98-290 ENR

CRS Report for Congress

MTBE in Gasoline:
Clean Air and Drinking Water Issues

March 24, 1998

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Congressional Research Service • The Library of Congress

ABSTRACT

This report provides background information concerning MTBE, an additive used to produce cleaner burning gasoline, and legislation (H.R. 630 / S. 1576) that would address the issue of its use in California reformulated gasoline. Controversy has surrounded the use of MTBE, most recently because of concern over contamination of drinking water supplies by leaking gasoline storage tanks and pipelines. The report briefly summarizes information concerning the environmental impacts of the additive's use and potential regulatory and legislative options. The report will be updated if legislative developments warrant.

MTBE in Gasoline: Clean Air and Drinking Water Issues

Summary

Concern over ground water contamination caused by the gasoline additive methyl tertiary butyl ether (MTBE) and recent announcements by two petroleum refiners have raised new questions concerning the desirability of using the additive as a means of producing cleaner burning fuel. MTBE is used by most refiners to produce the oxygenated or reformulated gasoline required in 27 states and the District of Columbia. It is credited with producing marked reductions in emissions of carbon monoxide and of the volatile organic compounds that react with other pollutants to produce smog. When it was introduced to new areas in 1992 and 1994, questions were raised concerning the health effects of breathing air containing MTBE/gasoline exhaust fumes. While research continues on this subject, analyses to date have found little scientific support for the expressed concerns and many reasons to believe that MTBE use has lowered the negative health effects of breathing gasoline fumes. More recently, incidents of ground water contamination by MTBE, particularly in California, have renewed concerns over the additive and led new voices to call for restrictions on its use.

EPA has authority under Section 211 of the Clean Air Act to regulate fuel and fuel additives, and under Section 303 of the Act to take emergency action to protect public health, welfare, or the environment. If the Agency determined that MTBE posed a significant threat, it could take action without new legislative authority. It does not appear likely that the Agency will take such action in the short term. In EPA's view, MTBE poses some risk, although no greater risk than that posed by other gasoline components. As a result, the Agency has chosen to respond by providing information, intensifying research, and focusing on the need to minimize leaks from underground fuel storage tanks.

Concern for potential impacts of MTBE have led some to discuss the availability of alternatives that might replace it. The major potential alternatives to MTBE are other forms of ether, such as ethyl tertiary butyl ether (ETBE), and alcohol fuels such as ethanol. These other oxygenates may themselves pose health and environmental impacts, although inadequate data leave EPA and other agencies unable to reach definite conclusions. In general, however, they cost more to produce than MTBE; in the case of ethanol and other alcohols, they pose challenges to the distribution system, requiring blending close to the market in which they will be sold; and, short term, none is likely to be available in sufficient quantity to replace MTBE. In recent months, two California refiners have discussed the possibility of making gasoline that meets the performance requirements for reformulated gasoline without using oxygenates, but the cost and feasibility of doing so have not been demonstrated, and current law would prohibit them from doing so.

The issue for Congress is whether Clean Air Act provisions concerning reformulated gasoline should be modified to allow refiners to discontinue their use of the substance. Legislation to permit California refiners to do so (H.R. 630 / S. I 576) has substantial support among that state's congressional delegation. The legislation would provide additional flexibility to refiners and marketers of reformulated gasoline in California only - not in other states.

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MTBE in Gasoline: Clean Air and Drinking Water Issues

Introduction

This report provides background information concerning the gasoline additive methyl tertiary butyl ether (MTBE) and the options available to congressional and other policy-makers concerned about it.

Under the Clean Air Act Amendments of 1990, numerous areas with poor air quality are required to add chemicals called "oxygenates" to gasoline as a means of improving combustion and, thus, reducing emissions.[1] The most commonly used of these oxygenates is MTBE. Portions of 27 states and the District of Columbia have reformulated gasoline (RFG) or oxygenated fuel requirements. A little more than 30% of the gasoline sold in the United States is sold in RFG areas. Of this gasoline, 76% contained MTBE in 1997. MTBE generally makes up 11 % of the total volume of RFG and up to 15% of the total volume of oxygenated fuel. It is also used in non-oxygenated, non-reformulated gasoline, as an octane enhancer, at lower concentrations.

Air Quality Benefits Resulting from MTBE Use

State and local environmental agencies and EPA attribute marked improvements in air quality to the use of fuels containing MTBE and other oxygenates. In Los Angeles, which has had the worst air quality in the country, the use of reformulated gasoline was credited with reducing ground-level ozone by 18% during the 1996 smog season, compared to weather-adjusted data for the same period in 1994 and 1995. Use of the gasoline also reduced the cancer risk associated with exposure to vehicle emissions by 30 to 40%, according to California EPA, largely because it uses less benzene, a known human carcinogen. [2]

EPA and an interagency group chaired by the White House Office of Science and Technology Policy (OSTP) have reported improvements in carbon monoxide (CO)

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[1] The requirements for reformulated gasoline, to reduce emissions that contribute to smog formation, are found in Section 211(k) of the Clean Air Act. Separate requirements for oxygenated fuel, to reduce carbon monoxide formation, are contained in Section 211(m). The latter requirements are in effect during winter months only and affect a small percentage of the nation's gasoline. Ethanol is the primary oxygenate used in winter oxygenated fuels and MTBE the primary oxygenate used in RFG, although either can be used in both fuels.

[2] See "Reformulated Fuels Help Curb Peak Ozone Levels in California," Daily Environment Report, November 6, 1996, pp. A-1 and A-2.

levels, as well, due to the use of oxygenates. According to the June 1997 OSTP report, "analyses of ambient CO measurements in some cities with winter oxygenated gasoline programs find a reduction in ambient CO concentrations of about 10%."[3] Since CO comes from other sources of combustion, in addition to motor vehicles, a 10% reduction in ambient CO from the addition of oxygenates to fuel would be a major improvement.

EPA "believes that the reductions estimated in air quality studies are significant and that these reductions help to protect the public from the adverse health effects associated with high levels of CO in the air."[4] The Agency bases its conclusions on both its own analysis and on a report prepared for two industry groups. The latter, using hourly data for more than 300 monitoring sites gathered over a 9-year period, concluded that use of oxygenated fuels was associated with a 14% reduction in ambient CO concentrations.[5]

Air-Related Health Questions

The improvements in measured air quality have not come without question. In several cities, residents have complained of a variety of health effects from exposure to MTBE/gasoline exhaust: headaches, dizziness, nausea, sore eyes, and respiratory irritation. Some complaints have centered around the use of MTBE in cold weather, two of the principal areas noting complaints being Alaska and Milwaukee, Wisconsin.

The Interagency Task Force examined these complaints and concluded:

> With regard to exposures ... experienced by the general population and motorists, the limited epidemiological studies and controlled exposure studies conducted to date do not support the contention that MTBE as used in the winter oxygenated fuels program is causing significant increases over background in acute symptoms or illnesses.[6]

Additional research is being conducted, including a Rutgers University study on self reported MTBE-sensitive individuals, the results of which are anticipated in the fall

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[3] Executive Office of the President, National Science and Technology Council, Interagency Assessment of Oxygenated Fuels, Washington, D.C., June 1997, p. iv. Referred to as the OSTP Report. The report expressed some hesitation about its conclusions, particularly regarding the impacts of MTBE in colder weather. It also noted methodological difficulties in identifying statistically significant reductions smaller than 10%, and recommended additional research.

[4] U.S. EPA Response to Interagency Assessment of Oxygenated Fuels, undated, p. 2.

[5] Systems Applications International, Inc., for the Renewable Fuels Association and the Oxygenated Fuels Association, Regression Modelling of Oxyfuel Effects on Ambient CO Concentrations, Final Report, January 8, 1997, p. 1. EPA has made this report available through its web site, although the Agency notes that it is still undergoing peer review.

[6] OSTP Report, p. vi. The report did suggest that "greater attention should be given to the potential for increased symptoms reporting among workers exposed to high concentrations of oxygenated fuels containing MTBE," however.

of 1998. EPA has also requested, under the authority of Section 211 of the Clean Air Act, that refiners conduct a number of health effects studies on oxygenated, reformulated, and conventional gasoline, which should provide additional information.

In the meantime, the Interagency Task Force, EPA, and some environmental groups have all argued that current knowledge suggests that MTBE is a less serious compound than the gasoline components it replaces. According to the OSTP report, the cancer risk from exposure to MTBE is "substantially less than that for benzene, a minor constituent of gasoline that is classified as a known human carcinogen; and more than 100 times less than that for 1,3-butadiene, a carcinogenic emission product of incomplete fuel combustion."[7]

Ground Water and Drinking Water Issues

Another potential cause for concern regarding the use of MTBE is that it has been detected at low levels in ground water in many locations nationwide and at elevated levels in some municipal drinking water wells, especially in California. [8] MTBE is very soluble, and once released, it moves through soil and into ground water more rapidly than other chemical compounds that are present in gasoline. It is also slow to biodegrade.

Data are limited on the occurrence of MTBE in ground and surface water and, more specifically, in drinking water. The prime example is the city of Santa Monica, California. There, two well fields that supplied 50% of the city's water supply have been contaminated by leaking underground storage tanks or pipelines that contained gasoline with MTBE, and the city has had to find alternative water supplies. One other California city (Marysville) also closed drinking water wells because of MTBE contamination - in this case, a secondary well used during periods of high demand.

With the exception of these two communities, however, the available data do not indicate a widespread occurrence of MTBE in drinking water supplies. [9] The 1997 OSTP report stated that MTBE had been detected in 51 public water systems based on limited monitoring in 5 states, and that MTBE concentrations in 47 of the wells were below the lower limit of EPA's health advisory level of 20 micrograms per liter

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[7] Ibid., p. vii.

[8] According to EPA, MTBE has been detected at high levels primarily in ground water near leaking underground storage tanks (USTs). Leaking aboveground tanks and pipelines have caused a limited number of instances of MTBE contamination of drinking water, while recreational water cra8 and storm water runoff are most likely to be the cause of contamination in shallow ground water and surface water. See U.S. Environmental Protection Agency. Drinking Water Advisory: Consumer Acceptability Advice and Health Effects Analysis on Methyl Tertiary-Butyl Ether (MTBE). Fact Sheet, EPA-822-F-97-009, December 1997. p. 2.

[9] Testimony of Charles N. Freed, Director, Fuels and Energy Division, U.S. Environmental Protection Agency, before the Assembly Natural Resources Committee, California Legislature, November 21, 1997, p. 10.

(ug/L).[10] Since 1996, California water suppliers have been monitoring for MTBE. As of February 1998, 34 sources (including 6 reservoirs) of more than 2,600 tested had reported detectable concentrations of MTBE; only 3 of the sources exceeded the EPA advisory upper level of 40 parts per billion. [ll]

Looking at ground water more broadly (not just drinking water wells), the data do indicate that low-levels of MTBE are found more often. In 1997, the California Environmental Protection Agency reported that, based on monitoring information available for underground storage tank (UST) sites, "MTBE can be expected to be found in [shallow, unused] ground water at several thousand UST sites throughout California" and often at high concentrations (in the parts-per-million range).[12] Additionally, analyses of more than 1,500 samples from monitoring, observation, and water supply wells by states and the U. S. Geological Survey (USGS) found MTBE in about 5% of the wells, although MTBE levels exceeded 10 g/L (or 10 parts per billion) in only 7 wells.[l3]

To address concerns raised by detections of MTBE in ground water and drinking water, EPA has taken action on three levels. The Agency has: I) issued a drinking water advisory; 2) intensified research and monitoring efforts, in cooperation with USGS and state agencies; and 3) continued, with the states, to implement the underground storage tank regulatory program, which should address the most serious point sources of MTBE in ground water.

EPA issues health advisories to provide information on drinking water contaminants that have not been regulated under the Safe Drinking Water Act. Advisories are not enforceable, but provide guidance to interested parties regarding potential health effects or consumer acceptability. Although the MTBE advisory, issued in December 1997, did not provide a health threshold level, it states that keeping levels of the contaminant in the range of 20-40 pg/L or below will protect consumer acceptance of the water resource and will also provide a large margin of exposure safety from toxic effects.[l4]

EPA has also formed an Oxygenates-Water Research Task Group that is identifying current and pending research on MTBE. Among other state and federal research efforts, the USGS is conducting assessments of the occurrence of MTBE in the mid-Atlantic and Northeastern states (where use of MTBE is common), and is monitoring surface and ground water for MTBE under the National Water-Quality Assessment Program.

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[10] OSTP Report, p. 2-43.

[ll] California Environmental Protection Agency, MTBE (Methyl Tertiary Butvl Ether) Briefing Paper, September 2, 1997, p. 18 and California Department of Health Services (at www.dhs.cahwnet.gov/dwem/publications/chemicals/mtbe/mtbsummary.htm. The briefing paper can be found on the Internet at http://www.arb.ca.gov/cbg/pub/mtbebp.pdf.

[l2] Ibid., p. 16.

[l3] lbid., p. 2-39.

[l4] EPA Drinking Water Advisory, p. 2.

The third focus of EPA efforts is implementation of the underground storage tank program established by the 1984 amendments to the Resource Conservation and Recovery Act (RCRA). Under this program, EPA has set operating requirements and technical standards for tank design and installation, leak detection, spill and overfill control, cleanup of releases, and tank closure. As of 1993, all tanks were required to comply with leak detection regulations. By December 22, 1998, tanks installed before December 1988 (when standards for new tanks took effect) must be upgraded to meet new tank standards or must be replaced or closed. As tank owners and operators meet these new requirements, the number of petroleum and related MTBE leaks from USTs should decline significantly. [15]

Other Regulatory Options

EPA has authority under Section 211 of the Clean Air Act to regulate fuel and fuel additives, and under Section 303 of the Act to take emergency action to protect public health, welfare, or the environment. If the Agency determined that MTBE posed what it considered a significant threat to air quality, water quality, or human health, it could take action without new legislative authority.

It does not appear likely that the Agency will take such action in the short term, however. In EPA's view, studies to date have not indicated that MTBE poses ant greater risk to health than other gasoline components, such as benzene. As a result, the Agency has chosen to respond by providing information, intensifying research, and monitoring implementation of UST requirements discussed earlier. Research could lead to regulatory action at some future point, but the immediate prospects for such action are slim.

Alternatives to MTBE

Concern for potential impacts of MTBE have led some to discuss the availability of alternatives that might replace it. The major potential alternatives to MTBE are other oxygenates. These include other forms of ether, such as ethyl tertiary butyl ether (ETBE), and alcohol fuels such as ethanol. These other oxygenates have themselves been criticized for potential health and environmental impacts, although inadequate data leave EPA and other environmental agencies unable to reach definite conclusions regarding their relative impacts. In general, they cost more to produce than MTBE; in the case of ethanol and other alcohols, they pose challenges to the distribution system, requiring blending close to the market in which they will be sold; and, short term, none is likely to be available in sufficient quantity to replace MTBE.

In recent months, some refiners have discussed the possibility of making gasoline that meets the performance requirements for RFG without using oxygenates. In late 1997, Tosco and Chevron, two firms with large stakes in the California gasoline market, alluded to this possibility, and asked for changes in the rules to allow the sale of RFG not meeting the oxygenate requirement. Tosco expressed concern about the growing evidence of the potential for extensive MTBE contamination in asking the

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[15] For more information on the federal UST program, see CRS Report 97-471, Leaking Underground Storage Tank Cleanup Issues, October 16, 1997, 6 p.

California Air Resources Board to "take decisive action" to "begin to move away from MTBE."[16] Chevron, California's largest refiner, followed suit, announcing that it "may be possible to make a cleaner burning gasoline without oxygenates, and still reduce emissions to the same extent achieved with current standards."[17] The company reiterated its support for legislation allowing it to stop or reduce its use of the additive. These statements were supported by the Western States Petroleum Association.

Petroleum refiners and marketers are not united in seeking authority to replace MTBE, however. The major producers of MTBE, notably ARCO, have not joined the efforts to promote alternatives, and some view the statements by Tosco and Chevron as efforts to achieve a competitive advantage in a market where they now have little bargaining power.[18]

Legislation

Legislation which could affect MTBE use has been introduced in both the 104th and 105th Congress, but as of March 1998, no action had been taken. The legislation in the current Congress (H.R. 630/ S. 1576) aims to change the regulatory requirements for reformulated gasoline as they pertain to California.

California has unique status under Section 211(c)(4)(B) of the Clean Air Act. Because its air pollution program predated the federal program and because air quality in portions of the state is worse than that anywhere else in the country, California is allowed to have separate regulations for fuels. Thus, gasoline sold in portions of the state (Los Angeles, Sacramento, and San Diego) must meet two separate sets of requirements - state and federal. The federal requirements, which were specified by Congress in Section 211 (k) of the Clean Air Act, mandate that RFG contain at least 2% oxygen by weight (a requirement now generally met by adding MTBE to the fuel). California's standards, which became effective a year later than the federal, include an oxygen content specification "because of the oxygen requirements in the federal RFG program."[19] According to Cal EPA, however, "a key element of the California program is a mathematical or `predictive' model that allows refiners to vary the composition of their gasoline as long as they achieve equivalent emission reductions. . . . For areas not subject to federal RFG requirements, refiners can use the predictive model to reduce or even eliminate the use of oxygenates," except

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[16] Letter of Duane B. Bordvick, Vice President, Environmental and External Affairs, Tosco, to John D. Dunlap III, Chairman, California Air Resources Board, October 17, 1997.

[17] “Chevron Seeks Changes to Reformulated Gasolines," Press Release, Chevron Corporation Public Affairs Department, December l, 1997.

[18] "Tosco Seen trying to Gain Competitive Advantage in Oxygenate Market," New Fuels & Vehicles Report, November 7, 1997, p. 1.

[19] California Environmental Protection Agency, MTBE Briefing Paper, September 2, 1997, p. 6.

during the four winter months, when they are subject to separate oxygenate requirements to reduce carbon monoxide.[20]

The complicated regulatory requirements faced by California refiners and marketers of gasoline led Rep. Brian Bilbray, of San Diego, to introduce legislation to provide for more flexible federal requirements in California's case. The legislation (H.R. 630 in the current Congress), would apply only to California, dispensing with the federal oxygen requirement provided that the fuel continues to achieve the required reductions in emissions of toxic air pollutants and ozone-forming compounds specified elsewhere in Section 211 (k). The legislation is supported by a number of oil companies, the California Air Resources Board, and the Governor of California, and it is cosponsored by 47 members of the California congressional delegation. EPA and most environmental groups have not taken a formal position on the legislation, and the bill has no congressional cosponsors outside the California delegation.

California's two Senators have also expressed interest in the MTBE issue: on December 9, 1997, Sen. Boxer chaired a field hearing of the Senate Environment and Public Works Committee in Sacramento to examine the reports of MTBE contamination, and later called on EPA to set an emergency drinking water standard, study the corrosive effects of the additive on underground storage tanks and pipelines, and prepare a plan to phase out its use. Sen. Feinstein introduced legislation identical to H.R. 630, S. 1576, on January 28, 1998.[21]

Conclusion

Controversy continues to surround the use of MTBE in gasoline, but research conducted to date suggests that the benefits of its use are substantial, while negative impacts on the environment appear to be limited. Research on MTBE and other gasoline additives is ongoing, and could provide additional information that might modify this conclusion.

Legislation introduced in Congress has addressed the limited issue of MTBE use in California, where federal requirements have prevented refiners from adopting a more flexible approach permitted by state regulations. Modifying the federal requirements as they pertain to California (as provided by H.R. 630 / S. 1576) has substantial support among the California congressional delegation. The legislation does not address (and is not intended to address) a broader issue: the desirability of statutory oxygenate requirements in other states.

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[20] Ibid.

[21] California state legislators have responded to the concerns over MTBE, as well. Legislation, signed October 8, 1997, requires the state to set standards for MTBE in drinking water, and requires the University of California to conduct a study of the health effects of MTBE and other oxygenates and risks associated with their use. The UC report is to be completed by January 1, 1999. Based on the report and on public hearings, the Governor is to certify whether MTBE poses a risk to human health or the environment and take appropriate action to protect public health and the environment, if warranted.