II.

PROPOSAL FOR REID VAPOR PRESSURE OF MOTOR VEHICLE GASOLINE

A. INTRODUCTION

1. Background

Gasoline volatility, as specified by the Reid vapor pressure (RVP), has a substantial effect on motor vehicle evaporative and exhaust ROG emissions. Since 1971 evaporative and exhaust ROG emissions have been reduced significantly in California by limiting the maximum RVP of motor vehicle gasoline to 9.0 psi during the smog season. The RVP limit, an integral part of California's gasoline evaporative emission control program, is estimated to be reducing evaporative emissions in California by 730 tons per day. The regulation limiting the RVP of motor vehicle gasoline is Section 2251, Title 13, of the California Code of Regulations (CCR). Figure 1 shows the times and the areas where the 9.0 RVP limit is in effect.

2. California Clean Air Act Requirements

The California Clean Air Act requires the ARB to adopt regulations to reduce motor vehicle exhaust and evaporative emissions. In this case, the staff is proposing to reduce the volatility of gasoline, which is one of the many strategies being developed to meet the goals of the CCAA. The CCAA requires that an initial workshop on a regulation governing gasoline volatility be held before February 1, 1990, and that hearings by the ARB to consider the adoption of such a regulation be held before November 16, 1990.

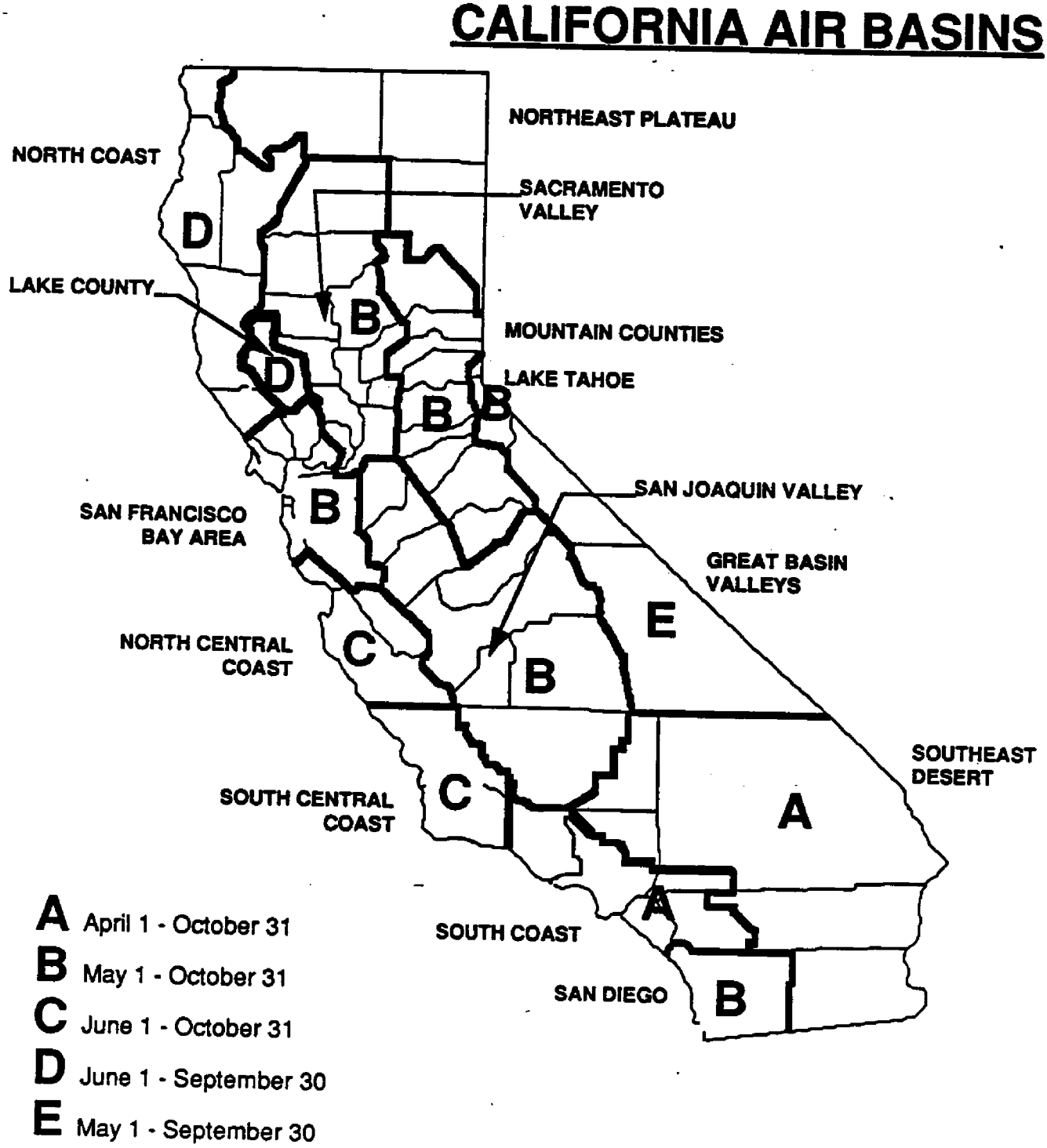
Vehicle emissions test data indicate that additional reductions in exhaust and evaporative ROG emissions can be achieved by reducing further the RVP of motor vehicle gasoline. Such reductions will be necessary to meet the emissions reductions requirements of the California Clean Air Act.

3. U.S. EPA Action

On March 21, 1989, EPA promulgated a regulation limiting the RVP of gasoline nationwide (54 Fed. Reg. 11868; 40 CFR Sec. 80.27). In California,

Figure 1

California 9 RVP Seasons



both the EPA and ARB regulations apply. As a practical matter the more stringent of the two in a given area and time period is the one affected parties must meet (see Federal Clean Air Act Section 211(c)(1), (4)(B); 52 Fed. Reg. 31311). The EPA regulation currently limits gasoline RVP in California to 9.5 psi. The limit applies from June 1 through September 15 for retail outlets and wholesale purchaser-consumer facilities, and May 1 through September 15 for all other facilities (e.g., upstream distribution points). In some northern California areas, EPA's RVP limit is 10.5 psi in May at the upstream facilities.

On June 11, 1990, EPA promulgated a Phase 2 RVP regulation, which will apply starting January 1, 1992 (55 Fed. Reg. 23658 (June 11, 1990)). The RVP limit will be 7.8 psi, for the period June 1 through September 15. A limit of 9 RVP will apply to upstream distribution points during the month of May. Unlike the 1989 EPA regulation, the Phase 2 RVP regulation has a practical effect because it is more stringent than the current California RVP limit of 9 psi.

B. DISCUSSION OF PROPOSED REGULATION

The staff proposes the adoption of 13 CCR Section 2251.5, which would limit the RVP of gasoline sold during the RVP control periods after January 1, 1992 to 7.8 psi. While this is the same limit as EPA's Phase 2 requirement, the staff proposal would have a practical effect because it applies to a longer time period, in some areas, than does EPA's requirement. The current RVP regulation would remain in effect until January 1, 1992.

1. Legal Authority

Health and Safety Code section 43830 is an RVP statute that was first enacted in 1970 as section 39051.1. It directs the ARB to establish maximum standards for volatility of gasoline at nine pounds per square inch RVP, giving consideration to topography and climatic conditions. Section 43830 also provides that until October 1, 1993, a blend of gasoline containing at least 10 percent ethyl alcohol shall not result in a violation of any regulation adopted by the Board pursuant to the section, unless the volatility of the gasoline used in the blend violates the applicable RVP standard.

There is some ambiguity whether section 43830 restricts the Board to a 9 RVP standard, or whether the CCAA now permits a more stringent standard because it generally authorizes the ARB to regulate fuel composition and directed the Board to take "whatever actions are necessary" to meet the mandated emissions reductions. On the one hand, section 43830 may be the operative provision because specific statutory provisions typically control over more general provisions. On the other hand, as a later-enacted statute, section 43018 reflects the current intent of the Legislature. Moreover, the mandatory direction in section 43018(d)(2) for the Board to conduct workshops and hearings on regulations governing gasoline RVP would be rendered essentially meaningless if the Board had no authority to change the present 9 RVP standards. This is reinforced by the fact that the

Legislature amended section 43018(d)(2) effective January 1, 1990 to provide that the workshops and hearings are to be conducted "notwithstanding section 43830." (Stats 1990, ch. 595.)

In any case, we expect this ambiguity to be resolved by pending legislation. Assembly Bill 3555, carried by Assemblyman Byron Sher (author of the CCAA), would amend section 43830 to authorize the Board to establish RVP standards at "or below" nine psi. Assuming this bill passes the Legislature as expected and is signed by the Governor, it will become effective January 1, 1991.

2. Proposed RVP Limit

The staff is proposing an RVP specification of 7.8 because, based on currently available information, this will result in the optimum combination of emissions reductions and minimal impacts on vehicle performance. Due to compliance margins implemented by refiners and due to fuel tank weathering, the actual in-use gasoline RVP is expected to be about 7.5 under the staff's proposal. Current data suggests that at RVPs less than about 7.5, exhaust emissions increase and tend to offset reductions in evaporative emissions. In addition, the performance of some vehicles could be impaired. For these reasons, the staff is not proposing to lower the limit on RVP to below 7.8, at this time. Several studies are being conducted by both government and private industry on the feasibility of lowering the RVP limit to 7.0. If these studies show net air quality benefits from RVP limits below 7.8 in the summer, or from RVP limits during other seasons, the staff will consider such limits as part of the second phase of the reformulated gasoline proposal scheduled for September 1991.

3. Regulatory Control Periods

Reid vapor pressure limits apply to both refiners and the "downstream" distribution system. For downstream facilities, the staff is generally proposing the same RVP control periods as apply in the Board's existing RVP regulation. There are two exceptions. First, the Northeast Plateau Air Basin is the only area in the state that is currently not subject to any ARB RVP limits (it <u>is</u> subject to the EPA limits). Since this air basin has to meet EPA requirements, and it has a climate, geography, and air quality problem sufficiently similar to the North Coast Air Basin, the staff proposes that it be added to the state program and subject to the same state RVP requirements as the North Coast Air Basin. Second, the staff is proposing to expand the RVP control period in San Diego County from May 1 through October 31 to April 1 through October 31. This change is being proposed because the air quality data indicate that San Diego County has similar climate and geography as the South Coast Air Basin and experiences a number of ozone standard exceedances during the month of April. This move will also simplify control requirements for industry since San Diego obtains its gasoline from refiners located in the South Coast Air Quality Management District.

At the "upstream" end of the system, the staff proposes that the RVP limits apply one month earlier for gasoline being transferred from a

refinery or import facility than for the downstream parts of the system. This requirement will help assure that by the time the limits apply to retailers, there has been sufficient replacement of their higher RVP gasoline inventory with lower RVP gasoline that they can be reasonably assured of coming into compliance by the start of the basic control period. This approach is similar to that in the EPA regulation. The difference is that EPA's earlier season applies to all points in the distribution process upstream from retail outlets. Given the time it can take for gasoline to work its way through the distribution network, we believe it is appropriate to have the earlier control period only apply to transfers directly from the refinery or importation facility.

4. Treatment of Blends Containing Ethanol

As noted in Section B.1, Health and Safety Code section 43830 exempts blends of gasoline containing at least 10 percent ethanol from the Board's RVP limits as long as the gasoline used in the blend meets the standard and other specified criteria are met. Since the staff believes that this provision represents the legislative intent for any current RVP regulation, the proposed language reflects and tracks the section 43830 treatment of gasoline blends containing ethanol. We are also proposing identification of a specific test method to be used in determining the ethanol content of gasoline ASTM D 4815-88. The statutory provision includes an October 1, 1993 "sunset" clause. We are proposing that the regulation state the special treatment of ethanol blends only apply as long as the statute requires special treatment.

The EPA regulation treats ethanol blends essentially the same by providing a 1 psi allowance for gasoline containing at least 9 percent ethanol.

5. Regulated Activities

The proposed regulation prohibits the sale, offer for sale, supply, offer for supply, and dispensing of gasoline exceeding the standard during the control period. All of these activities are covered by the EPA regulation as well. Prohibiting "offers" will help assure effective enforcement where a service station operator or refiner has a sizeable quantity of noncomplying gasoline that they are offering for sale or supply.

The regulation includes provisions intended to clarify the applicability of the standard when gasoline is sold upstream in one control area or time period and dispensed into vehicles in a different area or period. The basic prohibitions apply to sales or other transactions which occur in an air basin during a specified control period. However, there would be no liability for otherwise covered upstream transactions if the seller demonstrates that he or she has taken reasonably prudent precautions to assure the gasoline will only be delivered to a retail outlet when it is not subject to controls and is not in an area covered by the refiner or importer controls.

The proposed regulation also provides that the basic limits do not apply to sales to motor vehicles during a control period where the last delivery to the storage tank from which the fuel was dispensed occurred more than 14 days before the start of the control period. It protects operators of stations whose very low throughput and infrequent deliveries prevent the timely replacement of higher RVP gasoline with lower RVP gasoline.

The regulation would provide that each retail sale of gasoline for use in a motor vehicle, and each supply of gasoline to a motor vehicle fuel tank, is also deemed a sale by any person who previously sold the gasoline in violation of the RVP limits. This provision will help assure that Health and Safety Code section 43016 "per vehicle" penalties apply to persons who sell RVP gasoline before it is dispensed into vehicles. It is based on essentially identical language in other of the Board's fuels regulations. (e.g. 13 CCR secs. 2252(d)(6), 2253.2(e)(2))

6. Test Methods

There are a number of different methods available for measuring gasoline RVP. Each of the available methods can give slightly different readings and can have a different reproducibility and repeatability. To make the regulation equitable and enforceable it is necessary to specify the test method to be used.

The staff has conducted, in coordination with the Western States Petroleum Association (WSPA), a vapor pressure test program designed to compare four automated test instruments to the current (ASTM D 323-58) test method. The purpose of the program was to determine the repeatability and reproducibility of the automated instruments and to determine their accuracy when compared to ASTM D323-58. Sixteen laboratories participated in the interlaboratory study. The analytical instruments used in the test program included the Mini-Herzog, the laboratory Grabner, the portable Grabner, and the Seta Vap. Samples of 6 gasolines and one pure compound (neohexane) were provided to each laboratory for testing. The ARB tested identical samples using the ASTM D 323-58 test method. The test results obtained by the automated instruments showed that the laboratory Grabner and the portable Grabner met the 0.30 psi criterion for reproducibility and the 0.20 psi criterion for repeatability as specified in ASTM D 323-58. These two instruments were also able to determine the RVP of the samples, within 0.30 psi, when compared to the results using ASTM D 323-58. The other two instruments did not meet this criteria. Based on the results of the test program, the ARB staff is proposing revisions to the RVP test method to allow, in addition to the ASTM D323-58 test method now being used, the use of automated vapor pressure test instruments, which meet the above criteria for compliance testing. Specifically, staff is proposing the addition of ASTM Emergency Standards 14 and 15 restricted at this time to the Grabner portable and laboratory instruments.

The staff proposes to retain its current enforcement policy of allowing for the reproducibility uncertainty of 0.3 psi in the test method. Enforcement action would not be taken against a person subject to the rule unless the RVP, as determined by the ARB staff, is greater than 8.1 psi,

provided that the person subject to the rule determined the RVP to be 7.8 psi or less. If, at a future date, the test method is modified and becomes more reproducible, this policy would be changed accordingly.

7. Variance Provision

The staff is proposing to include in Section 2251.5 a variance provision. Under this provision, any person who cannot comply with the requirements of Section 2251.5 because of reasons beyond the person's reasonable control may apply to the Executive Officer for a variance. The variance provision would authorize the Executive Officer to grant variances allowing an applicant to meet a RVP standard up to 9.0 psi until January 1, 1994. The process for considering variances and the criteria for issuance would be similar to other ARB regulations such as that governing sulfur and aromatic hydrocarbon content of diesel fuel.

Refiners may have to make capital improvements to be able to meet the new RVP limit. If substantial new equipment, such as distillation columns, are required, refiners may need additional time to comply. This provision is being included because at least one refiner has made a credible argument to the staff that it may be unable to meet the proposed requirements within the proposed schedule. The variance provisions is only available until December 31, 1993.

The EPA regulation does not contain a variance provisions. Thus, even though a refiner attained a variance from ARB's regulation, the refiner would still have to comply with EPA's regulation.

C. VOC EMISSIONS AND VOC EMISSIONS REDUCTIONS DUE TO RVP REDUCTION

Shown in Table 1 are the staff's estimates of the VOC emissions from gasoline vehicles and the reductions in VOC emissions that would be achieved under the staff's proposal. Shown in Table 1 are estimates for the SCAB and for the state for the years 1992 and 2000. Estimates for the SCAB are shown for two scenarios. These are referred to as "FTP temps." and "high O3." The "FTP temps." scenario refers to estimates made under the assumption that ambient temperatures are equal to temperatures at which the federal test procedure (FTP) is conducted. The FTP is conducted at the following temperatures: diurnal emissions test at 60° to 84° F, hot soak and exhaust emissions tests at about 75° F. The FTP temperatures are about the average temperatures experienced in the South Coast Air Basin during the summertime. Thus, the emissions analysis based on FTP temperatures represents average daily emissions and average emissions reductions during the RVP control period.

The "high O3" scenario is the staff's estimate of emissions that occur on days with the highest ambient levels of ozone. Temperatures on these days are usually higher than average. The staff's estimates shown in Table 1 for the "high O3" scenario are based on temperatures that were measured on days with the highest ozone levels. The staff has concentrated

its efforts in estimating emissions on high ozone days mainly to the SCAB. Statewide estimates for the "high O3" scenario are not shown because the analysis has not yet been completed for some areas outside the SCAB. The "high O3" estimates will be used in 1991 plans prepared to meet California Clean Air Act requirements.

As shown in Table 1, the emissions and emissions reduction estimates for the SCAB are not substantially higher for the "high O3" scenario than for the "FTP temps" scenario. The difference between FTP and high ozone temperatures in the SCAB is not as large as in some areas of the state, particularly the Central Valley and the deserts. In these areas, high ozone days would benefit more from the control measure. The estimates shown in Table 1 are based on a reduction in gasoline RVP from 8.5 psi to 7.5 psi. Under the ARB's current 9 RVP regulation, the average RVP of gasoline, as it is dispensed into vehicle fuel tanks, is about 8.6 to 8.7 psi. Once in the vehicle fuel tank the gasoline weathers down to about 8.5 psi, on average. The staff anticipates that under its proposal, the average RVP of in-use gasoline will be about 7.5 psi. The drop in emissions between 1992 and 2000 reflects the benefits of fleet turnover to vehicles with lower evaporative emissions.

D. EFFECT OF RVP REDUCTION ON VEHICLE PERFORMANCE

In addition to its effect on emissions, the volatility of gasoline can effect vehicle performance. These effects must also be considered when evaluating the benefits of a gasoline RVP regulation, particularly as the change in performance also affects emissions. A minimum Reid vapor pressure is necessary to provide the vaporization of the gasoline that is necessary for cold starting, warm-up operation, and acceleration. Research has indicated that, up to a point, vehicle performance declines as the RVP of the gasoline is reduced. Based on this research a general indicator of vehicle performance has been developed for gasoline. The indicator, termed the driveability index (DI), is defined in terms of the 10, 50, and 90 percent distillation temperatures (T_{10}, T_{50}, T_{90}) of the gasoline.

The DI is defined by the following equation:

$$DI = 1.5 \times T_{10} + 3.0 \times T_{50} + 1.0 \times T_{90}$$

Generally, but not necessarily, the distillation temperatures, particularly the 10 percent and 50 percent distillation temperatures, increase as the RVP is reduced. Thus, the DI usually increases (vehicle performance decreases) as the RVP is reduced. The DIs of gasolines currently used in California during the RVP control period are about 1230 to 1240. Under the staff's proposal the DIs of gasoline would increase about 2 percent to 1250 to 1265. This could result in a small, but possibly unnoticeable, impairment in vehicle performance.

To ensure satisfactory vehicle performance the American Society for Testing and Materials (ASTM) has proposed a gasoline specification that would place an upper limit to the DI. The proposed ASTM driveability

Table 1

Volatile Organic Compound Emissions and Emissions Reductions Under the Staff Proposal

	VOC Emissions (TPD)			
	1992		2000	
	FTP Temps	High O_3	FTP Temps	High O_3
SCAB				
Total VOC Emissions- Gasoline Vehicle and Related	374	404	259	284
Total VOC Reductions	31	35	16	18
Statewide				
Total VOC Emissions- Gasoline Vehicle and Related	895	NA*	598	NA
Total VOC Reductions	77	NA	36	NA

*NA - not available.

Source: Air Resources Board.

specification will still be met and vehicle performance will remain satisfactory under the staff's proposal. The staff estimates that RVP can be safely reduced to 7.8 pounds per square inch (psi) with current gasoline formulations and not exceed the proposed ASTM driveability specification. A specification of 7.8 would also provide a safety margin of about 0.5 to 1 psi RVP for compliance with the ASTM driveability specification.

Other formulations of gasoline, such as those that will be considered in 1991, may show different D.I. sensitivities to RVP reduction and allow the Board to go below 7.8 psi. Data to be collected in the interim will assist the Board in considering lower RVP's.

E. COST OF RVP REDUCTION

The RVP of current gasoline is reduced mainly by reducing the amount of butane that is blended into the final product. The cost of RVP reduction depends mainly on the methods used to replace the octane and gasoline volume that is lost due to the rejection of butane. As noted earlier, one refiner has indicated to the staff that capital costs would be incurred in complying with the staff's proposal.

The staff has developed two independent estimates of the cost to comply with its proposal. The two estimates reflect two different scenarios of how lost gasoline volume and octane will be replaced. The first scenario assumes that refiners will increase crude oil throughput to make up lost gasoline volume and that refiners will increase the severity of refinery equipment used to increase octane. Increased throughput would be accomplished by increasing the operating time of refinery equipment that currently exists and is under permit from the local Air Pollution Control Districts. Turner, Mason, and Company (TM), a company with expertise in refinery modeling, developed a linear program model to simulate this scenario. The staff used the results of this model as a basis for its cost estimate.

The second scenario used by the staff to estimate the cost of complying with its proposal assumes that lost octane and volume will be made up by adding Methyl Tertiary Butyl Ether (MTBE) to the gasoline. This option is both viable and consistent with current and pending national requirements to increase the oxygen content of gasoline.

Based on results of the TM model, the cost to meet the staff's proposal is about 0.5 cent per gallon of gasoline produced during the RVP control period. If refiners choose to spread the costs out to gasoline purchasers throughout the year, and not only to purchases made during the RVP season, the cost would be about 0.4 cent per gallon of gasoline purchased throughout the year.

If refiners choose to comply with the staff's proposal by substituting MTBE for the butanes and all the cost is attributed to reducing RVP rather than meeting oxygen content requirements, the cost to the consumer would be

about 0.9 cent per gallon of gasoline purchased during the RVP control period, or about 0.6 cent per gallon purchased throughout the year.

The use of oxygenates will probably increase to meet Federal Clean Air Act requirements. A number of air quality benefits may be achieved. Thus, it is somewhat conservative to include only the RVP reduction benefits into the cost-effectiveness calculation for MTBE use.

The cost-effectiveness of complying with the staff's proposal is about $1.10 to $1.90 per pound of VOC reduced in 1990 and about $2.60 to $4.60 per pound of VOC reduced in 2000. The cost-effectiveness is greater in 2000 than in 1992 because the VOC emissions reductions are less in 2000. As noted earlier, the lower VOC emissions reductions in 2000 are attributable to lower baseline emissions because vehicles with better emissions control systems are being incorporated into the fleet and older vehicles are being retired. These cost-effectiveness estimates are within the range of cost-effectiveness estimates of other measures adopted or considered by the ARB.

The staff has received no comments from the small refiners or from the Independent Refiners Association indicating that small or independent refiners would have difficulty complying with the staff's proposal.

F. OTHER ENVIRONMENTAL IMPACTS

The staff has not identified any adverse environmental impact that would result from this proposal.