Winston H. Hickox
Agency Secretary

Air Resources Board

PDV

Alan C. Lloyd, Ph.D.
Chairman
2020 L Street • P.O. Box 2815 • Sacramento, California 95812 • www.arb.ca.gov

Gray Davis
Governor

December 24, 1999

Mr. Robert Perciasepe
Assistant Administrator for Air and Radiation
U.S. Environmental Protection Agency (6101)
401 M Street, S.W.
Washington, D.C. 20460

ADDITIONAL MATERIAL SUPPORTING CALIFORNIA'S REQUEST FOR A WAIVER OF THE FEDERAL RFG YEAR-ROUND OXYGEN MANDATE

Dear Mr. Perciasepe:

I am writing to provide additional information and analysis requested by your staff to further support California's request that the United States Environmental Protection Agency (U.S. EPA) exercise its authority under federal Clean Air Act section 211(k)(2)(B) to waive application of the year-round 2.0 percent oxygen mandate for federal reformulated gasoline (RFG) in California. The basis by which California qualifies for this waiver results from the fact that California administers its own California Reformulated Gasoline (CaRFG) program that achieves substantially greater reductions in emissions of oxides of nitrogen (NOx) than those achieved by the Phase II federal RFG regulations now being implemented. This letter and attachments, along with the previous materials we have provided, clearly demonstrate that both the newly-approved Phase 3 CaRFG regulations (CaRFG3) and the current Phase 2 CaRFG regulations (CaRFG2) will achieve substantially greater NOx reductions if the waiver is granted.

Additional NOx reductions are necessary in California's federal RFG areas to achieve the national ambient ozone and particulate matter air quality standards. Continued application of the year-round oxygen mandate would interfere with obtaining the NOx reductions needed for the timely attainment of those standards – the statutory grounds identified in the Clean Air Act that enables U.S. EPA to grant a waiver. Failure to grant the waiver would also delay the removal of MTBE from California's gasoline, and cost California's refiners and motorists hundreds of millions of dollars. Therefore, favorable and prompt action by the U.S. EPA on the waiver request is essential.

The attached analysis sets forth the statutory criteria for a waiver of the federal RFG oxygen mandate. It describes the CaRFG regulations, provides a review of our prior waiver submittals, and discusses CaRFG3 regulations approved by the Air Resources Board (ARB or Board) on December 9, 1999. The analysis demonstrates how the federal oxygen mandate reduces the NOx emissions benefits from both the CaRFG3 and CaRFG2 regulations, and why the loss of these benefits is expected to prevent or interfere with attainment of the national ambient air quality standards.

The analysis presented in the attached material shows that the CaRFG3 program, as approved by the Board, is fully consistent with the analyses previously prepared and submitted to U.S. EPA. Accordingly, we believe that U.S. EPA has more than sufficient data on which to grant an oxygen waiver.

To summarize, California's case for a waiver rests on the following key points:

- First, the technical analysis indicates the waiver is needed to achieve additional NOx reductions to attain and maintain the national ambient air quality standards. The waiver will substantially contribute to ozone and particulate matter improvement in California.

- Second, the waiver is needed to help California reduce ground and surface water contamination by MTBE. Refiners will be able to reduce the use of MTBE in California gasoline more quickly if the waiver is issued. In fact two major California refiners have pledged to remove MTBE well before the state mandated phase-out date if the waiver is granted.

- Third, a waiver will result in significant cost savings to California's motorists. With the waiver, the capital costs of compliance with the CaRFG3 regulations will be at least $100 million less than without the waiver, and the ongoing cost of compliance is expected to be one to two cents per gallon ($140 – $280 million per year) less.

Together, the policy considerations and technical facts present a compelling case that U.S. EPA has only one viable option – to approve the waiver request as quickly as possible. We urge U.S. EPA to do so.

If you should have any questions or wish to discuss the requested waiver, please contact me at (916) 445-4383, or Mr. Michael Scheible, Deputy Executive Officer, at (916) 322-2890.

Sincerely,

Michael P. Kenny
Executive Officer

Attachments

cc: Winston H. Hickox
Agency Secretary
California Environmental Protection Agency

Alan C. Lloyd, Ph.D.
Chairman

Michael Scheible
Deputy Executive Officer

List of Attachments

1. Updated Basis for Granting a Waiver of the Federal RFG Oxygen Mandate for California's Federal RFG Areas
2. April 12, 1999 letter and attachment from Governor Gray Davis to Carol M. Browner
3. July 9, 1999 letter from Michael P. Kenny to Robert Perciasepe
4. Staff Report: Initial Statement of Reasons for the Proposed California Phase 3 Reformulated Gasoline Regulations, Release date October 22, 1999.
5. Staff Report: Initial Statement of Reasons for the Proposed Amendments to California Exhaust and Evaporative Emission Standards and Test Procedures for Passenger Cars, Light-Duty Trucks and Medium-Duty Vehicles, and Proposed Amendments to California Motor Vehicles Certification, Assembly-Line and In-Use Test Requirements, Release date September 18, 1998.
6. Analysis of California Phase 3 RFG Standards, MathPro Inc.; Under contract to the California Energy Commission, December 7, 1999.

ATTACHMENT TO DECEMBER 24, 1999 LETTER TO ROBERT PERCIASEPE

UPDATED BASIS FOR GRANTING A WAIVER OF THE FEDERAL RFG OXYGEN MANDATE FOR CALIFORNIA'S FEDERAL RFG AREAS

CALIFORNIA AIR RESOURCES BOARD
December 24, 1999

I. The Federal RFG Oxygen Waiver Provision in the Clean Air Act

Clean Air Act section 211(k)(2)(B) directs U.S. EPA to include a year-round 2.0 percent by weight (wt.%) minimum oxygen requirement in the federal RFG program, but then expressly authorizes the Administrator to waive the requirement under specified circumstances. It provides:

> (B) OXYGEN CONTENT. – The oxygen content of the gasoline shall equal or exceed 2.0 percent by weight (subject to a testing tolerance established by the Administrator) except as otherwise required by the Act. The Administrator may waive, in whole or in part, the application of this subparagraph for any ozone nonattainment area upon a determination by the Administrator that compliance with such requirement would prevent or interfere with the attainment by the area of a national primary ambient air quality standard.

II. Overview of the CaRFG Regulations and the Role of the California Predictive Model

The CaRFG2 regulations, which became applicable in the spring of 1996, establish standards for eight gasoline properties that have significant impacts on emissions of criteria pollutants and toxic air contaminants from gasoline-powered motor vehicles. The standards cover sulfur, benzene, olefin, oxygen, and aromatic hydrocarbon contents, the 50-percent and 90-percent distillation temperatures (T50 and T90), and summertime Reid vapor pressure (RVP).

The primary element of the CaRFG2 standards is a set of limits that apply to gasoline when it is first supplied from the production facility (typically a refinery) or import facility. These will be referred to as the "refinery" limits. The CaRFG2 standards also include a set of "cap limits" that apply throughout the gasoline distribution system and for all properties but RVP are less stringent than the refinery limits. This approach allows the imposition of very stringent standards at the refinery while allowing refiners to vary the composition of individual batches in a cost-effective way up to the cap limits as long as overall equivalent emissions performance is achieved. The cap limits allow for effective enforcement for gasoline in transit to, and being sold at, service stations and other fueling facilities.

The regulations provide multiple compliance options that refiners and importers may elect for meeting the refiner limits. One option is to have the gasoline properties subject to "flat limits" or (except for RVP and oxygen) "averaging limits" specifically set forth in the regulations. A flat limit must be met by each batch of gasoline leaving the refinery. The averaging limits for each of the six properties are numerically more stringent than the comparable flat limits. Under the averaging option, the producer may assign differing "designated alternative limits" (DALs) to different batches of gasoline being supplied from the refinery. Each batch of gasoline must meet the DAL for the batch. A producer or importer supplying a batch of gasoline with a DAL above the averaging limit must, within 90 days before or after, supply sufficient quantities of gasoline subject to more stringent DALs to fully offset the excess over the averaging limit. The averaging approach does not apply between different regulated properties.

The CaRFG2 regulations also contain a second compliance mechanism for meeting the "refinery" limits. Under this mechanism, the refiner (or importer) uses the "CaRFG Phase 2 Predictive Model" to identify a slate of alternative flat and averaging limits applicable to a batch of gasoline when it is supplied from the refinery. Because of the flexibility afforded by the Predictive Model mechanism, almost all of the gasoline now marketed in California is sold using the Predicitive Model mechanism, and we expect this to remain the case in the future.[1]

The CaRFG2 Predictive Model consists of mathematical equations which predict the changes in exhaust emissions of hydrocarbons, NOx, and potency weighted toxics for four toxic air contaminants that result from different gasoline formulations. The four toxic air contaminants are benzene, 1,3-butadiene, acetaldehyde, and formaldehyde. The CaRFG2 Predictive Model is based on data from 18 vehicle emission test programs analyzing the relationship of gasoline properties and emissions. The Predictive Model can be used to compare the emissions from gasoline meeting the flat limits specified in the regulation to a slate of alternative flat limits selected by the refiner (none of which may exceed the cap limit for the property). The slate of alternative flat limits is acceptable if the Predictive Model shows that there will not be an increase in emissions of hydrocarbons, NOx, and potency-weighted toxics from the alternative flat limits compared to the flat limits in the regulation. (In determining if there is an increase, the percent change is essentially rounded to the nearest tenth of a percent , so a change of up to 0.04 percent is treated as zero). This test must be met for all three pollutants – there is no mechanism where a decrease in NOx can offset an increase in hydrocarbons or vice versa. Under most circumstances production limitations result in one of the three Predictive Model pollutants becoming the clear constraining factor. As

[1] The regulations also include another compliance option involving certification of alternative gasoline formulations based on the results of vehicle emission testing. Under this option, producers must perform a comparative vehicle emissions test program to show that their gasoline formulation achieves equivalent emissions as compared to a CaRFG2 reference test fuel. No refiner or importer has used this option, and we are aware of no plans to do so.

a result, fuel produced pursuant to the Predictive Model usually produces an excess emissions benefit for two of the three regulated pollutants.

The CaRFG2 regulations require and achieve in practice reductions in NOx and toxics that are substantially greater than the emission reductions required by the federal Phase II RFG rules that apply starting January 1, 2000. Attachment 1 provides a comparison of the emission benefits of the two sets of rules, based on application of U.S. EPA's Complex Model. The NOx emissions reductions from the California program are more than twice the reductions required by federal Phase II RFG – the CaRFG2 regulations achieve an additional overall NOx reduction of 8 percent. The toxic emissions reductions from the California program, on a potency-weighted basis, are about 20% greater than the corresponding emissions reductions from federal Phase 2 RFG. The VOC emissions reductions required by the two programs are comparable.

III. Prior Waiver Submittals and Support Materials

The April 12, 1999 submittal. Governor Davis transmitted California's request for a waiver of the federal RFG year-round 2.0 percent minimum oxygen content requirement on April 12, 1999 (Attachment 2). The Governor described California's plans to phase out MTBE in the state's gasoline because of the threat to our groundwater, surface water and drinking water presented by underground storage tank and piping leaks of gasoline containing MTBE. The ARB's technical analysis attached to the Governor's letter pointed out that continuing the federal RFG oxygen mandate in California despite the MTBE phase-out would significantly increase the cost of gasoline in the state and result in higher emissions of NOx than could be achieved if zero oxygen levels were allowed. Thus the federal oxygen mandate would significantly reduce the ARB's ability to achieve the most favorable ozone-reducing benefits when it established the CaRFG3 regulations in late 1999. This was the underlying premise of the request – that the federal RFG oxygen mandate would prevent the ARB from adopting CaRFG3 regulations that would achieve greater reductions in emissions of ozone-forming pollutants.

Whether or not there was a federal waiver, the California RFG program would be crafted so as to achieve overall ozone benefits at least equivalent to the benefits from the federal program. But removal of the oxygen mandate would enable the ARB to further strengthen the CaRFG program to achieve substantially greater reductions in emissions of ozone precursors. Our inability to achieve these additional emission reductions – an inability caused by the federal oxygen mandate – would prevent or interfere with attainment of the federal ozone standard in California's federal RFG areas. (At the time of the original request our work on developing the CaRFG3 program had not progressed sufficiently to enable staff to quantify the potential loss in benefits.)

The June 21 and July 9, 1999 submittals. On June 21, 1999, ARB provided U.S. EPA with an additional analysis that supported the first waiver request. An updated overall version of the request was transmitted on July 9, 1999 to Mr. Perciasepe (Attachment 3). The additional analysis included a quantification of the

extent to which a waiver would enable development of a cost-effective CaRFG3 program achieving incrementally greater benefits than could be achieved in the absence of an oxygen waiver.

By July, the ARB staff had further defined what was possible in the near term through regulation changes, and was focussing on potential CaRFG3 specifications that would achieve the twin goals of preserving the emissions benefits from the current CaRFG2 program in the absence of MTBE and enhancing those benefits to the extent feasible. Recognizing that a waiver of the federal oxygen mandate would create a distinctly different regulatory environment from one in which there was no waiver, the staff analyzed likely scenarios for a CaRFG3 program under the two environments. Three scenarios were identified: (1) No use of MTBE and federal oxygen flexibility; (2) No use of MTBE and a federal RFG 2.0 wt.% oxygen mandate met by 5.7 vol.% ethanol; and (3) No use of MTBE and a federal RFG 2.0 wt.% oxygen mandate met by 10 vol.% ethanol. For each scenario, staff started with a set of specifications meeting all of the refinery "flat" limits in the current CaRFG2 regulations. The staff next identified the changes in gasoline properties that refiners would necessarily have to make under each scenario, and identified the emissions impact of the changes. The staff then identified potential changes for the CaRFG3 standards that could be made to preserve the emissions benefits of the current program and to enhance those benefits to the extent feasible.

The analyses of the scenarios demonstrated that an oxygen waiver would enable the ARB to adopt technologically feasible CaRFG3 regulations resulting in increased reductions of NOx of 1.5% and potency-weighted toxics of 2.5% while concurrently achieving the goal of rapidly prohibiting the use of MTBE in gasoline.

The CaRFG3 Proposal and Staff Report. On October 22, 1999, the ARB staff released the CaRFG3 Staff Report (Attachment 4) and the proposed CaRFG3 regulations, for consideration at a December 9, 1999 hearing of our Board. The key objectives of the proposal were to phase out MTBE in California gasoline to protect ground and drinking water; to maintain the emission benefits of the CaRFG2 program; to provide additional flexibility to California refiners to facilitate the removal of MTBE, including flexibility to facilitate the expected significant use of ethanol in California gasoline; and to identify additional opportunities for further cost-effective emission reductions.

Given that U.S. EPA had not yet acted on California's request for a waiver of the federal RFG oxygen mandate, staff was compelled to propose a rule that achieved the objectives as best as possible assuming that a waiver would not be obtained. Rather than propose two alternative sets of standards – a less stringent one for the "no waiver" scenario and a more stringent one for the waiver scenario – the staff proposed a single set of standards along with an updated CaRFG3 Predictive Model. The standards and new model would be required to be met by December 31, 2002, at which time the use of MTBE in California gasoline would be prohibited. The proposal was designed to be technologically feasible if refiners and importers had to use at least 5.7 vol.% ethanol in

the federal RFG areas to comply with a continuing federal RFG 2.0 wt.% oxygen mandate. Staff recognized that the regulation would be significantly less costly and more effective in reducing emissions if a waiver allowed refiners and importers oxygen flexibility. The analysis in the staff report also demonstrated that the CaRFG3 proposal was more effective in reducing emissions than the CaRFG2 rule it replaced.

Table V-4 in the staff report showed the emissions reductions from gasoline expected to be produced under the proposed CaRFG3 flat limit specifications (which, for oxygen, are set at 2.0 wt.%), using the updated CaRFG3 Predictive Model. This analysis concluded that the CaRFG3 proposal achieved greater NOx, total hydrocarbons, and potency-weighted toxics reductions of 2.3%, 0.1%, and 7.2% respectively than those produced by the CaRFG2 program.

The staff report also identified three sets of possible alternative specifications for producing gasoline under the proposed CaRFG3 Predictive Model under three alternative oxygen content scenarios: zero oxygen, 2.7 wt.% oxygen and 3.5 wt.% oxygen. These are shown in Table V-6. The expected properties of the in-use gasolines that would be produced under the three sets of alternative specifications – adjusted to reflect a typical compliance margin – are shown in Table V-7. Table V-8 showed the emissions reductions each of the three in-use fuels derived from the three oxygen content scenarios would achieve compared to the proposed CaRFG3 flat limit specifications. It also showed the reductions achieved by the 1998 in-use fuel. Table 1 below shows these values, along with the expected change in emissions for the future in-use CaRFG3 fuel containing 1.8-2.2 wt.% oxygen that was shown in Table V-4 of the staff report. As can be seen, all blends perform better than the 1998 in-use fuel, but the zero oxygen fuel has much better NOx performance reducing NOx emissions by 5.4% while the 2.0 wt.% oxygen fuel reduces NOx by 2.0%[2]. These findings are discussed in more detail on pages 39-40 of the staff report.

[2] With removal of MTBE, T50 and T90 will become the parameters that most limit the production volume of complying fuel in California refineries. With this in mind, it is expected that refiners will use the Predictive Model to increase the T50 and T90 of their formulations where possible. We expect that it will be common practice for refiners to use any excess hydrocarbon reductions generated by using the Predictive Model to increase the T50 or T90 of the blend. However, increasing T50 or T90 has little effect on NOx. It is expected that the resulting difference between the expected NOx difference for zero percent oxygen and 2 percent oxygen will not be used, or will result in greater than required NOx reductions.

Table 1.
Expected Change in Emissions 1998 Average In-Use Fuel Versus Other Fuels Meeting Alternative CaRFG3 Predictive Model Limits (2005)

	1998 In-Use Fuel	Zero Oxygen	2.0 Percent Oxygen	2.7 Percent Oxygen	3.5 Percent Oxygen
NOx	0.3%	-5.4%	-2.0%	-1.7%	-0.7%
Hydrocarbons					
Exhaust	-3.6%	-1.7%	-3.7%	-6.0%	-6.0%
Evaporative	-6.6%	-12.6%	-6.6%	0%	0%
Carbon Monoxide	0%	0%	0%	-4.2%	-8.9%
Toxics(1)	-7.9%	-14.7%	15.2%	-15.6%	-15.7%

(1) Potency weighted

ARB staff transmitted the CaRFG3 Staff Report to U.S. EPA staff responsible for evaluating the requested federal RFG oxygen waiver. Knowing that the Board would not be acting on the CaRFG3 regulatory proposal until December 9, it was agreed that ARB would submit additional information and analysis *after* the Board had acted and there was greater certainty of what the CaRFG3 regulations would require.

IV. The CaRFG3 Regulations Approved by the ARB December 9, 1999

The Board considered the proposed CaRFG3 regulations at a December 9, 1999, hearing. At the conclusion of the hearing, the Board adopted Resolution 99-39, which approved the CaRFG3 proposal with several modifications suggested by staff at the hearing. (A summary of the staff modifications are appended as Attachment 5.)

The approved modifications included changes to the flat and averaging limits for one property – T50. In order to reduce the cost of the MTBE phase out and preserve gasoline production volume for CaRFG3 within California refineries, the Board revised the proposed CaRFG3 T50 flat limit specification from 211°F to 213°F, and the CaRFG3 T50 averaging specification from 201°F to 203°F. Based upon further analysis of the average in-use fuel in 1998, staff determined that this revision could be made while still preserving the full benefits of the current program. A second significant modification will allow refiners and importers to supply gasoline meeting the CaRFG3 standards, including the prohibition of MTBE use and the CaRFG3 Predictive Model, prior to December 31, 2002. This change will enable refiners to take advantage of the CaRFG3 rules to phase out MTBE use early. The other changes do not affect the emissions reductions or timing of the implementation of CaRFG3 and, therefore, are not discussed.

In approving the regulations, the Board also directed the Executive Officer, as part of this rulemaking, to revise the exhaust, evaporative and carbon monoxide (CO) weightings and the vehicle weightings in the CaRFG3 Predictive Model to reflect the ARB's EMFAC 2000 emissions inventory after EMFAC 2000 is approved by the Board

at a scheduled March 2000 meeting. This change will not affect the overall effectiveness of the regulations, but will help ensure that evaporative and exhaust effects are properly accounted for in the model.

While some administrative steps still need to be taken before the CaRFG3 regulations become effective under California law, there is every reason to believe that the CaRFG3 standards approved by the Board will become the final CaRFG3 rules. Therefore, the impact of the approved CaRFG3 standards on the previous analyses and justification for the requested federal RFG oxygen waiver was analyzed by ARB staff and is described below. With this information, we believe that U.S. EPA now possesses sufficient data on which to grant an oxygen waiver. If there are concerns that a final waiver must be premised on fully and formally adopted and operative CaRFG3 regulations, the waiver could be conditioned on the CaRFG3 specifications approved by our Board, on December 9, actually becoming operative under California law.

We also show below that issuance of a waiver effective immediately is justified under the Clean Air Act. This is because failure to grant an oxygen waiver applicable *prior* to December 31, 2002 will similarly prevent the CaRFG program from achieving additional NOx reductions.

V. The Basis for an Oxygen Waiver Applicable at the December 31, 2002 Implementation Date for the CaRFG3 Standards

The staff's analysis contained in the CaRFG3 staff report demonstrated that significant NOx reductions would result if refiners were allowed to blend fuels without being constrained by the federal 2 percent minimum oxygen requirement. Because the T50 specifications approved by the Board at the December 9 hearing were slightly different from the staff's initial proposal, staff evaluated the NOx benefits associated with non-oxygen containing fuels based upon the adopted specifications.

To compare fuels that could exist based on alternative formulations certifiable using the CaRFG3 Predictive Model, staff followed the same methodology employed in the October 22 staff report and created alternative specifications for a zero oxygen, a 2.7 percent oxygen, and a 3.5 percent oxygen fuel. The three alternative sets of specifications and the CaRFG3 flat limits (the 2.0 percent oxygen case) are presented in Table 2.

Table 2.
Example Fuel Properties

Fuel Properties	Zero Oxygen	2.0 Percent Oxygen	2.7 Percent Oxygen	3.5 Percent Oxygen
Aromatics, v%	25	25	25	25
Benzene, v%	0.6	0.8	0.7	0.7
Olefins, v%	6	6	4.0	1.0
Sulfur, ppm	10	20	14	5
T50, deg. F	210	213	206	213
T90, deg. F	305	305	310	310
Oxygen, w%	0	2.0	2.7	3.5
RVP, psi	6.8	6.9	7.2	7.2

Table 3 provides the expected in-use fuel properties associated with the fuels in Table 2. These were derived by applying known compliance margins to the fuel properties given in Table 2, and using these as inputs for the Phase 3 Predictive Model.

Table 3.
Example Future In-Use Fuels

Fuel Properties	Zero Oxygen	2.0 Percent Oxygen	2.7 Percent Oxygen	3.5 Percent Oxygen
Aromatics, v%	23.1	22.5	23.1	23.1
Benzene, v%	0.42	0.4	0.52	0.52
Olefins, v%	3.7	3.2	1.7	1
Sulfur, ppm	6	14	10	1
T50, deg. F	203	206	199	206
T90, deg. F	298	298	303	303
Oxygen, w%	0	2	2.7	3.5
RVP, psi	6.58	6.68	6.98	6.98

As shown in Table 4, NOx emissions are reduced by 3 percent when going from a 2.0 percent oxygen fuel to a non-oxygen fuel. Therefore, the change made to the specifications by the Board does not change the finding in the staff report that CaRFG3 will achieve substantial additional NOx reductions to the extent that non-oxygenated fuels are allowed and used.

Table 4.
Expected Percent Change in Reactivity Adjusted Emissions Using the CaRFG3 Predictive Model for Four Sets of In-Use Fuel Properties

Pollutant	Zero Oxygen	2.0 Percent Oxygen	2.7 Percent Oxygen	3.5 Percent Oxygen
NOx	-5.4%	-2.4%	-1.8%	-0.8%
Exhaust HC	-1.5%	-3.3%	-5.9%	-5.7%
Evap. HC	-7.2%	-5.0%	2.0%	2.0%
CO*	0%	0%	-0.1%	-0.2%
Total - HC plus CO	-3.1%	-3.6%	-3.8%	-4.5%
Pot. Wt. Toxics	-14.5%	-16.1%	-14.5%	-14.2%

* Changes in CO presented as reactivity adjusted to evaporative hydrocarbons.

Simulation Analysis.

In addition to the above analysis, staff conducted a computer simulation using the CaRFG3 Predictive Model to evaluate a very large number of complying 2 percent oxygen fuels versus a similarly large number of complying zero percent oxygen fuels. The simulation demonstrates that when the range of possible complying 2 percent oxygen fuels are compared to the range of possible complying zero percent oxygen fuels, the zero percent oxygen fuels inherently lead to significantly less NOx emissions. The simulation evaluated over 1 million different combinations of fuel properties within the cap limits for CaRFG3. The details of this simulations are presented below.

To further investigate the relationship between oxygen and NOx emissions, a simulation was constructed to generate a set of fuels representing the possible range of certifiable CaRFG3 fuels in California. The simulation then used the CaRFG3 Predictive Model to evaluate the emissions performance of two sets of fuels. The two sets of fuels were generated with oxygen fixed at zero percent and two percent, respectively[3]. RVP was set to the flat limit, 7.0 psi. The remaining properties were systematically varied from the upper bound to the lower bounds shown in Table 5.

[3] Once MTBE is phased-out, fuel that contains oxygen will contain ethanol. While it is permissible under the CaRFG3 program to use fuels that have between zero and 2 wt.% oxygen, this is unlikely because of the fact that fuels with less than 5.7 vol.% ethanol (2 wt.% oxygen) do not qualify for the federal tax credit. Accordingly, it is ARB staff's belief that fuels will either contain zero wt.% oxygen or at least 2.0 wt.%.

Table 5.
Boundary Values for Fuel Properties.

	Lower Bound	Upper Bound	Increment
Aromatics	15	35	5
Olefins	0	10	1
Sulfur	0	60	2
T50	175	220	2.5
T90	285	330	2.5
Benzene	0.1	1.1	0.1

Each set of fuel properties was then evaluated using the CaRFG3 Predictive Model. Only fuel sets that qualified as complying fuels under the model were retained for subsequent analyses. Of the approximately 1 million sets of fuel properties evaluated, about 400,000 sets passed and could be considered legal alternative formulations for Phase 3 reformulated gasoline. This computer simulation program was run using the SAS statistical software package from the SAS Institute Inc. Table 6 presents the differences between zero percent oxygen and 2 percent oxygen fuel based on the CaRFG3 Predictive Model in the inventory year 2005.

Table 6.
Estimated Reductions Based on the CaRFG3 Predictive Model at Two Oxygen Levels

	NOx
0 wt.% Oxygen	-4.0%
2 wt.% Oxygen	-2.5%
Difference	-1.5%

The results show that on average, among an extremely large number of permissible formulations, the additional reduction in NOx associated with going from a 2 weight percent oxygen fuel to a zero weight percent oxygen fuel is about 1.5 percent. This is less than the 3 percent reductions shown in Table 4 because the simulation included fuels which have lower NOx benefits and, although they are legal, they are not expected to be feasible or reasonable for a refiner to produce. The computer simulation is only intended to demonstrate that there exists additional NOx benefits associated with the removal of oxygen across a broad range of possible complying fuels. In fact, if the computer simulation were focused about very low sulfur and high T50 fuels then the expected additional NOx benefits would be expected to be larger than shown in Table 4.

Review of Other Assessment of Likely Fuels if a Waiver is Granted

To further assess if the NOx benefits of non-oxygenated fuels can be safely assumed to occur under a waiver, we reviewed the recent analysis of how the California refinery system would respond to changing fuel requirements performed for the California Energy Commission by MathPro, Inc. (Attachment 6.) This analysis concluded that given a waiver, economic and production factors would lead refiners to produce substantial amounts of gasoline with zero oxygen content. These analyses also provided an estimate of the average properties of such fuels. The ARB staff used these properties in the Predictive Model to determine emissions impacts. This assessment further demonstrated that non-oxygenated CaRFG3 would provide about a 2 percent reduction in motor vehicle NOx emissions compared to 2 percent oxygen CaRFG3 fuel.

Conclusion

The results of the analysis of the example CaRFG3 fuels containing 2 percent and zero percent oxygen, the analysis of 400,000 possible complying fuel sets derived by simulation modeling, and the MathPro Inc. work done for the California Energy Commission consistently demonstrate that zero oxygen in California will result in significant addition reductions in NOx emissions.

VI. The Basis for an Oxygen Waiver Applicable Immediately

It is important for U.S. EPA to not only grant the oxygen waiver to California but to make the waiver effective immediately. The analysis presented above demonstrated that with the waiver CaRFG3 gasoline will result in substantial additional reductions in NOx emissions in California. Presented below are the results of our analysis demonstrating that making the waiver effective immediately will result in additional NOx reductions from CaRFG2 fuels.

A similar simulation was done for CaRFG2 fuels as was done for CaRFG3 fuels. In conducting the CaRFG2 simulations the CaRFG3 Predictive Model was used with weights representing the light-duty motor vehicle emissions inventory in 2000 and the CaRFG2 flat limits as the baseline fuel properties. Table 7 shows the results. Under CaRFG2, going from a 2 percent oxygen fuel to a zero percent oxygen fuel will result in a decrease in NOx emissions of 1.6 present. Therefore, immediate granting of the waiver is necessary to capture the additional NOx benefits associated with non-oxygenated CaRFG2 fuels.

Table 7.
Estimated reductions based on the Predictive Model using CaRFG2 specifications at two oxygen levels

	NOx
0 Percent Oxygen	-3.7%
2 Percent Oxygen	-2.1%
Difference	-1.6%

The early CaRFG3 opt-in feature of the CaRFG3 regulations provides another reason an *immediately applicable* waiver of the federal RFG oxygen mandate would reduce the NOx emission reductions that would otherwise result from the CaRFG regulations. Tosco has publicly stated that it will market non-MTBE gasoline in less than a year (by December 15, 1999) at all of its 1600 California service stations if U.S. EPA promptly grants the oxygen waiver. British Petroleum/AMOCO has also stated a commitment to remove MTBE early from ARCO outlets (assuming its proposed merger is accomplished), with a waiver of the oxygen mandate being crucial to their ability to efficiently do so. The ARB's new labeling requirement for gasoline containing MTBE and other considerations may encourage other refiners to produce non-MTBE gasoline in the near future. Since the CaRFG3 standards were designed to provide refiners greater flexibility in producing non-MTBE gasoline, there is little doubt that Tosco and other refiners will use the early CaRFG3 opt-in feature for all non-MTBE gasoline they produce. All analyses have shown that the representative in-use non-oxygenated gasoline refiners will produce using the CaRFG3 Predicitive Model will result in greater NOx reductions than a representative in-use oxygenated CaRFG3 fuel. An immediately effective waiver will enable early production of non-MTBE gasoline, and would result in large quantities of non-oxygenated gasoline being produced that would displace oxygenated gasoline that has higher NOx emissions.

VII. Failure to Achieve the Additional NOx Reductions That Would Result From an Oxygen Waiver Will Prevent or Interfere With Attainment of the National Ozone and Particulate Matter Air Quality Standards in California's Federal RFG Areas

One of California's federal RFG areas is designated an "extreme" ozone nonattainment area, and the other two are designated as "severe" ozone nonattainment areas. Some of these areas are also in violation of national standards for particulate matter. Further NOx reductions are needed for attainment of the national ozone and particulate matter standard in these areas. Since issuance of a federal RFG oxygen waiver for these areas will result in significant additional NOx reductions, denial of the waiver will prevent or interfere with attainment and maintenance of the national ambient air quality standards.

California's State Implementation Plan (SIP) calls for reductions in both VOC and NOx emissions to attain the national ozone standard and have long been an integral component of California's attainment strategy. In addtion, NOx reductions are an essential element of our effort to attain standards for particulate matter. The 1994 Ozone SIP demonstrated attainment in every federal nonattainment area by reducing both ROG and NOx emissions and this strategy has been reviewed and accepted by the U.S. EPA.

NOx is an essential ingredient in ozone photochemistry and in the formation of nitrate particles. NOx compounds provide the free oxygen molecule necessary to form ozone. The importance of NOx is greatest when VOCs are abundant and the atmosphere is "NOx limited." NOx also appears to do more damage downwind than VOCs, since it does not react as quickly. This is a crucial factor in California, where fifteen intrastate ozone transport corridors have been identified.

The growing understanding of NOx effects has challenged conventional wisdom. For decades, a "VOC diet" was the preferred approach to ozone control. In the mid-1980s, California replaced that strategy with combined precursor control. In 1991, the National Research Council of the National Academy of Sciences concluded that "NOx control is necessary for effective reduction of ozone in many areas of the United States." As a result, California and many other states have developed ozone control strategies that rely on reducing both VOC and NOx emissions.

Multiple provisions of the federal Clean Air Act (Act) require NOx control. In addition, the Act presumes that combined VOC and NOx reduction strategy is effective in reducing ozone concentrations. Finally, a primary goal of the Act is to attain the national ozone standard as expeditiously as possible, an objective that, in many instances, requires prompt and continued NOx emission reductions.

All 'serious' and above nonattainment areas, which include the San Joaquin Valley, the South Coast, Sacramento, Ventura, San Diego, Santa Barbara, and the Mojave Desert, rely on emission control strategies that call for the reductions of NOx emissions. The attainment years for 'severe' areas is 2005 and additional emission reductions help expedite the attainment of the ozone standard. California continues to develop control to reduce VOC and NOx emissions through mobile, stationary, and area source control programs. Because of California's serious air pollution problem any reduction in ozone precursors can be considered crucial to expeditious attainment of the standards. In addition, California has a number of PM10 nonattainment areas where NOx has been recognized as a precursor to the formation of PM10. Therefore additional reductions in NOx is also essential in several PM10 nonattainment areas.

NOx reductions have long been a part of California's strategy to reduce both ozone and PM10. Additional NOx reductions can only benefit California's effort to attain the federal ozone and PM10 standard and any opportunities to provide additional NOx reductions should not be missed.

VIII. Important policy considerations compel issuance of the waiver

The ARB recognizes that use of the permissive "may" rather than the mandatory "shall" in Section 211(k)(2)(B) means that a waiver is a discretionary act even where prevention or interference with attainment of a national air quality standard is demonstrated. However, although U.S. EPA legally has discretion on a technically justified waiver, the policy considerations favoring a waiver are so strong in this case that they effectively compel the U.S. EPA to grant a waiver once the technical test has been met.

First, the waiver is needed for air quality considerations – to achieve additional NOx reductions needed in California's federal RFG areas to attain and maintain the national ambient ozone and particulate matter air quality standards. The express objective of the federal RFG program is to achieve "the greatest reduction in emissions of ozone forming volatile organic compounds (during the high ozone season) and emissions of toxic air pollutants (during the entire year) achievable through the reformulation of conventional gasoline," taking various factors into consideration. The waiver will contribute to ozone reductions in the state, and will result in decreased levels of nitrates, a key component of fine particulate matter in California.

Second, the waiver is needed to help California reduce ground and surface water contamination by MTBE. It is clear that refiners will be able to eliminate the use of MTBE in California gasoline more quickly if the waiver is issued and made effective immediately.

Third, a waiver will result in significant cost savings to California's motorists. The referenced MathPro Inc. analysis indicates that, with the waiver, the capital costs of compliance with the CaRFG3 regulations will be $350,000 million -- $150,000 million less than the $500 million capital costs expected if the waiver is denied. Further, the ongoing cost of compliance is expected to be one to two cents per gallon less if the waiver is granted.