State of California
Air Resources Board

# UPDATED INFORMATIVE DIGEST

## 2007 AMENDMENTS TO THE PHASE 3 CALIFORNIA REFORMULATED GASOLINE REGULATIONS

**Sections Affected:** Amendments to sections 2261, 2262, 2262.3, 2262.4, 2262.5, 2262.9, 2263, 2263.7, 2264.2, 2265 (and the incorporated "California Procedures for Evaluating Alternative Specifications for Phase 3 Reformulated Gasoline Using the California Predictive Model"), 2266, 2266.5, 2270, 2271, and 2273, and new sections 2260(a)(0.5), (0.7), (7.5), (8.5), (10.5), (10.7), (19.7), (23.5), and (23.7), 2262.3(d), 2264.2(a)(3), (b)(5), and (d), 2265(c)(4), 2265.1, 2265.5, and 2266(b)(3), (4), and (5) of Title 13, California Code of Regulations (CCR).

**Background:** The ARB administers the CaRFG regulations, which have applied to all California gasoline since March 1996; the Phase 3 CaRFG standards have applied since December 31, 2003. The CaRFG regulations establish specifications for the following eight gasoline properties: sulfur, benzene, olefin, aromatic hydrocarbon, and oxygen contents, 50 percent distillation temperature (T50), 90 percent distillation temperature (T90), and summertime RVP. The Phase 3 CaRFG regulations also prohibit the use of oxygenated compounds (oxygenates) other than ethanol in CaRFG, and regulate the composition of denatured ethanol that can be blended with California reformulated gasoline blendstock for oxygenate blending (CARBOB) to produce CaRFG.

The CaRFG regulations allow refiners to use a "Predictive Model" to certify alternative formulations. The Predictive Model is a set of mathematical equations that relate emissions rates of exhaust and evaporative hydrocarbons and carbon monoxide (CO), oxides of nitrogen (NOx), and potency-weighted toxics for four toxic air contaminants (benzene, 1,3-butadiene, formaldehyde, and acetaldehyde) to the values of the eight regulated gasoline properties. An alternative gasoline formulation based on the Predictive Model is acceptable if emissions of reactivity-weighted hydrocarbons and CO (total ozone forming potential), NOx, and potency-weighted toxics resulting from this formulation are no greater than emissions from gasoline having the specifications set forth in the CaRFG standards. Currently, most of the gasoline sold in California complies with the CaRFG regulations through the use of the Predictive Model.

Since 1995, most of the State's gasoline has contained about 2 percent oxygen by weight. From 1995 to 2002, methyl tertiary-butyl ether (MTBE) was the oxygenated compound used in most California gasoline. Since December 31, 2003 – the Phase 3 CaRFG compliance deadline – ethanol has been the only oxygenate allowed in California gasoline. The widespread use of oxygenated compounds in California gasoline has primarily resulted from two programs mandated by the federal Clean Air Act – the federal reformulated gasoline (RFG) program administered directly by the U.S.

Environmental Protection Agency (U.S. EPA) in the smoggiest areas of the country, and the wintertime oxygenates program which is ultimately administered by the states. The federal Energy Policy Act of 2005 directed U.S. EPA to lift the federal oxygen content requirement for federal RFG and set a renewable fuels standard (RFS) which requires an increasing use of renewable transportation fuel nationwide. In February 2006, U.S. EPA lifted the federal oxygen content requirement for federal RFG. The federal wintertime oxygen content requirement for carbon monoxide nonattainment areas is still in effect for wintertime gasoline sold in the South Coast Air Basin and Imperial County. Almost all gasoline marketed in California today contains ethanol.

**Description of the Regulatory Action:** Health and Safety Code 43013.1 requires that the Phase 3 CaRFG regulations preserve the emissions and air quality benefits of the Phase 2 CaRFG program. The ARB staff has determined that the use of ethanol in Phase 3 CaRFG increases evaporative emissions, relative to Phase 2 CaRFG, through a process known as permeation. Permeation occurs in both on-road vehicles and off-road engines and portable fuel containers.

At the June 14, 2007, public hearing, the Air Resources Board (ARB/Board) approved amendments to the California Phase 3 reformulated gasoline (CARFG3) and the incorporated "California Procedures for Evaluation Alternative Specifications for Phase 3 Reformulated Gasoline Using the California Predictive Model." These amendments and new sections to the CARFG3 regulations included an update to the Predictive Model to mitigate the increase in permeation emissions from on-road motor vehicles associated with ethanol in California gasoline. Under the amendments, starting December 31, 2009, a fuel formulation cannot be treated as fully complying with the Phase 3 CaRFG standards unless the permeation emissions from on-road vehicles are fully mitigated.

At this time, staff does not have adequate data to design amendments to the CaRFG3 rules to ensure that the increase in evaporative emissions due to the use of ethanol in off-road engines and portable fuel containers is fully mitigated. Staff is initiating additional test programs to evaluate the effect of ethanol in gasoline on both exhaust and evaporative emissions and plans to propose appropriate mitigation strategies as soon as practical.

To mitigate the permeation emissions from on-road vehicles, the refiners can choose one of two options. First, they can use the Predictive Model to develop an alternative fuel formulation. Using this approach will likely require the use of a very low sulfur fuel content and ethanol amounts approaching 10 percent by volume. As such, refinery modifications are needed to produce the very low sulfur fuels and rebalance the production to accommodate the higher ethanol contents. Therefore, a second option, referred to an alternative emissions reduction plan (AERP), may be used.

The AERP allows a producer, or an importer that produces gasoline, to mitigate the permeation emissions by obtaining emission reductions from combustion or other gasoline-related sources. The producer or importer must still comply with the default

flat limits, averaging limits, a test-certified alternative gasoline formulation, or the non-permeation portion of the Predictive Model. All alternative emissions reduction plans sunset on December 31, 2011, unless the Executive Officer approves an extension in advance.

The need to address permeation emissions associated with the use of ethanol will make it more difficult and costly for refiners to comply with the amended Phase 3 CaRFG regulations. Therefore, some additional flexibility to the producers and importers to address the expected ongoing difficulties in meeting the very low sulfur content requirements is provided. This option allows producers and importers to specifically offset a batch of gasoline that does not meet CaRFG3 standards due to an unintentionally high sulfur content. In this case, the producer or importer will be permitted to offset any increased emissions by producing a series of subsequent batches that are cleaner than the Phase 3 CaRFG standards. In no event could any batch exceed the cap limit for sulfur. This option would apply beginning December 31, 2009.

The Phase 3 CaRFG regulations added provisions allowing gasoline producers or importers to elect to use a new evaporative emissions element of the Predictive Model. In this Predictive Model evaporative emissions element, the Phase 3 CaRFG standard for RVP was set at 0.10 psi below the regular Phase 3 CaRFG flat limit for RVP in order to compensate for an expected increase in volatility due to the commingling of California gasolines blended with ethanol and California gasoline blended without ethanol. Since the use of the evaporative portion of the Predictive Model is voluntary, there is no assurance that any increase in emissions associated with commingling is actually being offset. The vast majority of gasoline now sold in California is produced with ethanol, and it is expected this will continue in the future given the federal RFS. Therefore, an emissions increase from commingling ethanol blended gasolines and non-ethanol blended gasolines in the fuel tanks of motor vehicles will only occur when non-ethanol blends are introduced in the California market. Accordingly, all non-ethanol blends of gasoline will be certified based on a flat limit of 6.90 psi RVP, while the normal Phase 3 CaRFG flat limit of 7.00 psi RVP be used for ethanol blends using the evaporative emissions element of the Predictive Model.

The enforcement caps for gasoline sulfur content will be lowered from 30 parts per million by weight (ppmw) to 20 ppmw (21 ppmw for CARBOB). Based on its analysis of projected complying formulations using the Predictive Model, staff believes that refiners will generally not be able to produce complying California gasoline with sulfur limits higher than 20 ppmw. The lower sulfur cap will not significantly affect flexibility to make complying fuels. It will, however, increase the enforceability of the CaRFG program by making it easier to detect noncomplying gasoline and help to protect the performance of sulfur-sensitive emission control components.

The other approved amendments to the CaRFG regulations improve consistency, flexibility, and enforceability. This includes amendments to section 2262.9 and section 2266.5 that would change the maximum allowed denaturant content in denatured

ethanol, consistent with the current standards of the American Society of Testing and Materials.

At the hearing the staff presented, and the Board approved, several additional modifications to the regulations in the original Staff Report. Staff developed the modifications in response to comments received since the Staff Report was published. At the hearing, after considering the staff's proposal and the public's comments and testimony, the Board adopted Resolution 07-21. Appended to the Resolution were the initially noticed regulatory text (as Attachment A) and the staff's suggested modifications to that text for which the staff had not yet developed specific regulatory language (as Attachment B), both of which were made available at the hearing. The Board also directed staff to incorporate the approved modifications into the regulatory text, with such other conforming modifications as may be appropriate, and to make the modified text available for a supplemental period of at least 15 days.

The following summarizes the substantive 15 day modifications to the regulations and the rationale for making them:

Allowing Third Parties to Develop an Alternative Emissions Reduction Plan

1. Add a provision that:
    a. allows third parties who are not producers or importers that produce gasoline to enter into an alternative emissions reduction plan, and
    b. defines how they may enter into an alternative emissions reduction plan. (See sections 2260(a)(37) and 2265.5)

2. Add other provisions to:
    a. allow certain third parties who are not producers or importers that produce gasoline to participate in an alternative emissions reduction plan by obtaining emission reduction offsets on behalf of producers or importers that produce gasoline, and
    b. improve consistency, flexibility, and enforceability (See section 2265.5). These additions were made to provide additional flexibility for the producers and importers.

Extending the Compliance Date for the Sulfur Cap

1. Amend provisions to change the date for lowering the sulfur content cap from 30 ppmw to 20 ppmw (21 ppmw for CARBOB) from December 31, 2009 to December 31, 2011. (See sections 2261, 2262, and 2266.5) This amendment was made to align the revised sulfur regulatory requirements with the expected schedule needed for refinery modifications at some facilities.

Modifications to the Provisions Allowing Early Compliance with the CaRFG Phase 3 Amendments Before December 31, 2009

1. Add clarifying language that:
    a. defines which compliance options are available relative to the use of the California Predictive Model before December 31, 2009, and
    b. specifies that anyone wishing to use an alternative emission reduction plan must notify the Executive Officer. (See section 2261(b)(4)).

Flexibility to Blend of Higher Levels of Ethanol Before December 31, 2009

1. Add provisions that allow for early use of the revised predictive model and other provisions of the amendments to allow earlier flexibility to increase ethanol blending provided there is full mitigation of any increase in emissions caused by the increase in ethanol content. (See sections 2261(b)(6) and 2261(b)(7)).

These early compliance sections provide two alternatives. The first alternative, provided in section 2261(b)(6), allows a producer or importer to mitigate emissions increases associated with early use (before December 31, 2009) of higher levels of ethanol through the use of alternative emission reductions. The emission reductions required are determined using the California Predictive Model. This section is generally patterned after the alternative emission reduction plans (AERP) presented in section 2265.5. As with the AERP, these emissions reductions may come from vehicle scrappage programs, offsetting emissions with lower emitting diesel fuel batches, or incentive grants for cleaner-than-required engines, equipment, and other sources of pollution providing early or extra emission reductions. The emission reductions must be achieved before the early blending can occur.

The second alternative, provided in section 2261(b)(7), allows a producer or importer to blend percentages of ethanol into California Reformulated Gasoline Blendstocks for Oxygenate Blending (CARBOB) that are higher than the common carrier pipeline specifications for oxygen and ethanol. To use this alternative, a producer or importer must first demonstrate that all emissions reduction requirements are met at the desired level of oxygenate blending, and that any fuel to be shipped in a common carrier pipeline also meets the specifications established by that carrier.

In both alternatives, there are reporting and recordkeeping requirements to ensure that there is a high level of accountability. Both of these alternatives sunset on December 31, 2009, the date after which fuels are generally regulated through use of the revised predictive model.

Potential Benefits of Early Blending on SMOG and PM precursors

The increased use of ethanol in California gasoline in the next two years under the flexibility provisions is expected to result in reductions in the exhaust emissions of hydrocarbons and carbon monoxide from motor vehicles and no increase in the evaporative emissions of hydrocarbons due to permeation. Any concurrent vehicle exhaust increases in oxides of nitrogen, ozone-forming emissions, or toxics weighted pollutants must be fully mitigated pursuant to the amendments. Thus, the

early blending flexibility options are expected to benefit efforts to reduce both ozone and particulate matter.

Impact of the Energy Independence and Security Act of 2007

The United States Congress recently enacted the Energy Independence and Security Act of 2007 (2007 Energy Act).[1] The 2007 Energy Act requires a rapid expansion of use of renewable fuels. Based on the Act, the U.S. Environmental Protection Agency now requires that fuel producers must increase their use of renewable fuels, generally ethanol, from a required average content in gasoline of 4.0% to 7.76% by volume in calendar year 2008.[2] Current California gasoline contains about 5.7% ethanol. In addition, ARB staff estimates that the required renewable fuel volumes in the 2007 Energy Act will necessitate a nationwide average of 9% ethanol in gasoline in 2009, and 10% in 2010.

The 2007 Energy Act requires substantial expanded production of advanced biofuels, such as ethanol derived from cellulosic material. However, compliance dates with these requirements are several years in the future, and it is expected that virtually all of the near term increased use of renewable fuel is likely to be accomplished through the use of ethanol derived from corn.

There are several impacts of this new legislation that are relevant to the current rulemaking and to the consideration of early blending options.

First, fuel producers now have a much greater obligation under federal law to use greater amounts of renewable fuels in the 2008 to 2009 timeframe. In fact, certain California fuel producers have indicated that they need an early blending option in order to comply with their obligations under the new federal requirements for increased use of renewable fuels.

Second, at the time the Board acted in June 2007 it was thought that, because national ethanol volumes far exceeded the minimum renewable fuel volume requirements of the 2005 Energy Act, additional early use in California would result in a net increase in ethanol use. However, much higher nationwide volume requirements have been established in the 2007 Energy Act and are now in place. Staff believes it is unlikely that a near term increase in ethanol use in California will have any impact on the amount of corn-based ethanol produced and consumed in the U.S. market.

Consideration of Greenhouse Gas Benefits of Crop-Derived Biofuels

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1 PUBLIC LAW 110–140—DEC. 19, 2007, 121 STAT. 1493

2 United States Environmental Protection Agency, “Revised Renewable Fuel Standard for 2008, Issued Pursuant to Section 211(o) of the Clean Air Act as Amended by the Energy Independence and Security Act of 2007,” [FRL-8528-9], Federal Register, Vol. 73, No. 31, February 14, 2008.

During its consideration of the amendments, the Board received testimony that flexibility to allow early blending of higher levels of ethanol would produce greenhouse gas (GHG) emission benefits. This premise appeared reasonable at that time. It was consistent with ongoing work at the Board and the California Energy Commission that suggested a GHG benefit when gasoline was replaced with ethanol derived from corn under most circumstances. However, our past assessments of the lifecycle GHG emissions attributable to current biofuel production did not account for indirect land use impacts, and new information suggests that these impacts are likely to be significant.

For example, articles recently published in Science magazine have questioned the net greenhouse gas emissions benefits of using ethanol derived from corn.[3] In general, the assessments point to indirect land use changes and increased greenhouse gas generation as a result of past and future reliance on crop-based biofuels. However, several individuals and organizations have challenged the assumptions and conclusions in the Science articles.[4] At present, there is no reliable quantification of the lifecycle greenhouse gas emissions resulting from the increased use of biofuels.

The ARB's CaRFG3 regulations do not currently address or regulate greenhouse gas emissions. Staff is currently in the process of developing a low carbon fuel standard (LCFS) for California. As part of the LCFS effort, ARB staff is carefully evaluating these studies and other data to determine and quantify the GHG emission impacts of a wide range of transportation fuels. The LCFS will be developed in consultation with top national and international experts on the issue. The ARB staff intends to consider emissions relating to both direct and indirect land use, extraction, production, refining, and transport in the LCFS effort to ensure an accurate accounting and mitigation of the potential impacts, if any, compared to fuels sold today.

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3 Searchinger, T., R. Heimlich, R.A. Houghton, F. Dong, A. Elobeid, J. Fabiosa, S. Tokgoz, D. Hayes, and T.H. Yu, 2008, "Use of U.S. Croplands for Biofuels Increases Greenhouse Gases through Emissions from Land Use Change," Sciencexpress, available at www.sciencexpress.org, February. 7, 2008

Department of Energy, "New Studies Portray Unbalanced Perspective on Biofuels: DOE Committed to Environmentally Sound Biofuels Development," available at http://www1.eere.energy.gov/biomass/printable_versions/news_detail.html?news_id=11574, February 14, 2008.

4 Wang, M., and Z. Haq, 2008, "Response to February 7, 2008 Sciencexpress Article," Letter to Science, available at http://www.transportation.anl.gov/media_center/news_stories/20080214_response.html, February 14, 2008

Mueller, S., 2008, "Sensitivity of Presented GHG Land Use Change Calculations," Comments to the Air Resources Board, available at http://www.arb.ca.gov/lists/lcfs-lifecycle-ws/9-erc_luc_comments.pdf, February 6, 2008

Further work is needed to determine the land use consequences and increased greenhouse gas emissions attributable to increased use of increased corn-based ethanol. At this time staff believes it is premature to conclude that increased ethanol use in California would produce greenhouse gas benefits.

Conclusions on Impact of Early Blending on California GHG Emissions

Based on the uncertainty of current GHG impact assessments and the impact of the 2007 Energy Act, staff believes it is inappropriate to assume that GHG emissions will either increase or decrease with early blending of ethanol. First, because of the increased volume requirements for ethanol on the federal level, increased ethanol blending in California in the next two years will likely have no impact on the emissions of greenhouse gases because the national level of production and use is unlikely to change with greater blending in California. Second, due to uncertainty in estimating the net lifecycle GHG impacts of crop based biofuels, staff believes that more data is needed be any such effect could be quantified. As part of the LCFS, the ARB staff will propose appropriate regulations to ensure that progress is made to move quickly to low carbon fuels.

Amending the California Predictive Model Procedures

1. Modify the "California Procedures for Evaluating Alternative Specifications for Phase 3 Reformulated Gasoline Using the California Predictive Model" to be consistent with the modifications to the original amendments, to correct errors, increase consistency, and provide clarifications.

**Comparable Federal Regulations:** The federal RFG regulations apply to about 80 percent of California's gasoline and are contained in 40 CFR §§ 80.40 and following. The CaRFG regulations apply to all gasoline sold, supplied, or offered in California. All CaRFG meets or exceeds the requirements of the federal RFG regulations resulting in significant additional emission reductions. Under 40 CFR § 80.81, gasoline meeting the Phase 3 CaRFG standards is exempt from several of the enforcement requirements of the federal RFG regulations.

The RFS standard of the Energy Policy Act of 2005 requires the use of renewable transportation fuels nationwide in an increasing amount annually. On April 10, 2007, the U.S. EPA Administrator announced the adoption of regulations for an RFS program for 2007 and beyond, contained in 40 CFR §§ 80.1100 and following.