

Presentation to U.S. EPA Technical Advisory Committee Regarding California Phase 3 Reformulated Gasoline Program

January 12, 2000



California's Gasoline Programs

Year Adopted	Major Changes Made
1971	Reid Vapor Pressure
1975	Sulfur
1976	Lead
1990	Phase 1 RFG <ul style="list-style-type: none">- Reid Vapor Pressure- Lead Phase-Out- Deposit Control Additives
1991	Phase 2 RFG <ul style="list-style-type: none">- 8 properties, including RVP
1994	Wintertime Oxygenates
1994	Phase 2 RFG Predictive Model
1998	Remove winter oxygen requirement where not needed

Overview of CaRFG2 Program

- ◆ Implemented in Spring 1996
- ◆ Limits on the following parameters:

RVP*	Sulfur
T50	Benzene
T90	Aromatic Hydrocarbons
Olefins	Oxygen Content

* Only the summer RVP limit is fixed, at 7.0 psi

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Specifications for CaRFG2 Program

	Typical Before CaRFG2	Flat Limit Standard	Cap for All Gasoline
RVP, psi	7.8	7.0	7.0
Sulfur, ppmw	150	40	80
Aromatic HC, vol%	32	25	30
Benzene, vol%	2.0	1.0	1.2
Olefins, vol%	9.9	6.0	10.0
Oxygen, wt%	0	1.8-2.2	1.8*-3.5
T90, deg F	330	300	330
T50, deg F	220	210	220

* Wintertime only

** Refinery cap = 310 deg F

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Benefits of Cleaner-Burning Gasoline

- ◆ Emission reductions equivalent to removing 3.5 million vehicles from region's roads
- ◆ Reduces smog forming emissions from motor vehicles by 15%
- ◆ Reduces potential cancer risk from vehicle emissions by 40%
- ◆ 1/4 of SIP reductions in 1996
- ◆ Reduces benzene emissions by half

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Additional Emission Benefits

1998 In-Use Fuel Compared to CaRFG2 Specifications
2005 (tpd)

Pollutant	Additional Benefits
	Realized
Total Hydrocarbons (HC)	31 tpd
Oxides of Nitrogen (NO _x)	32 tpd
Toxics	12%

* Based on on-road exhaust and evaporative emissions

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Cost of CaRFG2

- ◆ ARB staff originally estimated CaRFG2 would add 5 to 15 cents per gallon to gasoline production costs
- ◆ In 1996, California Energy Commission estimated CaRFG2 accounted for 5-8 cents per gallon increase in price of California gasoline
- ◆ November 1999, State Attorney General assessment
 - Wholesale prices for CARB gasoline has averaged about 4 cents greater than conventional gasoline

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History of Oxygenate Use

- ◆ Used since late 1970's to increase octane
- ◆ Clean Air Act required oxygen in winter gasoline starting in 1992 in CO non-attainment areas
- ◆ Year-round in federal RFG areas starting in 1995 (30% of gasoline nationwide)
- ◆ MTBE refiner's primary choice

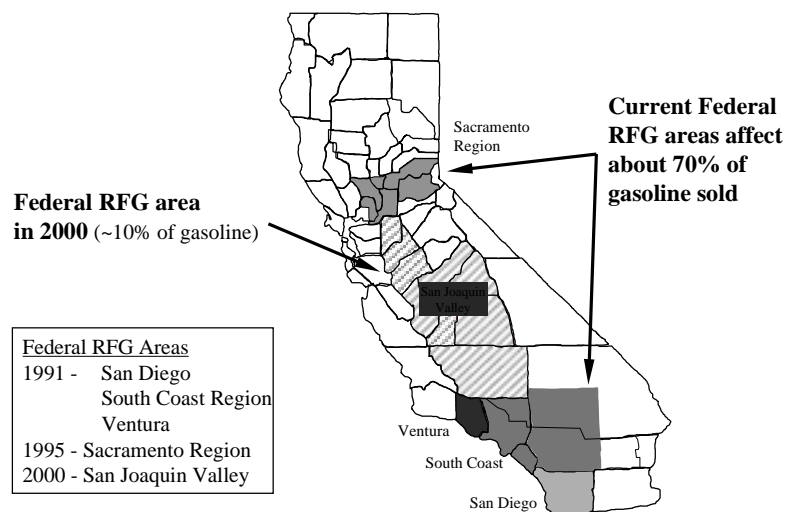
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Oxygen Requirements in California

- ◆ California's rules are flexible
- ◆ Emissions benefits can be met without oxygen except in winter in the South Coast area to reduce carbon monoxide
- ◆ Federal minimum oxygen content applies to Federal RFG areas and is a year-round requirement

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Federal Minimum Oxygen Requirement Affects Most of State



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Governor's Findings

Based on study by University of California,
and public hearings Governor found:

- ◆ MTBE presents threat to groundwater, surface water, and drinking water
 - Underground gasoline storage tanks are not leak proof
 - MTBE is highly soluble in water and transfers to groundwater faster than other constituents in gasoline
 - MTBE in small amounts renders drinking water unusable
- ◆ MTBE potential but not proven health problem
- ◆ MTBE not essential to cleaner-burning gasoline

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Governor's Executive Order



- ◆ On March 25, 1999 Governor Davis issued Executive Order D-5-99 for the phase-out of MTBE from California gasoline by earliest practical date but not later than December 31, 2002
- ◆ Directs ARB to adopt CaRFG regulations to provide additional flexibility in removing oxygen while preserving benefits
- ◆ Directs ARB to request waiver from Federal Oxygen Requirement from U.S. EPA

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Other Key Directives from Executive Order D-5-99

- ◆ ARB and the SWRCB to conduct analysis of environmental fate and transport of ethanol
- ◆ OEHHA to prepare an analysis of the health risks associated with the use of ethanol
- ◆ CEC to evaluate steps to foster waste-based or other biomass ethanol development in California if ethanol acceptable substitute for MTBE

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New State Legislation

- ◆ Senate Bill 989 (Sher)
 - Ensure the CaRFG3 regulations maintain or improve upon emissions and air quality benefits achieved by CaRFG2 and provide additional flexibility to reduce or remove oxygen from motor vehicle fuel
- ◆ Senate Bill 529 (Bowen)
 - Establishes a mechanism for conducting multi-media review of revisions to ARB's CaRFG standards
- ◆ Governor's Environmental Policy Council review January 18, 2000

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External Process

- ◆ Phase 3 gasoline (CaRFG3)
 - Met with individual stakeholders
 - Held 9 public workshops
 - Work with California Energy Commission
- ◆ Advised by consultants from the University of California
 - Dr. Robert Sawyer, UC Berkeley
 - Dr. David Rocke, UC Davis
- ◆ Peer Review
 - Dr. Catherine Koshland, UC Berkeley
 - Dr. Donald Lucas, UC Berkeley and Lawrence Berkeley National Laboratory
 - Dr. Larry Caretto, CSU Northridge, Dean of College of Engineering

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Overview of CaRFG3 Regulations

- ◆ Prohibit use of MTBE
- ◆ Change specifications to ensure benefits are preserved and to provide flexibility
- ◆ Update Predictive Model
- ◆ Evaporative emissions model added to Predictive Model
- ◆ Provide CO credit
- ◆ Increase oxygen cap for 10 percent ethanol blends
- ◆ Amend wintertime oxygenate period
- ◆ Amend the provisions (CaRBOB) for ethanol blending
- ◆ Wintertime Oxygen Program
- ◆ Early Opt-In

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Prohibition on Adding MTBE to Gasoline

- ◆ Consistent with Governor's Executive Order, effective December 31, 2002, MTBE cannot be added to gasoline
- ◆ Deminimus residual levels to be phased in over a three year period

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Proposed Specification Changes

- ◆ Reduce limits for sulfur and benzene to ensure benefits are preserved
- ◆ Increase limits for T50 and T90 and increase cap limit for aromatic hydrocarbons to provide flexibility
- ◆ Allow RVP to vary (6.4 to 7.2 psi.) with use of proposed evaporative model to provide flexibility

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Specifications for CaRFG3

Property	Flat Limits	Averaging Limits	Cap Limits
RVP, psi	7.0⁽¹⁾	none	6.4-7.2
Benzene, vol%	0.80	0.70	1.10
Sulfur, ppmw	20	15	60/30⁽³⁾
Aromatic HC, vol%	25	22	35
Olefins, vol. %	6.0	4.0	10
Oxygen, wt. %	1.8 to 2.2	na ⁽²⁾	3.7⁽⁴⁾
T50 °F	213	203	220
T90 °F	305	295	330

- 1) Equal to 6.9 psi. if using the evaporative element of the Predictive Model
 2) Not Applicable
 3) 60 ppmw. will apply December 31, 2002; 30 ppmw. will apply December 31, 2004
 4) Allow 3.7 for gasoline containing no more than 10 volume percent ethanol

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Updates to the Predictive Model

- ◆ More powerful statistics used
- ◆ Additional emissions data from nine studies included
 - About 2,500 additional data points
- ◆ New technology group added to model to reflect newer vehicles
 - 1996 to 2005 model year vehicles (“Tech 5”)
- ◆ Update weights for vehicle technology groups to reflect 2005 vehicle fleet

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Evaporative Emissions Element Added to the Predictive Model

- ◆ Allows exhaust hydrocarbons and evaporative hydrocarbons trading
- ◆ Increases flexibility
- ◆ Credit for RVP reductions

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Added CO Credit

- ◆ Provides credit recognizing role of CO in ozone formation

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Changes to the CARBOB Provisions

- ◆ Limited changes to simplify distribution with use of ethanol
- ◆ Further changes needed
- ◆ The staff is committed to address other necessary changes next year

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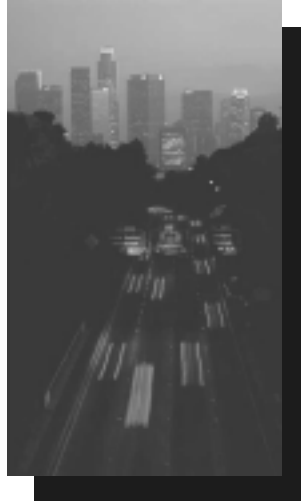
Wintertime Oxygen Requirement for South Coast

- ◆ Remove the month of October from the wintertime oxygen season in the South Coast Air Basin starting in 2003
 - Continues to be effective November through February
 - Only 1 exceedance during October in last 4 years
- ◆ By 2003 no exceedances of the CO standard would be expected in the month of October.

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Early Access to CaRFG3

- ◆ Facilitate early
MTBE removal
- ◆ Ensure continued
enforceability of
regulations



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Overview of Effects

- ◆ Emissions
- ◆ Economics
- ◆ Production volume
- ◆ Environmental effects

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Effect on Emissions

- ◆ Air Quality Objectives
 - Preserve emission benefits
 - Meets SB 989 (Sher) and Governor's Executive Order requirements

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Preserving Benefits

- ◆ Determined average properties of gasoline marketed in 1998
- ◆ Determined emissions benefits achieved with 1998 in-use gasoline
- ◆ Proposed specifications so that future in-use gasoline would be required to be as clean as 1998 gasoline
- ◆ Verified proposed specifications more stringent than CaRFG2 specifications

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Benefits of In-Use CaRFG2 Preserved

Pollutant	Emissions (2005)	
	Percent	tons/day
Hydrocarbon	- 0.1%	- 0.6
Oxides of Nitrogen (NOx)	- 1.2%	- 9.9
Potency Weighted Toxics	- 1.8%	na

na - not applicable

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Estimated Production Cost for CaRFG3

- ◆ Estimated capital costs significantly less than \$1 billion, mostly for MTBE removal
- ◆ In October, estimates of ongoing costs were 2 to 6 cents per gallon
- ◆ Ethanol industry and at least one refiner believe actual costs will be less
- ◆ Federal oxygen waiver could reduce costs up to 2 cents per gallon
- ◆ Under right conditions costs could be zero
 - If cost of ethanol or alkylate blendstocks are less than MTBE

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Environmental Impacts of CaRFG3

- ◆ MTBE contamination of existing water sources will be limited to pre-existing MTBE contamination
- ◆ Less benzene contamination of surface and ground water
- ◆ Increased ethanol use may result in slight increase in transportation emissions from rail and heavy duty trucks
- ◆ No net increase in greenhouse gas emissions
- ◆ Decreases in NO_x, potency weighted toxics and equivalency on hydrocarbon emissions

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Effects on Air and Water Quality

- ◆ ARB and SWRCB are evaluating the environmental fate and transport of ethanol in air and water
- ◆ OEHHA evaluating health impacts
- ◆ To be considered by the Environmental Policy Council (January 18, 2000)



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Effects of Commingling Gasoline with Ethanol and Gasoline Without Ethanol

- ◆ When gasoline with ethanol is blended with gasoline without ethanol, RVP increases
 - Results in higher evaporative emissions
- ◆ Effect on emissions depends on various factors
 - Oxygen waiver
 - Refiner choices; mix of fuel available in given area
 - Consumer choices; brand loyalty and grade loyalty

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Commingling Impacts

- ◆ The staff estimates commingling could increase average RVP by about 0.1 psi
- ◆ Proposed specifications provide cushion for commingling effects
- ◆ Propose commingling study by December 2001 to assure we have addressed commingling

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Next Steps

- ◆ Follow up on EPA oxygen waiver
- ◆ Adjust predictive model to reflect final EMFAC 2000
 - RVP and evaporative emissions relationship
 - Vehicle group weightings
- ◆ Return to Board by October 2000
 - CARBOB Amendments
 - Finalize small refiner provisions
 - Denatured ethanol specification
- ◆ Request US EPA to consider national DI specification
- ◆ Environmental Policy Council review January 18, 2000
- ◆ Initiate process to monitor refiner progress toward compliance

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Next Steps (Continued)

- ◆ Conduct commingling study in 2001
- ◆ In 2004
 - Evaluate real-world CaRFG3 gasoline properties to ensure real-world benefits of CaRFG2 are preserved
 - Evaluate real-world DI levels in CaRFG3
 - Complete evaluation with CEC on impacts of near zero sulfur levels in gasoline (including impacts on supply and cost of production), and CaRFG3 in-use sulfur levels

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Conclusion

- ◆ The Board adopted the staff proposal to phase out MTBE and to provide refiners additional production flexibility while maintaining the emissions benefits of the existing reformulated gasoline program
- ◆ The Board directed staff to return no later than October 2000 to address CaRBOB, denatured ethanol specifications, and small refiner provisions

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Predictive Model

- ◆ Used for virtually all gasoline produced
- ◆ Predicts how exhaust emissions change when fuel properties change from flat specifications
- ◆ Provides alternative means of compliance
- ◆ Increases gasoline producer's flexibility
- ◆ Reduces compliance costs / improves production capability

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Independent Peer Review of Staff's Assessment

- ◆ Followed Cal/EPA formal process for conducting peer review
 - Staff Proposal
 - Predictive Model
- ◆ Peer reviews confirm staff proposal meets objectives