Air Resources Board

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Winston H. Hickox

Secretary for Environmental Protection

Gray Davis

Governor

MEMORANDUM

TO: Winston H. Hickox
Secretary for Environmental Protection

FROM: Michael P. Kenny
Executive Director

DATE: February 22, 1999

SUBJECT: HEALTH & ENVIRONMENTAL ASSESSMENT OF MTBE, NOVEMBER 1998

We have reviewed the report to the Governor, Health & Environmental Assessment of MTBE (November 1998). The report was prepared by research staff of the University of California, as required by Senate Bill 521 and is subsequently referred to as the SB 521 Report. This memo transmits our comments for your consideration.

Air Resources Board (ARB) staff concur with a number of the conclusions in the SB 521 Report, and with the overall finding that California can move away from the use of MTBE in gasoline and still retain the substantial and essential air quality benefits provided by the current State regulations for California Phase 2 Reformulated Gasoline (CaRFG). We concur that our regulations and available refining technologies allow complying gasoline to be produced and marketed without adding MTBE or any other oxygenate. Such gasoline provides equivalent emissions benefits as fuel produced with oxygenates, provided the formulation is allowed under the ARB's predictive model compliance option. However, while some refiners are now able to make a portion of their gasoline under this option, it is important to note that it will take substantial refinery modifications and time before California refineries can make sufficient fuel under this option to satisfy the State's demand for gasoline with in-state production and retain the air quality benefits of CaRFG.

We also concur with the SB 521 Report that changes to the Federal Clean Air Act to remove the 2.0 percent oxygen requirement, that currently applies to most of the gasoline produced in California, are needed to enable an orderly move away from MTBE. Significant changes to the existing reformulated gasoline program in California are contingent upon changing federal law to lessen or eliminate the mandate for oxygenates in reformulated gasoline. The California gasoline program is designed to allow refiners the flexibility to decide which, if any,

oxygenate to use and how much to use, while preserving the full air quality benefits of the program. It is this flexibility that is presently allowing California refiners to market, in non-federal RFG areas, gasoline with no or reduced amounts of oxygenates with no loss in air quality benefits. Without a change in federal law, the transition away from MTBE will be more time consuming, more difficult and more costly.

We agree that additional study of the environmental and health effects of alternative oxygenates such as ethanol are needed before they are used as a widespread replacement for MTBE. We have addressed the impact of ethanol use on ozone air quality, but the questions raised by U. C. Scientists should be examined.

In December 1998, the ARB found that the ozone forming potential of gasoline with 10 percent ethanol and an elevated Reid Vapor Pressure (RVP) would increase ozone levels when compared to a gasoline fully complying with CaRFG requirements. This finding allows the use of elevated levels of ethanol as an oxygenate, but only if it is used in gasoline blends that fully comply with all CaRFG specifications, including RVP. Since evaporative emissions from vehicles and gasoline marketing are a substantial portion of overall vehicle related emissions of smog precursors and toxics, we believe the use of ethanol in CaRFG must be accomplished without any increase in evaporative emissions unless this increase is fully offset through decreases in exhaust emissions. The ARB staff report, a peer review conducted by a University of California Berkeley Scientist, and the Board's resolution on this are attached.

Finally, we have already acted to implement, or are pursuing a number of the policies suggested for consideration in the SB 521 Report. For example, the ARB acted in December, 1998 to adopt emission standards for personal watercraft and outboard engines. As part of this action, we established labeling requirements that allow consumers and officials charged with ensuring water quality protection with a means to determine the relative emissions from engines we regulate. Both of these options will greatly help to reduce discharges of MTBE and other gasoline components to surface water due to boating activity.

We also acted last year to remove the wintertime requirement to add oxygen to gasoline in most of the State, and will expand this action to include more areas as they attain the air quality standards for carbon monoxide. We are planning on revisiting our CaRFG regulations this year to amend the rules to provide gasoline producers greater flexibility to make gasoline without oxygenates such as MTBE, while maintaining or improving the emissions reductions obtained by the rules. The degree of flexibility we will be able to provide is affected by our success in obtaining relief from the federal oxygenate mandate. Without such relief, our ability to provide flexibility to refiners while preserving air quality benefits, will be limited.

Although we agree with the overall thrust of the SB 521 Report, and with much of the

analysis in the report that is within our area of expertise, there are several aspects of the assessment that we believe are not adequate. These are briefly discussed below.

First, we do not concur that the use of MTBE and other oxygenates in gasoline would not provide significant air quality benefits in vehicles with more advanced emission control technologies. Older vehicles that are prone to fail rich (have excess fuel which increases hydrocarbon and carbon monoxide emissions because it escapes from the engine unburned) realize significant emissions benefits directly from the oxygen in the fuel, which promotes more complete combustion under these circumstances. More advanced vehicles encounter this type of operation much less frequently, and receive less direct benefit from the added oxygen in the fuel. However, oxygenates do provide value in that they have blending properties that facilitate meeting the overall specifications for CaRFG. Also, the added volume from oxygenates helps refiners make up for lost volume from removal of undesirable components. Based on our assessment of the role of oxygenates, we believe it is more accurate to conclude that oxygenates are effective in making gasoline with lower emitting properties, but that alternative gasoline formulations that are equally effective and do not use oxygenates are also feasible to produce.

Second, we do not believe Cal/EPA should rely upon the cost benefit analysis in the SB 521 Report as the best source of information on the economic impacts of removing MTBE from gasoline. The analysis in the SB 521 Report has been extensively critiqued by others, and we believe that it includes several unrealistic assumptions. For example, the analysis of the cost of water remediation associated with the continued use of MTBE is dominated by the cost of cleanup of leaks that have already occurred. While these costs may be substantial, they will not be mitigated by a decision to phase out MTBE use. Similarly, we find that we cannot support the analysis of the relative cost of gasoline alternatives that employ MTBE, ethanol and a non-oxygenated blend that uses toluene as a replacement for MTBE. Using more reasonable assumptions we believe that analysis will show that the toluene blend is infeasible (because it does not comply with the CaRFG rules), and that both the toluene and the ethanol blends are more costly than the current fuel with MTBE.

Our conclusion is not that economic impacts preclude the ability to phase out MTBE, but rather that eliminating MTBE will likely result in higher fuel costs, and that this impact needs to be incorporated into the State's decision on how to deal with MTBE. Fortunately, the economic impacts of phasing out MTBE use were addressed extensively by the Energy Commission. We recommend that the Commission's assessment be used in preference to that in the SB 521 Report.

Attachment 1 contains our background discussion and specific comments pertaining to Volume I: Summary & Recommendations, and selected comments on items in subsequent chapters. These are more detailed comments that provide further clarification where we believe they are necessary.

In conclusion, I would like to reiterate that California gasoline regulations have been a vital part of our effort to improving air quality, and provide extensive health benefits in terms of reduced ozone, carbon monoxide, fine particles and airborne toxic compounds such as benzene. Cleaner-burning gasoline reduces ozone forming emissions from motor vehicle evaporative and exhaust emissions by about 15 percent and it reduces cancer risk from exposure to air toxics emitted by motor vehicles by about 40 percent. Also, motor vehicles built for sale in California since 1996 have been designed to take advantage of cleaner-burning gasoline's properties. Maintaining existing fuel standards is essential to maintaining the emission performance of these advanced vehicle technologies. These benefits are an essential element of California's federally required clean air plan (the SIP or State Implementation Plan), and cannot be replaced through any alternative controls. Whatever course is decided on relative to the future use of MTBE, it is essential that the health and emissions benefits of the CaRFG program be maintained.

ARB staff does not have the expertise of our sister agencies to critically review areas of the SB 521 Report related to health effects of MTBE or the impacts on groundwater resources. We did not review these sections in detail. However, we have been involved in the debate about MTBE for some time. From our perspective, it seems clear that MTBE is far more mobile in water than the more traditional constituents of gasoline, and there remains great uncertainty over the extent to which gasoline leaks, spills and boat exhaust will eventually contaminate water supplies. It also appears that even a low level of MTBE contamination can limit the use of water resources simply because of the impact on taste and odor, and because of the public's understandable reluctance to consume drinking water that may pose a health threat. Therefore, we believe that California refiners should move away from the use of MTBE as expeditiously as possible, either through a voluntary phase down, or by complying with a required phase out by a certain date. We further believe that elimination of the federal oxygenate mandate is vitally needed so that the transition from MTBE usage can proceed quickly, with minimum impact on consumers, and with preservation of the significant air quality benefits of CaRFG. We will do all we can to assist this movement in a way that continues the air quality benefits of CaRFG and concurrently reduces the risks posed to water and health by MTBE or its replacement chemicals.

If you have any questions regarding our comments on the report, please contact me at (916) 445-4383.

Attachments

cc: Alan C. Lloyd, Ph.D., Chairman
Air Resources Board

Walt Pettit, Executive Officer
Water Resources Control Board

Joan Denton, Director
Office of Environmental Health Hazards Assessment

Attachment I

Background and Comments
on
"Executive Summary & Recommendations"
and "Summary," Sections 1 and 2

A. Comments on Federal Reformulated Gasoline Requirements.

Background. The federal requirements for reformulated gasoline (RFG) include an average oxygen content of 2 percent by weight year round, an average benzene content of 1 percent by volume, specified reductions for volatile organic compounds (VOCs) and toxic air pollutants from combined exhaust and evaporative emissions, and no increase in oxides of nitrogen (NOx) emissions. The federal Phase II RFG requirements, effective in 2000, include additional reductions for VOCs and toxic air pollutants from combined exhaust and evaporative emissions, as well as specified reductions for NOx emissions. The emission reductions are determined with an arithmetic emission model by comparison with specified base-line emissions. Federal RFG requirements apply year round to areas of severe or extreme nonattainment for ozone. These areas include the South Coast Air Basin, San Diego County, Ventura County, the Sacramento Metropolitan Area (which includes Sacramento County, and parts of Sutter, Placer, El Dorado, Yolo, and Solano Counties). Gasoline sales in these areas amount to about 70 percent of total gasoline sales in California.

Comments.

Page 11, 2nd paragraph: **"...the term reformulated gasoline' does not itself imply the presence of oxygenates."** Federal RFG does require the use of oxygenates. The federal Clean Air Act Amendments specify that federal RFG must contain at least an average of 2 percent oxygen.

Page 11, 4th paragraph: **"In air basins that meet the NAAQS ("attainment areas"), non-oxygenated CaRFG2 may be sold."** It should be made clear that only the NAAQSs for ozone and CO are involved and that only severe or extreme ozone nonattainment is pertinent for determining federal RFG areas. Areas that are designated as marginal, moderate or serious non-attainment are not required to use federal RFG. The areas that are required to use Federal RFG are the South Coast Air Basin, San Diego County, Ventura County, the Sacramento Metropolitan Area (which includes Sacramento County, and parts of Sutter, Placer, El Dorado, Yolo, and Solano Counties).

Page 13, 4th recommendation: **"Promote the accelerated removal of older, high emitting motor vehicles...This program would be significantly more cost-effective than mandating the use of oxygenates in fuels...An aggressive program aimed at gross CO polluters would**

be cheaper." Vehicle retirement programs are already part of the state's effort to improve air quality, and are being pursued as part of California's State Implementation Plan, and as a component of the Smog Check II program. From experience to date it appears that while these programs can be used to reduce emissions, their benefits will be quite modest. It is not possible to perform these programs on the scale that would be needed to match the air quality benefits produced by the use of oxygenates in the California RFG program.

Page 16, 2nd paragraph: This paragraph discusses "reformulated gasoline" in the context of the federal Clean Air Act Amendments. In that context the statement that, **"Reformulated fuel may or may not include oxygenated compounds..,"** is not true. The federal rule explicitly mandates the use of oxygen in all areas where federal RFG is required.

B. Comments on California Reformulated Gasoline Requirements.

Background. All gasoline sold in California must meet the requirements for California RFG, which are not prescribed by federal law. The California RFG regulations allow a variable oxygen content from 0 to 3.5 percent by weight, a maximum benzene content of 1.20 percent by volume, a maximum Reid vapor pressure (Rvp) of 7.0 pounds per square inch, and include five additional compositional and property caps. The specific limits are shown in the attached table. Limiting aromatic and olefinic hydrocarbon contents controls exhaust emissions of NOx and potency-weighted toxic air contaminants (TACs); limiting the 50- and 90-percent volume distillation temperatures controls exhaust emissions of hydrocarbons and potency-weighted TACs; and limiting sulfur content controls exhaust emissions of all pollutants. The listed TACs are benzene; 1,3-butadiene; formaldehyde; and acetaldehyde. By using the California Predictive Model, refiners may produce California RFGs with variable properties within the caps, which have equivalent or lower exhaust emissions of all pollutants compared to a standard fuel with 2.0 percent by weight oxygen. The standard fuel may have the properties of the "flat" limits, which are the basic regulatory limits of California RFG, and are more stringent than the caps. Alternatively, the standard fuel may have the properties of the "averaging" limits, which are generally more stringent than the "flat" limits.

Comments.

Page 11, 1st paragraph: **"CaRFG2 ... must, as mandated by federal law, contain a certain percentage of oxygen..."** In the areas where Federal RFG is required, refiners must supply gasoline which meets the CaRFG specifications and contains at least 2 percent oxygen per federal law. For the areas where Federal RFG is not required, the CaRFG specifications allow refiners to supply gasoline without oxygen.

Page 11, 3rd paragraph: **"CaRFG2 specifies an oxygen content of 1.8 to 2.2%"** This statement only applies to the flat limit compliance option; we *allow* compliance through providing that oxygen content, but the only "specification" is that the equivalent emission effect be provided. Oxygen is not mandated when refiners choose to comply using the California Predictive Model.

The vast majority of gasoline sold in California is produced under the Predictive Model option of our rules, but contains oxygen due to the federal requirement.

Page 13, 1st paragraph: The statement, **"that refiners be given flexibility to achieve CARB's air quality objectives by modifying the caps in the CaRFG2 specifications to allow wide-scale production of non-oxygenated RFG,"** does not recognize the existing situation. Under current California RFG regulations, refiners may produce nonoxygenated California RFG which achieves CARB's air quality objectives. The ARB has initiated an effort to determine how the caps could be modified to more easily achieve the air quality objectives without oxygenated compounds.

Page 15, 3rd paragraph: The statement that, **"the main purpose for adding oxygenates to fuels is to promote efficient combustion..,"** does not adequately convey the fact that oxygen is *required* in most California gasoline by federal law. For the 30% of gasoline for which refiners can make a choice about adding oxygen, "efficient combustion" is a meaningful factor in that choice because the Predictive Model recognizes a diminution of hydrocarbon (HC) emissions with increased oxygen content. However, this factor may be less important than the major contributions provided by MTBE to the volume and octane of gasoline in California, and that MTBE has properties which assist refiners in meeting several other of the California RFG specifications.

Page 16, 4th paragraph: The effect of the **"altered distillation profile"** of California RFG, specifically and lowering of the 50-percent and 90-percent distillation temperatures, is to reduce exhaust emissions, not evaporative emissions.

Page 16, 4th paragraph: **"CaRFG2 must also reduce automotive air toxic and VOC emissions by 25% compared to conventional gasoline."** ARB has estimated that there has been an overall reduction in carcinogenic risk from exposure to TACs of about 40 percent as a result of the California RFG regulations. The decline in VOC emissions from gasoline motor vehicles is about 17 percent. However, the California RFG regulations do not require a particular reduction of toxic or VOC emissions. Rather refiners must provide fuel that meets all of the California RFG specifications, or equally effective alternative specifications determined by using the Predictive Model.

C. Comments on Distribution System Constraints.

Background. The Clean Air Act Amendments of 1990 specify a minimum of 2.7 percent by weight oxygen in gasoline for carbon monoxide nonattainment areas for a minimum of four months in the late fall and early winter. However, the United States Environmental Protection Agency (U.S. EPA) allowed California to set a lower minimum of 1.8 percent by weight oxygen for those areas and months, when the ARB adopted rules to meet this requirement. Originally, the rules affected all areas of the state. However, as air quality has improved, the minimum oxygen requirement has been removed. The only remaining areas of the state where oxygenated

gasoline is required for carbon monoxide control are the South Coast Air Basin, Imperial County, Fresno County, and Lake Tahoe Air Basin.

The Clean Air Act provides that fuels and fuel additives for light-duty motor vehicles must be substantially similar to fuels and fuel additives used in emission certification. Under this provision the U.S. EPA allows aliphatic alcohols, other than methanol, and aliphatic ethers to be blended with gasoline, provided that gasoline oxygen content does not exceed 2.7 percent by weight. For example, the maximum additive content is approximately equal to 12 percent by volume tertiary-butyl alcohol (TBA) or 15 percent by volume MTBE. Under a waiver provision a maximum of 10 percent by volume ethanol, approximately equal to a gasoline oxygen content of 3.5 percent by weight, is allowed by the U.S. EPA. The 10-percent by volume ethanol blend is also known as "gasohol."

The existing gasoline production and distribution system, the wintertime oxygenated gasoline program, and economic considerations result in a situation where refiners find it impractical to produce and distribute oxygenate-differing gasoline to areas of the state where oxygenated federal RFG is not required. The exception is the San Francisco Bay Area where some refiners are producing gasoline oxygenated with ethanol or nonoxygenated gasoline for local distribution. If the federal RFG mandate for oxygen in gasoline were to be eliminated, refiners would have the flexibility necessary to produce gasoline for all of California with a lower or no oxygen content. This could allow an easier transition to more widespread use of ethanol or oxygenate free gasoline. Gasoline with ethanol cannot be distributed by pipeline, so it must be blended with ethanol at each terminal and transported from there by tank truck. Gasoline storage tanks cannot be switch-loaded between gasoline without ethanol and gasoline with ethanol, unless the tank is emptied and dried between loads; thus, a steady supply of gasoline with ethanol must be maintained if the transition is made. If federal RFG requirements were to allow zero oxygen content, then oxygenated compounds could be used in small percentages for octane enhancement of premium grades of gasoline. Aromatic compounds cannot be used for this purpose because they would cause an increase in emissions of all pollutants, which would be costly, if not impossible, to offset by additional reformulation and refining of the gasoline.

Comments.

Page 13, 1st recommendation: **"Restrict the use of CaRFG2 with MTBE to ozone non-attainment areas during the summer months..."** This recommendation appears impractical and of limited value as part of a longer term effort to reduce MTBE use.

First, in areas that are affected by federal RFG requirements, oxygen use is mandated year round by federal law. Unless these areas receive an exemption to this requirement, limiting MTBE use outside of the ozone season would require that all gasoline use ethanol during that period. As pointed out in the CEC's evaluation, sufficient ethanol cannot be obtained in the short term to displace MTBE without sever price impacts and high risk of supply disruption.

Second, in non-federal areas refiners could replace only a limited portion of their production with non-oxygenated fuel, and would have to rely on ethanol for the bulk of their supplies. They would then face the same cost and supply problems for their remaining fuel that are mentioned above.

Finally, this option would likely have only modest benefits in terms of protecting water supplies from MTBE. For example, MTBE would be restricted in the winter when there is are relatively little boating, so discharges to surface water would be affected only to a small degree. Similarly, using MTBE seasonally in tanks offers only partial protection to groundwater. Most tanks would contain gasoline with MTBE for much of the year. Therefore, any leaks of long duration would result in MTBE discharges.

To the extent they can, we believe that refiners are already using the flexibility under state programs to reduce their use of MTBE. The preferred course is to make it unnecessary for MTBE to be used in order to meet either clean air, octane or volume requirements. Seasonal rules do not accelerate the time in which this can occur.

D. Comments on Benefits.

Background. The benefits of California RFG have been estimated for California's vehicle population, based on all of the properties of the gasoline compared to average properties of California's pre-RFG gasoline. Dynamometer testing of low emission vehicles (LEVs) with oxygenated and nonoxygenated gasolines does not provide enough data to predict the emission benefits of California RFG or of oxygenated gasoline. The emissions from non-LEVs, motorcycles, off-road vehicles, boat engines, and utility engines contribute significantly to air quality degradation, and oxygenated compounds may provide significant emission reduction benefits to these sources.

Comments.

Page 11, 5th paragraph: **"MTBE and other oxygenates were found to have no significant effect on exhaust emissions from advanced technology vehicles."** It must be made clear that **"advanced technology vehicle"** is Auto/Oil jargon (not generally meaningful) and that the data pertinent to the type of vehicle are for *only five* LEV *prototypes* tested on two fuels. The statement that **"there is no statistically significant difference in emissions ... between oxygenated and non-oxygenated ... CaRFG2"** must be heavily qualified to acknowledge the very small and possibly unrepresentative vehicle and fuel samples. Therefore, the statement that **"there is no significant additional air quality benefit to the use of oxygenates...relative to alternative CaRFG2 non-oxygenated formulations"** may not be true. The impact of oxygenated compounds on emissions from non-LEVs, motorcycles, off-road vehicles, boat engines, and utility engines may be significant, and those emissions contribute significantly to air quality degradation.

Page 17, 3rd paragraph: **"RFG has more pronounced emission benefits in older vehicles."** The stated basis for this statement is Auto/Oil Tech. Bulletin 17. However, in that bulletin, the fuel representing California RFG gave the greatest percent reductions of nonmethane hydrocarbons, NOx, and CO in the *newest* class of test vehicles (federal "tier 1") and the least reductions in the *oldest* class of test vehicles, in comparisons to the reference fuel. Also, using the Predictive Model to compare actual average California RFG properties in 1996 to the typical pre-RFG gasoline in California shows greater percent emission reductions of hydrocarbons, NOx, and toxic species in the *newer* vehicle class modeled ("Tech 4") than in the older class.

Page 18, 4th paragraph: **"MTBE and other oxygenates were found to have no significant effect on exhaust emissions from advanced technology vehicles..."** The comment about page 11, 5th paragraph, applies here. Also, while we agree that it is germane to distinguish the emission effects of MTBE from the overall emission benefits of California RFG, refiners cannot immediately eliminate MTBE from California RFG or from federal RFG and still meet the performance requirements for RFG for their full production. In the near term, providing the emission benefits of the California RFG regulations and meeting the federal laws on oxygen content are both contingent on a considerable use of MTBE, for practical reasons of gasoline production.

Page 18, 5th paragraph: **"Automotive CO, NOx, and VOC emissions are not significantly affected by including MTBE in RFG based on dynamometer tests..."** Please refer to comments about page 11, 5th paragraph; and page 18, 4th paragraph.

Page 19, 6th paragraph: **"Automotive CO, NOx, and VOC emissions are not significantly affected by including MTBE in RFG based on dynamometer tests..."** Please refer to comments about page 11, 5th paragraph; and page 18, 4th paragraph.

E. Comments on Environmental Impacts.

Page 12, paragraph continued from page 11: "**Since both groundwater wells and surface water reservoirs have been contaminated, alternative water supplies may not be an option for many water utilities."** This implies that many utilities have contamination in all their potential supplies, which is not true**.** Also, surface water contamination is generally a transient condition which occurs during boating season. The option to ban or restrict recreational boating, as necessary, will continue to exist.

Page 12, 3rd paragraph: ...**"we recommend a full environmental assessment of any alternative to MTBE in CaRFG2, including the components CaRFG2 itself..."** Before any other oxygenates are used to replace MTBE, a full environmental assessment should be performed. However, this statement also incorrectly implies that there are blending materials unique to gasoline in California. If the components of California RFG other than MTBE merit an environmental assessment, then so do the components of *any* gasoline. In any comparison with other gasolines, California RFG (aside from MTBE) should be environmentally superior because

of its lower content of olefins and aromatics, which are more water-soluble than paraffins, as well as its lesser emissions.

Page 14, 9th recommendation: **"If ethanol is found to provide a net energy savings and have minimal environmental impacts, then, increase the availability of ethanol as a potential oxygenate, by increasing the use of agricultural wastes such as rice straw for ethanol production."** This may happen whenever it becomes economically preferable over the production of MTBE and other alternatives. Even if MTBE were eliminated as an option for refiners, there is no guarantee that ethanol would be economically preferable over other alternatives.

Basic Limits for California Reformulated Gasoline

Property	Flat Limit	Averaging Limit	"Cap" Limit*
Reid vapor pressure (RVP), psi, max	7.0	---	7.0
Benzene, vol.percent, max	1.00	0.80	1.20
Sulfur, ppmw, max	40	30	80
Aromatic HC, vol.percent, max	25	22	30
Olefins, vol.percent, max	6.0	4.0	10
Oxygen, wt.percent	1.8 to 2.2	---	1.8 (min)** - 2.7 (max)
T50 (temperature at 50 percent distilled) deg. F, max	210	200	220
T90 (temperature at 90 percent distilled) deg. F, max	300	290	330

* The "caps" apply to all gasoline at any place in the marketing system
** The 1.8 wt. percent minimum oxygen specification is only in force during the winter