90 percent of oxygenate use. However, any agent not specifically prohibited by the EPA[95] may be used, provided that it meets the statutory requirements on volatility during the high ozone seasons.[96]

The California waiver and special standards

The Clean Air Act also permits a State to receive a waiver from the Federal fuel requirements if the State adopts standards that are at least as strict as the Federal standards.[97] California received such a waiver in 1994 and established its own emission standards (e.g., the CARB Phase 2 RFG program).[98] This waiver affords California the authority to control or prohibit the use of any fuel additive.[99]

Both the Federal RFG and the CARB Phase 2 RFG programs are in effect in certain areas of California (e.g., Southern California and Sacramento); the remainder of California is not subject to Federal RFG requirements. Since, according to a representative of the CARB, CARB Phase 2 RFG regulations regarding emissions are more stringent than the Federal regulations, gasoline used to meet CARB regulations will satisfy Federal regulations[100] and, therefore, all of the gasoline used in California is CARB Phase 2 RFG.[101] However, to ensure that there is no violation of Federal law, oxygen is required to be added to the CARB Phase 2 RFG in areas subject to Federal RFG standards (i.e., southern California and Sacramento).[102]

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[90] § 211(k)(2)(B) & (C) of the Act, 42 U.S.C.A. § 7545(k)(2)(B) & (C).

[91] § 211(k)(2)(D) of the Act, 42 U.S.C.A. § 7545(k)(2)(D).

[92] § 211(k)(4) of the Act, 42 U.S.C.A. § 7545(k)(4).

[93] S. Rep. No. 101-228 at 119, reprinted in 1990 U.S.C.C.A.N. at 3504.

[94] Ibid., p. 119; 3504. In reconciling the House and Senate versions, the Conference Committee specifically stated that the provisions would encourage the use of oxygenates, "like ethanol and MTBE." H.R. Conf. Rep. 101-952, 104 Stat. 3869.

[95] § 211(c) of the Act, 42 U.S.C.A. § 7545(c).

[96] § 211(h)(1) of the Act, 42 U.S.C.A. § 7545(h)(1).

[97] § 211(c)(4)(B) of the Act, 42 U.S.C.A. § 7545(c)(4)(B). A State must first seek a waiver under § 209(b) of the Act, 42 U.S.C.A. § 7543(b).

[98] 40 CFR 80.81(c).

[99] § 211(c)(4)(B) of the Act, 42 U.S.C.A. § 7545(c)(4)(B).

[100] Telephone discussion with a representative of the California Air Resources Board, June 23, 1999; California Air Resources Board, "Comparison of Federal and California Reformulated Gasoline," Fact Sheet 3, updated Feb. 1996, p. 1.

[101] Telephone conversation with a representative of the California Air Resources Board, June 24, 1999.

[102] Ibid.

According to the California Energy Commission, CARB Phase 2 RFG gasoline, introduced in June 1996, "has a different formulation and burns cleaner than regular reformulated gas."[103] One industry source states that "Overall, CARB gasoline is more tightly specified, and probably produces greater emissions reductions than its Federal counterpart."[104] One of the most significant differences between the CARB and the Federal RFG programs is that it is possible to meet the CARB regulations without using oxygen as long as equivalent emissions levels are met per a model that relates emissions to fuel properties.[105] According to a representative of the CARB, companies blending gasoline can choose one of two options: (1) they can use oxygen to meet the standards and not have to meet the specifications of the model or (2) they can use less (or no) oxygen, but would then have to meet the parameters established by the model.[106]

On March 25, 1999, the Governor of California issued an executive order mandating the removal of MTBE from gasoline by December 31, 2002.[107] In the same order, the Governor authorized a request to the EPA from California for a waiver from the Federal RFG program's oxygen content requirements currently in place in areas subject to the program.[108]

Implementation of the RFG program

Initially, the RFG transition was viewed with concern by the industry given the mixed results that had been associated with previous new-product introductions.[109] For example, the introduction of oxygenated gasoline in the fall of 1992 went smoothly because refiners had built up large stocks of MTBE and other emission-reducing oxygenates prior to the start of the program.[110] In contrast, the introduction of low-sulfur diesel in the fall of 1993 posed a number of difficulties that resulted in temporary product shortages with associated price increases, illustrating that transition periods for new products could be vulnerable to unexpected supply disruptions.[111]

From the start of the program, the wide-ranging areas to be served added some complications. RFG was required in designated ozone nonattainment areas and in attainment areas

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[103] "Types of Gasoline Available in the United States," dated Oct. 1996, found at *http://www.energy.ca.gov/ fuels/gasoline/types_of_gasoline.html*, retrieved on Apr. 21, 1999.

[104] DeWitt & Co., *MTBE and Oxygenates*, p. 35.

[105] Discussion with a representative of the California Air Resources Board, June 23, 1999.

[106] Ibid.

[107] Executive Order D-5-99 at ¶ 4. Methanex, a Canadian methanol producer, has indicated that it will challenge the executive order as constituting a breach of U.S. obligations under Chapter 11 of NAFTA. Methanex served a notice on the United States of intent to submit a claim to arbitration under Article 1119(b) of Chapter 11 of the North America Free Trade Agreement, on June 15, 1999.

[108] Ibid. at ¶ 2; § 211(k)(2)(B), 42 U.S.C.A. § 7545(k)(2)(B). Of further note, the Governor authorized an assessment of the health risks of ethanol in gasoline and the potential for an ethanol industry in California. Executive Order D-5-99 at ¶¶ 10 & 11.

[109] "First Oxygenated Gasoline Season Shakes Out Differently Than Expected," *Oil & Gas Journal*, Oct. 25, 1993, pp. 66-75.

[110] Ibid.

[111] Ibid.

that opted in to the program,[112] mostly located in the Northeast, southern California, and the Chicago area. In some regions, attainment areas were interspersed with nonattainment areas, making delivery complicated. Moreover, some regions (i.e., the Northeast and Midwest) are not self-sufficient in terms of RFG production and must rely on gulf coast production and imports.

Other features that made the RFG program complex were new production processes and diminished flexibility in the delivery system. New equipment was added to existing production facilities for additional refining steps because RFG was a totally new product and not just a slight change or addition to an existing production process.[113] In addition, the more than 250 types of conventional, oxygenated, and reformulated gasolines produced needed to be segregated in the pipeline systems and storage facilities. Any loss of flexibility in the delivery system could increase the potential for temporary shortages of any of these products.[114]

The RFG program also affected retail gasoline prices. The principal factor influencing retail gasoline prices is the price of crude petroleum to refiners, which is determined in the global market.[115] For RFG, the separate costs of oxygenates, such as MTBE, were also a significant added factor. Higher production and distribution costs for RFG were expected to create a price premium. Production costs had been estimated to be 4 to 6 cents per gallon higher than those for

[112] Areas opting into the program initially included sections of Connecticut, Delaware, Kentucky, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Wisconsin, and the District of Columbia.

[113] "First Oxygenated Gasoline Season Shakes Out Differently Than Expected."

[114] U.S. DOE, *The Energy Information Administration's Assessment of Reformulated Gasoline*, Vol.1, Oct. 1994, various pages and Vol. 2, Dec. 1994, various pages. As noted in this publication, a number of modes are used to transport all types of gasoline to consumers, including pipeline, waterborne tanker and barge, rail, and tanker truck. Storage is required at various points in the distribution system. However, refiners, transporters, bulk storage terminal operators, and marketers must segregate individual RFG batches and assure each batch's integrity by repeated testing as the batch moves from the refiner to the consumer. The RFG program requires substantial paperwork to identify each batch of RFG produced. The majority of all types of gasolines are moved to market via pipelines, which operate throughout the country. The efficiency of pipeline operations is predicated on moving large volumes of fungible products. As segregated products, such as RFG, enter the system, more interfaces and transmixes are created, and often a more valuable product is blended down into a less valuable class of product. In addition to the interface problems, disruptions in pipeline operations can affect the ability to move the product to market. An example of problems that could face the delivery system is the Renewable Oxygenate Standard (ROS), which required that 30 percent of the oxygenates for RFG be derived from ethanol and other renewable sources. Because of problems associated with transporting ethanol via pipelines, the ROS was postponed in early 1995 and later canceled entirely.

[115] Retail gasoline prices, as seen by consumers at the pump, are the product of a variety of influences, including crude petroleum prices; refining, transportation, and marketing costs; Federal, State, and local taxes; and profit margins at all levels of the industry. Seasonality is also a significant influence, with gasoline prices tending to rise in the summer, owing to higher demand, and fall in the winter.

conventional gasoline,[116] depending upon refinery configurations;[117] in turn, RFG was expected to cost consumers 10 cents per gallon more at retail than conventional gasoline. Additionally, local or regional supply disruptions were expected to result in temporary price increases.[118] During 1996-98, the price of RFG ranged from 1.9 to 3.5 cents per gallon more than that of conventional gasoline (table 3-14). Prices at the pump increased by about the same amount.

Table 3-14
RFG and conventional motor gasoline price relationship and the price of MTBE, 1995-98

	(cents per gallon)						
	New York Harbor			U.S. gulf coast			
Year	Conventional	RFG	Difference	Conventional	RFG	Difference	MTBE
1995--------	52.0	54.0	2.0	52.0	55.0	3.0	83.8
1996--------	53.5	56.7	3.2	51.0	54.5	3.5	83.8
1997--------	61.0	63.4	2.4	60.0	61.9	1.9	82.8
1998--------	59.6	62.2	2.6	59.0	61.1	2.1	83.2

Source: Derived from official statistics of the U.S. Department of Energy and various issues of *Platt's Oilgram Price Report, Price Average Supplement*.

Health and Environmental Concerns

Overview

In the early 1990s, concerns regarding the ill effects of exposure to MTBE in the air (e.g., from gasoline exhaust) were generated by health complaints from residents of areas with winter oxygenated fuel programs. In the mid-1990s, California, along with several other States, discovered MTBE in its public water supplies.[119] In 1998, the University of California conducted research to evaluate the health and environmental impacts of MTBE, the findings of which became a basis for the Governor of California's decision, in March 1999, to order a phaseout of MTBE.[120] A handful of other States have introduced legislation to curtail the use of MTBE (see

[116] Conventional gasoline is finished motor gasoline, not included in the oxygenated or reformulated gasoline categories.

[117] Various issues of *Platt's Oilgram Price Report, Price Average Supplement*.

[118] Ibid. For example, the MTBE price increase in late 1994 resulted in an increase in the price of oxygenated gasolines; the latter was priced over 7 cents per gallon more than the price of conventional gasoline. The increase in the price of MTBE was not the result of increased demand for the product but occurred because of the rise in the price of the MTBE feedstock, methanol, which more than doubled as a result of unexpected plant outages.

[119] MTBE is a compound that is "highly soluble, biodegrades slowly and is persistent in groundwater." Testimony by Robert Perciasepe, Assistant Administrator for Air Radiation, U.S. Environmental Protection Agency, before the U.S. House of Representatives, House Commerce Committee, *Amending the Clean Air Act: Hearing of the Health and Environment Subcommittee,* 106th Cong., May 6, 1999.

[120] Governor Davis' decision to call for the gradual rather than the immediate removal of MTBE was supported by findings both in the University of California study and in a study published by the California Energy Commission entitled *Supply and Cost Alternatives to MTBE in Gasoline*, Oct. 1998. In his executive order calling for a phaseout of MTBE, Governor Davis notes that "the findings and recommendations of the U.C. report, public

(continued...)

appendixes H and J). In addition, the EPA convened a panel of environmental and health experts to evaluate options for curbing MTBE contamination of air and water. The panel presented its recommendations to EPA Administrator Carol Browner in July 1999.[121]

Health concerns: the impact of MTBE on air quality

Health complaints arising from exposure to MTBE in the air were first registered in November 1992 in Fairbanks, AK, when residents reported symptoms such as headaches, nausea, dizziness, irritation of the nose and throat, and disorientation.[122] Similar complaints were recorded in Anchorage, AK; Missoula, MT; Milwaukee, WI; and New Jersey.[123] During the 1994-95 winter season, Anchorage replaced MTBE with ethanol as the primary fuel oxygenate because the latter's use had not generated reports of negative health effects.[124] Missoula also began substituting

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[120] (...continued)
testimony, and regulatory agencies are that, while MTBE has provided California with clean air benefits, because of leaking underground fuel storage tanks MTBE poses an environmental threat to groundwater and drinking water." Telephone discussion with a representative from the California Air Resources Board, May 11, 1999; Executive Order D-5-99 by the Governor of the State of California, Mar. 25, 1999, found at *http://www.ca.gov/s/ governor/d599.html,* retrieved Apr. 7, 1999.

[121] The health effects and the recommendations of the panel are discussed in more detail in the sections entitled ***Health concerns: the impact of MTBE on air quality*** and ***The EPA Blue Ribbon Panel***. For a more complete listing of events related to the use of MTBE, see appendix H.

[122] It is suggested that the complaints were generated from an increased sensitivity on the part of Alaska residents to the unpleasant odor of MTBE-blended gasoline. Executive Office of the President, National Science and Technology Council, "Interagency Assessment of Potential Health Risks Associated With Oxygenated Gasoline," found at *http://www.whitehouse.gov/WH/EOP/OSTP/NSTC/html/MTBE/report.html*, retrieved Apr. 24, 1999, p. 20.

Moreover, according to the World Health Organization, "Epidemiological studies of human populations exposed under occupational as well as non-occupational conditions, and experimental studies of human volunteers exposed under controlled conditions, have not been able to identify a basis for these complaints. Although results are mixed, community studies conducted in Alaska, New Jersey, Connecticut, and Wisconsin, USA, have provided limited or no evidence of an association between MTBE exposure and the prevalence of health complaints." World Health Organization, International Programme on Chemical Safety, *Environmental Health Criteria 206 (Summary): Methyl Tertiary-Butyl Ether*, undated, last modified Mar. 29, 1999, found at *http://www.who.int/pcs/docs/ehc_206.htm*, retrieved Aug. 25, 1999.

[123] Paul J. Squillace, John S. Zorgorski, William G. Wilber, and Curtis V. Price, *A Preliminary Assessment of the Occurrence and Possible Sources of MTBE in Ground Water of the United States, 1993-94*, U.S. Geological Survey, p. 3.

[124] Beginning on November 1, 1992, MTBE-blended gasoline was required in two areas of Alaska–the Municipality of Anchorage and the Fairbanks North Star Borough. In December 1992, Alaska suspended its use of MTBE, although the chemical was not formally banned. Representative from the Alaska Department of Environmental Conservation, correspondence via electronic mail with the Commission, Apr. 27, 1999.

ethanol for MTBE because of perceived health issues.[125] However, to date, research findings have not established a causal link between human exposure to gasoline containing MTBE and the occurrence of health-related symptoms.[126] Further, one study suggests that the carcinogenic risk associated with the inhalation of MTBE is "substantially less" than that for other gasoline components, including benzene, 1,3-butadiene, formaldehyde, and acetaldehyde.[127]

Environmental issues: MTBE contamination of ground and surface water

MTBE, a product with a strong taste and odor, has been discovered in the drinking water supplies of several States, most notably in California. In early 1997, the City of Santa Monica, CA, closed nearly half of its public drinking wells owing to contamination by MTBE. The contamination occurred as a result of the migration of MTBE from leaking underground gasoline storage tanks to nearby ground water.[128] MTBE has also been detected in California lakes and reservoirs, where it was found to be released from unburnt fuel leaking from two-stroke engines on motorboats and jet skis.[129] In June 1997, the City of South Lake Tahoe adopted an ordinance to

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[125] The City and County of Missoula switched to ethanol after voluntarily suspending use of MTBE. California Environmental Protection Agency, "MTBE," Briefing Paper, Apr. 24, 1997 (updated Sept. 3, 1998), p. 9, and telephone interview with representative from Montana Department of Environmental Quality, Apr. 27, 1999.

[126] California Environmental Protection Agency, "MTBE," pp. 8 and 11.

[127] These findings were published in a report entitled *Interagency Assessment of Oxygenated Fuels* by the White House Office of Science and Technology Policy in June 1997. The report qualifies its findings, however, and recommends that additional research be conducted. James E. McCarthy and Mary Tiemann, *MTBE in Gasoline: Clean Air and Drinking Water Issues*, Congressional Research Service, updated Mar. 26, 1999, p. 2.

[128] In 1997, Chevron and Shell reached a settlement in a lawsuit filed against them by the City of Santa Monica by agreeing to pay an initial $5 million to help clean up MTBE. "Boxer Urges EPA To Use Emergency Authority To Clean Up MTBE Drinking Water Contamination," a press release from Senator Boxer's office, Sept. 1, 1998, and Kara Sissell, "Chevron, Shell Settle MTBE Contamination Suit," *Chemical Week*, Sept. 17, 1997, p. 16.

In 1984, the EPA established a program to prevent water contamination by leaking underground gasoline storage tanks. Tanks constructed prior to December 1988 were either to be upgraded to meet new EPA standards or eliminated from service within 10 years. In December 1998, the EPA reported that over 1.2 million "substandard" tanks existing in 1988 were no longer in operation; and of the nearly 900,000 remaining tanks in use, over half reportedly complied with EPA regulations. Some industry sources have questioned the EPA's enforcement of its program given that it had not received 100 percent compliance by the December 1998 deadline. However, the EPA has asserted its commitment to achieving 100 percent compliance, and has estimated that it will be able to do so in roughly "a couple of years." McCarthy and Tiemann, *MTBE in Gasoline,* p. 6; U.S. Environmental Protection Agency, "Supplemental Information Regarding the August 10, 1998, Enforcement Strategy," Dec. 9, 1998, found at *http:// www.epa.gov,* retrieved Apr. 28, 1999; testimony by Robert Perciasepe, May 6, 1999; and USITC fieldwork in the United States.

[129] "Summer Boating Blamed for MTBE Pollution," *Environmental News Network*, found at *http://www.enn.com/,* posted July 24, 1998, retrieved Mar. 25, 1999.

prohibit the use of jet skis and, in October of the following year, voted to ban the use of MTBE.[130] Separately, in June 1998, a report published by California's Lawrence Livermore National Laboratory estimated that nearly 10,000 of the State's ground water sites,[131] located near leaking underground fuel tanks, were contaminated by MTBE.[132]

MTBE has also been detected in the public water systems of at least 10 east coast States,[133] and MTBE-contaminated wells have been found in Arizona, Kansas, Illinois, Texas, and Virginia.[134] The contamination has occurred primarily as the result of leaking underground gasoline storage tanks and, in some cases, has forced the closure of drinking wells.[135]

The EPA Blue Ribbon Panel

In November 1998, the EPA assembled a panel of outside experts, the Blue Ribbon Panel on Oxygenates in Gasoline,[136] to review the health concerns associated with MTBE contamination of water and evaluate the efficacy of available oxygenates in maintaining clean-air standards in the United States.

On July 27, 1999, the Panel presented its recommendations on domestic oxygenate use to EPA.[137] The Panel requested that EPA work with Congress and individual States to implement a

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[130] "MTBE Banned in South Lake Tahoe," *Environmental News Network*, found at *http://www.enn.com/*, posted Oct. 9, 1998, retrieved Mar. 25, 1999.

[131] The study's findings pertain to shallow ground water, which is not commonly used as a source of municipal drinking water supplies. California Environmental Protection Agency, "MTBE," p. 16.

[132] Anne E. Happel, E. H. Beckenbach, and R. U. Haden, *An Evaluation of MTBE Impacts to California Groundwater Resources*, Lawrence Livermore National Laboratory, June 11, 1998, p. iv.

[133] A U.S. Geological Survey study concludes that in areas where either RFG or oxygenated gasoline is used, detection frequencies of MTBE were four to six times greater than in areas without such programs. U.S. Geological Survey, presentation before EPA Blue Ribbon Panel meeting, Washington DC, Apr. 29, 1999.

[134] Jim Doyle and Susan Sward, "MTBE Leaks a Ticking Bomb: Gas Additive Taints Water Nationwide," *San Francisco Chronicle*, Dec. 14, 1998, found at *http://www.sfgate.com,* retrieved Mar. 29, 1999, and U.S. Geological Survey, presentation before EPA Blue Ribbon Panel meeting, Washington, D.C., Jan. 22, 1999.

[135] Doyle and Sward, "MTBE Leaks a Ticking Bomb."

[136] The 13 members of the Panel were as follows: Dan Greenbaum, Health Effects Institute, Panel Chair; Mark Buehler, Metropolitan Water District, southern California; Robert Campbell, Sunoco Inc.; Patricia Ellis, Delaware Department of Natural Resources and Environmental Conservation; Linda Greer, Natural Resources Defense Council; Jason Grumet, Northeast States for Coordinated Air Use Management; Anne Happel, Lawrence Livermore National Laboratory; Carol Henry, American Petroleum Institute; Michael Kenny, California Air Resources Board; Richard Sawyer, University of California, Berkeley; Todd Sneller, Nebraska Ethanol Board; Debbie Starnes, Lyondell Chemical; and Ron White, American Lung Association.

[137] It is important to note that the Panel was charged with providing *recommended*

(continued...)

four-part reform package, which would "simultaneously maintain air quality benefits while enhancing water quality protection and assuring a stable fuel supply at reasonable cost."[138] The Panel–

- ❏ Recommended a comprehensive set of improvements to the nation's water protection programs, including over 20 specific actions to enhance Underground Storage Tank, Safe Drinking Water, and private well protection programs.[139]

- ❏ Agreed broadly that the use of MTBE should be reduced substantially (with some members supporting its complete phase out), and that Congress should act to provide clear federal and state authority to regulate and/or eliminate the use of MTBE and other gasoline additives that threaten drinking water supplies;

- ❏ Recommended that Congress act to remove the current Clean Air Act requirement–that 2% of RFG, by weight, consist of oxygen–to ensure that adequate fuel supplies can be blended in a cost-effective manner while reducing usage of MTBE; and

- ❏ Recommended that EPA seek mechanisms to ensure that there is no loss of current air quality benefits.[140]

The Panel recommended that efforts to curtail the use of MTBE in gasoline should begin immediately, "with substantial reductions to begin as soon as . . . the removal of the 2 percent oxygen requirement is implemented."[141] Panel members also suggested that a lead time of up to 4 years would be required to ensure that the transition to alternative gasoline formulations would not

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[137] (...continued)
courses of action regarding the future use of oxygenates. At this point, it is not clear whether, when, or how these recommendations will be implemented.

[138] The Blue Ribbon Panel on Oxygenates in Gasoline, *Findings and Recommendations on the Use of Oxygenates in Gasoline*, Executive Summary and Recommendations, July 27, 1999, p. 3.

[139] Although the Panel supported the upgrading of underground gasoline storage tanks, it emphasized that no underground storage tank system is likely to be 100 percent foolproof, and that there exists the ever-present threat that gasoline will leak from such facilities. Comment made by member of the Blue Ribbon Panel on Oxygenates in Gasoline at the meeting of the Clean Air Act Advisory Committee, held in Washington, D.C., July 27, 1999.

[140] The Blue Ribbon Panel on Oxygenates in Gasoline, "Panel Calls for Action To Protect Water Quality While Maintaining Air Benefits From National Clean Burning Gas," press release dated July 27, 1999, p. 2.

[141] The panel notes that "although a rapid, substantial reduction will require removal of the oxygen requirement, EPA should, in order to enable initial reductions to occur as soon as possible, review administrative flexibility under existing law to allow refiners who desire to make reductions to begin doing so." The Blue Ribbon Panel on Oxygenates in Gasoline, *Findings and Recommendations on the Use of Oxygenates in Gasoline*, July 27, 1999, p. 8.

produce disruptions in the fuel supply or increases in the price of gasoline.[142]

Possible outcomes of the ongoing debate

Given the efforts by individual States to mandate the removal of MTBE or restrict its use and now the recommendations by the Blue Ribbon panel, industry sources suggest that the ongoing debate over use of MTBE in the United States could be played out in different ways:

- ❏ First, the industry is concerned that a ban on the use of MTBE might eventually be mandated nationwide on a Federal level.[143]

- ❏ Second, if MTBE is banned, whether on a State-by-State basis or nationwide, replacement options could vary depending on existing Federal oxygen requirements. If a waiver of existing oxygen requirements were to be granted, refiners could use options other than oxygenates to meet mandated national air-quality standards; if such a waiver is not granted, then an oxygenate of some sort would be required.[144]

Companies are already researching possible options, including the production of alternative blending components, such as isooctane, or, in some cases, different products altogether.[145] One option stated by an industry source would be to add additional aromatics, which are often considered undesirable and are currently reduced by the use of MTBE, to offset any octane reduction.[146]

Various sources have also expressed concern that, depending on the transition period involved, banning MTBE on a State-by State or nationwide basis could result in increased costs to consumers and refiners and, perhaps, a temporary short supply of gasoline.[147] As mentioned earlier, the Blue Ribbon Panel also suggested that a lead time of up to 4 years would be required to ensure a smooth transition.

In 1997, the California Energy Commission was requested to analyze the potential impact of discontinuing use of MTBE on the production, price, and supply of gasoline in California. The Energy Commission reported the following findings for the expected impact in that State:

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[142] This timeframe could be shortened should there be "a substantial reduction (e.g., returning to historical levels of MTBE use)" rather than the complete elimination of MTBE from gasoline supplies. Ibid., pp. 8-9.

[143] USITC fieldwork in the United States and in Europe; "California's MTBE Ban Threatens More Supply Disruptions," *Petroleum Argus*, Apr. 12, 1999, p. 4; "U.S. Could Catch Californian Contagion," *European Chemical News*, Apr. 19-25, 1999, p. 17.

[144] Ibid.; "Is Ethanol the Solution?", *European Chemical News*, Apr. 19-25, 1999, p. 17.

[145] USITC fieldwork in the United States; "Desperately Seeking Solutions," *European Chemical News*, Apr. 19-25, 1999, p. 16.

[146] USITC fieldwork in Europe.

[147] California Energy Commission, *Supply and Cost of Alternatives to MTBE in Gasoline*, Feb. 1999, pp. 3-4; "California's MTBE Ban Threatens More Supply Disruptions," *Petroleum Argus*, Apr. 12, 1999, p. 4.

(1) If the use of MTBE was discontinued immediately, the resulting consequences would be "dire" for consumers and "catastrophic" for the State's economy, including "significant gasoline and diesel supply shortfalls and a rapid increase in prices" (it was noted that replacing MTBE would also result in a need for alternatives for the components that are currently reduced in volume and effect when MTBE is used. As such, according to the commission, an immediate replacement of MTBE would mean immediate replacement of these components).

(2) A 3-year phaseout would result in time for refiners and oxygenate producers to "take the necessary actions to meet demand." It was noted that the average cost of gasoline would be expected to change in a broad range, depending on the alternative oxygenate used (from a decrease of 0.2 cent per gallon to an increase of 6.7 cents per gallon).

(3) A 6-year phaseout would result in companies' having still more time to manage the transition and, therefore, the average cost of gasoline would be expected to change in a narrower range (from a decrease of 0.4 cent per gallon to an increase of 2.5 cents per gallon), again depending on the alternative oxygenate used.[148]

Moreover, industry representatives have expressed concern that any action relating to MTBE might be broadened in terms of product scope to include all ethers (e.g., ETBE and TAME) or all oxygenates (e.g., ethers and ethanol).[149] According to the California Energy Commission–

> If the scope of replacing MTBE [in California] were to be broadened to include the elimination of all oxygenates from gasoline, the cost impact for consumers would be the greatest, regardless of the length of time allowed for the transition, ranging up to 8.8 cents per gallon [of gasoline] in the intermediate term and 3.7 cents per gallon in the long term.[150]

[148] California Energy Commission, *Supply and Cost of Alternatives*, pp. 3-4.
[149] USITC fieldwork in the United States and in Europe.
[150] California Energy Commission, *Supply and Cost of Alternatives*, p. 4.

According to one source, the "volatility of a finely balanced market" in the west coast market is exemplified by a "massive [gasoline] price spike" that occurred in California in April 1999, when several refineries producing CARB gasoline shut down and supplies were reduced.[151]

Substitutes for MTBE in the U.S. Market

Standards requiring a minimum oxygen content in gasoline have been widely debated. While industry analysts agree that performance standards for fuels are necessary, it is thought that industry should be allowed to design the fuels to meet such requirements rather than be specifically mandated to use certain mixtures in the gasoline pool.[152] However, the standards currently in place require oxygen, necessitating the blending of gasoline with oxygenates such as MTBE and ethanol to reduce carbon monoxide emissions. The choice of which oxygenate to use is based on relative cost as well as on the comparative value of the blending characteristics.

In the United States, economics have made MTBE the most widely used oxygenate; it is used in about 84 percent of all RFG production. Fuel ethanol accounts for much of the remainder. In turn, RFG accounts for about 30 percent of total U.S. gasoline consumption. Alternatives for MTBE as an octane enhancer and oxygenate include fuel ethanol, ETBE, TAME, and other chemical compounds such as TBA.

The California phaseout of MTBE and that State's eventual opt-out from the RFG program is expected by industry sources to result in other States following this lead and mandating the removal of MTBE from use in the gasoline pool.[153] Ethanol, ETBE, or other oxygenates could increase their gasoline market share in the future as replacement products increase where MTBE is banned. However, industry sources consider it likely that ethers such as ETBE, TAME, and similar products would be examined to the same degree as MTBE and possibly banned from use.[154]

The choice of which oxygenate to use will be dictated by several factors, including the requirements set forth in Phase II of the Federal RFG program to be implemented on January 1, 2000. Phase II includes a lower Reid Vapor Pressure (RVP) than is currently mandated.[155] Also, any waivers granted by the EPA releasing States from the mandatory use of oxygen will affect the use of oxygenates as octane enhancers in the gasoline pool.[156]

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[151] "California's MTBE Ban Threatens More Supply Disruptions," p. 4.

[152] "Methanol and MTBE Face Uncertainties," *Chemical Market Reporter*, Apr. 19, 1999, pp. 5 and 18.

[153] Discussions with industry sources; "California's MTBE Ban Threatens More Supply Disruptions," p. 4.

[154] "Methanol and MTBE Face Uncertainties," *Chemical Market Reporter*, Apr. 19, 1999, pp. 5 and 18.

[155] RVP is a measure of how quickly fuel evaporates. Reductions in RVP are said to result in the "majority" of VOC emissions reduced through use of RFG. "Is Reformulated Gasoline a 'New' Gasoline?", dated Apr. 1995, found at *http://www.epa.gov/orcdizux/ rfgnew.htm,* retrieved June 23, 1999.

[156] "Methanol and MTBE Face Uncertainties," *Chemical Market Reporter*, Apr. 19, 1999,
(continued...)

Optional blending characteristics also need to be considered. Desired characteristics for finished gasoline include a research octane number (RON)[157] of 88 to 120, RVP of 8 to 15 pounds per square inch, and an oxygen content of approximately 15-30 percent by weight. Table 3-15 presents the RON, RVP, and oxygen content for some of the primary gasoline additives. Whereas MTBE generally falls within the desired ranges, the variation of the other products in regard to these characteristics affects their use as substitutes for MTBE.[158]

Table 3-15
Gasoline additives: Octane, RVP, and oxygen content

Gasoline additives	Octane *(RON)*	RVP *(pounds/square inch)*	Oxygen content *(percent by weight)*
MTBE	110-112	8	18
ETBE	110-112	4	16
TAME	103-105	4	16
Ethanol	112-115	18	35
Source: Derived from official statistics of the U.S. Department of Energy.			

Ethanol

In the United States, fuel ethanol, an anhydrous denatured aliphatic alcohol intended for gasoline blending, is derived primarily from the fermentation of grains (corn, milo, wheat, and barley). However, ethanol can also be made from cellulose biomass such as agricultural crop residuals, switchgrass, and other agricultural wood crops.

U.S. industry

There are five to seven major U.S. producers of ethanol for fuel use, with one producer accounting for about 50 percent of total U.S. production. In 1998, U.S. production of fuel ethanol amounted to 33 million barrels, compared with 30 million barrels in 1997.[159] The 1998

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[156] (...continued)
pp. 5 and 18.

[157] The motor octane number (MON) is a guide to engine performance at high speeds or under heavy load conditions, and the RON represents engine performance during low-speed driving when acceleration is relatively frequent. The difference between the MON and RON of a gasoline is an indicator of the changes in performance under both city and highway driving and is known as the "sensitivity" of the gasoline.

[158] "Methanol and MTBE Face Uncertainties," *Chemical Market Reporter*, Apr. 19, 1999, pp. 5 and 18.

[159] Derived from official statistics of the U.S. Department of Energy.

level almost reached the record high of 35 million barrels achieved in 1995, and production could reach a new record high by the end of 1999.[160]

Ethanol can be blended with gasoline to produce gasohol, which is a mixture of 90 percent gasoline and 10 percent ethanol. A gallon of ethanol contains nearly twice as much oxygen as a gallon of MTBE; however, ethanol cannot be transported in pipelines because of its affinity for water, and thus requires different transportation and blending infrastructure than MTBE. Ethanol is usually blended with gasoline at the terminals, whereas MTBE is blended at the refinery.

At the time Congress passed the CAAA, fuel ethanol blenders were receiving a Federal income tax credit of 6 cents per gallon.[161] Congress recently established an incremental reduction of this credit, from its current level of 5.4 cents per gallon[162] to 5.1 cents per gallon by 2005.[163] In addition, producers and blenders of any gasoline mixture containing at least 5.7 percent ethanol receive a Federal excise tax credit.[164] However, the income tax credit is offset by any amount taken as an excise tax credit.[165] Both credits currently are set to expire in 2007.[166] Whereas some industry sources believe that tax credits are the only reason that fuel ethanol is competitive with other oxygenates,[167] others consider the credits to be subsidies which, according to one source,

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[160] Interview with Eric Vaughn, President, Renewable Fuels Association (RFA).

[161] S. Rep. No. 101-228 at 119, reprinted in 1990 U.S.C.C.A.N. at 3504.

[162] 26 U.S.C.A. § 40(h) (1998). The tax credit is 5.4 cents per gallon on gasoline blended with 10 percent ethanol and prorated for blends of less than 10 percent.

[163] Pub. L. No. 105-178 § 9003, 112 Stat. 502 (1998).

[164] 26 U.S.C.A. § 4081(c), as amended by Pub. L. No. 105-178 § 9002. Some States, such as Idaho and South Dakota, also provide an excise tax credit for gasoline blended with ethanol. I.C. § 63-2405; SDCL § 10-47B-4. To encourage ethanol production, Nebraska has established an Ethanol Production Incentive Cash Fund. Neb. Rev. Stat. § 66-1345.

[165] 26 U.S.C.A. § 40(c).

[166] Pub. L. No. 105-178 § 9003. According to a press release from Senator Thomas Daschle's office, the Senator wrote in a 1997 letter to President Clinton that "Failure to extend the incentives would doom the ethanol industry throughout the midwestern states in only a few years, resulting in serious economic harm to states like South Dakota where rural value-added processing of agricultural products is a mainstay of local economic growth" and that it was important to "let prospective ethanol makers know that the tax incentives will be in place in the future so they will be willing to invest the money needed to build new ethanol and ETBE facilities. . ." In 1998, Senator Daschle credited passage of a 1998 highway bill that extended the ethanol tax credit until 2007 with allowing planned ethanol plants in South Dakota to progress "from the drawing board to the field" by providing lenders assurances that the tax credits would continue. Industry sources have cited similar concerns. "Daschle Urges Clinton To Meet Members of Congress on Ethanol," Press Release, Sept.19, 1997, found at *http://www.senate.gov/~daschle/releases/97/ 970919-d.html*, retrieved June 11, 1999; "Ethanol Tax Credit Passed By Congress Will Be Boon for South Dakota Economy," column by Senator Daschle, dated May 1998, found at *http://www.senate.gov/~daschle/releases/98/9805_column.html*, retrieved June 11, 1999; and USITC fieldwork in Europe.

[167] "Ethanol Outlook Positive Again," *Chemical Marketing Reporter*, Mar. 23, 1998, p. 3; "Submission of Information–Methyl Tertiary Butyl Ether (MTBE): Conditions Affecting the Domestic Industry (Inv. No. 332-404)," submitted by Miller & Chevalier, Chartered, counsel

(continued...)

"distort the U.S. market for MTBE, artificially lowering the cost of ethanol in competition with U.S. and imported MTBE."[168] Industry groups have criticized the extension of the tax credits for ethanol producers through 2007 while other countries are cutting back such credit programs.[169]

Despite increased production, tax credits, and the uncertain future of MTBE, ethanol has not achieved commercial success as a renewable fuel for several reasons, including low crude petroleum prices coupled with high corn prices.[170] In addition, ethanol's high volatility and water solubility have made it less desirable as a gasoline additive.

Foreign sources

Brazil is the world's largest producer of ethanol, with more than 600 production facilities and a capacity to produce about 95 million barrels. Brazil's industry is based on sugarcane feedstocks, and the industry is controlled by the state-owned oil company Petrobras. The use of ethanol over gasoline has historically been encouraged in Brazil by its being priced at 75 percent of the price of gasoline; as a result, ethanol blends currently account for about 50 percent of motor vehicle fuels consumed in Brazil.[171] However, Brazil's Interministerial Council on Alcohol plans to cut incentives to Brazil's ethanol industry by 15 percent by the end of 1999 and freeze subsidies to sugarcane growers.[172]

There is little consumption of fuel ethanol in Western Europe, where it is produced from molasses, potatoes, grains, sugar, fruits, and wine lakes,[173] as well as from the hydration of ethylene. Production of ethanol in Europe has not increased significantly during the 1990s, and production from wine lakes has actually decreased to the point of extinction. Many in Western

[167] (...continued)
on behalf of SABIC and SABIC Americas, dated May 10, 1999, p. 12 (reproduced in appendix I); USITC fieldwork in the United States and Europe. For more information regarding SABIC's comments on this subject, see the copy of the submission reproduced in appendix I.

[168] Prehearing brief submitted on behalf of SABIC, Mar. 19, 1999, p. 15; "Submission of Information," pp.12-13.

[169] "Ethanol Outlook Positive Again," p. 3.

[170] Ibid.; "Fueling Ethanol," *Chemical Engineering*, Feb. 1999, p. 37.

[171] Telephone conversation with a representative of the RFA on July 22, 1999.

[172] "Fueling Ethanol," p. 37.

[173] Defined as a surplus of wine generated by the price support system of the Common Agricultural Policy (CAP). "A Glossary of The European Communities And European Union: Acronyms, Initiatives, Institutions, Policies, Programmes, and Terms," undated, found at *http://www.abdn.ac.uk/pir/sources/eurogide.htm*, retrieved Aug. 3, 1999. The surplus wine consists of distilled wine and wine or grape "must" (grape "must" is the liquid product obtained naturally, or by physical processes, from fresh grapes).

Europe consider ethanol to be too costly to be used as an additive for gasoline blending, and its affinity for water absorption makes it undesirable as an oxygenate.[174]

As a result of the provisions of the 1983 Caribbean Basin Economic Recovery Act (CBERA), distillation facilities were built in Caribbean nations to take advantage of the elimination of tariffs on U.S. imports of fuel ethanol from the area. Some European wine lake ethanol was shipped to the Caribbean for further distillation prior to entering the U.S. market.[175] However, to offset the influx of product from the Caribbean, the CBERA was amended to require that only 7 percent of total domestic capacity could receive duty-free treatment in the United States.

Advantages and disadvantages as an oxygenate

If MTBE and other ethers used as oxygenates are banned from use in some, if not all, States, ethanol demand is expected to increase significantly.[176] Ethanol is considered to be the most likely alternative oxygenate, especially if an oxygenate waiver is not granted, because it is environmentally friendly, achieves an octane rating desired by most consumers, and is a renewable energy source.[177] It is considered as part of the solution to any ban on MTBE and other ethers; however, there are a number of environmental, cost, and supply issues that are associated with redirecting U.S. supplies of ethanol from the traditional producing and consuming areas in the Midwest to California and other major gasoline-consuming areas.[178]

Ethanol absorbs water in the petroleum products distribution and storage systems normally used, keeping the water trapped in the fuel mixture. Water in gasoline causes problems such as increased corrosion, separation, and atmospheric hazing (a cloudy appearance to an otherwise transparent liquid). As a result, ethanol cannot be blended with gasoline at the refinery since it cannot be shipped via pipelines. In order to avoid contact with water, ethanol must be blended into the gasoline at the pipeline terminal in “splash down” operations, increasing the RVP of the gasoline blend. As a result of the increase in the RVP, ethanol cannot meet the volatility standards under Phase II of the RFG program. Using more ethanol could further increase VOC emissions at the pump while decreasing tailpipe emissions. If ethanol’s use is to increase, the RVP regulations under Phase II would likely have to be waived.[179]

ETBE

ETBE is an oxygenate blend stock formed by the catalytic etherification of isobutylene with ethanol. Production processes for ETBE are similar to those for MTBE. However, the

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[174] USITC fieldwork in Europe.

[175] Ibid.; interviews with industry sources.

[176] Interviews with industry sources; “Methanol and MTBE Face Uncertainties,” pp. 5 and 18.

[177] “Methanol and MTBE Face Uncertainties,” pp. 5 and 18.

[178] Ibid.

[179] “Is Ethanol the Solution?” Apr. 19-25, 1999, p. 17.

ethanol feedstock for ETBE must be anhydrous[180] in order to avoid undesirable byproducts and chemical reactions. The amount of ETBE used in gasoline to make a blend comparable to that with MTBE is about 15 percent greater than the amount of MTBE needed.

Currently, ETBE can be produced domestically in six to eight refineries, with total capacity of approximately 15 to 20 million barrels. Because the production processes for MTBE and ETBE are similar, most refineries and other production facilities can easily switch from production of one to the other with a minimum capital investment in their plant operations.[181] In Europe, ETBE is produced in France, Germany, Italy, Spain, the Netherlands, and the United Kingdom. However, MTBE, rather than ETBE, is the primary oxygenate used in Western Europe.

Compared with MTBE, ETBE is superior in all areas except price.[182] ETBE is almost identical to MTBE except that it has a higher boiling point, which is an advantage in blending fuels because it results in a lower RVP and is less soluble in water. It has excellent octane enhancement properties, reduced sulfur, handling advantages, and high renewable component.[183] ETBE is also more biodegradable than MTBE.[184] Unlike ethanol, ETBE does not have properties that corrode fuel systems.

The tax credits provided by the Federal Government may be used by ETBE producers for offsetting Federal excise taxes; however, unlike ethanol, ETBE is blended more cheaply into gasoline directly at the refinery, and most refiners cannot use the tax credit. Disadvantages in the use of ETBE include the high cost of dehydration.

TAME

TAME is an oxygenate blend stock formed by the catalytic etherification of isoamylene with methanol. It is similar to both MTBE and ETBE in terms of octane-enhancing capabilities, but because of its higher molecular weight, TAME has a lower oxygen content than MTBE and ETBE. TAME has been used as a blend stock since 1992 and can be blended directly into the gasoline at the refinery.

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[180] Anhydrous ethanol has had all water removed. The process used to remove the water is costly.

[181] Testimony of Mr. David E. Hallberg, President, BioClean Fuels, Inc., at the Commission's hearing on Apr. 1, 1999.

[182] Posthearing brief of the Nebraska Ethanol Board, Apr. 14, 1999.

[183] A press release from Senator Daschle's office notes that demand for RFG in the United States in 2005 is estimated to be 300,000 barrels per day and that "if all that demand were met with domestic ETBE, it would require an additional one billion gallons of ethanol per year, which could inject more than a billion per year into the rural economy." The Senator notes in the press release that "My goal is to provide ethanol makers with the tools to gain access to at least half that market." "Daschle: Ethanol Industry Faces Economic Crossroads," Press Release, Nov. 13, 1997, found at *http://www.senate.gov/~daschle/ releases/97/971113-a.html*, retrieved Mar. 15, 1999.

[184] Testimony of Mr. David E. Hallberg, Apr. 1, 1999.

TAME is produced in about five to seven U.S. refineries in conjunction with MTBE. U.S. production capacity is estimated at approximately 7 million barrels. Since TAME is a coproduct with MTBE, it is not necessarily a substitute for MTBE as they are both ethers and, therefore, have similar chemical properties.[185] TAME is blended into gasoline at 10 percent by volume to increase the MON and the RON of the gasoline. In Europe, TAME is used as an oxygenate in Finland, Germany, Italy, and the United Kingdom.

The use of TAME in gasoline blending is likely to be affected by any legal action that may be taken in regard to the use of MTBE as well as other products. Under Phase II of the RFG program, the reduced RVP requirements could result in the increased use of TAME or a TAME/MTBE mixture as a replacement for ethanol.[186]

TBA

TBA is produced as a coproduct with propylene oxide from isobutane, propylene, and oxygen. Crude TBA is further treated to remove unwanted chemicals. In addition to being used as an oxygenate, TBA is a raw material in the production of isobutylene, which is further processed to produce MTBE.

During the 1980s, TBA was produced commercially as an octane enhancer by only two or three refineries. Demand for its use declined in the late 1980s, along with low crude petroleum prices. U.S. capacity to produce TBA is estimated at about 9 to 10 million barrels; however, most TBA is used captively in the production of MTBE. The United States is currently the only major producer of TBA. There has been renewed interest in TBA as a result of the environmental concerns associated with the use of MTBE in gasoline and the vapor pressure problems associated with the use of ethanol in Phase II of the RFG program.[187]

[185] Conversations with a representative of Valero Energy Corp., a producer of TAME.
[186] Ibid.
[187] Conversations with a representative of ARCO Chemical Co., a producer of TBA.

CHAPTER IV
THE SAUDI ARABIAN MTBE INDUSTRY

This chapter focuses on the production, trade, and consumption of MTBE in Saudi Arabia. The chapter has four main sections: (1) information briefly detailing the establishment of a domestic petrochemical industry based on natural gas; (2) a profile of the Saudi Arabian MTBE industry; (3) a section addressing Saudi production costs for MTBE in 1999, the availability and pricing of MTBE inputs, and a presentation of market data during 1994-98; and (4) a discussion regarding Government policies.[1]

Background

Saudi Arabia has traditionally been a major presence in the world petroleum market. In the late 1960s and early 1970s, however, Saudi Arabia started focusing on utilizing its large reserves of natural gas, "especially its light hydrocarbon gases–mainly methane, ethane, propane, butane, and natural gasoline."[2] Although some perceived this move as an effort to shift consumption from petroleum to gas, thereby allowing the petroleum currently being used in the domestic petrochemical industry to be exported,[3] H.E. Ali Bin Ibrahim Al-Naimi, the Saudi Minister of Petroleum and Mineral Resources, noted in a 1997 address that "Perhaps oil is the first thing associated with Saudi Arabia by the outside world, but to us gas is equally essential to

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[1] Industry data presented in this section have been obtained from multiple sources and, therefore, may differ. The various sources of the data have been identified in the presentation. In some cases, information available from only one source, including certain information submitted on the record to the Commission, is presented as quotations.

[2] "Saudi Arabia's Gas Industry in the 21st Century: A SABIC Perspective," presented by Mohamed Al-Mady, Director General, Projects, SABIC, at the 2nd Saudi Arabian Forum on Gas Utilisation for Power and Industrial Development, Oct. 18-20, 1997, Yanbu Industrial City, Saudi Arabia (organized by the Middle East Infrastructure Development Congress - Dubai (MEIDC - Dubai)) and reprinted in the *Official Forum Record* of the conference, p. 39.

[3] The Arab Petroleum Research Center, "Numerous Political and Economic Factors Behind Prince Abdullah's Call for Recommendations and Suggestions From U.S. Energy Companies," *Arab Oil & Gas*, Oct. 16, 1998, pp. 10-12; U.S. DOE, *Country Analysis Brief: Saudi Arabia*, Jan. 1999, found at *http://www.eia.doe.gov/emeu/cabs/saudi.html*, retrieved Feb. 23, 1999.

our continued economic growth."[4] He stated the following in regard to the development of the Saudi natural gas industry:

> The Government decreed a series of Five Year Plans to develop the infrastructure, increase competitive capacity and boost self-sufficiency. Oil, and later natural gas liquids, would continue as the nation's principal exports, but gas now had a critical new domestic role. The flares would be capped, and gas–clean-burning and rich in petrochemical potential–would now be channeled into a broad new complex of basic industries.[5]

This progression towards the use of natural gas generally resulted in increased production of petrochemicals based on natural gas and natural gas liquids, such as MTBE. Saudi Arabia is expected to continue the expansion of its natural-gas-based petrochemical production.[6] For example, the Sixth Development Plan calls for the use of natural gas resources to the extent possible to allow for "horizontal and vertical expansion of petrochemical industries," calling on the participation of domestic and international companies, including those in the private sector.[7] Under that plan, the petrochemical industry's annual output is reportedly expected to increase by 8.3 percent.[8] According to H.E. Dr. Hashim Bin Abdullah Bin Hashim Al-Yamani, King Fahd Bin Abdul Aziz Al-Saud "stressed at the meeting of the Council of Ministers on 14.06.1416H [November 7, 1995], that industrialization is an ideal vehicle to expedite the attainment of the

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[4] H.E. Ali Bin Ibrahim Al-Naimi, Minister of Petroleum and Mineral Resources, "The Achievement and the Future of Saudi Arabian Natural Gas," presented at the 2nd Saudi Arabian Conference on Gas Utilization for Power & Industrial Development, Yanbu Industrial City, Saudi Arabia, Oct. 1997 (organized by the Middle East Infrastructure Development Congress - Dubai (MEIDC - Dubai)), found at *http://www.us-saudi-business.org/ alnaimi.html*, retrieved Jan. 7, 1999.

[5] Ibid. The first two 5-year plans occurred during the 1970s; the third and fourth 5-year plans were in the 1980s; and the fifth and sixth 5-year plans have been in the 1990s. "Industrial Development," *Arab Oil & Gas Directory, 1998*, p. 397.

[6] U.S. DOE, *Country Analysis Brief: Saudi Arabia*; "Feedstock Prices Raised; Projects Firmed Up," *Chemical Week*, Oct. 29, 1997, p. 24; H.E. Ali Bin Ibrahim Al-Naimi, Minister of Petroleum and Mineral Resources, "The Achievement and the Future of Saudi Arabian Natural Gas."

[7] An address by H.E. Dr. Hashim Bin Abdullah Bin Hashim Al-Yamani, Minister of Industry and Electricity; and an address by Alfredo Moroni, Chairman, AGIP Petroli, both presented at the 2nd Saudi Arabian Forum on Gas Utilisation for Power and Industrial Development, Oct. 18-20, 1997, Yanbu Industrial City, Saudi Arabia (organized by the Middle East Infrastructure Development Congress - Dubai (MEIDC - Dubai)) and reprinted in the *Official Forum Record* of the conference, pp. 15 and 71.

H.E. Dr. Hashim Bin Abdullah Bin Hashim Al-Yamani, the Minister of Industry and Electricity, stated in his presentation that "it was natural for the Kingdom's Development Plans to be aimed at maximizing the use of associated gas, which . . . used to be flared, as a source of energy and as industrial feed-stock."

[8] "Industrial Development," *Arab Oil & Gas Directory, 1998*, p. 397.

Kingdom's development goals, and as a basic factor in diversifying the production base, and that petrochemical industries constitute the cornerstone in industrial development."[9]

Industry Profile [10]

The Saudi Basic Industries Corporation (SABIC) is the main producer of MTBE in Saudi Arabia, with total MTBE production capacity of about 63,000 barrels per day as of 1997 through three joint venture operations.[11] A refinery in Saudi Arabia, SAMREF, a joint venture between Mobil and Saudi Arabian Oil Company (Saudi Aramco),[12] also produces MTBE, albeit with a lower capacity level (2,260 barrels per day).[13] MTBE produced at the SAMREF facility is reportedly consumed captively at the refinery.[14]

SABIC, a joint-stock company established in 1976 by royal decree, is a significant producer of petrochemicals, fertilizers, metals, plastics, and industrial gases, reportedly accounting for 5 to 7 percent of world petrochemical production.[15] SABIC's exports of petrochemicals and other chemicals, about two-thirds of its annual production, currently account for about 60 percent of Saudi Arabia's nonpetroleum exports.[16] The company encompasses at least 15 manufacturing subsidiaries; 3 marketing, services, and investment subsidiaries; and 3 associated companies, with assets of about $18 billion in 1997. SABIC's sales revenues in 1997 were $6.4 billion, compared

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[9] An address by H.E. Dr. Hashim Bin Abdullah Bin Hashim Al-Yamani, Minister of Industry and Electricity, p. 18.

[10] "The Supreme Petroleum Council governs the nationalized oil industry, including Saudi Arabian Oil Co. (Saudi Aramco)–crude production, refining and marketing; Saudi Basic Industries Corp. (SABIC)– petrochemicals." U.S. DOE, *Country Analysis Brief: Saudi Arabia.*

[11] "Submission of Information," p. 5 (reproduced in appendix I); the SABIC *Annual Report, 1997*, p. 17.

[12] "Industrial Development and Expansion at Yanbu," presented by Bidah M. Al-Gahtani, Director General for the Yanbu Project, Royal Commission for Jubail and Yanbu, at the 2nd Saudi Arabian Forum on Gas Utilisation for Power and Industrial Development, Oct. 18-20, 1997, Yanbu Industrial City, Saudi Arabia (organized by the Middle East Infrastructure Development Congress - Dubai (MEIDC - Dubai)) and reprinted in the *Official Forum Record* of the conference, p. 73; "Yanbu," *Arab Oil & Gas Directory, 1998*, p. 363.

[13] As noted earlier in this report, MTBE production capacities at refineries are limited, primarily by the levels of isobutylene available at the refinery.

[14] "Historical PPD Data–MTBE (Europe, Middle East/Africa), 1995-98." Independent Commodity Information Services–London Oil Reports (ICIS-LOR) provides an extensive range of pricing and plant production data to the chemical, petroleum, and semiconductor industries on a global basis. Information obtained from a company representative of ICIS-LOR and "ICIS-LOR On-Line Brochure," found at *http://www.icislor.com/brochure.html*, retrieved June 18, 1999.

[15] U.S. Department of State, "Petrochemical Expansion Plans," *International Market Insight*, June 1, 1998, found at *http://www.tradeport.org/ts/countries/saudiaarabia/mrr/mark0043.shtml*, retrieved Feb. 21, 1999; "Saudi Arabia–The Petrochemical Sector," *APS Review Downstream Trends*, Dec. 1, 1997, p. 1.

[16] Petroleum accounts for about 85 percent of revenues accruing from Saudi Arabian exports. U.S. DOE, *Country Analysis Brief: Saudi Arabia*.

with $5.5 billion in 1996.[17]

As of early 1997, SABIC was said to be the world's largest exporter of oxygenates,[18] accounting for about 13 percent of world MTBE production in 1996.[19] The SABIC 1997 annual report indicates that SABIC employed about 14,238 people in that year, with Saudis accounting for about 70 percent of the total.[20] According to SABIC estimates, employment related to total Saudi MTBE production amounted to an estimated 600 to 850 annually during 1994-98.[21] Average research and development expenditures during 1994-98 made by the Saudi Arabian MTBE industry accounted for approximately 1 to 2 percent of sales.[22]

SABIC is primarily a state-held entity, with the Government of Saudi Arabia holding 70 percent of the company's stock and the remaining shares owned by "citizens of Saudi Arabia and other Gulf Cooperation [Council] States."[23] Privatization of the company has reportedly been considered for several years. One option studied in 1997 examined the idea of selling about 30 percent of the Government's stake. If such a sale were to occur, the Government would lose its position as majority shareholder.[24] According to one source referring broadly to Saudi Arabian privatization efforts, "progress on privatisation is slow and hindered by government concerns that private companies would not invest sufficient funds in increasing capacity or that sales of government shares would be purchased by small numbers of private or princely investors, concentrating, rather than spreading, national wealth."[25]

Three SABIC subsidiaries produce MTBE: Saudi Petrochemical Co. (SADAF); National Methanol Co. (IBN SINA); and Saudi-European Petrochemical Co. (IBN ZAHR).[26] Two SABIC companies, including one of the MTBE producers, produce methanol. As shown in the tabulation below, each of the SABIC MTBE and methanol production facilities is a joint venture:[27]

SADAF: (MTBE)	SABIC (50 percent) and Pecten Arabia, a subsidiary of Shell Oil Co. (50 percent); the joint venture was established in 1980.

[17] SABIC *Annual Report, 1997*, p. 9.

[18] "Saudi Arabia–The Petrochemical Sector," p. 1.

[19] Ibid.; "Petrochemicals," *Arab Oil & Gas Directory, 1998*, p. 388.

[20] *SABIC Annual Report, 1997*, p. 5. For more on "Saudization" (i.e., employment of Saudi nationals), see the section entitled ***Government Policies*** later in this chapter.

[21] "Submission of Information," p. 5.

[22] Ibid., p. 4.

[23] *SABIC Annual Report, 1997*, p. 43. The public was offered shares in 1984.

[24] "Government Still Committed to SABIC Privatization Plans," *Chemical Week*, Apr. 9, 1997, p. 19; "SABIC Sharpens Its Market Focus," *Chemical Week*, Jan. 21, 1998, p. 51. The latter says that, according to company sources, SABIC will be privatized "within 5 years."

[25] The Economist Intelligence Unit, *Investing, Licensing, and Trading in Saudi Arabia*, released in April 1999, p. 10. An earlier version of this report was released in March 1998. For consistency and brevity, hereinafter the report from April will be listed without a date; the March issue will be always identified by date.

[26] *SABIC Annual Report, 1997*, p. 43; "Submission of Information," p. 6.

[27] Ibid., p. 32; "Petrochemicals," *Arab Oil & Gas Directory, 1998*, p. 389.

IBN SINA: (Methanol and MTBE)	SABIC (50 percent); Hoechst Celanese–USA (25 percent); and Duke Energy (25 percent); the joint venture was established in 1981.
IBN ZAHR: (MTBE)	SABIC (70 percent); Neste Oy–Finland (10 percent); Ecofuel–Italy (10 percent); and the Arab Petroleum Investment Corp. (APICORP)[28] (10 percent); the joint venture was established in 1985.
Saudi Methanol Co., AR-RAZI: (Methanol)	SABIC (50 percent) and a Japanese consortium, Japan Saudi Arabia Methanol Co., headed by Mitsubishi Gas Chemical Co.; the joint venture was established in 1979.

In 1997, SABIC restructured into strategic business units (SBUs).[29] The company projects that there will ultimately be 30 such SBUs in 5 main product sectors–basic chemicals, intermediates, polymers, fertilizers, and metals.[30] Each SBU, responsible for groups of products, will be tasked with complete responsibility for production and marketing of the products and is expected to "sharpen market focus" and improve operating efficiency.[31] Consolidation of SABIC's management of several of its subsidiaries, including its methanol operations, is also reportedly underway.[32]

Much of SABIC's chemical production is generally centered at the Al-Jubail and Yanbu Industrial Cities, with most of the company's MTBE produced at Al-Jubail. SAMREF production is at Yanbu. Al-Jubail and Yanbu, located on the east and west coasts of Saudi Arabia, respectively, were built with the intention of expanding petrochemical production in Saudi Arabia. Construction on both cities started during 1977-79; both are currently being expanded and upgraded.[33]

The cities provide numerous services to producers. According to information submitted by SABIC, Al-Jubail offers "generally available industrial infrastructure, access to reliable supplies of feedstock, necessary utilities, and proximity to an industrial seaport."[34] According to information from IBN ZAHR, its production facility stores its MTBE in a "tank farm" at King Fahd Industrial

[28] APICORP, based in Saudi Arabia and considered the "investment arm of the Organization of Arab Petroleum Exporting Countries" (OAPEC), was established on November 23, 1975. Shares in APICORP are owned by members of OAPEC. APICORP's "prime objective" is said to be "participation in financing petroleum projects and industries" with priority being given to Arab ventures." "Saudi Alujain Completes Italy Equity Deal for MTBE," *The Wall Street Journal Interactive Edition*, retrieved Oct. 20, 1997; APICORP annual report; "Organization of Arab Petroleum Exporting Countries," found at *http://mbendi.co.za/cb05.htm*, retrieved Mar. 15, 1999; and "Arab Petroleum Investments Corp.," found at *http://mbendi.co.za/cb08.htm*, retrieved Mar. 15, 1999.

[29] *SABIC Annual Report, 1997*, p. 11; "SABIC Sharpens Its Market Focus," p. 50.

[30] *SABIC Annual Report, 1997*, p. 11.

[31] "SABIC Sharpens Its Market Focus," p. 50.

[32] Ibid.

[33] "Industrial Development," *Arab Oil & Gas Directory, 1998*, p. 397.

[34] "Submission of Information," p. 5.

Port in Madinat Al-Jubail.[35] Both Al-Jubail and Yanbu also allow for international transport and are able to accommodate petrochemical tankers ranging from 50,000 to 500,000 deadweight tons.[36]

Production Capacity

Most of the MTBE production capacity in Saudi Arabia is fairly modern, having come onstream between 1988 and 1997 (when the new MTBE capacity at the SADAF facility began producing) (see table 4-1). Industry sources speculate that much of the output of SABIC's MTBE production capacity was originally, and is still, intended for export.[37] As in the United States, the industry is highly capital intensive.

In 1997, Alujain Corp., a private-sector company in Saudi Arabia,[38] announced the intention of bringing onstream by the year 2000 an MTBE plant in Yanbu producing 20,900 barrels per day in a joint venture with Ecofuel (a subsidiary of ENI of Italy) and Neste Oy (Finland).[39] According to industry sources, however, plans for this plant have been put on hold indefinitely because of the high level of current production capacity for MTBE worldwide and the decision in California to ban the use of MTBE.[40] The locally incorporated limited liability company, to be named the National Fuel Additives Co. (Tahseen),[41] was expected to cost about

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[35] IBN ZAHR general presentation, published in early 1997, p. A9.

[36] "Industrial Development,"*Arab Oil & Gas Directory, 1998*, p. 397; IBN ZAHR general presentation, published in early 1997, p. 19. According to plans expressed in 1997, the Yanbu facility was to have had a new jetty built that would accommodate liquid petrochemicals. The project was to have been built on land leased to SABIC.

[37] DeWitt & Co., *MTBE and Oxygenates*, p. 149. Some MTBE is reportedly blended into gasoline that is itself exported.

[38] According to information provided by Alujain Corp. to companies in 1995, Alujain is an "industrial joint stock company with paid up capital of SR 173 million." The company's objectives are to "develop/implement industrial projects utilizing the inherent competitive advantages in Saudi Arabia, namely, energy and natural resources such as oil, natural gas and minerals" and "invest in any company or entity which has similar objectives." The company information stated that it has 227 shareholders in Saudi Arabia and GCC countries; major shareholders include Saudi Cable Co./Xenel Industries, Ltd.; Bin Al Brahim Group; Dallah Al Baraka Group; Haji Abdullah Alireza Co.; and the Bin Laden Group.

[39] Private-sector investment in the petrochemical industry, as well as in other "basic industry" sectors, was said to be encouraged again by the Ministry of Industry and Electricity in 1994. *Investing, Licensing, and Trading in Saudi Arabia*, p. 9.

[40] USITC fieldwork in Europe.

[41] ENI press release, "ENI: New MTBE Plant in Saudi Arabia," Rome, Nov. 26, 1997. (*http://www.eni.it/english/notizie/comunicati/cs_saud.html*); Marwan N. Nusair, "The Tahseen MTBE Project: An Example of Private Sector Participation in the Saudi Petrochemical Industry," presented at the 2nd Saudi Arabian Forum on Gas Utilisation for Power and Industrial Development, Oct. 18-20, 1997, Yanbu Industrial City, Saudi Arabia (organized by the Middle East Infrastructure Development Congress - Dubai (MEIDC - Dubai)) and reprinted in the *Official Forum Record* of the conference, p. 203; "Saudi Alujain Completes Italy Equity Deal for MTBE"; "Feedstock Prices Raised; Projects Firmed Up," p. 24.

Table 4-1
MTBE plants in Saudi Arabia:[1] Company name, location, start-up year, production capacity, average capacity utilization levels, 1994-98, and the source of the isobutylene used

Company	Location	Start-up year	Capacity (1,000 B/D)	Average capacity utilization levels, 1994-98 (percent)	Source of isobutylene
SADAF	Al-Jubail	1997	16.3	60	Butane dehydrogenation
IBN SINA	Al-Jubail	1994	16.3	100	Butane dehydrogenation
IBN ZAHR I	Al-Jubail	1989	11.6[2]	100[3]	Butane dehydrogenation
IBN ZAHR II	Al-Jubail	1993	16.3[2]	([3])	Butane dehydrogenation
IBN ZAHR III	Al-Jubail	1993-94[2]	2.8[2]	([3])	Steam cracker unit[4]
Saudi Aramco-Mobil Refining Co. (SAMREF) .	Yanbu	1992[5]	2.3	([6])	FCCU

[1] A joint venture between Mobil Corp. and Saudi Chemical Investments, a group of private Saudi investors, that would have resulted in a production facility starting-up in mid-1995 with a capacity of about 19,430 barrels per day was reportedly denied a license by Saudi Arabia in 1993. "Petrochemicals," *Arab Oil & Gas Directory, 1998*, p. 396; "Cheaper Saudi Butane Feedstock Could Boost MTBE Projects," *The Middle East Economic Survey*, Jan. 11, 1993; and the *Petroleum, Minerals, and Petrochemicals Statistical Handbook*, 1994, p. 353.
[2] USITC fieldwork in Europe.
[3] Ibid. An average capacity utilization level was reported by SABIC for IBN ZAHR as a whole.
[4] Ibid. The unit uses steam cracker feeds "obtained locally."
[5] "Yanbu," *Arab Oil & Gas Directory, 1998*, p. 363.
[6] Not available. SABIC provided average utilization levels for SADAF, IBN SINA, and IBN ZAHR.

Source: DeWitt & Co., *MTBE and Oxygenates*, and "Submission of Information," except as noted.

$415 to $500 million.[42] The Tahseen facility, projected to be the biggest in the world, would have been the first MTBE plant in the private sector.[43] Inasmuch as the startup of this private-sector venture displayed similarities to those of the ongoing SABIC operations, more information on the Alujain project is presented in the box below.

[42] Industry sources have stated that building an MTBE plant in the Middle East is routinely more expensive than building a comparable plant on the U.S. gulf coast. DeWitt & Co., *MTBE and Oxygenates*, appendix C; USITC fieldwork in the United States and in Europe.

[43] U.S. Department of State, U.S. and Foreign Commercial Service, "Methyl Tertiary Butyl Ether Plant Projections," *International Market Insight*, Dec. 12, 1997, p. 1; "Petrochemicals," *Arab Oil & Gas Directory, 1998*, pp. 395-396.

Alujain was to have held about 30 percent of the initial capital of $133 million, Ecofuel and Neste were each to have held about 15 percent, and APICORP (a joint-stock company that provides financing for petroleum projects and industries) was to have held about 10 percent.[1] The remaining 30 percent was to have been offered to private-sector companies in Saudi Arabia (shareholders were reportedly not sought outside Saudi Arabia).[2] Industry sources have stated that SABIC was not a participant in the venture.[3]

Financing for the project was to have included a loan sought by Alujain from the Saudi Industrial Development Fund ($107 million) and commercial loans, valued at about $160 million. The latter were to have been raised by APICORP (APICORP also confirmed its intent to underwrite 50 percent of the required commercial facility).[4]

Marketing plans for the first 5 years projected that Ecofuel and Neste would market a combined 16,000 to 19,000 barrels per day (either to third parties or directly), and Tahseen would market the remainder.[5] Moreover, Ecofuel and Neste reportedly entered into technical assistance agreements to "provide a comprehensive training program for Saudi personnel to manage and operate the plant at the appropriate time."[6]

[1] "ENI: New MTBE Plant in Saudi Arabia."
[2] The Arab Petroleum Research Center, "Saudi Companies Invited To Invest in Tahseen," *Arab Oil & Gas*, May 1, 1998, p. 19; USITC fieldwork in Europe; "Petrochemicals," *Arab Oil & Gas Directory, 1998*, p. 395. Public investment is required for major projects.
[3] USITC fieldwork in Europe. SABIC states in its annual report that "domestically and in the Gulf Region, the wholly owned SABIC Industrial Investment Company (SIIC) contributes to the development of the industrial sector through venture capital minority participation in promising private sector companies. To date, SIIC venture capital investments have been made in seven regional enterprises." *SABIC Annual Report, 1997*, p. 10.
[4] "Saudi Companies Invited To Invest in Tahseen," p. 19; Marwan N. Nusair, "The Tahseen MTBE Project: An Example of Private Sector Participation in the Saudi Petrochemical Industry."
[5] "Feedstock Prices Raised; Projects Firmed Up," p. 24; and Marwan N. Nusair, "The Tahseen MTBE Project: An Example of Private Sector Participation in the Saudi Petrochemical Industry."
[6] Marwan N. Nusair, "The Tahseen MTBE Project: An Example of Private Sector Participation in the Saudi Petrochemical Industry."

Distribution

SABIC Marketing Ltd. markets SABIC's petrochemicals and chemicals worldwide. SABIC Americas is SABIC's marketing representative in the United States. In 1997, SABIC's main markets for petrochemicals, in order of ranking, included Saudi Arabia, Southeast Asia, the Far East, Europe, the Americas, and the Middle East and Africa.[44] Exported MTBE "generally is transported by ocean vessels to regional marketing agents or affiliates, which take title from the time the product leaves Saudi Arabia until it is delivered to the customer. Customers, in turn, transport MTBE to mixing or refining facilities by pipeline, barge, or truck."[45] According to information provided by SABIC, transportation costs for MTBE shipped between Saudi Arabia and the United States are estimated to be $25 to $50 per metric ton, depending on factors such as

[44] *SABIC Annual Report, 1997*, p. 13.
[45] "Submission of Information," pp. 6-7.

"the availability of shipping vessels and distance."[46] Information obtained from U.S.-based shippers, however, suggests that such costs are closer to the lower end of the range.[47] A representative of SABIC stated, "A large portion of our material is sold under contracts, which are fairly standard in the industry, and a much smaller portion is sold in the merchant market."[48] Each of the shareholders in the MTBE joint ventures receives a portion of the joint venture's production, which they then market overseas.[49] As such, U.S. imports of MTBE from Saudi Arabia consist of product from SABIC, as well as from the other shareholders in the MTBE ventures.[50]

SABIC has "27 dry and liquid product distribution centers and warehouses" for its chemical products.[51] These facilities are considered to be "strategically located," close to SABIC's markets.[52] The company also holds a 20-percent stake in the Saudi Arabian shipping company National Chemical Carriers Ltd. (NCC).[53] NCC maintains "a specialized high-seas fleet of 14 chemical parcel tankers with a combined capacity of 381,000 deadweight tons."[54]

Production, Trade, and Consumption of MTBE

SABIC's annual MTBE production during 1994-96 averaged about 47,000 barrels per day.[55] Production then increased in 1997 as a result of the startup of the SADAF production facility, approaching 63,000 barrels per day in 1998.[56]

According to SABIC, Saudi Arabia imported no MTBE during 1994-98 and "maintains no duty rate applicable to MTBE imports."[57] In regard to Saudi exports of MTBE, "during the period 1994-98, levels of exports on average were roughly comparable to levels of production."[58] According to SABIC, the top five major markets during 1996-98 for MTBE produced in Saudi Arabia included the United States, Southeast Asia/Far East, Europe, Africa, and the Middle East

[46] Ibid., p. 7.
[47] Information obtained from U.S.-based shippers.
[48] Commission hearing transcript, Apr. 1, 1999, p. 46.
[49] SABIC reportedly markets the product domestically as well as overseas.
[50] USITC fieldwork in Europe.
[51] *SABIC Annual Report, 1997*, p. 13.
[52] Ibid.
[53] The other partner in the NCC alliance is the National Shipping Co. of Saudi Arabia. The partnership was established in 1990.
[54] *SABIC Annual Report, 1997*, p. 26.
[55] "Submission of Information," p. 1. The response actually was "just over 2 million [metric tons] per year" during 1994-96 and "just under 2.7 million [metric tons] per year" in 1998. If 2.7 million metric tons is used as a basis, production in 1998 amounted to 62,829 barrels per day.
[56] Ibid.
[57] Ibid., p. 2.
[58] Ibid., p. 1.

(presented in descending order).[59] They state that the rankings in 1994 and 1995 were as follows:[60]

1994	1995
Southeast Asia/Far East	United States
United States	Southeast Asia/Far East
Europe	Europe
Middle East	Middle East

SABIC states that demand in Europe and Asia is increasing, or is expected to increase, because of environmental regulations enacted in those areas and because of World Bank and International Monetary Fund environmental requirements that are also being imposed. SABIC also states that SABIC Marketing has "sought to maintain diverse markets and not to become too dependent on the United States, or any other single market."[61] According to some sources, however, the combination of the Asian economic crisis, a decline in petroleum prices, and a worldwide decline in petrochemical prices contributed to a two-thirds decline in SABIC's earnings during 1995-98 (from $1.675 billion to $539 million).[62] Moreover, it has been noted by industry sources, that SABIC's production of chemicals, although large in volume, is limited in terms of the number of products actually produced, consisting primarily of basic petrochemicals rather than more "value-added" products.[63]

Although no data were presented by SABIC on Saudi exports of MTBE to specific countries, Saudi exports to the United States and the European Union (EU)[64] are known from published trade statistics. Based on SABIC's statement that annual exports "were roughly comparable" to annual production levels, the ratio of these exports to Saudi production levels can give an idea of the balance of Saudi exports to other countries. On a volume basis, the percentage of total Saudi production of MTBE accounted for by annual Saudi exports of MTBE to the United States and Europe during 1995-98[65] ranged from 50-60 percent, increasing from 35 percent in

[59] Ibid., p. 2.

[60] Ibid.

[61] Ibid.

[62] "SABIC: Moving Further Along the Value Chain," *Middle East Economic Digest*, Apr. 23, 1999, obtained using Profound (an online subscription search package), retrieved May 7, 1999; The Arab Petroleum Research Center, "Recession in the Petrochemical Industry Expected To Continue Until the End of 1999," *Arab Oil & Gas*, Dec. 1, 1998, p. 20.

[63] "SABIC: Moving Further Along the Value Chain."

[64] The import data presented were compiled from official statistics of the U.S. Department of Commerce and from data provided by the European Commission's statistical office, Eurostat. The data provided by Eurostat are for Harmonized System (HS) heading 2909.19. On an aggregate level, EU import statistics included under that HS heading can potentially contain products other than MTBE (e.g., ETBE). According to information provided by industry representatives, however, MTBE accounts for most, if not all, of the imports from Saudi Arabia reported under that heading. If other products were included, the data used could be considered to present an upper-bound estimate of possible EU imports of MTBE.

[65] In the absence of a production estimate from SABIC for 1997, an estimate for

(continued...)

1994.

SABIC states that annual consumption of MTBE in Saudi Arabia was "negligible" during 1994-95, grew to between 349 and 1,047 barrels per day during 1996-97, and increased to about 2,327 barrels per day in 1998.[66] Consumption of MTBE in Saudi Arabia is said to be low because leaded gasoline is still sold in the country. While some industry sources believe that some unleaded gasoline may be introduced in Saudi Arabia in the year 2000, another source indicates that it is currently in use but too expensive for regular use.[67]

SABIC notes that "local prices for MTBE consumption in Saudi Arabia were approximately 80-90 percent of export prices, due mostly to lower transportation costs."[68] The domestic sales, generally on a contract basis (c.i.f.) but "based on current market rates," averaged $210 to $250 per metric ton during 1994-98.[69] Transportation costs for the product shipped within Saudi Arabia are $15 to $20 per metric ton.[70] According to SABIC, the product sold domestically is carried by ship to storage facilities on the coasts and then delivered via truck or pipeline to the consumer.[71]

The annual production and consumption data presented in the following tabulation for the period 1996-98 were obtained by the Commission from an independent consulting firm to supplement the data provided by SABIC (in barrels per day):[72]

	1996	1997	1998
Production	54,219	53,056	58,175
Consumption	2,211	2,327	2,327

According to the consulting firm, capacity utilization rates for Saudi Arabian production of MTBE declined from 111 percent in 1996 to 96 percent in 1998.

[65](...continued)
production obtained from an independent consulting firm was used. The production estimates from the firm are reported later in this section.

[66] "Submission of Information," p. 1.

[67] USITC fieldwork in Europe; *Investing, Licensing, and Trading in Saudi Arabia*, p. 17.

[68] "Submission of Information," p. 1.

[69] Ibid., pp. 6 and 7.

[70] Ibid., p. 7.

[71] Ibid., p. 6.

[72] Data obtained from Parpinelli Tecnon. Parpinelli Tecnon has stated that the data were prepared at the end of 1998, prior to current changes in legislation in the United States.

According to information provided at the company's Internet site, Parpinelli TECNON srl, established in 1959, is an independent consulting organization that offers a variety of marketing and planning services, specializing in the area of energy, petroleum, oil refining, petrochemical feedstocks, basic petrochemicals and intermediates, plastics, elastomers, and specialty chemicals. "The Group," undated, found at *http://www.tecnon.com/company.htm*, retrieved on June 11, 1999.

Using minimum estimated operating rates provided by another independent consulting firm, the following tabulation presents estimates of Saudi Arabian MTBE production by each facility on an annual basis (including scheduled and unscheduled shutdowns), in barrels per day:[73]

Facility	1995	1996	1997	1998
SAMREF	2,200	2,200	2,200	1,700
IBN SINA	19,000[1]	19,600[1]	15,300	16,300
IBN ZAHR I	10,800	11,700	11,600	11,000
IBN ZAHR II	15,200	14,700	16,300	15,300
IBN ZAHR III	800	1,300	1,600	2,100
SADAF	0	0	([2])	([2])

[1] The estimated operating rates provided by ICIS-LOR for IBN SINA were often significantly above 100 percent nameplate capacity.

[2] Not available. The SADAF production facility was reportedly started up in June 1997. Although initially operating at a reported 100 percent of capacity, industry sources state that the plant has since run into production problems and has been shut down several times since startup. According to the ICIS-LOR data, operating rates for SADAF were 50 percent (July 1998); 100 percent (August 1998); 100 percent (September 1998); and 80 percent (October and November 1998). SABIC notes that the average annual operating rate for SADAF was about 60 percent.

Cost of Producing MTBE in Saudi Arabia

Industry analysts note that building a grassroots "on-purpose" butane dehydrogenation MTBE plant[74] in the Middle East is more expensive than building a similar one on the U.S. gulf coast. Whereas the capital investment in such a grassroots MTBE plant on the U.S. gulf coast can amount to about $200 to $300 million, a similar plant in the Middle East can routinely cost about $400 to $450 million.[75] A comparison of the capital costs needed to build a butane dehydrogenation plant with a capacity of 500,000 metric tons per year in four regions of the world in 1996 showed that the capital cost increased significantly depending on the region, starting from a low of about $285 million in the United States and then increasing to about $335 million in Europe, about $410 million in North Africa, and about $420 million in the Persian Gulf. The

[73] "Historical PPD Data–MTBE (Europe, Middle East/Africa), 1995-98"; "Submission of Information," p. 6. According to Commission fieldwork in the United States and a telephone interview with an industry source on Feb. 25, 1999, one reported problem with the SADAF facility was the scaleup of technology bought from another source. The original user of the technology was said to have been running it at a lower production level than that used at SADAF.

[74] A "grassroots" plant is the term generally used to refer to a facility built from "the groundup" (the term is generally used regardless of the final product produced at the site–e.g., automobile plants, television plants, refineries, chemical plants).

[75] DeWitt & Co., *MTBE and Oxygenates,* appendix C; USITC fieldwork in the United States and in Europe.

higher costs in Europe and North Africa were attributed to "the need to store imported butanes onsite" and higher import and construction costs for materials, respectively .[76] Higher construction costs were cited for plants in the Persian Gulf.

In Saudi Arabia, butane dehydrogenation is the main process used, accounting for over 90 percent of total domestic MTBE production capacity. SABIC states that "the total production cost of MTBE varies based on changes in the costs of inputs" and that, depending on the cost of the feedstocks, input costs can account for 65 to 80 percent of the total cost of production of MTBE.[77] SABIC continues by stating that on an individual basis, again depending on their cost, butane accounts for 45 to 60 percent of total production costs, while methanol can account for 20 to 30 percent of the total.[78]

A breakdown of production costs for a plant in Saudi Arabia utilizing the butane dehydrogenation process with a production capacity of about 500,000 metric tons per year (or about 11,635 barrels per day) in 1999 is presented in table 4-2. The underlying assumptions used in the production-cost breakdown for the Saudi plant are basically similar to those used in the breakdown for the U.S. plant shown in table 3-2, including the levels of production technology used and the age of the production facilities.[79] The technology used in both countries was obtained from leading engineering companies and, with the exception of one plant brought onstream in Saudi Arabia in 1997, the ages of the butane dehydrogenation plants in Saudi Arabia are generally comparable with those in the United States.

However, there are differences in the sources and values of the feedstocks and the variable and fixed costs in Saudi Arabia compared with those in the United States. The Saudi facilities generally start with mixed butanes which need to be fractionated into their individual components and, in the case of the *n*-butane, isomerized to isobutane. As shown in table 4-2, the costs of the Saudi butane and methanol feedstocks were $93.10 per metric ton (reflecting a 30-percent reduction applied to a butane price of $133)[80] and $81.40 per metric ton, respectively, compared with $163.50 and $98.75 per metric ton, respectively, in the U.S. plant. This results in a total cash cost in the valuation of the Saudi production costs (per barrel of MTBE produced) that is $7.85 lower than that in the valuation of the U.S. production costs and a full cost that is

Table 4-2

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[76] DeWitt & Co., *MTBE and Oxygenates*, appendix C.

[77] "Submission of Information," p. 11.

[78] Ibid.

[79] Industry sources interviewed noted that the use of new technology in MTBE production in Saudi Arabia has generally resulted in an environmental impact similar to that in the United States. One source notes, however, that in general, although "local concern for environmental protection is still more theoretical than practical . . .concern for the environment has substantially increased since the end of the Gulf war and is becoming increasingly evident in the demands being made on major industrial plant construction projects, particularly in petrochemicals." USITC fieldwork in the United States and in Europe; *Investing, Licensing, and Trading in Saudi Arabia*, p. 16.

[80] The reduction is intended to be representative of the reduction provided under Resolution No. 68. For further information on the resolution, see the section entitled "***Feedstock Pricing Practices***."

The cost of producing MTBE from *n*-butane in Saudi Arabia, 1999

DeWitt & Co., Inc.						
500,000 metric tons per year of	MTBE from *n*-butane (about 11,635 barrels per day)					
Saudi Arabian Plant						
Capital Cost, $MM :	450.00					
1999 Conditions					Dollars	Dollars
(As of 04/26/99)			Unit		per metric	per barrel
Cost Element			Cost	$MM	ton MTBE	MTBE
FEED STOCKS						
Butanes	376,691.00	Metric Tons @	$93.10 /Metric Ton =	35.07	70.14	8.28
Methanol	186,518.00	Metric Tons @	$81.40 /Metric Ton =	15.18	30.37	3.58
TOTAL FEEDS				50.25	100.50	11.86
VARIABLE COSTS						
Electricity	34.23	MMKwh@	0.02 $/Kwh	0.68	1.37	0.16
Fuel Gas	5.50	MMMM	0.60 $/MM	3.30	6.60	0.78
Cooling Water	21.10	MM Gal	0.10 $/MMGal	2.11	4.22	0.50
Catalyst Repl.				1.25	2.50	0.29
				7.34	14.69	1.73
MARGINAL CASH COST				57.60	115.19	13.59
FIXED COSTS						
Labor/Overhead	8.00	/shift @	0.45 $MM	3.60	7.20	0.85
Maintenance	3.50	Pct of	450.00 $MM	15.75	31.50	3.72
Insurance etc	1.00	Pct of	450.00 $MM	4.50	9.00	1.06
TOTAL FIXED COSTS				23.85	47.70	5.63
TOTAL CASH COST				81.45	162.89	19.22
Depreciation[1]	10.00	Pct of	450.00 $MM	45.00	90.00	10.62
FULL COST				126.45	252.89	29.84

[1] In consultation with a representative of DeWitt & Co., the original valuation of a 15-percent return on investment was modified to reflect a 10-percent charge for depreciation.

Source: DeWitt & Co., Inc., except as noted. Reprinted with permission from DeWitt & Co., Inc.

$4.31 lower (the absolute difference between the full cost estimates and the cash cost estimates is lower because of the higher depreciation charges for the Saudi plant resulting, in turn, from the higher capital investment in the facility). Moreover, the variable costs (electricity, fuel gas, and cooling water) for the Saudi Arabian facility are lower than those in the United States, amounting to $1.73 per barrel of MTBE produced versus $4.44. The variable costs represent about 9 percent of the total cash cost. Fixed costs, however (labor/overhead, maintenance, and insurance), are higher than those in the United States, representing about 29 percent of the total cash cost.

Like the plant in the United States, the Saudi plant is also subject to fluctuations in feedstock costs. Table 4-3 compiles these feedstock costs and their shares of total feedstock and total cash costs for 1995[81] and 1999[82] so as to compare the effects of different feedstock valuations. If, using the same underlying methodology used for the 1999 Saudi and U.S. estimates, the input values of the butane and methanol feedstocks in the Saudi cost breakdown are increased to the levels of those presented in the U.S. valuation ($163.50 and $98.75 per metric ton, respectively), the scenario changes. The variable and fixed costs remain the same in this valuation, but the estimated total cash cost of production increases to $26.24 per barrel of MTBE produced versus $27.07 in the United States. The full cost of production for the prototypical Saudi plant becomes higher than that for the plant in the United States–$36.86 per barrel of MTBE produced versus $34.15.[83]

Production and Consumption Data for the Major Inputs

As of 1997, SABIC maintained about 3.13 million metric tons of production capacity for methanol, producing it at its IBN SINA and AR-RAZI subsidiaries.[84] Another methanol production facility is scheduled to come onstream in 1999 at AR-RAZI, which will increase SABIC's production capacity for the product by 850,000 metric tons per year.[85] Over half of the methanol output from AR-RAZI is said to be marketed by SABIC's partner in the venture, the Japan Saudi Arabia Methanol Co.; SABIC is said to be responsible for marketing the entire output from the IBN SINA facility.[86] Butane is produced and marketed in Saudi Arabia by Saudi Aramco.

According to available information and industry sources, whereas all of the MTBE producers in Saudi Arabia obtain methanol from SABIC, those that have to buy butane as raw

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[81] DeWitt & Co., *MTBE and Oxygenates*, appendix C.
[82] The 1999 data referred to are presented in table 4-2.
[83] Based on information obtained from DeWitt & Co.
[84] *SABIC Annual Report, 1997*, p. 19; "Appendix B-Middle East/Europe Methanol Capacities by Company," *Methanol Update/Chemicals-Major*, Deutsche Bank Research (US), obtained using Profound (an online subscription search package), May 7, 1999.
[85] Ibid.; "Saso and SABIC Move Forward on Grassroots Methanol Plans," *Chemical Marketing Reporter*, Sept. 22, 1997, p. 5.
[86] "Petrochemicals," *Arab Oil & Gas Directory, 1998*, p. 389.

Table 4-3
Butane dehydrogenation production process: Feedstock costs and shares of total feedstock and total cash costs, 1995 and 1999

Year	Unit input costs		Cost of feedstock		Input costs as a share of total feedstock costs		Total cash costs	Input costs as a share of total cash costs		Total feedstock costs as a share of total cash costs
	Methanol	Butane	Methanol	Butane	Methanol	Butane		Methanol	Butane	
	----Per metric ton----		*Per metric ton MTBE*		*------Percent------*		*Per metric ton MTBE*	*------Percent------*		
1995	$137.00	$144.00[1]	$50.92	$108.49	32	68	$218.02	23	50	73
1999	81.40	93.10[2]	30.37	70.14	30	70	162.89	19	43	62

[1] This price reflects a 30-percent discount applied to a butane price of $206.
[2] This price reflects a 30-percent discount applied to a butane price of $133.

Source: Information presented in table 4-2; DeWitt & Co., *MTBE and Oxygenates*, appendix C.

material obtain it from Saudi Aramco.[87] SABIC facilities producing MTBE obtain methanol from the IBN SINA and AR-RAZI production facilities.[88] According to SABIC, IBN SINA both sells the methanol it produces and consumes it itself to produce MTBE.[89] The butane needed to produce MTBE is obtained from Saudi Aramco.[90] As of 1997, SABIC was said to consume about 67,000 barrels of butane each day, converting it into a myriad of chemical products including MTBE.[91] Prior to putting plans to develop the proposed MTBE plant on hold, Alujain Corp. had reportedly already reached agreement with Saudi Aramco to obtain butanes for the Tahseen facility at "about 70 percent of the world price" and was negotiating with SABIC to obtain methanol.[92]

Saudi Aramco

Within Saudi Arabia, according to information publicly distributed by the company, Saudi Aramco "is responsible for almost all of the Kingdom's extensive oil and gas operations and manages a quarter of the world's crude oil reserves."[93] Saudi Arabia accounts for about 25 percent of known world petroleum reserves and about 4 percent of known world natural gas reserves.[94] The company produces and processes both associated gas (i.e., that located in fields containing petroleum[95]) and nonassociated gas. Associated gas accounts for the majority of the country's reserves of natural gas.[96] According to Saudi Aramco, the natural gas produced is both

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[87] USITC fieldwork in Europe; telephone interviews with industry representatives in the United States and the Middle East; IBN ZAHR general presentation, published in early 1997, p. 9; *SABIC Annual Report, 1997*, p. 32; "Yanbu," *Arab Oil & Gas Directory, 1998*," p. 363; a telephone conversation with a representative of the industry in the United States on May 5, 1999; the SAMREF Annual Report, p. 8. According to the *Arab Oil & Gas Directory*, MTBE production at the SAMREF facility allows it to operate its FCCU unit at its maximum capacity.

[88] *SABIC Annual Report, 1997*, p. 32.

[89] "Submission of Information," p. 4.

[90] IBN ZAHR general presentation, published in early 1997, p. 9.

[91] Mohamed Al-Mady, Director General, Projects, SABIC, "Saudi Arabia's Gas Industry in the 21st Century: A SABIC Perspective."

[92] "Saudi Companies Invited To Invest in Tahseen"; USITC fieldwork in Europe. Also see Marwan N. Nusair, "The Tahseen MTBE Project: An Example of Private Sector Participation in the Saudi Petrochemical Industry."

[93] "Saudi Aramco Today," found at *http://www.saudiaramco.com/aboutus/satoday.html*, retrieved May 5, 1999.

[94] Official statistics of the U.S. Department of Energy, 1999.

[95] According to the U.S. DOE, a field is an area consisting of a single reservoir or multiple reservoirs all grouped on or related to the same individual geological structural feature and/or stratigraphic condition. U.S. DOE, "Glossary," found at *http://www.eia.doe.gov/emeu/perfpro/glossary.html*, retrieved May 31, 1999.

[96] "Natural Gas," *Arab Oil & Gas Directory, 1998*, p. 373. The amount of associated gas flared rather than produced decreased in 1996 after having increased since 1993; moreover, the amount lost through processing or evaporation (i.e., "shrink") increased in 1996. Further, "according to the International Energy Agency, Saudi Arabia accounts for 10 percent of all the natural gas wasted in the world," primarily because a large percentage of its natural gas production/processing is associated gas. It further states that, to reduce the (continued...)

consumed domestically "as fuel and feedstock for the Kingdom's backbone industries and utilities" and exported.[97]

Natural gas liquids are transported by pipeline to fractionation units at Juayma, Ras Tanura, and Yanbu for separation into individual components, including butane. Although much of the butane is then said to be exported, "domestic demand by industries in Al-Jubail and Yanbu is increasing."[98] Saudi Arabia is said to export about 16 million tons per year of butane and propane (of which about 75 percent is intended for Asia), primarily under 1- or 5-year contracts.[99] In early 1996, when some of the contracts were up for negotiation, Saudi Aramco reportedly sought to increase the propane proportions of the product mix being exported in anticipation of increased domestic use for butane resulting from the startup of a new MTBE plant in Saudi Arabia in that year, which was to require 500,000 tons per year of butane.[100]

The predecessor company to Saudi Aramco–the Arabian American Oil Co., or Aramco–resulted from a concession agreement signed in 1933 between the King of Saudi Arabia and a petroleum company to allow exploration for petroleum. In subsequent years, other companies joined the agreement, forming Aramco.[101] During 1973-80, the Kingdom of Saudi Arabia gradually purchased Aramco's assets, gaining full ownership of the company in 1980.[102] Saudi Aramco was officially established in 1988 by royal decree.

According to information published by Saudi Aramco, the company is the major world producer and exporter of crude petroleum; it is 1 of the top 10 companies involved in gas production and among the top 5 companies in terms of gas reserves.[103] The company has continued to explore for, produce, and export petroleum and became active in natural gas

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[96](...continued)
amount flared, "Saudi Aramco announced in 1996 that it was to embark on a five-year expansion of the country's gas gathering and processing network (the Master Gas System)." The expansion will also make gas available to the central region of Saudi Arabia. H.E. Ali Bin Ibrahim Al-Naimi, Minister of Petroleum and Mineral Resources, "The Achievement and the Future of Saudi Arabian Natural Gas."

[97] "Saudi Aramco Today," found at *http://www.saudiaramco.com/aboutus/satoday.html*, retrieved May 5, 1999.

[98] Mohamed Al-Mady, Director General, Projects, SABIC, "Saudi Arabia's Gas Industry in the 21st Century: A SABIC Perspective."

[99] "Natural Gas," *Arab Oil & Gas Directory, 1998*, p. 376. According to the *Directory*, the contracts used to be primarily 5-year contracts; starting in 1993, however, some companies changed to 1-year contracts.

[100] Ibid.

[101] Former partners in Aramco included Exxon, Chevron, Mobil, and Texaco. "Numerous Political and Economic Factors Behind Prince Abdullah's Call for Recommendations and Suggestions From U.S. Energy Companies," pp. 10-12.

[102] "Brief History," from *http://www.saudiaramco.com/aboutus/briefhis.html*, retrieved May 5, 1999.

[103] Ibid.

exploration and production, expanding its natural gas operations with its construction of the Master Gas System (MGS) in the late 1970's.[104]

The MGS is reportedly being expanded through the year 2001, largely through increased gas-processing capacity and fractionation plant capacity. However, the project is reportedly behind schedule and, since much of the natural gas base in Saudi Arabia is associated gas, concerns exist that a decline in the production of petroleum will result in a corresponding decline in production of natural gas.[105] Separately, although investment in developing natural gas reserves is underway, potential constraints on such development could include limitations on Saudi Aramco's capital spending because of low prices for, and, therefore, low production of, petroleum, and gas prices that currently are said to be less than those needed to recover the needed costs for exploration.[106] According to the U.S. Department of State, petroleum revenues generally generate the capital needed in Saudi Arabia for investment and other spending.[107]

Pricing

According to SABIC, the price of the inputs is a "significant factor in determining the source of inputs. Part of that price reflects transportation costs."[108] The company states that it does not have production facilities outside of the Kingdom "largely because proximity to feedstock sources lowers the cost of transporting inputs to plants."[109]

Detailed information about the pricing of methanol to industries in Saudi Arabia is not available at this time. However, according to industry sources, the price is not set by the Government.[110] One industry source notes that under a typical negotiated pricing formula the

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[104] Ibid.; "Natural Gas," *Arab Oil & Gas Directory, 1998*," p. 374.

[105] "SABIC: Moving Further Along the Value Chain"; "Kingdom has No Plans To Export Gas, Says Naimi," *Saudi Gazette*, Oct. 20, 1997, as reprinted in the *Official Forum Record* of the 2nd Saudi Arabian Forum on Gas Utilisation for Power and Industrial Development, Oct. 18-20, 1997, Yanbu Industrial City, Saudi Arabia (organized by the Middle East Infrastructure Development Congress - Dubai (MEIDC - Dubai)), p. 311; The Arab Petroleum Research Center, "Saudi Arabia," *Arab Oil & Gas*, Jan. 1, 1999, p. 48.

[106] "SABIC: Moving Further Along the Value Chain." The article notes that the price of natural gas in Saudi Arabia was increased in 1998 from 50 cents per million British Thermal Units (BTUs) to 75 cents per million BTUs, or by 50 percent. According to the article, however, industry sources have noted that the price would have to increase to 100-120 cents per million BTUs to recover such costs and "there is no sign that such an increase is imminent." See also "Kingdom has No Plans To Export Gas, Says Naimi," *Saudi Gazette*, Oct. 20, 1997; "Saudi Arabia," p. 48.

[107] U.S. Department of State, *1998 Country Reports on Economic Policy and Trade Practices*, submitted to the Senate Committees on Foreign Relations and on Finance and to the House Committees on Foreign Affairs and on Ways and Means, January 1999, found at *http://www.state.gov/www/issues/economic/trade_reports/neareast97/saudiarabia97.html*, retrieved May 27, 1999.

[108] "Submission of Information," p. 11.

[109] Ibid.

[110] Communications with industry representatives; "Submission of Information," p. 8.

price would be determined by deducting costs associated with shipping the methanol to the intended export market (e.g., freight and duty) from the weighted average of SABIC's delivered methanol prices to worldwide export customers in any calendar quarter.[111] This practice reportedly enables methanol consumers in Saudi Arabia to purchase methanol at the same average f.o.b. price that SABIC realizes from all of its export sales, and the price, thereby, reflects world market prices.[112] The price of methanol in Saudi Arabia during 1994-98 reportedly ranged from about $50 to about $310 per metric ton.[113] According to another source, the price reached a high of over $400 per metric ton during this period.[114] The reported highs, however, occurred early during the 5-year period and reportedly coincided with similar highs in the U.S. methanol market. One industry source notes that the price in Saudi Arabia runs about $40 per metric ton less than contract prices in the United States or the EU (the differential is said to be freight and duty).[115]

SABIC states that the average price of butane in Saudi Arabia during 1994-98 was $65 to $194 per metric ton. Resolution No. 68, issued by the Council of Ministers of the Kingdom of Saudi Arabia on November 25, 1992, implemented a 30-percent discount on liquefied petroleum gases (LPG), including butane, that were to be consumed by industries within Saudi Arabia.[116] According to at least one industry source, applying the 30-percent discount to butane export prices would provide an indication of the butane prices paid by the Saudi petrochemical industry (i.e., 70 percent of the world price for butane). The tabulation below presents the export price of butanes in Saudi Arabia during 1997-98 and January 1999, and the assumed domestic price (the 30-percent discount applied by the Commission to the export price), per metric ton:[117]

[111] Communication by an industry source with the Commission on May 13, 1999.
[112] Ibid.
[113] "Submission of Information," p. 7.
[114] Communication by an industry source with the Commission on Feb. 23, 1999.
[115] Communication by an industry source with the Commission on May 13, 1999.
[116] More specifically, according to the resolution, "granting national industries using liquid gases (butane-propane-natural gasoline) a 30% discount of the lowest international price obtained by the exporting party in any quarterly period from any overseas consumer is hereby approved." See the copy of the resolution in the attachment to the "Submission of Information" (***appendix I***). For more information regarding the resolution and the feedstock discount, see the section in this chapter entitled ***Feedstock Pricing Practices.***
[117] The export prices for butane were obtained from the *Middle East Economic Survey* (MEES), 42:2, Jan. 11, 1999, p. A6. According to domestic sources, the price for butanes overseas generally increases in the winter, when they are used for fuel, cooking, and heating purposes. USITC fieldwork in the United States.

Date	Export price	Domestic price	Date	Export price	Domestic price
Jan. 1, 1997	330.00	231.00	Jan. 1, 1998	180.00	126.00
Feb. 1, 1997	305.00	213.50	Feb. 1, 1998	140.00	98.00
Mar. 1, 1997	277.00	193.90	Mar. 1, 1998	135.00	94.50
Apr. 1, 1997	207.00	144.90	Apr. 1, 1998	125.00	87.50
May 1, 1997	192.00	134.40	May 1, 1998	125.00	87.50
June 1, 1997	192.00	134.40	June 1, 1998	115.00	80.50
July 1, 1997	192.00	134.40	July 1, 1998	105.00	73.50
Aug. 1, 1997	192.00	134.40	Aug. 1, 1998	105.00	73.50
Sept. 1, 1997	195.00	136.50	Sept. 1, 1998	120.00	84.00
Oct. 1, 1997	203.00	142.10	Oct. 1, 1998	155.00	108.50
Nov. 1, 1997	215.00	150.50	Nov. 1, 1998	200.00	140.00
Dec. 1, 1997	215.00	150.50	Dec. 1, 1998	218.00	152.60
			Jan. 1, 1999	180.00	126.00

Prior to October 1994, the pricing of Saudi Arabian LPGs was based on a linkage between the price of butane and that of Arabian Light crude petroleum, a process that, according to Saudi Aramco, caused LPG pricing to be "dragged down by crude oil prices."[118] As a result, as of October 1994, Saudi Aramco initiated a new pricing system in which the "monthly contract price is set by a committee on the basis of the offers made for three spot cargoes tendered the previous month and of other market factors."[119] This reportedly resulted in a "sharp rise in prices," which, in turn, reportedly caused some purchasers to cancel their contracts.[120]

The price for butane declined during January-June 1998, reaching a 4-year low.[121] The decline was said to be the result of "pressure" from Saudi Aramco's contract customers in late 1997 to follow declines in the spot market that were attributed to factors such as "high stock levels, a mild winter, and a decline in demand in the Asian markets disrupted by the financial crisis."[122] It was noted that some Western customers reportedly reduced their orders for 1998 or canceled contracts as a result of the declines in the spot market.[123]

[118] "Natural Gas," *Arab Oil & Gas Directory, 1998*, pp. 376-377.
[119] Ibid., p. 376.
[120] Ibid.
[121] The Arab Petroleum Research Center, "LPG Prices Cut by $10/Ton to New Four-Year Low," *Arab Oil & Gas*, June 16, 1998, p. 28.
[122] The Arab Petroleum Research Center, "Big Cut in LPG Prices in January," *Arab Oil & Gas*, Feb. 1, 1998, p. 17; "LPG Prices Down Again by $40/T to $140/T in February," *Arab Oil & Gas*, Feb. 16, 1998, p. 24.
[123] Ibid.

Government Policies

This section presents information relating to Government policies affecting production and trade of MTBE and affecting investment, both foreign and domestic, in the Saudi MTBE industry. Inasmuch as several of these issues are also factors in Saudi Arabia's efforts to accede to the World Trade Organization (WTO), they are also presented in this context. Other than the policies discussed below, interviews with industry sources identified no Government policies in Saudi Arabia that were considered to hinder the production of, transport of, or trade in MTBE.[124] According to SABIC, "There are no government policies in effect in Saudi Arabia that govern the production or trade of MTBE. Nor are there government policies that govern the prices at which methanol and isobutylene are sold."[125]

Investment Climate

Foreign direct investment in Saudi Arabia is generally encouraged by the Saudi Government, and there are a variety of Saudi policies in place that are considered incentives to investment (e.g., low-cost availability of land, utilities priced at or below the cost of production, and low-interest "soft" loans from the Saudi Industrial Development Fund (SIDF)), some of which are said to accrue only to firms with at least 25 percent Saudi participation. Conversely, certain policies, such as a high tax rate on a foreign partner's corporate profits, a Government policy requiring the hiring of Saudis, and the practical requirement for a foreign investor to have a Saudi partner, are viewed by some as disincentives to investment. Many foreign companies are already operating in Saudi Arabia, albeit most, if not all, are participating in joint ventures. Investment incentives and disincentives provided to firms are discussed in this section. The prevalence of joint ventures is also discussed.

Incentives and disincentives

In its *Country Commercial Guide: Saudi Arabia*, the Department of Commerce states that the Saudi Government "generally encourages foreign direct investment, particularly in the case of foreign investment in joint ventures with Saudi partners."[126] Industry representatives operating in

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[124] USITC fieldwork in the United States and in Europe.

[125] "Submission of Information," p. 8.

[126] U.S. Department of Commerce (DOC), "Investment Climate," *Country Commercial Guide: Saudi Arabia, 1998*, found at *http://infoserv2.ita.doc.gov/tcc/InternetCountry.nsf*, retrieved May 9, 1999. According to the *Country Commercial Guide*, "the Ministry of Industry and Electricity licenses direct foreign investment, except for mineral concessions, which are governed by separate agreements." See also *Investing, Licensing, and Trading in Saudi Arabia*, p. 11.

According to the *Country Commercial Guide*, the current foreign capital investment code in Saudi Arabia specifies three conditions for foreign investments: (1) The undertaking must be a "development project"; (2) The investment must generate technology transfer; and (3) A Saudi partner should own a minimum of 25 percent equity (although this last stipulation can be waived). Moreover, the *Country Commercial Guide* states that

(continued...)

Saudi Arabia interviewed by the Commission did not identify any Government policies in Saudi Arabia that would prevent a company from establishing operations in the Kingdom.[127] On the contrary, industry representatives note that news and other sources indicate that increased involvement, on a private-sector and international basis, in downstream Saudi ventures is officially being sought.[128] For example, SABIC has stated that "much of SABIC's past success has been based" on joint-venture arrangements,[129] but that "the company would accept lower participation in future Saudi projects, particularly in petrochemical intermediates and derivatives, with the majority stakes held by private-sector Saudi or overseas companies."[130] H.E. Ali Bin Ibrahim Al-Naimi, Minister of Petroleum and Mineral Resources, stated in 1997 that "with regard to downstream investment in the petrochemical industry, it is also completely open and encouraged."[131]

Programs in place in Saudi Arabia intended to support local industries and foreign investment include "artificially low costs" for establishing facilities in the industrial cities; low-cost availability of land; utilities priced at or below the cost of production; and low-interest "soft" loans from the SIDF[132] up to 50 percent of the needed capital cost.[133] Other reported incentives, said to

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[126](...continued)
"development projects" were defined in Ministry of Industry and Electricity Resolution 11/k/w of February 12, 1990, to include industrial, agriculture, health, contracting and specialized service projects." U.S. DOC, "Investment Climate," *Country Commercial Guide: Saudi Arabia, 1998.* See also U.S. Department of State, *1998 Country Reports On Economic Policy and Trade Practices.*

[127] USITC fieldwork in Europe; telephone interviews with industry representatives on various dates.

[128] USITC fieldwork in Europe; H.E. Ali Bin Ibrahim Al-Naimi, Minister of Petroleum and Mineral Resources, "The Achievement and the Future of Saudi Arabian Natural Gas"; *Investing, Licensing, and Trading in Saudi Arabia*, p. 11.

[129] *SABIC Annual Report, 1997*, p. 11. However, according to one source, SABIC "increasingly . . . sees foreign companies as licensors of technology rather than traditional joint venture partners." *Investing, Licensing, and Trading in Saudi Arabia*, p. 11.

[130] "SABIC Sharpens Its Market Focus," p. 51.

[131] H.E. Ali Bin Ibrahim Al-Naimi, Minister of Petroleum and Mineral Resources, "The Achievement and the Future of Saudi Arabian Natural Gas"; *Investing, Licensing, and Trading in Saudi Arabia*, released Mar. 1998, p. 15. As recently as February 6, 1999, in a press conference in Saudi Arabia between the Minister and U.S. Energy Secretary Bill Richardson, the Minister confirmed that proposals for producing petrochemicals from natural gas are being sought. He later stated that investment is open to all "international companies," with no restrictions "provided that [a company's] proposal meets Saudi Arabia's needs." "Documentation on U.S. Energy Secretary's Visit to Saudi Arabia," *The Middle East Economic Survey*, Feb. 15, 1999, pp. D1-D6.

[132] The SIDF also has a 29-percent stake in the National Shipping Co. of Saudi Arabia. The Arab Petroleum Research Center, "New Board of Directors Appointed at the National Shipping Co. of Saudi Arabia," *Arab Oil & Gas*, Mar. 16, 1999, p. 15; U.S. Department of State, *1998 Country Reports On Economic Policy and Trade Practices.*

[133] USTR, "GCC: Export Subsidies," *1999 National Trade Estimate Report on Foreign Trade Barriers*, p. 153. See also Steven Miles, "Subsidies in the Petrochemical Sector?", *Middle East Economic Digest*, *Weekly Special Report* (Legal Briefing), dated Mar. 26, 1999, obtained using Profound (an online subscription search package), retrieved May 7, 1999;
(continued...)

be available to all sectors in the Kingdom, include 10-year tax holidays and exemption from import duties for construction equipment imported to develop certain sites.[134]

Conversely, investors in the petrochemical industry in Saudi Arabia have also expressed concern about a number of factors considered to be "hampering the development and financing of projects," including the following:

- ❏ Limitation on foreign ownership in Saudi companies;
- ❏ Limitation on forms of doing business;
- ❏ Inability of foreign investors to own real estate, inability of lenders to register mortgages, and uncertainty regarding the lenders' ability to direct the sale of real property in the event of default;
- ❏ Nonrecognition and nonenforcement of foreign arbitral and judicial awards;
- ❏ Lack of transparency in government approvals and licensing requirements; and
- ❏ Restrictions on business visas into the Kingdom.[135]

Moreover, the Department of Commerce states in its *Country Commercial Guide*, that "Disincentives include a high tax rate on a foreign partner's corporate profits, a Government policy of forced hiring of Saudis, the practical requirement for a foreign investor to have a Saudi partner, an ultraconservative cultural environment, and an extreme desert climate."[136] They note that "there is a clear hierarchy of privileges and preferences in Saudi Arabia that favors Saudi companies and joint ventures with Saudi participation" and that although Saudi Arabia "technically allows wholly foreign-owned firms to operate, such ventures are rare."[137] For example, according to one source, industry representatives have expressed concern about corporate tax rates in the Kingdom. A corporate income tax as high as 45 percent of net profits is said to be applicable only for foreign-owned corporations and the foreign-owned portion of joint ventures. Foreign investors are

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[133](...continued)
"Saudi Arabia: MEED Special–Petrochemicals–Dip in Profits Is No Bar to Expansion," *Middle East Economic Digest*, Mar. 17, 1997, p. 1; *Investing, Licensing, and Trading in Saudi Arabia*, p. 20.

[134] Miles, "Subsidies in the Petrochemical Sector?"; "SABIC Stays Steady on a Fast Track," *Chemical Week*, May 14, 1997, p. 29; *Investing, Licensing, and Trading in Saudi Arabia*, p. 20.

[135] Steven Miles, "Outlook on Foreign Investment," *Middle East Economic Digest*, *Weekly Special Report* (Legal Briefing), dated Mar. 26, 1999, obtained using Profound (an online subscription search package), retrieved May 7, 1999.

[136] U.S. DOC, "Investment Climate," *Country Commercial Guide: Saudi Arabia, 1998.*

[137] Ibid.

also said to pay "substantially higher" taxes than Saudi partners.[138] Furthermore, according to the source, "many enterprises have reached the end, or are coming to the end, of their tax-holiday period" and "foreign joint-venture companies have long been lobbying for either an extension of the tax holiday or a lower rate of corporate tax when the tax holiday has been exhausted."[139] The source notes that H.E. Dr. Hashim Bin Abdullah Bin Hashim Al-Yamani, the Minister of Industry and Electricity, "has indicated that the latter possibility was under consideration."

Joint ventures

SABIC's general operating practice is reportedly to establish joint ventures with international companies;[140] as noted earlier, the three SABIC companies producing MTBE in Saudi Arabia are joint ventures.[141] When the high incidence of joint ventures in the Saudi Arabian MTBE industry was discussed among industry representatives of some of the joint-venture partners and others, the primary reason for the ventures was stated to be a reduction in risk, especially financial risk, by the shareholders. A company's individual investment in the facility would be lower than if the company established independent operations. For example, in the MTBE joint ventures, individual partners are responsible for 10 to 50 percent of capital investment in a production facility.[142] Other reasons cited for joint ventures include assistance with local regulations and access to an established infrastructure.

As noted above, joint ventures are also said to be favored by tying existing investment incentives to Saudi participation.[143] Certain investment incentives offered (e.g., tax holidays and SIDF interest-free loans) are said to accrue only to firms "with at least 25 percent Saudi ownership."[144] and investment of foreign capital without Saudi participation is said to mean that the enterprise doesn't qualify for certain incentives.[145] For example, the SIDF loans, which some consider to be "a form of anti-competitive subsidy,"[146] are said to be "generally unavailable" to firms without Saudi participation.[147] According to a source familiar with the Saudi industry, one

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[138] *Investing, Licensing, and Trading in Saudi Arabia*, p. 13.

[139] Ibid., pp. 12-13.

[140] According to the *Country Commercial Guide*, although a variety of corporate structures can be established under existing legislation in Saudi Arabia, "joint ventures almost always take the form of limited liability partnerships."

[141] U.S. DOC, "Investment Climate," *Country Commercial Guide: Saudi Arabia, 1998.*

[142] USITC fieldwork in Europe, and *SABIC Annual Report, 1997*, p. 32.

[143] *Investing, Licensing, and Trading in Saudi Arabia*, p. 11.

[144] U.S. DOC, "Investment Climate," *Country Commercial Guide: Saudi Arabia, 1998.*

[145] "New Investment Law in 18 Months," *Gulf Today*, Oct. 19, 1997, and "SABIC To Be Privatized Slowly: Yamani," *Arab News*, Oct. 19, 1997, both reprinted in the *Official Forum Record* of the 2nd Saudi Arabian Forum on Gas Utilisation for Power and Industrial Development, Oct. 18-20, 1997, Yanbu Industrial City, Saudi Arabia (organized by the Middle East Infrastructure Development Congress - Dubai (MEIDC - Dubai)), p. 320.

[146] "Saudi Arabia: MEED Special–Petrochemicals–Dip in Profits is No Bar to Expansion," p. 1.

[147] Miles, "Subsidies in the Petrochemical Sector?" See also U.S. Department of State, *1998 Country Reports On Economic Policy and Trade Practices; Investing, Licensing, and Trading in Saudi Arabia*, released Mar. 1998, p. 15.

intent of the investment condition requiring Saudi participation is to foster the employment of Saudi nationals, per a Government human resources program called "Saudization."[148] According to the U.S. Department of State, "Saudi labor law requires companies to employ Saudi nationals."[149] The U.S. Department of Commerce states that labor and workman regulations implemented in Saudi Arabia in 1969 require that

> 75 percent of a firm's work force and 51 percent of its payroll must be Saudi, unless an exemption has been obtained from the Ministry of Labor and Social Affairs. Each company employing over 20 workers is reportedly required to include a minimum of five percent Saudi nationals.[150]

King Fahd Bin Abdul Aziz Al-Saud has stated that Saudization is a "national duty."[151] SABIC as a whole has 70 percent Saudization; Saudi Aramco, 83 percent.[152]

Feedstock pricing practices

Resolution No. 68, issued by the Council of Ministers of the Kingdom of Saudi Arabia on November 25, 1992, grants "national industries using liquid gases (Butane-Propane-Natural gasoline) a 30% discount of the lowest international price obtained by the exporting party in any quarterly period from any overseas consumer . . . "[153] SABIC notes in its submission that the price is an "adjusted price, based on the export price of the applicable liquid gas" that is available to all consumers of liquefied gases in Saudi Arabia regardless of their geographical location or company ownership.[154]

In response to the question regarding the original intent behind the imposition of Resolution No. 68, SABIC states that several reasons prompted it (see appendix I for a more

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[148] Discussion with industry representatives, May 26, 1999.

[149] U.S. Department of State, *1998 Country Reports on Economic Policy and Trade Practices.* See also *Investing, Licensing, and Trading in Saudi Arabia*, p. 13.

[150] U.S. DOC, "Investment Climate," *Country Commercial Guide."*

[151] "King Fahd Speaks Out in Magazine Interview," Apr. 1, 1998, found at *http://www.saudiembassy.net*, retrieved May 28, 1999.

[152] SABIC *Annual Report, 1997,* p. 5; "Saudi Aramco Reports High Level of Saudization," Oct. 1, 1997, found at *http://www.saudiembassy.net,* retrieved May 28, 1999.

[153] "Submission of Information," attachment 1. When the resolution was implemented, some industry sources expected the butane discount to result in an increase in the number of MTBE production facilities in Saudi Arabia because butane accounts for a major portion of the feedstock needed for MTBE. "Cheaper Saudi Butane Feedstock Could Boost MTBE Projects," *The Middle East Economic Survey*, Jan. 11, 1993, p. A2.

[154] Ibid., pp. 8-9. There it is stated that "it has been suggested that some foreign-owned companies [specifically the Mobil-Chemvest venture that was intended to come onstream in 1995] have not been deemed eligible for the price adjustment." SABIC's response is that the venture was never licensed in Saudi Arabia "for reasons having nothing to do with the price adjustment" and that, had it come onstream, it too would have been eligible. See ***appendix I*** for more information.

detailed presentation of SABIC's statement regarding this issue), including efforts to allow for the offset of transportation costs typically incurred in exporting the butane.[155] It also states that prior to the resolution some buyers were paying less than 70 percent of the export price for butane and that the resolution "uniformly pegged" the price at 70 percent of the export price for all users. SABIC contends that some domestic consumers of liquid gases, including "certain foreign venture partners of Saudi MTBE producers," believe that the adjusted price set by the resolution is too high.[156]

Feedstock costs represent a significant portion of MTBE production costs and, hence, feedstock prices can be one of the deciding factors as to whether a project is considered to be competitive. According to a representative of Alujain, for example, referring to the Tahseen project before it was put on hold–

> The plant is expected to be able to deliver product to the United States, the major market for MTBE, at costs competitive with those of local production because of the attractive financing, feedstock and tax arrangements available in Saudi Arabia for projects of this nature. It will also be well placed to export product to the other emerging markets, particularly Europe, Japan, and Far Eastern countries."[157]

Other companies operating petrochemical projects in Saudi Arabia have cited similar factors.[158] One industry source noted that "the support the government provided to the industry in the form of feedstock supply and loans from the Public Investment Fund was critical during the early development years" of the petrochemical industry in Saudi Arabia.[159] According to an article in an industry publication, a representative of SABIC noted in 1997 that "SABIC derives a 'clear feedstock advantage' from the access it has to low-priced raw materials in Saudi Arabia," allowing the company to be "more flexible with its profit margin for petrochemicals." He states, however,

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[155] "Submission of Information," p. 10.

[156] Ibid.

[157] "The Tahseen MTBE Project: An Example of Private Sector Participation in the Saudi Petrochemical Industry." The representative of the Alujain Corp. states, however, that the company's production facility location (Yanbu) would result in the piping of about 45 percent of its annual butane feedstock requirements from the east coast of Saudi Arabia because of "limitations on the pumping capacity of the East-West pipeline carrying LPGs and other gases." The representative noted that this could be expected to decrease the cost competitiveness of the MTBE produced at the Tahseen facility, despite "other economic benefits of locating the project in Yanbu."

[158] Essam F. Himdy, A.H. Zamil Group of Companies, "Al-Zamil Petrochemical Projects,"presented at the 1st Saudi Arabian Forum on Petrochemical Development and Finance, Nov. 14-16, 1998, Jubail Industrial City, Saudi Arabia (organized by the Middle East Infrastructure Development Congress - Dubai (MEIDC - Dubai)) and reprinted in the *Official Congress Record* of the Conference, p. 141.

[159] Richard A. Low, "Financing the Petrochemical Industry in Saudi Arabia: Past, Present, and Future."

that "this is only a limited cushion against the effects of the petrochemical industry cycle" and that "SABIC is not immune to market forces."[160] Still another source notes that the feedstock pricing policy "has boosted the feasibility of petrochemical projects that otherwise would not have been considered commercially viable at world prices."[161]

A representative of Chevron stated in a presentation in 1998 that "Aramco's favorable feedstock pricing for methane and gas liquids has been essential for attracting petrochemical investment in Saudi Arabia . . .[and that] this pricing is necessary to compensate for the initial high cost of creating a grassroots company in Jubail." He also stated that the feedstock pricing policy is necessary to "offset the high freight costs to ship the chemical products to the consuming regions of the world. . .[because the plants built in Saudi Arabia are] mostly structured around export sales."[162]

However, some industry sources in the United States and overseas have alleged that this pricing policy is a subsidy. For example, according to an industry representative–

> The presence of enormous quantities of subsidized Saudi MTBE has seriously damaged the U.S. ethanol and MTBE industries in two ways. One, it has exerted downward pressure both on ethanol and MTBE prices by providing petroleum refiners with huge leverage to negotiate one-sided pricing formulas; and two, it has had an enormous chilling effect on investment in new plants.[163]

The industry representative also stated that "some experts have calculated that the subsidy reduces Saudi MTBE production costs by as much as 20 cents per gallon for a product whose spot price today on the U.S. gulf coast is approximately 65 cents per gallon."[164] European producers also

[160] "SABIC Stays Steady on a Fast Track," p. 29.

[161] *Investing, Licensing, and Trading in Saudi Arabia*, p. 13.

[162] John G. Sharum, Vice President and General Manager, Chevron Chemical Co., "Keys to a Successful Investment Decision in Saudi Arabia," presented at the 1st Saudi Arabian Forum on Petrochemical Development and Finance, Nov. 14-16, 1998, Jubail Industrial City, Saudi Arabia (organized by the Middle East Infrastructure Development Congress - Dubai (MEIDC - Dubai)) and reprinted in the *Official Congress Record* of the conference, p. 37. Despite this, it has been noted by other sources that, in their perception, Saudi Aramco is becoming more aggressive in its pricing of butanes and more reluctant to sell butane to the domestic market at a price lower than the world price. USITC fieldwork in Europe; "SABIC: Moving Further Along the Value Chain."

[163] Commission hearing transcript, p. 10.

[164] Ibid. It should also be noted that Senator Thomas Daschle (D-SD) introduced legislation (S. 2391) on July 30, 1998, that sought the initiation by the Department of Commerce of an investigation, under Section 702 of the Tariff Act of 1930, on MTBE imported from Saudi Arabia. According to S. 2391, entitled "Fair Trade in MTBE Act of 1998," "the expansion of Saudi Arabian production capacity has been stimulated by government subsidies, notably in the form of a governmental decree guaranteeing Saudi Arabian MTBE producers a 30 percent discount relative to world prices on feedstock." The

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reportedly believe that "SABIC's access to low-cost feedstocks amounts to a subsidy."[165] For example, the European Chemical Industry Council (CEFIC) has stated that it has concerns about the 30-percent discount on all LPGs.[166]

SABIC takes issue with such claims, noting that although it "does get LPG at a 30 percent discount to the export price," "as a local buyer, it is not paying the cost of storage, transport, and marketing which Saudi Aramco must charge to its overseas customers."[167] SABIC states that "the cost difference between domestically sold liquid gases and exported liquid gases is attributable, in part, to the transportation costs that the seller must bear in the case of export sales."[168] Moreover, industry sources have stated that it is expensive to export butane from Saudi Arabia, given the costs involved to liquefy it, transport it, and regasify it, and that it is less expensive to ship liquids such as MTBE from Saudi Arabia than the gas input itself.[169] SABIC states that "by selling LPGs to domestic consumers under long term supply contracts, costs for domestic terminaling, pipeline facilities, marketing, and sales administration are avoided" and that "in fact, when these cost savings are accrued, they total more than the 30 percent adjustment which is provided to consumers in Saudi Arabia."[170]

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[164](...continued)
bill stated that "the subsidized Saudi Arabian MTBE exports have reduced the market share of American producers of MTBE, ethyl *tertiary*-butyl ether (ETBE), and ethanol, as well as discouraged capital investment by American producers." "Daschle: Ethanol Industry Faces Economic Crossroads," Press Release dated Nov. 13, 1997, found at *http://www.senate.gov/~daschle/releases/97/971113-a.html*, retrieved Mar. 15, 1999; "Daschle Introduces Legislation To Protect U.S. Ethanol From Unfairly Subsidized Imports," Press release dated July 30, 1998. For more information on this legislation, see ***appendix J***.

[165] "Saudi Arabia–MEED Special–Petrochemicals–Dip in Profits Is No Bar to Expansion," p. 1. See also "Saudi Arabia–The Petrochemical Sector," *APS Review Downstream Trends*, Dec. 1, 1997, p. 2; Miles, "Subsidies in the Petrochemical Sector?" The latter notes that several feedstocks are offered to domestic consumers at "relatively low prices."

[166] USITC fieldwork in Europe.

[167] "Saudi Arabia – MEED Special–Petrochemicals–Dip in Profits Is No Bar to Expansion," *Middle East Economic Digest* (MEED), Mar. 17, 1997, p. 1.

[168] "Submission of Information," p. 9.

[169] USITC fieldwork in Europe. Industry sources have stated that the costs of shipping MTBE to the United States are about $30 per unit compared with $50-$55 per unit for shipping LPG.

[170] *Prehearing Brief of Saudi Basic Industries Corporation (SABIC) and SABIC Americas, Inc.*, submitted by Miller & Chevalier, dated Mar. 19, 1999, p. 12. SABIC also states that "any cost savings enjoyed by Saudi imports over U.S. production derive from Saudi Arabia's natural comparative advantage in oil- and gas-related products, not from any countervailable subsidy." It states that the feedstock pricing policy is "similar to programs determined to be not countervailable in previous U.S. CVD cases." SABIC also states that "the adjusted price applies to all domestic purchasers" of butane and that it "applies to foreign-owned companies the same as it applies to all other companies licensed to do business in Saudi Arabia." Posthearing letter submitted by Miller & Chevalier, dated Apr. 14, 1999, p. 2; *Prehearing Brief of Saudi Basic Industries Corporation (SABIC) and SABIC Americas, Inc.*, p. 14; "Submission of Information," pp. 8 and 9.

In another argument, several sources have stated that the discount could be considered an effort to increase benefits to local companies and local consumers, allowing the citizens of the country to benefit from the indigenous natural resources.[171] SABIC states that "since Saudi Arabia recovers far more LPGs than it can consume domestically, it utilizes these feedstocks to facilitate economic development and diversification" and that "to accomplish these objectives in part, a domestic pricing program was instituted by Resolution No. 68."[172]

WTO Accession

Several of the aforementioned Government policies, including the feedstock pricing policy, might be modified as a result of Saudi Arabia's efforts to accede to the WTO. Saudi Arabia has been seeking accession to the WTO since 1995, in continuation of its efforts begun in 1993 to join the General Agreement on Tariffs and Trade,[173] and, according to USTR, one of the issues raised in the context of the accession negotiations has been dual pricing.[174] Under dual pricing, the domestic price of a product is set by the government at a level lower than the export price. Some sources consider the Saudi 30-percent feedstock discount to be a form of dual pricing, which under some circumstances or conditions may be considered a subsidy.[175] USTR indicates that the issue of whether this pricing program constitutes a subsidy is being considered in the context of the accession negotiations.[176]

USTR has stated that the EU has taken the lead in discussions on Saudi Arabia's dual

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[171] USITC fieldwork in Europe; Mohamed Al-Mady, Director General, Projects, SABIC, "Saudi Arabia's Gas Industry in the 21st Century: A SABIC Perspective." According to the latter source, "Every direct or indirect job created as a result of this 'gas driven' domestic industrial growth adds further value within the Kingdom as a cost benefit, or a cost saving." He further states that the result is "increased financial stability and diversity, improved trade balances for Saudi Arabia and more desirable employment opportunities for Saudi nationals."

[172] *Prehearing Brief of Saudi Basic Industries Corporation (SABIC) and SABIC Americas, Inc.*, p. 12.

[173] Several sources, including some in Saudi Arabia, believe that Saudi accession to the WTO will allow its petrochemical industry increased market access worldwide and lessen or remove the risk of unilateral trade measures potentially taken against it as a nonmember. See Steven Miles, "WTO and the Impact on Foreign Investment In Petrochemical Projects," *Middle East Economic Digest*, *Weekly Special Report* (Legal Briefing), dated Mar. 26, 1999; "SABIC: Moving Further Along the Value Chain"; "World Trade Organization Team Holds Talks on Saudi Candidacy," *AFP Asia*, dated Apr. 11, 1999; "WTO Delegation Hold Important Meetings With Saudi Ministers," *Middle East Newsfile.* All of the articles cited in this note were obtained using Profound (an online subscription search package) and retrieved May 7, 1999.

[174] Telephone interview with a representative from USTR, May 11, 1999.

[175] USITC fieldwork in Europe; the Association of Petrochemicals Producers in Europe (APPE), *Activity Review*, *1995-96*, p. 23; telephone interview with Geoffrey Gamble, Esq., Chair, Industry Sector Advisory Committee 3 (ISAC-3), on June 11, 1999. Separately, subsidies are defined in Art. 1.1 of the WTO Agreement on Subsidies and Countervailing Measures (hereinafter called the WTO Agreement).

[176] Telephone interview with a representative from USTR, July 28, 1999.

pricing practices, but that other delegations, including that of the United States, have also commented and asked for further information.[177] CEFIC has had a longstanding concern regarding dual pricing practices in Saudi Arabia.[178] According to one industry source, for example, CEFIC has "consistently lobbied for modification of Mideast feedstock pricing structures to be made a condition of forming a free-trade pact between the European Union and the Gulf Cooperation Council."[179] In the United States, several companies in the chemical sector have also expressed concern about dual pricing.[180] While the issue has been raised in the WTO Working Party on the Accession of Saudi Arabia, no definitive conclusion has been reached.[181] It has been noted that there are varying opinions within the U.S. industry regarding this issue.

Information from various sources indicates that questions exist as to whether investment incentive programs and feedstock discounts will continue if Saudi Arabia accedes to the WTO.[182]

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[177] Telephone interview with a representative from USTR, May 11, 1999. According to a press release from the International Council of Chemical Associations (ICCA), dated June 23, 1999, the ICCA "expressed strong support for a new round of multilateral negotiations in the World Trade Organization." Issues of interest would be a phased elimination of all tariffs and the "elimination" of certain nontariff measures, including dual pricing. The press release notes that the ICCA, which represents numerous chemical trade associations, including CMA and CEFIC, "welcomes the accession of new members to the WTO provided these countries adopt all the agreements required for entry to the organization." ICCA, "Chemical Industry Strongly Supports New Trade Round Tariff Elimination," press release dated June 23, 1999.

[178] USITC fieldwork in Europe. According to CEFIC industry officials, Saudi Arabia's pricing practices with regard to butane could be considered an example of dual pricing.

Also see APPE, *Activity Review, 1995-96*, p. 23 and APPE, *Activity Review, 1996-97*, p. 23. As noted in the 1995-96 issues, "an example of [dual pricing] is the granting by Saudi Arabia of a 30% discount from FOB prices of naphtha and liquid petroleum" and that "APPE will continue to press the OECD, the WTO, and regulatory authorities to control the growing practice of [dual pricing]." (In these publications, the term "double pricing" is used to refer to dual pricing.)

[179] "Mideast Builds Export Power," *Chemical Week*, May 14, 1997, p. 23.

[180] Mr. Gamble, Chair, ISAC-3, states that ISAC-3 seeks the elimination of dual pricing. According to Mr. Gamble, "We feel that elimination of dual pricing would be a prerequisite for our support of Saudi Arabia's accession to the WTO." Telephone interview with Geoffrey Gamble on Aug. 4, 1999.

Mr. Gamble has also stated that "Representatives of ISAC-3 and the Chemical Manufacturers Association (CMA) had hoped that they could meet with the Saudi delegation of the WTO accession group and possibly work out a common ground so that the group could move toward WTO accession with ISAC-3 and CMA's support. Unfortunately, the Saudi delegation was unable to meet with representatives of ISAC-3 and CMA and, therefore, the ISAC-3 has not yet developed a complete position that can be made public." Telephone interviews, Apr. 7 and Aug. 6, 1999.

[181] Telephone interview with a representative from USTR, May 6, 1999.

[182] Miles, "WTO and the Impact on Foreign Investment in Petrochemical Projects"and "Subsidies in the Petrochemical Sector?"; USITC fieldwork in Europe; Mohamed Al-Mady, Director General, Projects, SABIC, "Saudi Arabia's Gas Industry in the 21st Century: A SABIC Perspective"; Marwan N. Nusair, "The Tahseen MTBE Project: An Example of

(continued...)

Opinions within the industry differ as to the eventual outcome. According to the representative of Chevron, discussions regarding this pricing policy have been underway in his company and between other potential investors in the Kingdom as to "whether or not this favored pricing would disappear," noting that "this is a major concern for investors today." The response he presented was that "from our perspective, if the basis for feedstock pricing changes such that prices increase, the pace of future investment in basic petrochemicals could be impacted."[183]

Saudi Arabia is reportedly addressing some of the issues raised during the accession negotiations. For example, Saudi Arabia is said to be modifying several regulations, including the Foreign Capital Investment Law (which is said to affect investment across the Saudi economy).[184] According to a statement made by His Royal Highness Prince Abdullah Bin Faisal Bin Turki Al-Saud in 1997, when discussing new investment prospects in Al-Jubail and Yanbu, foreigners will be able to invest in Saudi Arabia without participation of Saudi Arabian companies under the new laws, "but, in that case, they will not get certain benefits."[185]

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[182](...continued)
Private Sector Participation in the Saudi Petrochemical Industry."

[183] "Keys to a Successful Investment Decision in Saudi Arabia," p. 37.

[184] Miles, "Subsidies in the Petrochemical Sector?"

[185] "SABIC To Be Privatized Slowly: Yamani," *Arab News*, Oct. 19, 1997. Also "New Investment Law in 18 Months," *Gulf Today*, Oct. 19, 1997.

Appendix A
Request Letter from the United States Trade Representative

(Not available in the electronic version)

Appendix B
Federal Register Notice

(Not available in the electronic version)

Appendix C
Witness List

CALENDAR OF PUBLIC HEARINGS

Those listed below appeared as witnesses at the United States International Trade Commission's hearing:

Subject:	**METHYL TERTIARY BUTYL ETHER (MTBE): CONDITIONS AFFECTING THE DOMESTIC INDUSTRY**
Inv. No.:	**332-404**
Date and Time:	**April 1, 1999 - 9:30 a.m.**

Sessions were held in connection with the investigation in the Main Hearing Room 101, 500 E Street, S.W., Washington, D.C.

ORGANIZATION AND WITNESS

PANEL 1

BioClean Fuels, Incorporated, Omaha, Nebraska

David E. Hallberg, President

Renewable Fuels Association ("RFA"), Washington, D.C.

Bob Dinneen, Legislative Director

PANEL 2

Miller & Chevalier
Washington, D.C.
on behalf of

Saudi Basic Industries Corporation ("SABIC")
SABIC Americas, Incorporated

Phil Lingamfelter, Advisor

John E. Davis–OF COUNSEL

-END-

Appendix D

Glossary

Anhydrous–No water is associated with the chemical product.

Aromatics–The U.S. Department of Energy (U.S. DOE) defines aromatics as very reactive hydrocarbons that tend to be relatively uncommon in crude petroleum (typically 10 percent or less). However, light aromatics increase the octane number in gasoline, and consequently are deliberately created by steam reforming of naphtha. The most common aromatics are benzene (C_6H_6), toluene (C_7H_8), and xylene (C_8H_{10}).

Associated natural gas–defined by the U.S. DOE as natural gas produced in a field containing both petroleum and gas. The field is developed primarily for extraction of crude petroleum.

Attainment areas–Those that meet the national primary or secondary ambient-air-quality standards for a pollutant or pollutants as determined by the U.S. Environmental Protection Agency (EPA).

Butane–A liquefied petroleum gas with the molecular formula C_4H_{10} which is extracted from natural gas or refinery gas streams. Butane, normally a straight-chain (the normal (or *n*-) butane isomer) or branch-chain hydrocarbon (the isobutane isomer), is used both as a fuel and as a raw material for chemicals, including MTBE.

Clean Air Act–The Clean Air Act, initially enacted in 1963 and significantly amended in 1990 by the Clean Air Act Amendments of 1990 (CAAA), addresses air quality, defines certain pollutants, and sets air-quality standards.

Conventional gasoline–Finished motor gasoline, not included in the oxygenated or reformulated gasoline categories.

Dehydrogenation–Removal of hydrogen.

Dehydration–Removal of water.

Endothermic reaction–A chemical reaction in which heat is absorbed.

Ethanol (fuel ethanol)–An anhydrous denatured aliphatic alcohol intended for gasoline blending, derived primarily from corn production. Fuel ethanol accounts for much of the remaining 20 percent of the U.S. oxygenate market not served by MTBE. Fuel ethanol can also be blended with gasoline to produce "gasohol," a mixture of 90 percent gasoline and 10 percent ethanol.

Ethyl *tertiary*-butyl ether (ETBE)–An oxygenate blend stock formed by the catalytic etherification of isobutylene with ethanol. ETBE can be used as a substitute for MTBE.

Exothermic reaction–A chemical reaction in which heat is released.

Field–According to the U.S. DOE, an area consisting of a single reservoir or multiple reservoirs all grouped on or related to the same individual geological structural feature and/or stratigraphic condition. A field containing petroleum, for example, can also be called an "oilfield."

Gasohol–A mixture of 90 percent gasoline and 10 percent ethanol.

Grassroots–Generally refers to a facility built from "the ground up" (the term is generally used regardless of the final product produced at the site–e.g., automobile plants, television plants, refineries, chemical plants).

Gulf Cooperation Council (GCC)–the GCC's charter states that the basic objectives of the GCC are to effect coordination, integration, and interconnection between the Member States (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates) in all fields in order to achieve unity between them.

Hydrocarbon–An organic chemical compound of hydrogen and carbon in either the gaseous, liquid, or solid phase. As noted by the U.S. DOE, the molecular structure of hydrocarbon compounds varies from the simplest (e.g., methane, a constituent of natural gas, with the molecular formula CH_4) to the very heavy and very complex.

Isobutane–A natural gas liquid that is dehydrogenated to form isobutylene, a raw material for MTBE.

Isobutylene–A hydrocarbon with 4 carbons that is generally obtained from steam cracking or catalytic cracking operations or that is created from the dehydrogenation of isobutane. Isobutylene is a raw material for numerous products, including MTBE.

Isomers–Chemical products with the same molecular formula but dissimilar molecular structures and properties. Examples of isomers included branched (e.g., isobutane) and straight- chain (e.g., *n*-butane) hydrocarbons.

Isomerization–The conversion of a chemical product from one isomeric molecular structure to another (i.e., from one isomer to another).

Liquefied petroleum gases (LPGs)–Ethane, ethylene, propane, propylene, normal butane, butylene, and isobutane produced at refineries or natural gas processing plants, including plants that fractionate raw natural gas liquids.

Methanol–A commercially significant organic alcohol, usually produced from natural gas, with the molecular formula of CH_3OH. It can also be produced from coal, from the destructive distillation of wood, and from biomass. Methanol is a raw material for several products, including MTBE.

Methyl *tertiary*-butyl ether (MTBE)–A colorless, flammable liquid with a strong odor, used as a gasoline additive. Formerly used primarily as an octane enhancer, MTBE is now the primary oxygenate used in the United States, accounting for about 80 percent of the market.

Natural gas–A mixture of hydrocarbons (primarily methane and small quantities of various nonhydrocarbons) existing in gaseous phase or in solution with crude petroleum in natural underground reservoirs).

Natural gas liquids (NGLs)–Defined by the U.S. DOE as light hydrocarbons with boiling temperatures close to room temperature that are typically found in vapor form in natural gas reservoirs. The most common NGLs are ethane (C_2H_6), propane (C_3H_8), and butane (C_4H_{10}). NGLs also include smaller amounts of heavier hydrocarbons, such as "natural gasoline" (also called "pentanes plus").

Nonassociated natural gas–Generally defined as natural gas not produced in a field containing petroleum.

Nonattainment areas–Those that do not meet (or that contribute to ambient air quality in a nearby area that does not meet) the national primary or secondary ambient-air-quality standards for a pollutant or pollutants as determined by the EPA.

Octane enhancers–As defined by the U.S. DOE, these are added to gasolines to control engine pre- ignition or "knocking" by slowing combustion rates.

Oxygenates–Generally defined as any substances (usually ethers or alcohols) which, when added to gasoline, increase the amount of oxygen in the gasoline blend.

Oxygenated gasolines–Finished motor gasolines having an oxygen content of 1.8 percent or higher by weight and required by the EPA to be sold in areas with higher-than-acceptable levels of carbon monoxide. Oxygenated gasolines do not include RFG or certain other blends.

Propylene oxide (PO)–A petrochemical used to produce downstream products (e.g., foams for furniture and automobile seats; pleasure boats; fiberglass tubs and showers; and aircraft deicing fluids) that are used in numerous industrial sectors (e.g., home furnishings, construction, and packaging). TBA is produced as a coproduct in the production of PO.

Reformulated gasoline (RFG)–To qualify as RFG, gasoline must contain at least 2 percent oxygen by weight and no more than 1 percent benzene by volume.

Reid Vapor Pressure (RVP)–A measure of how quickly fuel evaporates. Reductions in RVP are said to result in the "majority" of VOC emissions reduced through use of RFG.

Saudization–A human resources program mandated at the Government level intended to foster the employment of Saudi nationals in Saudi Arabia.

***Tertiary*-amyl methyl ether (TAME)**–An oxygenate blend stock formed by the catalytic etherification of isoamylene with methanol. TAME can be used as a substitute for MTBE.

***Tertiary*-butyl alcohol (TBA)**–Used as both a raw material in the manufacture of MTBE (formed as a coproduct in the production of PO) and as an oxygenate in its own right.

Ton-mile–A ton-mile is a unit of measure reflecting the movement of 1 ton of freight 1 mile. The freight cost per ton-mile is the cost to move 1 ton this distance.

Transfer price–Generally defined as the monetary value assigned to products, services, or rights conveyed or exchanged between related parties, including those occurring between units of a consolidated entity.

Volatile organic compounds (VOCs)–Organic compounds that participate in atmospheric photochemical reactions; they are said to contribute significantly to the formation of ground-level ozone (smog).

Wine lake–Defined by the EU as a surplus of wine generated by the price support system of the Common Agricultural Policy (CAP).

Appendix E

MTBE Production Processes

MTBE Production Processes

STEAM CRACKER UNITS[1]

Mixed C_4 streams are generated by steam crackers as a byproduct of ethylene production (C_4 streams, regardless of their source, primarily contain hydrocarbons with four carbon atoms–e.g., isobutylene, *n*-butylene, and butadiene). The mixed streams can then be either sold to third parties which process the streams through a butadiene extraction unit (to remove the butadiene) or processed through such a unit by the producing companies themselves (see figure E-1(A)). The processor then either uses the resulting stream (also called raffinate 1) directly or sells it.

In the United States, regardless of who manufactures these streams, MTBE producers which consume them are generally refiners. (Refiners basically have two options if their own internal C_4 streams are not sufficient for their production needs: they can purchase external C_4 streams or purchase MTBE.) When used to produce MTBE, the stream itself is then reacted directly with methanol (see figure E-2(A)); the methanol will react "virtually 100 percent" selectively with the isobutylene in the stream.[2] The other hydrocarbons in the streams, including *n*-butylene, pass through the reactor without reacting with the methanol and can then be routed to alkylation facilities (or, as an alternative, the process can be designed such that the *n*-butylene in the stream is isomerized to isobutylene).[3] MTBE production capacity in these facilities is small in volume, accounting for only 1,000 to 8,000 barrels per day.

Isobutylene from C_4 streams derived from steam crackers is not used extensively either in the United States or in Saudi Arabia.[4] In the United States, MTBE production capacity employing isobutylene obtained from this process accounts for about 4 percent of total MTBE production capacity (reported for those companies said to be using this feed solely; some companies produce MTBE using multiple feeds, such as a combination of steam cracker and FCCU feeds).[5] The MTBE produced using this feedstock is generally consumed captively by the producing companies. In Saudi Arabia, MTBE production capacity using isobutylene obtained

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[1] Additional information for this production process was obtained from telephone conversations with industry representatives during May 17-18, 1999.

[2] USITC fieldwork in the United States and in Europe; Chem Systems, Inc., *Process Evaluation Research Planning Report*, p. 37.

[3] Chem Systems, Inc., *Process Evaluation Research Planning Report*, p. 17.

[4] Many olefins producers in the United States, particularly those that produce ethylene, use lighter feedstocks that don't produce C_4 streams in sufficient quantity or quality. Telephone discussions with industry representatives, Apr. 17-18, 1999; USITC fieldwork in Europe.

[5] The total percentage of U.S. production capacity accounted for by each source of isobutylene will not total 100 percent because some facilities use combined feeds (e.g., from steam crackers and from FCCUs or from steam crackers and butane dehydrogenation). DeWitt & Co., *MTBE and Oxygenates*, p. 48.

Figure E-1 is not available in the electronic version.

Figure E-2 is not available in the electronic version.

from steam crackers accounted for about 4 percent of total domestic MTBE production capacity in 1998.

FLUID CATALYTIC CRACKING UNITS (FCCUS)

Mixed C_4 streams are also generated by FCCUs as a byproduct of refinery processing operations (see figure E-1(B)). In the United States, many refiners use these internal streams to produce MTBE captively and generally consume the MTBE captively as well. As with the steam cracker streams, these C_4 streams can be reacted directly with methanol because the methanol reacts "virtually 100 percent" selectively with the isobutylene in the stream (see figure E-2(B)).[6] The remaining unreacted hydrocarbons in the streams can then be routed to alkylation facilities (or, as an alternative, the process can be designed such that the *n*-butylene in the stream is isomerized to isobutylene).[7]

The production of MTBE using C_4 streams derived from FCCUs is limited in terms of volume by the amount of isobutylene produced in the facility. In many cases, the MTBE production unit was added to add value to the isobutylene produced internally. As a result, the MTBE production capacity in these facilities is small, accounting for only 1,000 to 8,000 barrels per day. In the United States, MTBE production capacity employing isobutylene obtained from this process accounts for about 31 percent of the total (reported for those companies said to be using this feed solely; some companies produce MTBE using multiple feeds, such as a combination of steam cracker and FCCU feeds). This process is also used in Saudi Arabia, although to a lesser degree (it accounted for about 4 percent of total Saudi Arabian MTBE production capacity in 1998).

TERTIARY-BUTYL ALCOHOL (TBA)

TBA, a coproduct of propylene oxide (PO), is produced by PO manufacturers (see figure E-1(C)). Although it can be used directly as an oxygenate, it can also be used as a raw material in the production of MTBE (see figure E-2(D)). In the United States, two PO manufacturers produce MTBE starting from TBA. They start with isobutane as a feedstock to produce TBA and then, ultimately, MTBE, as part of the "PO/MTBE" manufacturing process.[8] The TBA is used captively by the PO producers to produce MTBE either in a process in which isobutylene is produced as an intermediate (reportedly the Arco process, in which the TBA is

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[6] The primary difference between the C_4 streams obtained from steam crackers and those obtained from FCCUs is in the concentration of isobutylene contained in the streams. According to one source, "depending on feedstock, operating conditions, plant configuration, and other factors, the isobutylene content [of C_4 streams from steam crackers] can range from 35 to 50 volume percent, with about 44 percent considered typical," compared with about 15 percent for the FCCU streams. Chem Systems, Inc., *Process Evaluation Research Planning Report*, pp. 7 and 9.

[7] Chem Systems, Inc., *Process Evaluation Research Planning Report*, p. 17, and DeWitt & Co., *MTBE and Oxygenates*, appendix C.

[8] Telephone conversations with industry representatives, May 20 and June 1, 1999.

dehydrated to form isobutylene) or in a one-step process in which isobutylene is not produced (formerly the Texaco process; now the Huntsman process).[9]

The MTBE produced by these companies is either used captively or sold on the merchant market. MTBE production capacity using isobutylene obtained from this process accounts for about 20 percent of total MTBE production capacity in the United States. This process is not used in Saudi Arabia.

BUTANE DEHYDROGENATION

Butane is also used as a feedstock in "on-purpose" plants, which are built specifically to manufacture MTBE. In these plants, isobutane is dehydrogenated to produce isobutylene, which is then reacted with methanol to form MTBE (see figures E-1(D) and E-2(C)). The endothermic dehydrogenation reaction,[10] generally run at 540^{O}-$760^{O}C$ and at low pressure, usually results in an isobutylene mixture containing "75-85 percent isobutylene and unreacted isobutane."[11] The particular catalyst used varies, depending on the technology used.

The isobutane itself can be obtained from different sources. Although companies can start with either *n*-butane or isobutane, in one scenario, which is said to be used in Europe and in Saudi Arabia, companies start with a feed of mixed butanes (i.e., *n*-butane and isobutane), separate the feed into the separate components by fractionation, and then dehydrogenate the isobutane into isobutylene. The separated *n*-butane is generally isomerized into isobutane in a separate step to provide additional isobutane. The isomerization reaction runs at about 150^{O}-$200^{O}C$, using a catalyst. Isomerization technologies include UOP Butamer and the Engelhard C4 isomerization process.[12] Another supplemental source of isobutane is unreacted isobutane from the MTBE reactor, which accounts for about 80 to 85 percent of the recycled isobutane stream from the reactor.[13]

"On-purpose" plants are generally much larger than the units in refineries, each having a production capacity of 12,000 to 25,000 barrels per day. Several companies license the technology used in the dehydrogenation process: ABB Lummus Crest (the Catofin process); Phillips (the STAR process); BASF/Linde; Snamprogetti (the Yarsintez process); and UOP (the Oleflex process).[14] Differences among these technologies include the feeds needed, the reaction pressure, the catalyst system, and the size and cost of the equipment.

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[9] The individual TBA processes are proprietary in nature. The information above was obtained from discussions with representatives of Huntsman on June 1, 1999, and from Chem Systems, Inc., *Process Evaluation Research Planning Report*, p. 39. Separately, Lyondell acquired Arco Chemical Co. (and its MTBE operations) in 1998; Huntsman purchased Texaco's MTBE production facility in 1997.

[10] An endothermic reaction absorbs heat.

[11] Chem Systems, Inc., *Process Evaluation Research Planning Report*, p. 18.

[12] DeWitt & Co., *MTBE and Oxygenates*, appendix C.

[13] Chem Systems, Inc., *Process Evaluation Research Planning Report*, p. 24.

[14] Ibid., p. 49, and DeWitt & Co., *MTBE and Oxygenates*, appendix C.

In the United States, MTBE production capacity using isobutylene obtained from this process accounts for about 35 percent of total domestic MTBE production capacity. In Saudi Arabia, this process is the primary process used, accounting for about 92 percent of domestic production capacity. The MTBE produced at such facilities in the United States is generally sold on the merchant market, predominantly to refiners; most MTBE produced in Saudi Arabia is exported.

Appendix F
U.S. Production and Consumption Trends for the Major MTBE Inputs

U.S. PRODUCTION AND CONSUMPTION TRENDS FOR THE MAJOR MTBE INPUTS

The two main inputs in the production of MTBE are methanol and isobutylene. Most MTBE producers in the United States purchase methanol, primarily from the merchant market. Isobutylene, however, can be obtained from different sources (see appendix E for more detail):

(1) Through the dehydrogenation of isobutane, a process used in "on-purpose" MTBE plants (the isobutane can be obtained either preseparated or through the isomerization of *n*-butane);
(2) Through the dehydration of TBA, a byproduct of propylene oxide manufacture (TBA is itself derived from isobutane); and
(3) Directly from refinery and petrochemical C_4 streams.

Only two firms produce MTBE from TBA in the United States; thus, data related to TBA production in the United States are business proprietary. Accordingly, the following discussion of MTBE feedstocks will consist of three sections: a discussion of the U.S. methanol industry and market; a discussion of the U.S. isobutylene industry and market, focusing primarily on refinery production; and a discussion of the U.S. butane industry and market (addressing both *n*-butane and isobutane).

Methanol

Methanol is a commercially significant organic alcohol usually produced from natural gas. It can also be produced from coal, from the destructive distillation of wood, and from biomass.

In 1998, there were 15 producers of methanol in the United States. The three largest were Celanese Chemicals, Inc., Borden Chemicals & Plastics, LP, and Beaumont Methanol Corp. These producers, concentrated in Texas and Louisiana because of abundant natural gas supplies, obtain natural gas from independent pipeline networks, and, therefore, are not considered to be fully vertically integrated.

Capacity

Total U.S. production capacity for methanol as of July 1998 amounted to about 2.5 billion gallons (see table F-1). Plants in Texas accounted for 55 percent of the total; those in Louisiana, 33 percent. The 15 domestic producers maintained 16 production locations in the United States. The addition of new production capacity in the United States is not expected in the foreseeable future because of a substantial amount of new capacity coming onstream overseas and

Table F-1
U.S. methanol producers, locations, and production capacities as of July 1998

Producers	Location	Production capacity: Quantity Tons	Gallons
		Thousands	*Millions*
Air Products	Pace, FL	180	60
Ashland Chemical	Plaquemine, LA	460	153
Beaumont Methanol[1]	Beaumont, TX	850	283
Borden	Geismar, LA	990	330
Celanese	Bishop, TX	500	167
	Clear Lake, TX	600	200
Coastal Chemical	Cheyenne, WY	80	27
Eastman Chemical	Kingsport, TN	195	65
Enron	Pasadena, TX	375	125
Fortier Methanol[2]	Fortier, LA	570	190
Georgia Gulf[1]	Plaquemine, LA	480	160
Lyondell	Channelview, TX	730	243
Millennium	Deer Park, TX	600	200
Sterling/BP[1]	Texas City, TX	450	150
Star Enterprise[3]	Delaware City, DE	300	100
Terra	Woodward, OK	120	40
Total		7,480	2,493

[1] Major plants closed or idled indefinitely in the United States include Beaumont Methanol (Terra Ind.), since Jan. 23, 1999; Georgia Gulf, since Dec. 1, 1998; and Sterling/BP since Aug. 1998.
[2] Ownership 30/70 percent, Cytec Ind., United States (30 percent) and Methanex Corp., Canada (70 percent).
[3] Tenneco/Saudi Aramco joint venture (50/50 percent).

Source: American Methanol Institute; Mannsville Chemical Corp.; and various trade journals.

the corresponding soft market conditions.[1] Three domestic producers have already shut down plants for economic reasons; these producers represent about 590 million gallons of U.S. methanol capacity, or roughly 24 percent of the total. Domestic producers and market analysts alike have cautioned that more production cutbacks would be likely before the market improves.[2]

According to industry sources, a reasonable balance between domestic production and consumption in this industry is considered to be achieved at capacity utilization rates above 90 percent. In 1994, the U.S. capacity utilization rate was 94 percent. In 1995, the rate decreased (see table F-2), principally because of a large increase in domestic methanol capacity that came onstream during 1994-95, coupled with an increase in imports and slower growth in domestic MTBE production. After increasing slightly through 1997, the capacity utilization

[1] Information provided to the Commission by the American Methanol Institute, Washington, DC, Feb. 9, 1999.
[2] "Methanol Market Remains Devastated," *Chemical Market Reporter*, Feb. 8, 1999.

Table F-2
U.S. methanol capacity and capacity utilization, 1994-98

Year	Capacity[1]	Capacity utilization[2]
	Million gallons	*Percent*
1994	1,740	94
1995	2,400	71
1996	2,450	71
1997	2,490	73
1998	2,490	70[3]

[1] U.S. effective annual operating capacity.
[2] Production as a percent of effective operating capacity
[3] Estimated by the Commission.

Source: Chemical Manufacturers Association, except as noted.

rate declined again in 1998. This decline was attributed primarily to a sharp rise in lower priced imports, which, in turn, resulted in a decline in domestic methanol production.[3]

Overseas, however, a substantial amount of new production capacity is coming onstream in 1999 in countries having abundant supplies of lower cost natural gas. This new capacity is expected to amount to about 4 million tons, with another 6 million tons under evaluation.[4] Trinidad and Tobago and Chile, traditional U.S. methanol suppliers, will account for about 2 million tons of the new capacity, or roughly 50 percent of the total. The remainder consists of new plants in Saudi Arabia, Qatar, and Iran. This increase in capacity overseas is expected to result in the continuation of current soft market conditions globally, including low prices (e.g., 20 cents per gallon quoted on the spot market in the United States).

Production and Consumption

In terms of volume, methanol ranked 19th out of the top 50 chemicals produced in the United States in 1997.[5] The average annual growth rate for U.S. methanol production during 1994-97 was about 4 percent, compared with about 2 percent for apparent domestic consumption. U.S. imports declined moderately from record levels established in 1994. Major methanol derivatives,[6] in order of importance by volume, were MTBE, formaldehyde, and acetic acid, together accounting for about 75 percent of the total. According to industry sources, methanol used in MTBE production is purchased from noncaptive sources at spot prices or under contract. Table F-3 presents data on total U.S. methanol production, trade, and domestic consumption

[3] Ibid.
[4] "Prices Sink Under a Flood of Capacity," *Chemical Week*, Dec. 9, 1998.
[5] Chemical Manufacturers Association, *U.S. Chemical Industry Statistical Handbook 1998*, Sept. 1998, p. 41.
[6] Methanol derivatives are end-use products or production intermediates generally derived by reacting methanol with other chemicals.

Table F-3
U.S. methanol production, imports, exports, domestic consumption, and ratio of imports to consumption, 1994-98[1]

Source	1994	1995	1996	1997	1998
Production (*million gallons*)	1,633	1,706	1,752	1,817	1,730[2]
Imports (*million gallons*)	764	601	675	687	874
Exports (*million gallons*)	37	67	49	77	46
Domestic consumption (*million gallons*)	2,360	2,240	2,379	2,427	2,560[2]
Ratio of imports to consumption (*percent*)	32	27	28	28	34[2]

[1] Data include total U.S. methanol produced and consumed for chemical feedstocks and direct fuels for reason of conformity (e.g., production, imports, and exports include chemical feedstocks and fuels).
[2] Estimated by the Commission.

Source: Chemical Manufacturers Association and official statistics of the U.S. Department of Commerce, except as noted.

during 1994-98 (including methanol consumed as fuel; import data for methanol used only for chemical synthesis (i.e., the production of MTBE and other chemicals) are presented in the following section).

Trade

The United States is a major importer of methanol, primarily because of growing domestic demand for octane boosters and fuel oxygenates in reformulated gasoline (see table F-3).[7] The ratio of imports to consumption rose steadily in the 1980s and early 1990s as a result of the increasing use of MTBE in gasoline to meet more stringent environmental regulations. During this period, domestic consumption of formaldehyde, acetic acid, and other methanol derivatives also rose steadily. However, during 1994-98, the ratio of methanol imports to consumption rose only slightly, from 32 percent to an estimated 34 percent.[8] Exports of methanol during this period were relatively minor, accounting for less than 5 percent of total U.S. production.

Approximately 90 percent of the total volume of methanol imported into the United States for chemical synthesis during 1994-98 came from Canada, Trinidad and Tobago, Venezuela, and Chile (see table F-4). These countries have abundant natural gas reserves and are highly competitive. The share of total imports accounted for by the latter three countries

[7] U.S. imports of methanol can be classified under one of two Harmonized Tariff Schedule (HTS) subheadings, depending on how the imported product will be used. HTS 2905.11.10 covers methanol imported only for use in producing synthetic natural gas or for direct use as a fuel. HTS 2905.11.20 covers all other methanol. Imports enter free of duty under the fuel-use subheading; the rate on the other subheading is 11.8 percent. Methanol used to produce MTBE is classified in HTS 2905.11.20. U.S. imports under this subheading accounted for about 99 percent of total U.S. imports of methanol during 1994-95 before declining to 97 percent in 1996, 92 percent in 1997, and 74 percent in 1998.

[8] Data are based on the following sources: Mannsville Chemical Products Corp.; Chemical Manufacturers Association; U.S. DOC; and Commission estimates.

Table F-4
U.S. methanol imports for chemical synthesis, by sources in terms of customs value and quantity, 1994-98[1]

Source	1994	1995	1996	1997	1998
	Quantity (1,000 gallons[2])				
Trinidad and Tobago	154,384	91,609	183,433	169,836	217,412
Canada	379,407	363,478	312,651	250,988	183,588
Venezuela	85,715	82,496	121,035	137,975	122,316
Chile	43,863	12,005	14,125	21,526	53,687
Bahrain	32,836	33,199	22,042	25,156	41,046
Russia	18,800	5,502	0	25,426	17,461
Saudi Arabia	7,769	3,171	3,484	0	3,504
Other	30,368	174	32	3,635	9,935
Total	753,144	591,633	656,802	634,541	648,950
	Value (1,000 dollars)				
Trinidad and Tobago	120,976	70,819	67,485	90,596	58,051
Canada	188,934	209,818	102,154	116,799	51,860
Venezuela	71,499	52,061	35,623	62,382	32,160
Chile	31,399	4,764	3,479	8,210	10,749
Bahrain	28,396	20,194	6,237	11,501	10,265
Russia	18,776	6,740	([3])	16,243	7,594
Saudi Arabia	2,447	793	707	([3])	554
Other	19,830	260	66	2,065	5,061
Total	482,206	365,449	215,751	307,794	176,294
	Unit value (Per gallon)				
Trinidad and Tobago	$0.784	$0.773	$0.368	$0.533	$0.267
Canada	0.498	0.577	0.327	0.465	0.282
Venezuela	0.834	0.631	0.294	0.452	0.263
Chile	0.716	0.397	0.246	0.381	0.200
Bahrain	0.865	0.608	0.283	0.457	0.250
Russia	0.999	1.225	([3])	0.639	0.435
Saudi Arabia	0.315	0.250	0.203	([3])	0.158
Other	0.653	1.498	2.048	0.568	0.509
Total	0.640	0.618	0.328	0.485	0.272

[1] Methanol feedstock for chemicals production, including MTBE (HTS 2905.11.20). In 1998, the general rate of duty for methanol chemical feedstocks was 13 percent; Uruguay Round provisions stage to a floor rate of 5.5 percent effective 1/1/2004. Excludes duty-free methanol imported for use in producing synthetic natural gas, or for direct fuel use (HTS 2905.11.10).
[2] One U.S. gallon of methanol is equal to 3.7854 liters.
[3] Not applicable.

Source: U.S. Department of Commerce and U.S. International Trade Commission.

increased during this period; Canada's, however, declined. The average unit value of U.S. methanol imports from all suppliers declined significantly between 1994 and 1998, largely as a result of increased capacity worldwide. In 1998, total U.S. import volume remained relatively unchanged,[9] but there was a significant decline in both the value and unit value of the imports; the latter declined 44 percent, from 48.5 cents per gallon in 1997 to a record low of 27.2 cents per gallon in 1998.

In 1998, Trinidad and Tobago ranked as the top U.S. import supplier, accounting for approximately 34 percent of total U.S. imports of methanol, followed by Canada (28 percent), Venezuela (19 percent), and Chile (8 percent). These four countries combined accounted for 89 percent of the import market; Bahrain (6 percent), Russia (3 percent), and Saudi Arabia (1 percent) supplied most of the remainder.

These 1998 rankings represented significant shifts for many of the countries. For example, whereas imports from Chile, Trinidad and Tobago, and Bahrain (combined) increased by about 14 percentage points during 1997-98, Canada's share declined by approximately 12 percentage points. On an individual-country basis, Chile's share increased by about 5 percentage points, Trinidad and Tobago's increased by about 7 percentage points; and Bahrain's increased by more than 2 percentage points.

U.S. imports of methanol are expected to continue to increase until after the year 2000 from sources in South America, the Caribbean, the Middle East, and Europe, with occasional shipments from Asia. Imports from Russia and Bahrain are expected to continue depending upon prevailing global market conditions. In comparison, higher cost domestic methanol plants are expected to be idled or permanently closed.[10]

Prices

U.S. methanol prices progressively strengthened during 1994, peaking toward the end of the year because of short supply in the market resulting from rising demand for MTBE, formaldehyde, and acetic acid (see figure F-1). The price rise was also the result of plant outages as producers stressed plants beyond capacity limits during the winter of 1994-95. As a substantial amount of new domestic capacity came onstream in 1995, market tightness moderated and prices stabilized. The later decline in prices experienced in 1998 and into the first quarter of 1999 is attributed primarily to downward price pressures resulting from new global capacity

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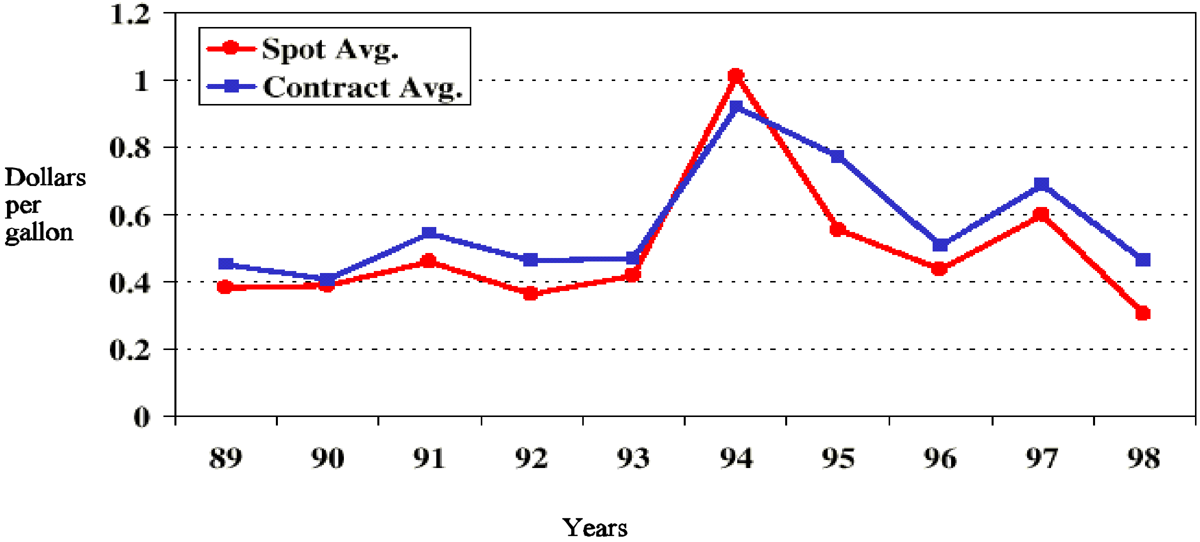
[9] The volume of U.S. imports of methanol in all forms (chemical feedstocks plus direct fuel use) increased to a new record level of 875 million gallons in 1998, or 26 percent more than the 1997 level and 15 percent above the previous record (764 million gallons) established in 1994. Unit values, however, were at record lows. Most of the methanol imported for use as a chemical feedstock (currently subject to a rate of duty of 11.8 percent) was believed to have entered free of duty under the provisions of the North American Free Trade Agreement, the Generalized System of Preferences, the Caribbean Basin Economic Recovery Act, and other trade agreements.

[10] Information provided to the Commission by the American Methanol Institute and representatives of DeWitt & Co.

Figure F-1
Spot and contract methanol prices in the United States, 1989-98.



Source: "Methanol Historical Pricing," found at the web site of the American Methanol Institute (*http://www.methanol.org/methanol/fact/methhistpr.html)*, retrieved May 21, 1999. Reprinted with permission from the American Methanol Institute.

coming onstream. Production from this new capacity is reportedly intended for the U.S. methanol market.[11]

Isobutylenes

The United States is basically self-sufficient in isobutylene consumption, as exports and imports[12] are insignificant. Although there are no official U.S. production statistics for isobutylene owing to its transient nature, industry sources estimate that most U.S. isobutylene is consumed directly in refineries for gasoline (55 to 65 percent) and MTBE production (30 to 40 percent)[13];

[11] Information provided to the Commission by the American Methanol Institute, Apr.-May 1999.

[12] Isobutylene is aggregated under "butylene and isomers thereof," under HTS subheading 2901.23.00.

[13] Commission telephone interviews with representatives of DeWitt & Co., Feb.-May 1999, and other industry representatives, Mar. 1-5, 1999.

another 3 to 5 percent is reportedly consumed in specialty chemical markets.[14]

In petroleum refineries, "crude petroleum is broken down into gasoline and lighter fractions,"[15] predominantly in FCCUs. These lighter fractions include "C_4 streams," which include isobutylene. According to industry sources, the FCCU C_4 stream can be reacted directly with methanol to form MTBE because methanol will selectively react only with isobutylene in the stream.[16] C_4 streams are also produced in steam crackers; however, butadiene is generally removed from steam cracker C_4 streams before the streams are reacted with methanol.

The majority of U.S. isobutylene-producing facilities are located along the Texas and Louisiana gulf coast. In the United States, approximately 44 percent of the isobutylene produced for MTBE manufacture is produced and consumed in petroleum refining operations. Overall, in terms of isobutylene obtained from C_4 streams, about 70 percent is obtained from FCCUs; 21 percent, from combination feeds (e.g., streams from both FCCUs and steam crackers); and the remainder, from steam cracker streams (table F-5). Most of the MTBE facilities situated in petroleum refineries were built during the late-1980s to mid-1990s.

Butanes

Butanes, both *n*-butane and isobutane, are the starting materials used to produce MTBE in "on-purpose" butane dehydrogenation plants in the United States. Isobutane is also a starting material in the production of TBA, a coproduct of PO production. Butanes, also called liquefied petroleum gases (LPGs), are liquid C_4 hydrocarbon fractions extracted primarily from natural gas; they are also obtained, albeit to a lesser extent, from petroleum refining operations. LPGs are considered a subset of a broader grouping of natural gas liquids (NGLs). According to the U.S. Department of Energy, NGLs are defined as light hydrocarbons with boiling temperatures close to room temperature, typically found in vapor form in natural gas reservoirs. The most common NGLs are ethane (C_2H_6), propane (C_3H_8), and butane (C_4H_{10}). NGLs also include smaller amounts of heavier hydrocarbons, such as pentane, which are commonly described as "natural gasoline" (or "pentanes plus").[17]

Capacity

The United States possesses the world's largest production capacity for, and is the world's largest producer of, NGLs, accounting for about 38 percent of global production in 1997.[18] U.S. natural gas liquid hydrocarbon production capacity, including LPG production capacity, is directly related to natural gas production in that liquid hydrocarbons and other

Table F-5
Isobutylene feedstock production capacity for certain MTBE plants in the United States [1]

(Barrels per stream day (B/SD) and metric tons per annum (MTPA[2]))

[14] Specialty chemicals manufactured from isobutylene are principally polyisobutylene, butyl rubber, methyl methacrylate, and diisobutylene.
[15] James Gary and Glen E. Handwerk, *Petroleum Refining: Technology and Economics*, p. 86.
[16] USITC fieldwork in the United States.
[17] U.S. DOE, "GG Appendix A on Emissions Coefficients/rev 10/12," undated, found at *http://www.eia.doe.gov/ oiaf/1605/87-92rpt/*, retrieved on June 4, 1999.
[18] *Oil & Gas Journal*, "Worldwide Gas Processing," June 8, 1998.

Company	Location	B/SD	Capacity MTPA	Isobutylene source
Lyondell Petrochemical	Channelview, TX	6,000	194,477	Combination[3]
Mobil	Beaumont, TX	2,200	70,012	Combination
Exxon	Baton Rouge, LA	1,200	38,895	Combination
Shell	Norco, LA	4,800	155,582	Combination
Deer Park Pet Refinery LP	Deer Park, TX	4,000	129,652	Combination
Subtotal		18,200	588,618	21%
Valero	Corpus Christi, TX	2,000	64,826	FCCU Gas[4]
	Houston, TX	1,200	38,895	FCCU Gas
	Krotz Springs, LA	1,700	54,454	FCCU Gas
	Texas City, TX	1,200	38,895	FCCU Gas
Amoco	Whiting, IN	400	12,965	FCCU Gas
	Yorktown, VA	600	18,151	FCCU Gas
Huntsman	Port Neches, TX	8,000	259,303	FCCU Gas
Diamond Shamrock	Sunray, TX	1,600	51,861	FCCU Gas
Phillips	Sweeney, TX	2,400	77,791	FCCU Gas
Sun	Marcus Hook, PA	2,000	64,826	FCCU Gas
Citgo	Lake Charles, LA	2,200	70,012	FCCU Gas
Lyondell Petrochemical	Houston, TX	1,600	51,861	FCCU Gas
Marathon	Detroit, MI	900	28,523	FCCU Gas
Conoco	Lake Charles, LA	1,600	51,861	FCCU Gas
Chevron	El Segundo, CA	1,600	51,861	FCCU Gas
	Richmond, CA	1,600	51,861	FCCU Gas
	Pascagoula, MS	1,900	62,233	FCCU Gas
Ashland	Catlettsburg, KY	2,600	82,977	FCCU Gas
Atlantic Richfield	Watson, CA	2,000	64,826	FCCU Gas
Hess	Port Reading, NJ	1,200	38,895	FCCU Gas
Koch	Corpus Christi, TX	2,200	72,605	FCCU Gas
	Rosemont, MN	1,200	38,895	FCCU Gas
Star Enterprise	Convent, LA	2,000	64,826	FCCU Gas
	Delaware City, DE	1,600	51,861	FCCU Gas
Exxon	Baton Rouge, LA	5,600	181,512	FCCU Gas
	Baytown, TX	5,600	181,512	FCCU Gas
	Benicia, CA	3,200	103,721	FCCU Gas
Tosco	Martinez, CA	1,800	57,047	FCCU Gas
Subtotal		61,500	1,988,856	70%
Exxon	Baytown, TX	2,400	77,791	Raffinate 1[5]
Citgo	Corpus Christi, TX	3,600	116,686	Raffinate 1
OxyChem	Chocolate Bayou, TX	1,600	51,861	Raffinate 1
Subtotal		7,600	246,339	9%
Total U.S. captive capacity		87,300	2,823,813	100%
Percent of total U.S. capacity			44%	
Total U.S. capacity		197,000	6,378,861	

[1] Reported MTBE capacity adjusted for isobutylene feedstock requirement (63.6 percent of total MTBE capacity by weight; and 80 percent of total MTBE by volume, in barrels).

[2] Annual capacity in tons, and barrels per stream day based on 340 days effective operating capacity.

[3] Isobutylene feedstock from steam cracker C_4 streams and/or FCCUs.

[4] Isobutylene feedstock from FCCUs. FCCU C_4 streams are generally used captively in the producing refineries.

[5] Defined by DeWitt as C_4 streams (minus already-extracted butadiene fractions) from steam crackers. The streams can be purchased.

Source: DeWitt & Co., Inc., *MTBE and Oxygenates*.

products found in natural gas, such as sulfur, nitrogen, and carbon dioxide, are typically removed to produce the principal product: dry marketable natural gas, or methane (CH_4). During the period 1995-97, the U.S. dry natural gas capacity utilization rate was relatively steady, ranging from 70 to 71 percent during 1995-97, maintaining an average annual growth rate of about

2 percent. This growth rate was in line with the growth in NGLs production.[19]

NGL extraction and storage facilities are concentrated principally along the Texas gulf coast; Texas and Louisiana account for nearly half of all U.S. natural gas processing plants. In 1997, these States accounted for nearly 57 percent of the entire U.S. NGL production, including butanes, with Texas alone producing more than 42 percent.[20] After removing byproducts such as hydrogen sulfide, water, nitrogen, and carbon dioxide from natural gas, processors use a national network of some 70,000 miles of high-pressure pipelines to ship the conditioned natural gas product to large fractionation facilities, where the liquids are separated into individual components. Four major raw-mix pipelines extend from the West Texas-New Mexico fields to Mt. Belvieu, TX, the major terminal and fractionation center of the United States. Other pipeline systems deliver West Texas-New Mexico NGLs to a second major terminal, storage, and fractionation point at Conway in central Kansas.[21]

Approximately 70 NGL fractionation plants operate in the United States, some with capacities of about 200,000 barrels per day of product (including butanes).[22] Some fractionators may handle the mixed natural gas liquids produced by a single recovery facility; larger central fractionators may process mixed streams from many plants, some of which may be located hundreds of miles away. After separation, the fractions are stored, usually in large underground salt caverns. Most fractionation and salt cavern storage capacity is located in Texas, Louisiana, Kansas, and Mississippi (in order of importance). The largest U.S. salt cavern storage capacity for NGLs is located at Mt. Belvieu, TX.[23]

Production and Consumption

During 1994-98, U.S. production of *n*-butane and isobutane together remained fairly constant, fluctuating from a low of 121 million barrels to a high of 125 million barrels. In 1998, production of the two products (totaling 121 million barrels) represented about 23 percent of all LPGs recovered from natural gas in the United States (see figure F-2 and table F-6). Butanes recovered in refineries (which account for about 25 percent of all butanes recovered in the United States) are used predominantly for captive gasoline blending.[24]

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[19] Ibid.

[20] Ibid.

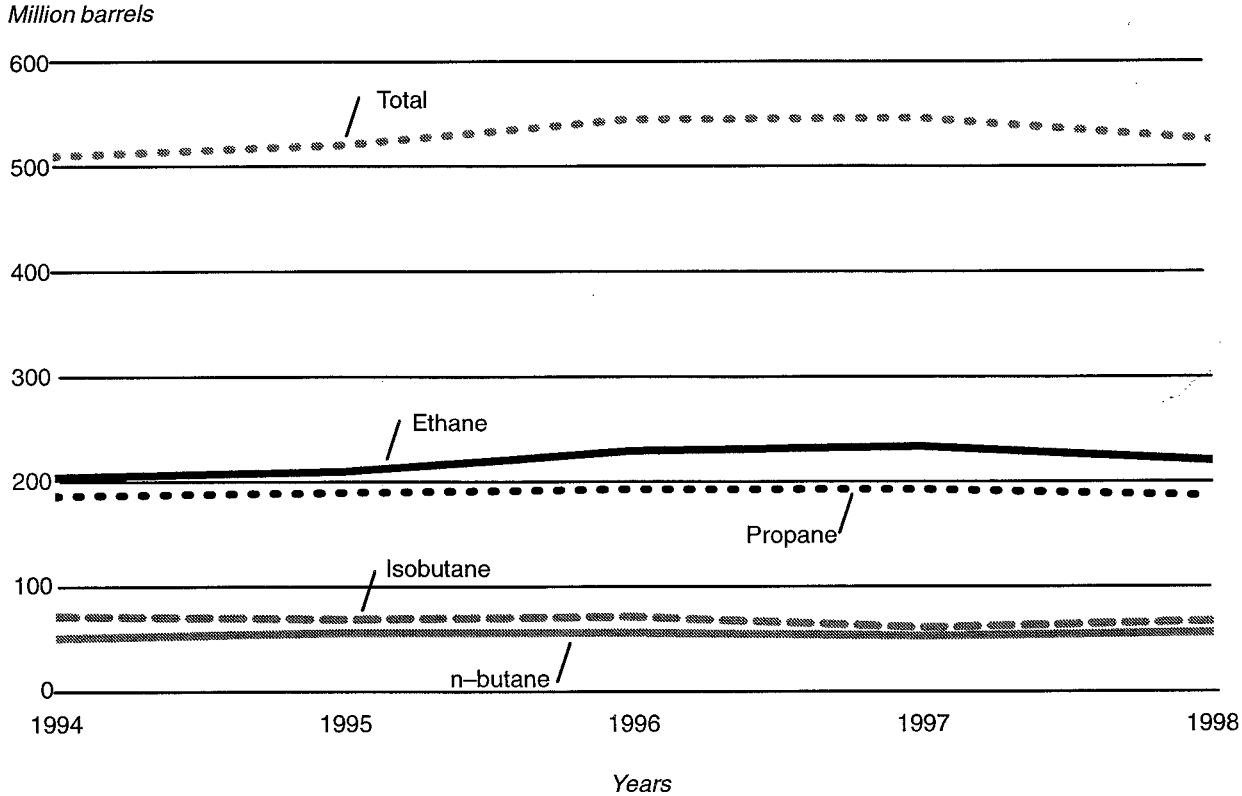
[21] Ibid.

[22] Warren Petroleum Co. and Enterprise Products Co. were cited by industry representatives as two sources for separated butanes. USITC fieldwork in the United States.

[23] Gas Processors Association, *The Gas Processing Industry: Its Function and Role in Energy Supplies*, Tulsa, OK, 1998.

[24] U.S. DOE, *Petroleum Supply Annual* (1994-97); *Petroleum Supply Monthly* (1998 series).

Figure F-2
Annual production of LPGs in the United States, 1994-98



Source: Petroleum Supply Annual (1994-97); Petroleum Supply Monthly (1998); U.S. Department of Energy, Energy Information Administration, Washington, DC.

Table F-6
Annual production of liquefied petroleum gases (LPGs) in the United States[1]

LPG	1994		1995		1996		1997		1998	
	Million barrels	Percent	Million barrels	Percent	Million barrels	Percent	Million barrels	Percent	Million barrels	Percent
Ethane	204	40	209	40	229	42	233	43	220	42
Propane	186	36	189	36	192	35	192	35	186	35
n-Butane[2]	50	10	55	11	55	10	52	9	55	10
Isobutane[2]	71	14	68	13	70	13	70	13	66	13
Total	511	100	521	100	546	100	547	100	527	100

[1] Excludes pentanes plus fraction (natural gasoline).
[2] Data adjusted for isomerization of *n*-butane to isobutane at fractionation facilities.

Source: U.S. DOE, *Petroleum Supply Annual* (1994-97); *Petroleum Supply Monthly* (1998 series).

However, *n*-butane production increased relative to that of isobutane during this period. Overall, the ratio of annual isobutane production to that of *n*-butane averaged about 1.5:1, or 60 percent versus 40 percent.[25] The average annual production for all butanes is roughly three to five times that needed to satisfy the amount consumed to produce MTBE in butane dehydrogenation facilities.[26]

Most of the MTBE plants using butane feedstocks have been built since 1990 and, as a result, a substantial new market for butanes has been created. The butane dehydrogenation process accounts for about 20 to 25 percent of U.S. butane consumption.[27] Another major use for *n*-butane is as a gasoline blending component during the winter months; other major uses for isobutane are in alkylate conversion and in motor fuels. Average annual domestic consumption of *n*-butane and isobutane for all uses during 1994-98 averaged 129 million barrels per year; U.S. production accounted for about 95 percent of the total (see table F-7).

Trade

In the United States, imports of both *n*-butane and isobutane together amounted to about 15 million barrels in 1998, accounting for about 12 percent of domestic consumption of butanes in that year (see table F-7). Imports of *n*-butane fluctuated in 1995 and 1996, although they amounted to 9 million barrels during the rest of 1994-98. The net trade deficit for *n*-butane in 1998 was about 3 million barrels; the import-to-consumption ratio was 16 percent. During 1994-98, imports of isobutane increased from 4 million to 6 million barrels. In 1998, such imports amounted to roughly 8 percent of domestic consumption. There were no exports of isobutane during 1994-98. Total imports of butanes as a share of domestic consumption averaged about 15 percent during the period.[28]

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[25] Both *n*-butane and isobutane are also recovered in petroleum refineries (60 percent and 6 percent of the total recovered from natural gas in 1997, respectively). According to DOE, however, the purity of these materials does not match that recovered from natural gas. Accordingly, refinery *n*-butane is either used as a blend in gasolines during the winter months; isomerized to isobutane to produce alkylate; or burned from refinery fuel.

[26] Assuming an upper-bound estimate of 37 million barrels, which takes into account the butane used as a starting material to produce TBA. Lyondell and Huntsman produce MTBE from TBA in the United States.

[27] Commission estimates based on telephone conversations with representatives of DeWitt & Co. and Lyondell, May 1999. The upper bound would be increased to about 30 percent if isobutane used as the starting material in the production of TBA (which would then itself be used to produce MTBE) is included. Separately, isobutane can be produced in-house by isomerizing *n*-butane or purchased from fractionators either as isomerized n–butane or as straight isobutane depending upon the price of the purchased product and type of MTBE production technology used at their plant.

[28] Trade in liquefied butanes is reported as an aggregate total of *n*-butane and isobutane having a minimum purity of 90 liquid volume percent (HTS 2711.13.00.10). In 1998, Canada and Saudi Arabia were the two top sources of U.S. imports.

Table F-7
U.S. annual production, trade, and consumption of *n*-butane and isobutane from natural gas liquids, 1994-98

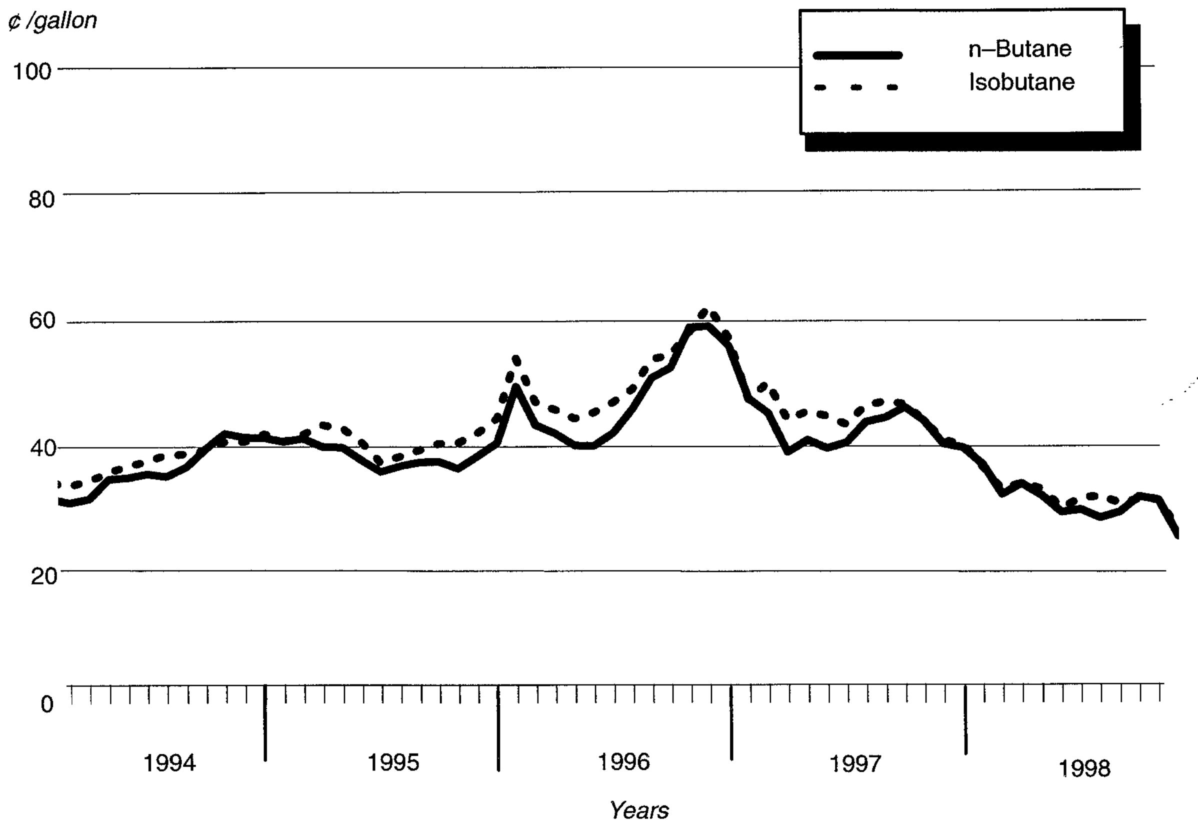
Item	1994	1995	1996	1997	1998
	Million barrels				
Production:					
n-Butane	50	55	55	52	55
Isobutane	71	68	70	70	66
Subtotal	121	123	125	122	121
Imports:					
n-Butane	9	6	7	9	9
Isobutane	4	4	5	6	6
Subtotal	13	10	12	15	15
Exports:					
n-Butane	5	7	8	6	6
Isobutane	0	0	0	0	0
Subtotal	5	7	8	6	6
Domestic consumption:					
n-Butane	54	54	54	55	58
Isobutane	75	72	75	76	72
Subtotal	129	126	129	131	130
Ratio of imports to consumption:					
n-Butane	17	11	13	16	16
Isobutane	5	6	7	8	8
Subtotal	10	8	9	11	12

Source: U.S. DOE, *Petroleum Supply Annual*, volume 1 (1994-97); *Petroleum Supply Monthly* (1998 series).

Prices

U.S. prices for *n*-butane and isobutane trended up and down in a relatively uniform manner during 1994-98, with isobutane prices running 2 to 4 cents above *n*-butane prices (see figure F-3). Prices peaked in 1997 owing to a combination of factors, including relatively stable crude petroleum and natural gas prices, increasing gasoline and petrochemicals demand, and greater heating oil demand during the winter months. Subsequently, however, declines in crude petroleum and natural gas prices, warmer winter weather patterns in the United States, and declining prices for MTBE and methanol resulted in prices for *n*-butane and isobutane during June 1998-March 1999 reaching the lowest levels in 5 years. At the end of March 1999, *n*-butane and isobutane on the gulf coast were quoted at 29 cents per gallon and 31 cents per gallon, respectively. This relatively small price differential reportedly encouraged U.S. producers of isobutylene from natural gas liquids to favor isobutane feedstocks, as *n*-butane costs including isomerization exceeded the price of isobutane.

Figure F-3
U.S. price trends for n-butane/isobutane, 1994-98



Source: U.S. Department of Energy.

Appendix G

U.S. Tariff Treatment and Trade Investigations

U.S. TARIFF TREATMENT AND TRADE INVESTIGATIONS

U.S. imports of MTBE have been classified in subheading 2909.19.14 of the Harmonized Tariff Schedule of the United States (HTS) since June 1997;[1] prior to that time, they were classified in HTS subheading 2909.19.10. The general (i.e., normal trade relations (NTR)) rate for imported MTBE in 1999 is 5.5 percent ad valorem, compared with 5.6 percent ad valorem during 1994-June 1997.[2] Column 1-general duty rates apply to all countries except those enumerated in HTS general note 3(b) (Afghanistan, Cuba, Laos, North Korea, and Vietnam), which are subject to the statutory rates set forth in column 2.[3] The column 2 rate for the same commodity is 37 percent ad valorem. Specified goods from designated NTR-eligible countries may be eligible for reduced rates of duty or for duty-free entry under one or more preferential tariff programs;[4] such tariff treatment is set forth in the special rate of duty column or in the general notes. If eligibility for special tariff rates is not claimed or established, goods are dutiable at column 1-general rates.

Major U.S. sources of MTBE imports during 1994-98 were Saudi Arabia, Canada, the UAE, and Venezuela. U.S. imports of MTBE from Saudi Arabia and the UAE are subject to the general rate of 5.5 percent, those from Venezuela may enter free of duty if eligible for entry under the provisions of the Generalized System of Preferences, and those from Canada may enter free of duty, under the provisions of the North American Free Trade Agreement.

The USITC has not conducted any investigations with respect to MTBE under any of the statutory provisions it administers. However, in 1989 the USITC published the results of a section 332 investigation on fuel oxygenates, such as ethanol, which may be used as substitutes for MTBE.[5]

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[1] The unit of quantity of MTBE for duty purposes is based on weight (i.e., kilograms or kg) rather than volume (i.e., gallon).

[2] The general rate of duty decreased in accordance with provisions of the Uruguay Round Agreement. In its submission to the Commission, SABIC states that whereas some countries have to pay this rate of duty, others are eligible for preferential duty treatment and that “any duty adds costs to imported MTBE that are not incurred by U.S. MTBE producers.” “Submission of Information,” p. 13. For more information regarding SABIC’s comments on this subject, see ***appendix I.***

[3] No MTBE imports entered the United States from these countries in 1998.

[4] Such trade agreements include the Generalized System Preferences, the North American Free Trade Agreement, the United States-Israel Free Trade Area, the Caribbean Basin Economic Recovery Act, and the Andean Trade Preference Act.

[5] *Ethyl Alcohol and Mixtures Thereof: Assessment Regarding the Indigenous Percentage Requirements for Imports in Section 423 of the Tax Reform Act of 1986 (*investigation No. 332-261), USITC Publication 2161, 1989. This report presented an analysis of different fuel oxygenates and summarized their advantages and disadvantages.

Appendix H

Chronology of Events Related to the Use of MTBE in the United States

Chronology of Events Related to the Use of MTBE in the United States [1]

Year	MTBE-related incidents, academic studies, and legislation
1979	California first uses MTBE in gasoline as an octane enhancer as a replacement for lead.
1980	MTBE is found to contaminate groundwater near a Shell Oil station in Rockaway, NJ.
1986	Pollution experts advise the U.S. Environmental Protection Agency (EPA) to regulate the use of MTBE because of the health risks associated with groundwater contamination.
1990	The Clean Air Act is amended to require the wintertime use of oxygenates in gasoline sold in carbon monoxide nonattainment areas. The amendment becomes effective on November 1, 1992.
1991	The EPA approves the use of MTBE-blended gasoline in high smog and carbon monoxide nonattainment areas.
1992	In January, California introduces the Phase I Reformulated Gasoline program (CaRFG);[2] in November, it begins a Wintertime Oxygenate Program.[3] Although neither program mandates the use of a specific oxygenate, MTBE is the primary oxygenate employed.
1992	In November, residents of Fairbanks, AK, report health problems associated with ambient air exposure to MTBE. Similar complaints are reported by residents of Missoula City, MT, and Colorado Springs, CO, during the winter season of 1992-93.
1993	In December, Alaska suspends its use of MTBE as a fuel oxygenate.
1994	Milwaukee, WI, begins using MTBE in its reformulated gasoline.
1995	MTBE is discovered in drinking wells in Santa Monica, CA. The chemical is also found in product released from 75 percent of the leaking underground storage tanks in Santa Ana, CA.
1995	Beginning January 1, 1995, Congress mandates the use of reformulated gasoline (RFG) in the country's nine most severe nonattainment areas: Baltimore, Chicago, Hartford, Houston, Los Angeles, Milwaukee, New York City, Philadelphia, and San Diego.

Chronology of Events Related to The Use of MTBE in The United States–Continued

[1] The following is a representative, rather than an exhaustive, account of MTBE-related events. For more information on legislation regarding MTBE, see ***appendix J***.

[2] California Phase I Reformulated Gasoline meets Federal requirements (effective on January 1, 1995) for the use of oxygenated fuel in carbon monoxide nonattainment areas. The gasoline contains oxygen-rich chemicals such as MTBE, which reduce levels of carbon monoxide from car exhaust that is released to the environment.

[3] Winter-oxygenated gasoline is sold from November to March in areas where excessive carbon monoxide emissions from motor vehicles compromise air quality. The fuel contains oxygenates in greater concentrations than in federally mandated reformulated gasoline. MTBE accounts for approximately 90 percent of oxygenates used in California's wintertime gasoline, and ethanol, for roughly 10 percent. California Environmental Protection Agency, "MTBE," Briefing Paper prepared on Apr. 24, 1997 (updated Sept. 3, 1998), p. 5.

Year	MTBE-related incidents, academic studies, and legislation
1995	Maine begins using MTBE-blended RFG.
1996	In June, California introduces Phase II Reformulated Gasoline (CARB Phase II RFG)[4] to meet Federal clean-air standards.
1997	MTBE is discovered in several California lakes and reservoirs, including Lake Shasta, Lake Tahoe, and Donner Lake. The chemical is found to be leaking from two-stroke engines on motorboats and jet skis.
1997	In February, the Los Angeles Regional Water Quality Control Board reports that MTBE has been found in 10 of the area's 436 drinking wells. The City of Santa Monica closes 7 of its 12 public drinking wells owing to the presence of MTBE.
1997	In June, the Tahoe Regional Planning Agency adopts an ordinance to ban the use of jet skis in Lake Tahoe. (The ordinance became effective on June 1, 1999.)
1997	In October, legislation introduced by California State Senator Richard Mountjoy (R-Arcadia) authorizes the University of California to study the health and environmental effects of MTBE.[5]
1997	Chevron and Shell settle a lawsuit filed against them by the City of Santa Monica by agreeing to pay more than $5 million to help alleviate MTBE contamination. The contamination reportedly occurred when MTBE migrated from the two petroleum companies' gasoline tanks to municipal drinking wells.
1997	In December, U.S. Senator Barbara Boxer (D-CA) urges the EPA to phase out the use of MTBE through a four-step process. One step requests the EPA to create a panel of experts to study public health hazards surrounding MTBE.
1998	On March 8, two Pennsylvania State Representatives introduce legislation prohibiting the use or sale of MTBE-blended gasoline.
1998	In June, Lawrence Livermore National Laboratory releases a study entitled *An Evaluation of MTBE Impacts to California Groundwater Resources*. The study examines the environmental impact of MTBE contamination from leaking underground fuel tanks (LUFTs), and finds that MTBE has affected nearly one-third of California's ground water sites.[6]

Chronology of Events Related to the Use of MTBE in the United States–Continued

[4] CARB Phase II RFG is formulated differently and is designed to burn cleaner than federally mandated reformulated gasoline.

[5] This legislation was introduced in California as State Senate Bill (SB) 521.

[6] Anne E. Happel, E. H. Beckenback, and R. U. Haden, *An Evaluation of MTBE Impacts to California Groundwater Resources*, Lawrence Livermore National Laboratory, June 11, 1998, pp. i and iv.

Year	MTBE-related incidents, academic studies, and legislation
1998	In October, the city council of South Lake Tahoe votes to ban the use of MTBE. (The ban took effect on April 1, 1999, at which time local fuel marketers had to eliminate MTBE from their gasoline supplies.)
1998	In October, Maine Governor Angus King asks the EPA for a waiver from the Federal oxygenate program. The request follows a study which reveals that nearly 4,300 of the State's drinking wells are contaminated with MTBE.
1998	In October, the California Energy Commission publishes a study, *Supply and Cost Alternatives to MTBE in Gasoline*. The study considers a statewide phaseout of MTBE under three different timeframes: the immediate term; a 3-year term; and a 6-year term. The study concludes that a gradual phaseout of MTBE over a period of either 3 or 6 years would have less of an adverse impact on the cost of gasoline than an immediate replacement of the product.[7]
1998	In November, the University of California releases its study, *Health and Environmental Assessment of MTBE*. The study concludes that while there are no significant environmental benefits derived from the use of MTBE-blended gasoline, there exist substantial health risks pertaining to MTBE contamination of water. Further, the study recommends that MTBE be phased out over a period of several years to allow for increased production of nonoxygenated gasoline.[8]
1998	In November, the EPA convenes a panel, composed of experts from the scientific and public health communities, to review the impact of MTBE and other oxygenates in gasoline. The "Blue-Ribbon Panel" reported its findings to the EPA in July 1999.
1999	On January 6, U.S. Congressman Brian Bilbray (R-CA) introduces a bill in the House of Representatives (HR 11) which requests a waiver from the Federal oxygenate mandate. U.S. Senator Dianne Feinstein (D-CA) introduces an identical companion bill in the U.S. Senate.
1999	On January 6, California State Assemblyman Rico Oller introduces a bill in the California State Legislature (AB 129) which would make it a misdemeanor to use MTBE in gasoline.
1999	On January 19, California State Senator Richard Mountjoy introduces a bill identical to that proposed by California Assemblyman Rico Oller (AB 129). In addition, California State Senator Don Perata introduces legislation (SB 192) requiring the labeling of gasoline pumps containing MTBE and calls for a statewide ban on MTBE by December 1, 1999.

[7] California Energy Commission, *Supply and Cost Alternatives to MTBE in Gasoline*, Oct. 1998, pp. 1-10.

[8] University of California, *Health and Environmental Assessment of MTBE*, Volume I: Summary & Recommendations, Nov. 1998, pp. 11-13.

Year	MTBE-related incidents, academic studies, and legislation
1999	On January 20, Senator Dianne Feinstein introduces three bills in the U.S. Senate to protect California's water supply from MTBE contamination. S. 266 requests a waiver from the Federal oxygenate mandate by permitting California to apply its own carbon monoxide emissions standards. S. 267 directs the EPA to conduct a cleanup of petroleum contaminants in drinking water. S. 268 requests that the EPA apply stricter emission controls to personal watercraft by 2001, 5 years earlier than the EPA had originally proposed.
1999	On January 21, legislation is introduced in the New York State Legislature to prohibit the use of MTBE.
1999	On February 26, California State Senator Byron Sher introduces a bill (SB 989) that would make it a misdemeanor to sell gasoline containing MTBE or any other ether-based oxygenate in California. The bill would take effect on December 31, 2002.
1999	In early March, New Hampshire lawmakers propose prohibiting the statewide use of gasoline containing MTBE.
1999	On March 17, Senator Dianne Feinstein introduces S. 645, which would provide a waiver to any State that could prove it is able to meet Federal air-quality standards without the use of an oxygenate in its gasoline.
1999	On March 25, California Governor Gray Davis signs an executive order to institute a statewide ban on MTBE. The ban is to take effect no later than December 31, 2002.
1999	On March 25, Connecticut State lawmakers introduce legislation that would result in a statewide ban on MTBE.
1999	On March 28, Arizona's Department of Environmental Quality announces that it plans to hold hearings to assess the environmental impact of MTBE in the State's ground water resources.
1999	On April 12, U.S. Representative Bob Franks of New Jersey presents legislation that calls for banning the use of MTBE nationwide.

Appendix I

“Information Submitted to the Commission on Behalf of SABIC and SABIC Americas”

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Accepted per Vila Chairman's Office 5/11/99.

May 10, 1999

RECEIVED
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US INT'L TRADE COMM
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DOCKET

VIA HAND DELIVERY

The Honorable Donna R. Koehnke
Secretary
United States International Trade Commission
500 E. Street, S.W.
Washington, D.C. 20436

Re: Submission of Information -- Methyl Tertiary Butyl Ether (MTBE): Conditions Affecting the Domestic Industry (Inv. No. 332-404)

Dear Secretary Koehnke:

On behalf of the Saudi Basic Industries Corporation (SABIC) and SABIC Americas, Inc., I hereby request that you accept the enclosed submission of information in the above-captioned investigation. This information was initially to be provided on or before April 14, 1999. However, SABIC and SABIC Americas, Inc. encountered complications in obtaining the information from government entities. The ITC investigative team was informed early on about the difficulty in collecting the requested information and consented to this submission.

The attorneys of record for SABIC and SABIC Americas, Inc., Homer E. Moyer, Jr. and John E. Davis, are unavailable to sign the submission. Accordingly, I will be signing the submission on their behalf. Please contact me, if you have any questions or require any additional information.

Respectfully submitted,

Kevin M. King

Kevin M. King

Enclosure

PUBLIC DOCUMENT

**RESPONSES TO QUESTIONS
FOR THE SAUDI ARABIAN MTBE INDUSTRY
USITC Inv. No. 332-404**

(1) What were MTBE production, import, export, and consumption levels in Saudi Arabia (in terms of both quantity and value) during 1994-98?

Quantity

Production: From the years 1994-96, production averaged just over 2 million MT/year. With the start-up on SADAF's plant in 1997, production levels increased to just under 2.7 million MT/year by 1998.

Imports: Saudi Arabia did not import MTBE during the period 1994-98.

Exports: During the period 1994-98, levels of exports on average were roughly comparable to levels of production.

Consumption: Consumption of MTBE in Saudi Arabia is very low. Consumption was negligible in 1994-95. In 1996-97, it grew to levels between 15,000 and 45,000 MT/year. By 1998, levels had increased to approximately 100,000 MT/year.

Value

The value of each category depends on the price paid at a particular time at the location to which products were shipped. As noted above, there were no imports of MTBE to Saudi Arabia during the period 1994-98. For exports, Appendix H of the 1998 DeWitt Annual for MTBE and Oxygenates contains data on historical prices for MTBE during the period 1994-98 to various export destinations, including the main destinations for exports of Saudi MTBE. Local prices for MTBE consumption in Saudi Arabia were approximately 80-90 percent of export prices, due mostly to lower transportation costs.

(2)(a) Who were the top 5 major sources for Saudi Arabian imports of MTBE (annually during 1994-98)?

Saudi Arabia did not import MTBE during the period 1994-98.

(b) Why?

Domestic supply of MTBE was sufficient to meet domestic demand.

(3) What were the annual rates of duty in Saudi Arabia for Saudi Arabian imports of MTBE during 1994-98?

Saudi Arabia does not import MTBE. Saudi Arabia maintains no duty rate applicable to MTBE imports.

(4) Are annual historic market share data available for shares of the Saudi Arabian MTBE market held by foreign companies for 1994-98?

Since Saudi Arabia did not import MTBE during the period 1994-98, this question is not applicable.

(5)(a) Who were the top 5 major markets for Saudi Arabian exports of MTBE (annually during 1994-98)?

The top five major markets for Saudi Arabian exports of MTBE for each year during the period 1994-98 were as follows (in order based on quantity shipped):

1994: Southeast Asia/Far East; United States; Europe; Middle East

1995: United States; Southeast Asia/Far East; Europe; Middle East

1996-98: United States; Southeast Asia/Far East; Europe; Africa; Middle East

(b) Why?

Major markets are a function of market demand. Overall demand for MTBE typically increases when local law requires a reduction in automobile emissions in order to improve air quality in that market; such requirements produce demand for MTBE as an oxygenate, not just as an octane enhancer. More and more countries in Europe and Asia are requiring the use of oxygenates as fuel additives for environmental reasons. Demand in those countries is increasing, or is expected to increase, accordingly. Both the World Bank and the IMF are also imposing environmental requirements that are accelerating this trend. An example is Korea, where environmental requirements that are being phased in over the next two years are expected to convert Korea from a net exporter of MTBE to a net importer. In addition to responding to market demand, SABIC Marketing has sought to maintain diverse markets and not to become too dependent on the United States, or any other single market.

(6) Are annual historic market share data available for the Saudi Arabian shares of MTBE markets in other countries?

The Saudi MTBE industry does not have access to readily-available data on historic levels of Saudi market share in the markets to which it exports. Using data on

imports into the United States provided by the ITC, it appears that Saudi MTBE accounted for approximately 10 percent of total U.S. consumption from 1994-97, and approximately 9 percent of total U.S. consumption in 1998.

(7)(a) Please identify the producers of MTBE, methanol, butane, and isobutylene in Saudi Arabia during 1994-98, noting who are the leading producers in any given year.

The following companies in Saudi Arabia produced the following products. The first company in each list was the leading producer for the period 1994-98:

MTBE:	**Ibn Zahr (The Saudi-European Petrochemical Company)** **Ibn Sina (The National Methanol Company)** **SADAF (The Saudi Petrochemical Company)**
Methanol:	**Ar-Razi (The Saudi Methanol Company)** **Ibn Sina (The National Methanol Company)**
Butane:	**Saudi Aramco**
Isobutylene:	**Saudi Aramco**

(b) Also please indicate if the producers listed are national companies or private companies and/or if they are joint ventures (or other forms of strategic alliances) with foreign companies.

All of the MTBE companies are joint ventures between American or European and Saudi companies.

Ibn Sina: Joint venture (50 percent foreign partners, 50 percent SABIC)
SADAF: Joint venture (50 percent foreign partner, 50 percent SABIC)
Ibn Zahr: Joint venture (70 percent SABIC, 30 percent foreign partners)
Ar-Razi: Joint venture (50 percent foreign partners, 50 percent SABIC)
Saudi Aramco: Company owned 100 percent by the Government of Saudi Arabia

SABIC, in turn, is owned 70 percent by the Government of Saudi Arabia and 30 percent by private investors from Saudi Arabia and other GCC countries. Accordingly, the percentage of government ownership in each of the joint ventures mentioned above is lower than the SABIC percentage of ownership listed.

The distinction implied in the question between "national companies" and "private companies" does not exist. The term "national companies," which is used in Resolution No. 68, refers to all companies licensed to do business and operating in Saudi Arabia. It does not draw a distinction based on foreign versus domestic ownership or government versus private ownership.

(8) Has there been consolidation in the Saudi Arabian MTBE industry during 1994-98?

No.

(9)(a) Please discuss briefly the level of vertical integration in the Saudi Arabian MTBE industry.

Of Saudi Arabia's three major producers of MTBE, only Ibn Sina (The National Methanol Company) has vertically integrated production.

(b) Are many MTBE producers back-integrated to the production of methanol and/or butane or do many MTBE producers purchase the inputs from other companies in Saudi Arabia?

Ibn Sina produces methanol, which it both sells and uses itself to produce MTBE. Other MTBE producers purchase feedstock from the feedstock producers listed in the response to Question 7(a).

(10) Please identify the levels of domestic and foreign investment in the MTBE industry during 1994-98.

The start-up of Ibn Zahr (The Saudi-European Petrochemical Company) was in 1989. Expansions in Ibn Zahr occurred between 1989 and 1994. Ibn Zahr is 30 percent foreign owned, 70 percent Saudi-owned.

The start-up of the MTBE plant of Ibn Sina (The National Methanol Company) occurred in the first quarter of 1994. Ibn Sina is 50 percent owned by American and European investors, 50 percent by Saudi investors.

The start-up of the MTBE plant of SADAF (The Saudi Petrochemical Company) was in the first quarter of 1997. SADAF is 50 percent owned by an American investor, 50 percent owned by Saudi investors.

(11) In what forms is foreign investment in the MTBE generally realized (i.e., mergers, acquisitions, joint ventures, etc.)?

Foreign investment in MTBE production in Saudi Arabia has been through joint venture investments. Each of the three major Saudi MTBE producers is a joint venture between American or European partners and Saudi partners.

(12) What were levels of research and development expenditures in the Saudi Arabian MTBE industry during 1994-98?

On average, the Saudi MTBE industry expended between 1-2 percent of the sales value of its products during the period 1994-98.

(13)(a) Where in Saudi Arabia are many or most of the MTBE producers located?

All three of the major Saudi MTBE producers are located at Al-Jubail.

(b) What dictates location (e.g., proximity to input sources, etc.)?

Al-Jubail offers generally available industrial infrastructure, access to reliable supplies of feedstock, necessary utilities, and proximity to an industrial seaport.

(14)(a) Which MTBE production processes are used in Saudi Arabia?

The production process used by all three MTBE producers in Saudi Arabia is a three-step process. First is the isomirization of butane. Second is butane dehydrogenation to isobutylene. The final step is the synthesis of MTBE by reacting isobutylene with methanol.

(b) What inputs are used in the production processes in Saudi Arabia?

The inputs used in the production of MTBE in Saudi Arabia are butane and methanol.

(15) Do different companies/facilities in Saudi Arabia use different inputs? If so, why?

All Saudi MTBE producers use the same inputs.

(16) From which sources in Saudi Arabia are the inputs obtained (please indicate company for each input)?

Butane is obtained from Saudi Aramco. Methanol is obtained from Ibn Sina and Ar-Razi (The Saudi Methanol Company, a 50-50 SABIC-Japanese joint venture).

(17)(a) Is a breakdown of average or estimated MTBE production costs for Saudi Arabia available?

Publicly-available data on MTBE production costs is not available.

(b) Are similar breakdowns available for the inputs (i.e., methanol, butane, isobutylone, etc.)

Publicly-available data on production costs for MTBE inputs is not available.

(18) Please provide any information as to employment levels in the Saudi Arabian MTBE industry during 1994-98.

The Saudi MTBE industry directly employed between 600 and 850 persons per year during the period 1994-98.

(19)(a) Please provide information as to production capacity (by facility, if available) and capacity utilization levels in the Saudi Arabian MTBE industry during 1994-98.

	Design Capacity	Avg. Utilization Levels (1994-98)
Ibn Zahr	**1,300,000 MT/year**	**100 percent**
Ibn Sina	**700,000 MT/year**	**100 percent**
SADAF	**700,000 MT/year**	**60 percent (came on-stream in 1997)**

Even plants operating at 100 percent levels do not produce their full design capacity in any given year. Because of the need for maintenance and upkeep, plants do not operate every day of the year.

(b) Please give an idea as to the general age of the individual MTBE production facilities (and, if possible, the ages of the input production facilities).

Ibn Zahr: The original plant is 10 years old, with expansions and modifications between 5 and 7 years old.

Ibn Sina: 5 years old.

SADAF: 2 years old.

(20)(a) If MTBE is consumed within Saudi Arabia, are the sales on a spot or contract basis?

Sales of MTBE in Saudi Arabia generally are made on a contract basis, although the contracts call for pricing based on current market rates.

(b) Please provide an indication of marketing channels/distribution channels for MTBE within Saudi Arabia and delivery modes for MTBE within (domestic sales) and outside the country (exports).

The three producers of MTBE in Saudi Arabia also market MTBE in Saudi Arabia. Domestic sales are generally made on a CIF basis. Domestically sold MTBE is first transported by sea vessels to domestic storage facilities on both coasts and subsequently delivered by truck and by pipeline to customers. Each of the joint venture partners of the producers of MTBE in Saudi Arabia markets its own off-take. Thus, for example, SABIC Marketing will export SABIC's share of MTBE from SADAF, while Shell Oil will export and market the share held by its subsidiary, Pecten Arabian Company. Exported product generally is transported by ocean vessels to regional marketing agents or affiliates, which take title from the time the product leaves Saudi Arabia until it is delivered to the customer.

Customers, in turn, transport MTBE to mixing or refining facilities by pipeline, barge, or truck.

(21)(a) What are the approximate transportation costs for product shipped within Saudi Arabia?

Approximate transportation costs for product shipped within Saudi Arabia is US$15-20 per metric ton.

(b) For MTBE exported from Saudi Arabia to the United States?

For MTBE exported from Saudi Arabia to the United States, approximate transportation costs are US$25-50 per metric ton, depending on a variety of factors, such as availability of shipping vessels and distance.

(c) For MTBE exported to the EU?

For MTBE exported to Europe, approximate transportation costs are US$20-40 per metric ton, depending on a variety of factors, such as availability of shipping vessels and distance.

(22)(a) What were annual pricing levels in Saudi Arabia for MTBE, butane, methanol, isobutylene, and natural gas during 1994-98?

Average prices (in US$/metric ton, or in $/mm BTU for gas) during the time period 1994-98 were as follows:

<u>MTBE</u>: 210 - 250

<u>Butane</u>: 65 - 194

<u>Methanol</u>: 50 - 310

<u>Natural Gas</u>: 0.50 (1994-97); 0.75 (1998)

(b) What is the current price level (i.e., spring 1999) for these products?

The current (spring 1999) prices (in US$/metric ton, or in $/mm BTU for gas) are the following:

<u>MTBE</u>: Not publicly available

<u>Butane</u>: Not publicly available

<u>Methanol</u>: Not publicly available

<u>Natural Gas</u>: 0.75

Isobutylene is produced from butane and is used to produce MTBE. It is not, however, purchased as a feedstock for MTBE and is not a separately-marketed commodity in Saudi Arabia. Therefore, no pricing information is available.

(23) What Government policies are in effect in Saudi Arabia that affect the production, trade, and pricing of MTBE and/or its inputs (e.g., butane, methanol, and isobutylene)? One example cited was a reported discount of 30 percent for butane for butane consumers in Saudi Arabia.

There are no government policies in effect in Saudi Arabia that govern the production or trade of MTBE. Nor are there government policies that govern the prices at which methanol and isobutylene are sold.

Through Resolution No. 68, dated 29.5.1413H (Nov. 25, 1992) (Attachment 1), the government of Saudi Arabia has set the price at which butane, as well as propane and natural gasoline, is to be sold domestically. That price is an adjusted price, based on the export price of the applicable liquid gas. Specifically, liquid gases sold in Saudi Arabia are sold at 70 percent of the lowest international price obtained by Saudi Aramco (the exporter of such liquid gases) from any overseas company in any quarter. Accordingly, the domestic sales price of, for example, butane fluctuates as the export price of butane fluctuates.

This adjusted price is the price charged to any and all companies that purchase liquid gases in the Kingdom of Saudi Arabia. (See response to Question (24) for additional detail.) That price applies without regard to geographical location of the buyer within the country, the industry in which a purchasing company operates, or whether the company is owned by private Saudi parties, by private foreign parties, by the Saudi government, or by any combination of the three. Thus, this adjusted price is generally available to all domestic purchasers of liquid gases from Saudi Aramco within Saudi Arabia, and all such purchasers pay the adjusted price. The reasons that the government established this adjusted price are set forth in the response to Question (25).

(24)(a) If such Government policies exist, who is eligible for the policies?

The term "national industries" used in Resolution No. 68 means all companies located within the country. The term, which is similarly used in other government decrees, thus expresses merely a geographical limitation. Accordingly, the adjusted price applies to all domestic purchasers. Further, the adjusted price is the standard price automatically charged to all domestic purchasers. Hence, "eligibility" is not an apt concept in connection with this price.

The domestic users of the liquefied gases are numerous. For example, propane (which is subject to the price adjustment) is sold as fuel to all types of small businesses and to households. The gases are also sold to various utilities to be used in power generation, again for a broad range of customers. Industrial users use these gases in production of many products.

(b) Are foreign-owned companies eligible?

The adjusted price applies to foreign-owned companies the same as it applies to all other companies licensed to do business in Saudi Arabia.

It has been suggested that some foreign-owned companies have not been deemed eligible for the price adjustment. Specifically, a venture co-owned by Mobil and Chemvest has been cited as having been denied access to the adjustment. That venture, however, was never licensed to do business in Saudi Arabia generally, for reasons having nothing to do with the price adjustment. The venture thus never went forward into production. If the venture had entered business in the country, it would have been entitled to buy liquefied gases at the adjusted price.

(c) Would joint-ventures be eligible? (Please answer parts a, b, and c for each policy identified in question 23.)

The adjusted price likewise applies to joint-ventures the same as it applies to all other companies licensed to do business in Saudi Arabia.

(25) What was the original intent behind the imposition of any such Government assistance programs for the feedstocks? (Please enumerate for the individual policies listed in question 23.)

The Saudi government established the adjusted price in Resolution No. 68 in recognition that the cost of liquid gases sold in Saudi Arabia are different from, and lower than, the cost of liquid gases sold for export. Because the seller's cost is lower in the case of domestic sales of liquid gases, selling liquid gases domestically at export prices would arguably be unfair to domestic buyers. To avoid that inequity and to reflect the difference in actual costs of liquid gases sold domestically and domestic gases sold on the world market, the government established the adjusted price described above for domestic sales of liquid gases.

The cost difference between domestically sold liquid gases and exported liquid gases is attributable, in part, to the transportation costs that the seller must bear in the case of export sales. Exported liquid gases are sold FOB at the Saudi port of shipment. The cost of transporting the butane to the port (typically by pipeline) is borne by the seller, as are the associated costs of handling, loading, and the like.

By contrast, in the case of domestic sales of liquid gases, the cost of transporting the liquid gases (typically by pipeline) is borne by the buyer. For example, contracts between the seller of butane, Saudi Aramco, and domestic buyers of butane, such as SABIC and its venture partners, require that the buyer pay for costs of transporting the butane. Thus, it is the responsibility of the buyers of these liquefied gases in Saudi Arabia to build, maintain, and operate the pipelines through which butane is delivered from the seller, Saudi Aramco, to the buyers. Accordingly, in those domestic transactions, the transportation costs are shifted from the seller to the buyer.

Indeed, even before Resolution 68, some companies paid only 70 percent of the export price obtained by Saudi Aramco for butane. Other domestic buyers were charged even less. As a result of Resolution No. 68, however, the price for all domestic industrial sales was uniformly pegged at 70 percent of Saudi Aramco's export price. This price still allows Saudi Aramco to recover its costs of production for liquid gases and generally to realize a healthy profit.

Indeed, some domestic purchasers of liquid gases believe that the adjusted price set by Resolution 68 is too high. A study was undertaken in Saudi Arabia at the behest of the Saudi government to compare the price paid by domestic purchasers of liquid gases in Saudi Arabia with the price paid by domestic purchasers of liquid gases in the United States. This study, which examined the example of propane, concluded that the "adjusted price" charged to domestic purchasers in Saudi Arabia was at times higher than the price paid by domestic purchasers in the United States. Furthermore, certain foreign venture partners of Saudi MTBE producers have repeatedly asserted that they are able to buy feedstocks at lower prices elsewhere in the world, despite the fact that Saudi Arabia enjoys a natural comparative advantage in the production of such feedstocks.

In addition, many of the contracts under which Saudi Aramco sells liquefied gases domestically are long-term contracts, which guarantee Saudi Aramco a reliable source of sales for those products as it lifts them. These contracts create greater certainty for the company. In other markets, such long-term contracts have offered price discounts of 15-20 percent off of world market prices to account for this stability of demand.

Thus, the adjusted price for domestic sales of liquid gases in Saudi Arabia was established to take into account that the seller's costs are lower in the case of domestic sales than in the case of export sales, and to recognize the effects of long-term contracting. Although some domestic purchasers believe that the adjusted price is higher than it should be in purely commercial terms, the adjusted price is now uniform and mandatory.

(26) Are there any transportation or environmental policies in Saudi Arabia that affect the MTBE industry and/or the input industries? If so, please enumerate.

Pursuant to guidance from the Royal Commission of Jubail and Yanbu, SABIC complies with international ISO 9000 standards.

(27)(a) How much of the total MTBE production cost in Saudi Arabia is accounted for by inputs?

The total production cost of MTBE varies based on changes in the costs of inputs. Depending on their relative costs at any given time, input costs can account for between 65 and 80 percent of the total production cost of MTBE. The remainder is made up of various fixed and variable costs.

(b) How much for each input?

Input costs vary over time, and thus account for different percentages of the total cost of producing MTBE at any specific time. Generally, however, butane can account for between 45 and 60 percent of the production cost, while methanol can account for between 20 and 30 percent of the production cost.

(28) To what extent is the source of inputs determined by input price?

Input price is a significant factor in determining the source of inputs. Part of that price reflects transportation costs.

(29) Is the MTBE production process in Saudi Arabia labor intensive or is it largely automated?

In Saudi Arabia, the production processes for MTBE are highly automated, employing state-of-the-art technology.

(30)(a) Do Saudi Arabian MTBE producers have production or distribution facilities in another country?

Saudi Arabian MTBE producers do not have production facilities in other countries, largely because proximity to feedstock sources lowers the cost of transporting inputs to plants. They do, however, maintain storage facilities in all major markets.

(b) If so, where? Why?

Storage and distribution facilities are maintained or leased in most major industrial countries of the world to facilitate sales.

(31)(a) Are there substitutable products for MTBE in Saudi Arabia? (b) If so, are such products produced in Saudi Arabia?

None of the products that are considered to be substitutes for MTBE are produced in or imported into Saudi Arabia, as domestic production of MTBE fills all available Saudi demand.

(32)(a) Is the Saudi Arabian market affected by increased imports of MTBE from other countries? (b) If so, how is it affected? (c) Which countries are involved?

The Saudi Arabian MTBE is not affected by imports of MTBE from other countries, because no such imports exist.

(33)(a) Are there any government policies in place in the United States would aid or hinder your ability to market product in that country?

There are various U.S. federal and state programs that aid or hinder the Saudi Arabian MTBE industry's ability to import and market its product in the United States. These include the following:

a. <u>Clean Air Act Amendments of 1990 ("Amendments")</u>. **The Amendments mandated inclusion of certain levels of oxygenates in refined gasoline, and thus substantially increased demand for MTBE in the United States due to compliance requirements.**

b. <u>EPA Reformulated Gasoline (RFG) Regulations (1995)</u>. **The EPA's regulations imposed limits on emissions from RFG in certain geographic areas of heavy consumption. The role of MTBE in refining gasoline to comply with these requirements economically further substantially increased U.S. demand for MTBE. Following implementation of these regulations, U.S. demand for MTBE exceeded the effective capacity of the U.S. MTBE industry.**

c. <u>California Air Resources Board (CARB) Phase II Standards</u>. **The CARB Phase II standards are state requirements that introduced more stringent emissions standards than federal RFG requirements. The Standards increased demand for MTBE in California.**

d. <u>Subsidies Provided by U.S. Federal and State Governments to Ethanol Producers and Users</u>. **Substantial tax subsidies and incentives make ethanol economical in markets where it otherwise would be unable to compete with MTBE on a cost-basis. These subsidies therefore distort the U.S. market for MTBE, artificially lowering the cost of ethanol in competition with U.S. and imported MTBE. Federal tax subsidies include: (a) a partial tax exemption from motor fuels excise taxes (worth 5.4 cents per gallon for gasoline containing** at least 10 percent ethanol); (b) the alcohol mixtures credit, allowing blenders to reduce their income taxes by 54 cents per gallon of ethanol of a certain proof that they use in blended fuel; (c) the alcohol credit, which allows businesses that use neat alcohol fuels or sell them at a retail level to reduce their income taxes by 54 cents per gallon of alcohol fuel; and (d) an income tax credit for small ethanol producers, equal to 10 cents per gallon of qualified ethanol produced for qualified recipients. In addition, certain states in the U.S. Midwest provide additional subsidies to ethanol producers and users.

e. California Phase-Out of MTBE. The details of the California government's March 1999 order phasing out MTBE over the next several years are still under discussion, and thus the industry does not have sufficient information to evaluate fully its potential effects on MTBE demand and supply. It is likely that demand for MTBE in California will decrease, but it is not clear whether demand for MTBE in the United States will decrease overall. Ethanol may fill some of the oxygenate demand in California, but at present there is not enough capacity in that industry to fill that demand and maintain existing market share in the U.S. Midwest. U.S. demand for MTBE may also be affected in the future by the actions of other states and by the federal government (for example, California legislators are reportedly working on modifications to federal air quality requirements to support the MTBE phase-out).

   Even if this order or other U.S. government policies substantially affect demand in the United States, the Saudi MTBE industry has a substantial number of alternative and growing markets in Europe and Asia. In the future, the industry would likely focus on increasing demand elsewhere in the world.

f. U.S. Customs Duties on MTBE Imports. Imports of MTBE from Saudi Arabia are charged a customs duty of 5.5 percent *ad valorem*. Imports from some other countries are charged this duty, while imports from yet other countries are eligible for preferential rates or a duty exemption. Any duty adds costs to imported MTBE that are not incurred by U.S. MTBE producers. Imports are also sometimes subject to U.S. harbor fees.

(b) Were they any during 1994-98?

Except for the phase-out of MTBE ordered by the state of California, all of the above U.S. policies were in effect during the period 1994-98.

(34) Are there any U.S. policies that have affected your ability to export product to the United States?

See response to Question 33(a).

Respectfully submitted,

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ATTACHMENT 1

Kingdom of Saudi Arabia
General Secretariat to the Council of Ministers

Resolution No. 68, Dated 29.5.1413H.

The Council of Ministers,

After reviewing the papers attached hereto including a Cable from H. E. Minister of Finance and National Economy under No. 3/2595, dated 23.3.1413H., stating that based on the Royal Order No. 3/B/8949, dated 30.6.1407H, forming a Committee from the Ministry of Finance and National Economy, Ministry of Petroleum and Mineral Resources, Ministry of Planning, Ministry of Industry & Electricity and the Public Audit Bureau to study a number of subjects including proposing selling prices for petroleum products sold within the Kingdom, the said Committee has agreed upon the Minutes of Meeting attached to His Excellency's cable, recommending the pricing for liquid gases sold to national industries using such gases on the basis that a 30% discount of the lowest international price obtained by the exporting party in any quarterly period from any overseas consumer, to be granted to said industries,

hereby resolves as follows:

Granting national industries using liquid gases (Butane - Propane - Natural Gasoline.) a 30% discount of the lowest international price obtained by the exporting party in any quarterly period from any overseas consumer is hereby approved.

Signature

Prime Minister

Appendix J

Legislation and Other Actions Regarding MTBE

LEGISLATION AND OTHER ACTIONS REGARDING MTBE[1]

Legislation pertaining to MTBE has been introduced in several State Legislatures as well as in Congress. In addition, action related to MTBE through other measures has also been sought. This discussion presents a sampling of these efforts.

In December 1997, in a letter to EPA Administrator Carol Browner, U.S. Senator Barbara Boxer requested that the EPA consider four steps to abate MTBE water contamination. These steps comprised establishing an emergency drinking water standard, studying the corrosive effects of MTBE on underground storage tanks, assessing the health risks associated with exposure to MTBE, and developing a plan to phase out MTBE use.[2]

On July 30, 1998, Senator Thomas Daschle (D-SD) introduced a bill, S. 2391, with the reported intent to protect the U.S. ethanol industry from being injured by increased imports of MTBE from Saudi Arabia.[3] Entitled "Fair Trade in MTBE Act of 1998," the bill stated that the expansion of Saudi Arabian production of MTBE has been stimulated by Government subsidies and, as a result, exports of Saudi MTBE to the United States have increased rapidly in recent years.[4] The bill stated that increasing imports decreased demand for domestic MTBE and its substitutes, such as ethanol. It also sought to authorize and direct the Secretary of Commerce to initiate an investigation, under section 702 of the Tariff Act of 1930, on MTBE imported from Saudi Arabia. However, the bill did not pass.[5]

More recently, on January 20, 1999, Senator Dianne Feinstein introduced three MTBE-related bills in the U.S. Senate. The first bill (S. 266) granted a State waiver from the federal oxygenate program;[6] the second (S. 267) directed the EPA to give "the highest priority" to the remediation of MTBE-contaminated drinking water; and the third (S. 268) required the EPA to amend its regulations to apply stricter emission controls to personal watercraft by 2001. Finally, in April 1999, U.S. Representative Bob Franks of New

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[1] For more information on events related to MTBE, see ***appendix H***.

[2] "Boxer Officially Calls on EPA To Phase Out MTBE," press release from Senator Boxer's office, Dec. 11, 1997.

[3] S. 2391, entitled "Fair Trade in MTBE Act of 1998," was introduced in the U.S. Senate by Senator Daschle on July 30, 1998 (105th Congress, 2nd Session). Also "Daschle Introduces Legislation To Protect U.S. Ethanol From Unfairly Subsidized Imports," press release from Senator Daschle's office, July 30, 1998.

[4] According to S. 2391, "the expansion of Saudi Arabian production capacity has been stimulated by government subsidies, notably in the form of a governmental decree guaranteeing Saudi Arabian MTBE producers a 30 percent discount relative to world prices on feedstock." The bill also stated, "the subsidized Saudi Arabian MTBE exports have reduced the market share of American producers of MTBE, ethyl *tertiary*-butyl ether (ETBE), and ethanol, as well as discouraged capital investment by American producers."

[5] So far, Congress has not enacted any legislation mandating removal of MTBE.

[6] An identical piece of legislation was introduced by Congressman Brian Bilbray in the House of Representatives on January 6, 1999.

Jersey introduced legislation that calls for terminating the use of MTBE nationwide.[7]

Bills have been introduced in several State Legislatures regarding MTBE. Beginning in 1997, California State and Federal lawmakers introduced legislation to limit MTBE usage. In October 1997, California enacted legislation introduced by California State Senator Richard Mountjoy which directed the University of California to study the health and environmental effects of MTBE. The University of California's study found that the health risks associated with contamination of drinking water by MTBE exceed the environmental benefits of the chemical's use in gasoline. Further, the study recommended the removal of MTBE from gasoline over an interval of several years.[8]

In March 1998, a bill to ban the sale of MTBE-blended gasoline was introduced in Pennsylvania; the bill did not pass, however, and there have been no further bills introduced pertaining to MTBE in that State.[9] In October 1998, Maine Governor Angus King requested that EPA grant a State waiver from the Federal oxygenate program; the request followed the detection of MTBE in over 4,000 of the State's drinking wells.[10] On January 21, 1999, a New York State lawmaker introduced legislation to prohibit the use of MTBE.[11] Subsequently, legislators in Connecticut and New Hampshire introduced legislation calling for the elimination of MTBE from gasoline supplies.[12]

Finally, on March 25, 1999, California Governor Davis signed an executive order calling for the elimination of MTBE from California gasoline no later than December 31, 2002. The order also required the California authorities to seek a waiver from the Federal oxygenate program. If such a waiver is received, they may elect to use nonoxygenated gasoline formulations, such as those currently developed by Chevron and Tosco.[13] If a waiver is not received, then they are required to use an oxygenate of some

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[7] "Bill Would Outlaw MTBE in Gasoline Throughout the Nation," *Chronicle News Service*, Apr. 13, 1999, and "NJ Rep. Calls for US Ban of Gasoline Additive MTBE," *Reuters*, found at *http://www.oxybusters.com*, retrieved Apr. 24, 1999.

[8] The study, entitled *Health & Environmental Assessment of MTBE*, was presented to Governor Davis on November 12, 1998. Although the report proved significant in Governor Davis' decision, its analysis and findings were the subject of criticism. For example, the Oxygenated Fuels Association, a group that represents oxygenate producers, commented that the report did not "provide a fair and balanced comparison of the costs and benefits associated with the use of MTBE when compared to alternative oxygenates" and that it made "numerous errors in calculating water and remediation costs." Oxygenated Fuels Association, "Oxygenated Producers Call on Governor To Keep MTBE in California Gasoline," News Release, Feb. 19, 1999, found at *http://www.ofa.net/ pr225.htm*, retrieved Mar. 16, 1999.

[9] Dennis Barbagello, "Reformulated Gas Ban Bill Pushed," *Tribune-Review State Capitol Reporter*, Mar. 10, 1998, and Commission telephone interview with a representative from the Pennsylvania Environmental Quality Board, May 10, 1999.

[10] Dieter Bradbury, "Oil Firms Offer Maine Alternative to MTBE," *Press Herald*, Jan. 21, 1999, found at *http://www.oxybusters.com*, retrieved Apr. 8, 1999.

[11] S. 1369, introduced by New York State Senator Johnson.

[12] Daniel P. Jones, "Lawmakers Push Ban on Fuel Additive," *The Hartford Courant*, Mar. 25, 1999, found at *http://www.oxybusters.com/*, retrieved Apr. 24, 1999, and "Keep Water Clean: N.H. Should Eliminate MTBE in Gasoline," *Daily Democrat*, Mar. 14, 1999, found at *http://207.180.37.11/comment/editorials99/march/ ed03114b*, retrieved Apr. 26, 1999.

[13] Chris Bowman, "Tahoe Will Get MTBE-Free Gas," *Sacramento Bee*, Mar. 27, 1999, found at

(continued...)

kind.[14]

[13](...continued)

http://www.sacbee.com/, retrieved Mar. 29, 1999; Wendy Tanaka, "Chevron Will Cut MTBE in Two Years," *San Francisco Examiner*, Mar. 30, 1999, found at *http://www.sfgate.com,* retrieved Mar. 30, 1999; and "California's MTBE Ban Threatens More Supply Disruptions," *Petroleum Argus*, Apr. 12, 1999, p. 4.

[14] Industry sources warn that ether-based oxygenates such as ETBE and TAME may eventually be subject to the same restrictions as MTBE. One California legislator has already introduced a bill which would make it a misdemeanor to sell gasoline containing MTBE or any other ether-based oxygenates in California, starting from December 31, 2002. John Hoffman, "Methanol and MTBE Face Uncertainties," *Chemical Market Reporter*, Apr. 19, 1999, and Senate Bill 989, introduced by California State Senator Byron Sher into the California State Legislature on Feb. 26, 1999.