

**CALIFORNIA PHASE 2 REFORMULATED GASOLINE**  
*A publication from the California Air Resources Board in cooperation with the Phase 2 Reformulated Gasoline Public Education Subcommittee*

## California Reformulated Gasoline—An Overview

### What is Reformulated Gasoline?

Reformulated Gasoline (RFG) is "clean-burning" gasoline that will significantly improve air quality by reducing emissions from all gasoline-burning motor vehicles and engines. RFG is required by U.S. Environmental Protection Agency (U.S. EPA) and California Air Resources Board (ARB) regulations to help meet air quality standards.

Beginning January 1, 1995, federal law requires the use of federal RFG in the worst polluted areas of the nation, including southern California. Then in March 1996, state law will require the production of even "cleaner-burning" gasoline: California Phase 2 RFG (California RFG). By June 1996, all gasoline sold in the state must be California RFG.

### Why Do We Need California RFG?

California has severe air quality problems, and motor vehicles are the largest contributors. Motor vehicles account for about one-half of the emissions of volatile organic compounds (VOCs) and nitrogen oxides (NOx), which contribute to the formation of ground level ozone — the main ingredient in smog.

### What are the Benefits of California RFG?

**Clean Air**—California RFG will immediately reduce emissions from all existing on-road gasoline-burning cars and trucks. It will produce the largest emission reductions of any control measure in the last decade. Reductions from on-road vehicular emissions in 1996 are estimated to be:

California Phase 2 RFG Emission Reductions	
Compound	Reduction
Volatile Organic Compounds	17% (190 tons/day)
Nitrogen Oxides	11% (110 tons/day)
Sulfur Dioxide	80% (30 tons/day)
Carbon Monoxide	11% (1300 tons/day)

**Reduced Cancer Risk**—California RFG will also reduce emissions of cancer-causing pollutants. These reductions translate into approximately a 40% decrease in the cancer risk due to gasoline-powered motor vehicles.

**More Jobs**—Gasoline producers will need to modify their refineries, creating about 20,000 temporary construction and several hundred permanent jobs.

**Clean Cars**—Auto manufacturers will use California RFG to meet California's stringent low-emission vehicle regulations.

### What Makes California RFG Different from Current Gasoline?

California RFG will pollute less. Because additional refining steps will be required to make this "cleaner-burning" gasoline. California RFG will cost more to produce. Gasoline producers must remove or modify components that contribute most significantly to vehicle emissions. The resulting "cleaner-burning" gasoline may lead to slight reductions (2-4%) in vehicle fuel economy.

### What is Being Done to Help Ensure a Smooth Transition to California RFG?

The ARB is working with industry as well as other government agencies to implement a comprehensive gasoline performance testing program. Beginning in early 1995, over one thousand motor vehicles will be tested using California RFG. The six month testing program will help ensure that California RFG will perform well long before it is sold to consumers. Testing is also planned for lawn and garden equipment, agricultural equipment, marine engines, and off-road vehicles (construction and recreational).

Recently, independent researchers completed a two year test program on delivery vans operating on alternative motor fuels, including California RFG. During the study, 21 vans burning California RFG were driven about 18,000 miles each. Preliminary findings show no fuel-related problems.

#### For more information:

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California Phase 2 Reformulated Gasoline *Fact Sheets* \*\* are published by the California Air Resources Board in cooperation with the Phase 2 Reformulated Gasoline Public Education Subcommittee. The Subcommittee members include:

*Assoc. of International Automobile Manufacturers, Inc.*  
*Automobile Club of Southern California*  
*Automotive Trade Organizations of California*  
*California Air Resources Board*  
*California Assoc. of Council of Governments*  
*California Building Industry Association*  
*California Chamber of Commerce*  
*California County Superintendents Educational Services Assoc.*  
*California Department of Transportation*  
*California Independent Oil Marketers Assoc.*  
*California Public Utilities Commission*  
*California Renewable Fuels Council*  
*California Service Station and Automotive Repair Assoc.*  
*California State Automobile Assoc.*  
*Chrysler Corporation*  
*Coalition for Clean Air*  
*General Motors Corporation*  
*National Assoc. of Fleet Administrators, Inc.*  
*Natural Resources Defense Council*  
*Parallel Products*  
*Petroleum Marketers Assoc. of America*  
*Texaco Inc.*  
*Ultramar Inc.*  
*United States Environmental Protection Agency*  
*Unocal Corporation*

\* The price of gasoline is difficult to predict. A subsequent fact sheet will discuss factors that affect the cost and price of gasoline.

\*\* Other fact sheets in this series will include:

- Comparison of federal and California RFG
- California RFG Performance Testing
- Cost-effectiveness of California RFG
- The cost and price of gasoline

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**California Reformulated Gasoline—Testing Underway**

*Testing is underway to evaluate California Phase 2 Reformulated Gasoline (California RFG) in gasoline-powered motor vehicles and equipment. The purpose of this testing is to evaluate the performance and compatibility of California RFG before it is introduced statewide in June 1996.*

**California Air Resources Board-Sponsored Test Program**

The California Air Resources Board (ARB) Test Program will evaluate on-road and off-road vehicle fleets and equipment fueled with California RFG. For comparison, control vehicles will operate on conventional unleaded gasoline. This test program is a cooperative effort between government and industry. Between February and August 1995, researchers will:

- Conduct periodic "under-the-hood" vehicle fuel system inspections
- Collect data to monitor vehicle fuel economy
- Monitor vehicle emissions (selected vehicles)
- Investigate vehicles and components with any fuel-related problems. A Technical Review Panel, consisting of representatives from the automotive and oil industries, automotive trade organizations, the ARB, and the California Bureau of Automotive Repair, will evaluate problem vehicles or equipment.

**On-Road Test Fleets**

The on-road test fleets are comprised of a wide variety of vehicles including:

- 1,000 light and medium-duty vehicles fueled with California RFG
- 800 light and medium-duty vehicles fueled with conventional gasoline
- Early through late model year vehicles
- Low through high mileage vehicles
- Northern and southern California vehicles from the City and County of Sacramento, CalTrans, Bank of America, GTE California, Pacific Bell, and California State University, Fresno.

**Off-Road Vehicles and Equipment**

The ARB is working with equipment operators to test a variety of off-road vehicles and equipment using California RFG including:

- Utility, Lawn and Garden Equipment—Maintenance staff at the University California, Davis, will be using test fuel in lawn mowers, edgers, blowers, garden tractors, and other equipment.
- Industrial/Construction Equipment—Testing is planned for generators, forklifts and other equipment at California State University (Fresno) and Caltrans.
- Farm Equipment—Staff at Cal Poly-San Luis Obispo and U.C. Davis will be using test fuel in agricultural equipment.

**Test Fuel**

Over 500,000 gallons of California RFG test fuel will be produced and delivered to over 12 northern and southern California test sites (see specifications in table).

California RFG Test Fuel Specifications	
Oxygenate	MTBE
RVP, psi	
Summer	6.5-6.9
Winter	11.5-12
Aromatic, v. %	18-20
Olefins, v. %	3.0-5.0
Sulfur, ppm	15-25
Benzene, v. %	0.5-1.0
T50, °F	190-210
T90, °F	280-300
Oxygen, wt. %	1.8-2.2
(These values represent ranges for blending tolerance around regulatory values.)	

*Phillips 66 Company is blending fuel for the ARB-sponsored test program to meet these specifications.*

## Manufacturer-Sponsored Testing Programs

Automobile and other equipment manufacturers are testing California RFG in a variety of on-road and off-road vehicles and equipment including:

### On-Road Vehicles

- General Motors—Engineers are testing material compatibility with a variety of California RFG blends to evaluate the effects on fuel system components.
- Ford—Researchers will be testing six blends of California RFG to study lubricity effects in fuel pumps, fuel injectors, and other fuel system components used by original and aftermarket equipment manufacturers.

### Off-Road Vehicles and Equipment

- Marine Engines—Mercury Marine and Outboard Marine Corporation will test a variety of pleasure crafts including outboard, inboard, and inboard-stern drive models.
- Motorcycles and All-Terrain Vehicles—Honda is planning to conduct testing on various fleets. In addition, some on-road motorcycles will be tested as part of the ARB Test Program.
- Snowmobiles—Manufacturers are planning to test in-use fleets.
- Utility, Lawn and Garden Equipment—Briggs & Stratton Corporation and Tecumseh Products Company have completed laboratory and field testing. Preliminary findings from these tests show no fuel-related problems.
- Portable Equipment—The Portable Power Equipment Manufacturers Association will be testing engines on chainsaws, trimmers, and blowers for several engine manufacturers in Sweden, Germany, Japan and the U.S.

## Other Testing of California RFG

- Federal Express CleanFleet Study—Researchers from the Battelle Memorial Institute recently completed a comprehensive side-by-side evaluation of Federal Express delivery vans operating in southern California on alternative fuels, including California RFG. Preliminary findings show no fuel-related problems. For more information, contact Helen Latham of Battelle at (614) 424-4062.
- Texaco Inc. is evaluating the potential for testing low-aromatic blends of California RFG in their company fleet in Bakersfield, California.

### For more information:

California Air Resources Board  
 P.O. Box 2815  
 Sacramento, CA 95812  
 (800) ARB-HLP2 (in California)  
 (916) 323-3336 (outside California)

## California RFG Publications

### ARB Test Program—Test Results

- Results will be published and made available to the public as data is collected and analyzed.

### Fact Sheet Series

1. *California RFG—An Overview (12/94)*
2. *California RFG—Testing Underway (2/95)*
3. *Federal and California RFG (planned)*
4. *RFG and Your Health (planned)*
5. *Cost-Effectiveness of California RFG (planned)*
6. *The Cost and Price of Gasoline (planned)*

### California RFG Forum

Quarterly newsletter

California Environmental Protection Agency

 Air Resources Board

Published by the California Air Resources Board and the California Reformulated Gasoline Public Education Subcommittee—representing industry, environmental groups, and government agencies committed to cleaner air for California.

## Comparison of Federal and California Reformulated Gasoline

Reformulated gasoline (RFG) is gasoline that pollutes less. This is important in California and other areas in the country that need to reduce health-threatening levels of air pollution. Since January 1, 1995, the U.S. Environmental Protection Agency has required federal Phase I RFG in the nine worst-polluted areas in the nation, including southern California. Lower polluting federal Phase II RFG will be required in these areas in the year 2000.

However, because California has the most serious air quality problems in the nation, the state's Air Resources Board (ARB) requires the statewide production of even lower-polluting gasoline—California RFG—beginning March 1996. This fuel will reduce air pollution emissions more than federal RFG and will satisfy federal RFG requirements.

### Health Benefits

Both federal and California RFG reduce levels of lung-damaging ozone (the main ingredient of smog), carbon monoxide, and airborne toxic chemicals that can cause cancer. Initially, California RFG will cut smog-forming air pollution twice as much as federal Phase I RFG. It will also reduce sulfur dioxide emissions, which can damage lung tissues and impair vehicle smog control systems.

### Performance

Since its introduction, federal Phase I RFG has performed well in all gasoline-powered vehicles and equipment. With over three billion gallons already sold to southern California motorists, no performance problems have been reported.

The ARB and industry are currently testing the performance of California RFG in over 1000 motor vehicles and in other gasoline-powered equipment such as lawn mowers, boats, and snowmobiles. Results from ARB's test program will be available in late Fall 1995 and will be presented in future fact sheets.

### Production Cost

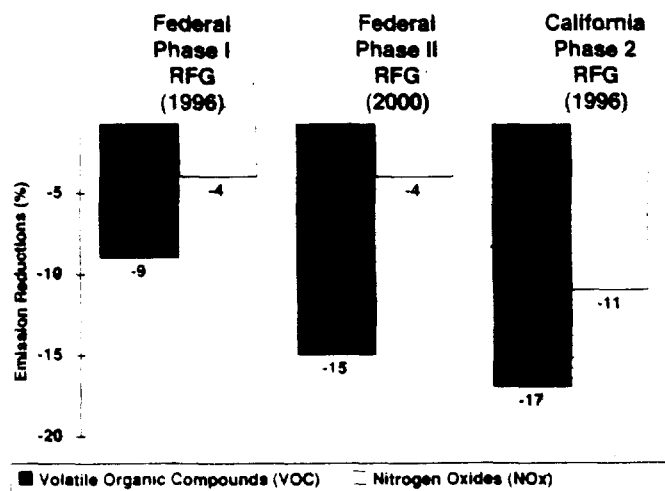
RFG costs more to produce than California 1994 conventional gasoline. To make California RFG, most refiners must invest in new equipment, add processing steps, and use more expensive blending ingredients. Depending on the refiner, this will increase production costs by about 5 to 15 cents per gallon (an average of 10 cents). This includes the additional 2 to 5 cents per gallon needed to make federal Phase I RFG.

However, even though RFG will cost more, it makes economic as well as environmental sense. When compared with other methods of reducing air pollution such as additional controls on businesses or added Smog Check requirements for motor vehicles, RFG is a very cost-effective way to clean the air.

### Price at the Pump

The price of gasoline cannot be accurately predicted because it is influenced by many factors including production costs, weather, crude oil prices, and product supply and demand. However, it is expected that increased RFG production costs will be reflected in the price at the pump.

**RFG Reduces Smog-forming Pollution**  
(Compared to California 1994 Conventional Gasoline\*)



\* Exhaust and evaporative emission reductions from California gasoline-fueled vehicles.

California RFG will pollute significantly less than federal RFG. In addition to reducing smog-forming gases, federal and California RFG will also reduce emissions of carbon monoxide (CO), sulfur dioxide (SO<sub>2</sub>), and air toxics.

**Federal and California Reformulated Gasolines Compared to California 1994 Conventional Gasoline**

	Federal RFG		California RFG
<b>Implementation Dates</b>	Phase I 1/1/95 (retail)	Phase II 1/1/2000 (retail)	3/1/96 (producer) 6/1/96 (retail)
<b>Areas Affected</b>	L.A. County Orange Riverside Sacramento (6/96) San Bern. (part) Ventura San Diego	Same as 1995	Statewide
<b>Emission Reductions (%) (Date)</b>	(1996)	(2000)	(1996)
Volatile Organic Compounds	9	15	17
Nitrogen Oxides	4	4	11
Carbon Monoxide	11	11	11
Sulfur Dioxide	0	0	80
<b>Reduced Cancer Risk (%) <sup>2</sup></b>	20-30	30-40	30-40
<b>Fuel Properties <sup>3</sup></b>			
Reid Vapor Pressure (RVP), psi	7.0	6.7	6.8
Oxygen, wt. %	2	2	2
Benzene, v. %	0.8	0.8	0.8
Aromatics, v. %	27	25	22
Olefins, v. %	8.5	8.5	4
Sulfur, ppm	130	130	30
Distillation temperatures			
T50, °F	210	207	200
T90, °F	329	321	290
<b>Production Cost Increase</b> (cents/gallon)	2-5	unknown	5-15 <sup>4</sup>
<p>1. California RFG will satisfy federal Phase II RFG requirements.            2. Analysis includes an adjustment for methyl tertiary butyl ether (MTBE).            3. Specifications for gasolines that could comply with Federal and California RFG regulations.            4. Average of 10 cents per gallon—based on individual refiner production costs.</p>			

**For more information:**

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