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Analysis of Connecticut's Request for Waiver of the Reformulated Gasoline Oxygen Content Requirement for Connecticut Covered Area:

Technical Support Document

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Transportation and Regional Programs Division
Office of Transportation and Air Quality
U.S. Environmental Protection Agency

Docket OAR-2004-0429

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EXECUTIVE SUMMARY

Section 211(k)(1) of the Clean Air Act (CAA) requires that the Administrator of the Environmental Protection Agency promulgate regulations establishing requirements for reformulated gasoline (RFG) to be used in gasoline-fueled vehicles in specified ozone nonattainment areas. The CAA mandates RFG use in certain nonattainment areas, based on ozone air quality and population criteria. Other ozone nonattainment areas are allowed to opt into the RFG program. Within the state of Connecticut, RFG is mandated in the Connecticut State portion of the Hartford-New Haven-Springfield Consolidated Metropolitan Statistical Area (CMSA) and the Connecticut State portion of the New York City CMSA. Parts or all of Litchfield, Hartford, Middlesex, New London, Tolland, and Windham Counties, Connecticut are an opt-in area.

Section 211(k)(2)(B) of the Act, 42 U.S.C. § 7545(k)(2)(B), establishes an oxygen content requirement for federal RFG, but allows EPA to waive compliance with the requirement under certain circumstances. Section 211(k)(2)(B) provides that:

> 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 this 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 attainment by the area of a national primary ambient air quality standard.

In a letter dated April 22, 2002 from Connecticut Governor John G. Rowland to then Administrator Whitman, Connecticut expressed intent to submit a waiver request under CAA Section 211(k)(2)(B) from the federal RFG oxygen content requirement. In a letter dated September 29, 2004 from Connecticut Department of Environmental Protection (DEP) Commissioner Arhtur J. Rocque, Jr., to Assistant Administrator Jeff Holmstead, Connecticut officially submitted such a request for the Connecticut RFG area. The submission stated that because MTBE was banned in the State of Connecticut beginning January 1, 2004, and because of the Act's oxygen requirement for RFG, ethanol would be used as an oxygenate in the RFG areas in the State of Connecticut. DEP asserted that the use of ethanol as a replacement for MTBE in RFG would result in an increase in Volatile Organic Compounds (VOCs), and oxides of nitrogen (NOx) during the summer ozone season. DEP further argued that "increases in these pollutants will immediately interfere with Connecticut's ability to attain the

National Ambient Air Quality Standard (NAAQS) for both one-hour and eight hour ozone and fine particulates in its RFG areas.

In order to determine whether the RFG oxygen content requirement prevents or interferes with Connecticut's ability to attain National Ambient Air Quality Standards (NAAQS), it is necessary to consider the gasoline quality and related emissions impacts that would be likely to exist with and without the RFG oxygen content requirement. To evaluate the potential for interference with the ozone NAAQS, EPA must first consider the emissions differences for each pollutant contributing to ozone formation (NOx, VOC and carbon monoxide (CO)), between cases where the oxygen requirement remains in effect ("no-waiver") and cases where the oxygen requirement is waived ("waiver"). To evaluate the potential for interference with the particulate matter NAAQS, EPA must first determine the emissions differences for NOx between cases where the oxygen requirement remains in effect ("no-waiver") and cases where the oxygen requirement is waived ("waiver") as described above for ozone. In deciding whether to grant or deny a waiver, as a threshold matter EPA must determine what difference, if any, a waiver would have on emissions, and what effect, if any, the difference in emissions would have on ambient ozone and particulate matter levels.

Certain underlying information is required in order to make a quantitative estimate, or even a reasonably certain qualitative directional estimate of the emissions changes that might occur from a waiver. This information includes knowledge of certain emission-related fuel properties of the RFG that would be supplied to Connecticut with and without a waiver. Models relating these fuel properties to vehicle emissions would then be used to estimate percent differences in emissions between the "no waiver" and "waiver" conditions. Additionally, area-specific on-road and off-road gasoline emission inventory data are needed in order to convert relative (%) changes to absolute (tons/day) changes.

Connecticut DEP's submissions included essentially no information or analysis of the expected fuel properties of RFG with and without a waiver. Connecticut did not provide sufficient information or analysis to show either quantitative or directional estimates of the emissions differences between "no waiver" and a "waiver," for the pollutants contributing to ozone formation (NOx, VOCs and CO) or particulate matter formation (NOx). Changes in VOC, NOx, and CO emissions were not quantified, and the lack of adequate information and analysis means that even the direction of any change in NOx, and VOC is not clear. Changes in CO emissions were not addressed in Connecticut's submission.

If Connecticut had provided quantitative estimates of the emission differences between the "no waiver" and "waiver" situations, EPA's evaluation of its waiver submission would have included a thorough review of the basis for these estimates (fuel property estimation and emission modeling methodology), and subsequently, a thorough review of whether these emission differences indicate that ambient ozone or particulate matter are likely to be higher with the oxygen requirement than without.

However, EPA's review of the information contained in DEP's waiver submissions determined that it lacked not only the quantitative estimates of the "no waiver" to "waiver" emission changes, but the underlying information necessary to make such estimates. Since this information has not been submitted, EPA is unable to determine whether implementation of the oxygen content requirement in the Connecticut RFG area will prevent or interfere with the attainment of a NAAQS.

EPA has considered the information that Connecticut has provided which may be relevant to an analysis of Connecticut's waiver request. EPA has determined that the relevant no-waiver to waiver comparison cannot be made either qualitatively or quantitatively. In making this evaluation, EPA has considered the information provided by Connecticut with regard to the potential effect of a waiver on each of the pollutants, NOx, VOC and CO, for both on-road and off-road gasoline vehicles and engines.

In order to evaluate the information submitted by Connecticut, we have identified the fuel properties, vehicle fleets (e.g., on-road versus off-road, older technology vehicles versus newer technology, etc.), and emission sources (e.g. exhaust, "as blended" evaporative, commingling and permeation-related) that would need to be considered in a waiver/no-waiver analysis. We have also identified emissions models and other information necessary to make the relevant emission estimates that could be utilized to make the waiver/no-waiver comparison.

The information that DEP has provided fails to clearly demonstrate what effect a waiver would have an on ozone or particulate matter levels in Connecticut. This is because: 1) there are three pollutants whose emission rates could be altered by a waiver (NOx, CO and VOC) and all three affect ozone formation to varying degrees; 2) the lack of information on fuel qualities with and without a waiver and the lack of other relevant and necessary information precludes even a directional estimate of the impact of a waiver on NOx and VOC emissions; 3) the best estimate of the net impact of a waiver on CO emissions is that CO emissions would be greater with a waiver than without, but the difference cannot be quantified; 4) no analysis has been provided or performed, and the information before the agency does not allow an analysis to be performed, on the combined effect of these emissions changes on ozone.[1]

In addition, (1) NOx emissions affect PM, (2) the lack of information on fuel qualities with and without a waiver and the lack of other relevant and necessary information precludes even a directional estimate of the impact of a waiver on NOx, (3) no analysis has been provided or performed, and the information before the agency does not allow an analysis to be performed, on the effect of any NOx emissions changes on particulate matter.

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[1] CO plays a far less important role in ozone formation that NOx or VOC. Thus, even though a gross directional determination can be made for CO, such a determination provides little information in making an overall judgement about ozone formation.

Since no determination can be made regarding the overall effect of a waiver on emissions related to ozone and particulate matter, the information that DEP has provided fails to clearly demonstrate what effect a waiver would have on ozone or particulate matter. Since this threshold demonstration has not been made, EPA is not able to determine whether the oxygen requirement for RFG interferes with attainment of the ozone or particulate NAAQS in the Connecticut RFG area. EPA concludes that Connecticut's request therefore should be denied.

I. BASIS FOR DEC'S REQUEST FOR A WAIVER

As EPA interprets it, Connecticut's request for a waiver is based primarily on DEP's contentions that use of ethanol-oxygenated gasoline will interfere with attainment of the ozone and particulate NAAQS because:

- The NOx and VOC emissions performance of ethanol-oxygenated RFG will be worse than the emissions performance of the MTBE-oxygenated RFG supplied to Connecticut prior to its MTBE ban or to non-oxygenated fuel.

- Commingling and permeation resulting from ethanol use will increase VOC emissions compared to MTBE-oxygenated RFG or non-oxygenated fuel.

- Ethanol-oxygenated RFG will not provide the NOx reduction benefits expected under the RFG program because the Complex Model does not fully capture the effects of oxygenates on vehicle emissions of Nox.

- There would be emissions associated with ships and barges transporting ethanol into the Connecticut area for adding to RFG at terminals.

- Because the NOx emission performance will be worse for ethanol blended RFG as compared to fuel under an oxygen waiver, fine particulate matter will increase.

II. GENERAL CONCLUSIONS EPA CAN MAKE ABOUT EMISSIONS BASED ON DEP'S SUBMISSION AND OTHER INFORMATION AVAILABLE

DEP submitted no emissions modeling for Connecticut in its September 29, 2004 waiver request. DEP provided no information on the likely properties of the oxygenated or non-oxygenated RFG that would be supplied to Connecticut with a waiver, nor has DEP discussed the market share of non-oxygenated RFG market share should a waiver be granted.[2] The only information supplied by DEP on oxygenated RFG without a waiver is that it is likely to contain ethanol at 10% by volume. As discussed in Section IV of this document, information on likely fuel properties would be critical to an estimation of the emissions differences between the waiver and non-waiver scenarios in Connecticut, as is evidenced by EPA's evaluation of California's waiver request.

In other words, DEP has asked EPA to grant a waiver of the RFG oxygen requirement, based solely on its assertion that NOx and VOC emissions will increase with RFG using ethanol when compared to the use of RFG oxygenated with MTBE or non-oxygenated fuel. In light of Connecticut's ban on the use of MTBE as an oxygenate, EPA must compare the base case of ethanol-oxygenated RFG without a waiver to the RFG that would be supplied if an oxygen content waiver were granted. This is the proper comparison for determining whether continuing to maintain the oxygen content requirement interferes with attainment of the ozone or particulate matter NAAQS. The properties of MTBE-oxygenated RFG are irrelevant to this analysis. To put it another way, maintaining the current oxygen content requirement could not amount to interference, unless, at a minimum, a waiver is likely to produce a better situation with respect to ozone-forming or PM forming pollutants than would exist absent the waiver. As noted, DEP has not provided information regarding the emission-related

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[2] Although the program report enclosed with DEP's September 2004 submission included analyses for the gasolines used in a New York test program discussed in sections III-C and III-D below, DEP has provided no basis for EPA to conclude that these formulations are likely to represent the gasoline that would be supplied were a waiver granted. All fuels met the 30 ppm sulfur standard. However, the report notes that the ethanol RFG and non-oxygenated equivalent RFG test fuels were specified to have Complex Model performance similar to the study MTBE RFG. The MTBE RFG was specified, except for sulfur, to represent "typical year 2000 NYCMA RFG". No other restrictions or specifications were imposed on the fuel supplier. As noted, the composition and emissions performance of actual RFG with or without a waiver will be determined by a number of regulatory, economic and technical constraints. Consequently the specifications DEC imposed on the test fuels are insufficient to ensure that they will be similar to actual future RFG, with or without a waiver.

properties of the RFG that would be supplied were a waiver granted, nor did it address the issue of non-oxygenated RFG market share were a waiver granted.[3] As noted, DEP has not provided the kinds of information necessary to reach this conclusion. In summary, with the information at hand, EPA cannot estimate no-waiver to waiver emission changes, as it must do to ascertain whether the oxygenate requirement interferes with NAAQS attainment.[4] This general conclusion is explained in more detail below with respect to each individual pollutant of concern.

Below are more detailed discussions of the information submitted by Connecticut. The following sections of this TSD discuss EPA's evaluation of the information. Our evaluation clearly shows that the information is insufficient to come to any definitive conclusion regarding the effect of an oxygen waiver on ozone or particulate matter.

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[3] Ethanol-oxygenated RFG could constitute a portion, potentially a substantial portion, of Connecticut's gasoline pool even if a waiver were granted. DEP may have implicitly assumed in their submissions that all RFG would be non-oxygenated if a waiver were granted, but it has provided no information or analysis, such as refinery modeling, to substantiate this position. This is an issue not only because the pool average emission-related property values of Connecticut's "waiver" RFG would depend on the extent to which ethanol is used, but because substantial market shares of both ethanol RFG and non-oxygenated RFG in Connecticut could result in "worst case" commingling-related VOC emissions.

[4] In the California waiver analysis, EPA evaluated twelve "no waiver" to "waiver" scenarios. Each scenario consisted of a set of "no waiver" and "waiver" fuel properties predicted by refinery modeling with a specific set of assumptions. EPA treated the "no waiver" case as the reference, computed percent differences in emissions between "no waiver" and "waiver" fuels, and applied these percent differences to emission inventories to determine tons/day differences in NOx, VOC and CO emissions. EPA assumed that the tons/day emission inventory information that was available for the California analysis represented the all ethanol-oxygenated "no waiver" reference condition. EPA was therefore able to compute "no waiver" to "waiver" tons/day differences from percent differences in a single step. While it would be possible in a waiver analysis to calculate emissions changes from a different reference condition than the "no waiver" baseline, *it still necessary to make a "no waiver" to "waiver" emissions comparison*. If a different reference condition (e.g. pre-MTBE ban) were used, it would be necessary to first estimate both reference to "waiver" and reference to "no waiver" percent change and tons per day emissions changes, and subsequently combine them to estimate the total "no waiver" to "waiver" changes.

III. INFORMATION CONNECTICUT HAS PROVIDED TO EPA

In a letter dated September 29, 2004 from Connecticut Department of Environmental Protection (DEP) Commissioner Arthur J. Rocque, Jr., to Assistant Administrator Jeff Holmstead, Connecticut requested a waiver from the federal oxygen content requirement for reformulated gasoline, under Section 211(k)(2)(B).[5] The submission stated that because MTBE was banned in the State of Connecticut beginning January 1, 2004, and because of the Act's oxygen requirement for RFG, ethanol would be used as an oxygenate in the RFG areas in the State of Connecticut. DEP asserted that the use of ethanol as a replacement for MTBE in RFG would result in an increase in Volatile Organic Compounds (VOCs), and oxides of nitrogen (NOx) during the summer ozone season. DEP further argued that "increases in these pollutants will immediately interfere with Connecticut's ability to attain the National Ambient Air Quality Standard (NAAQS) for both one-hour and eight hour ozone and particulate matter in its RFG areas.

In the sections below, EPA describes in detail the information that DEP has submitted in detail.

A. Information on VOC emissions

DEP argues that the use of ethanol as a replacement oxygenate for MTBE will result in substantial increases in VOC emissions due to (1) increased permeation through vehicle components that hold gasoline, and (2) commingling of ethanol-blended fuels with fuels that do not contain. [6] However, DEP has not attempted to quantify what

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[5] Filed in docket OAR-2004-0429, document number 0001.

[6] Permeation refers to the escape of gasoline constituents through the walls of non-metallic fuel lines and gasoline tanks. These soft components of automotive fuel systems tend to be more permeable to ethanol than to other hydrocarbons in gasoline. Thus, ethanol-RFG blends tend to result in an increase in evaporative emissions due to permeation through these components. Commingling refers to the RVP increase (with resultant emission increase) that occurs when non-ethanol and ethanol-oxygenated gasoline blends are mixed in the gas tanks of consumer's automobiles. Since the presence of ethanol causes an increase in the volatility of the gasoline (as measured by the Reid Vapor Pressure or RVP), such commingling would contribute to an increase in evaporative VOC emissions.

the increase in VOC emissions might be for Connecticut. DEP has provided some attached studies regarding permeation and commingling in California (e.g. Docket OAR-2004-0429, items 003 and 006-008), but failed to explain their applicability to Connecticut or develop a methodology to quantify such effects for Connecticut.

DEP also notes that there will be emission increases (for both VOC and NOx) due to the transport of ethanol to the Connecticut RFG area from production centers in the Midwest, but has not provided a quantitative estimate of the emission increases that will occur within the Connecticut RFG area.

DEP has not identified or quantified any other VOC emission changes (increases or decreases) that could occur with ethanol use, nor has it clearly stated that no other significant VOC emission changes will occur.

B. Information on NOx emissions

DEP claims that NOx emissions will increase with the use of ethanol blended RFG compared to MTBE-blended RFG or non-oxygenated fuel, but has not quantified the anticipated increases. DEP stated in its April, 2002 letter that existing test data indicate that NOx emissions from newer vehicles increase with ethanol, although it did not explicitly define “newer vehicles”.

DEP notes that Phase II RFG regulations require refineries to produce gasoline that reduces NOx emissions by 6.8 percent and VOC emissions by 27.4 percent compared to 1990 levels, as quantified by the EPA Complex Model. DEP states, however, that it believes that the EPA Complex Model does not fully capture the effects that oxygenates such as ethanol have on emissions from current fleet vehicles. It believes that NOx emissions will increase due to the use of ethanol compared to MTBE, and that this actual increase in NOx emissions will not be identified by, or constrained through the use of, the Complex Model to measure RFG compliance with phase II RFG regulations.

C. Information on CO emissions

DEP made no explicit references to the potential effect of a waiver on CO emissions or the relationship of CO to ozone formation in its April 22, 2002 or September 29, 2004 letters but others have done so in studies DEP attached.

In the New York study entitled "Emission Impacts of Fuels to Accommodate the NY State Oxy-waiver Request and MTBE Ban,"[7] (Docket OAR-2004-0429-0009), New

[7] “Program Report: Emission Impacts of Fuels to Accommodate the NY State Oxy-waiver Request and MTBE Ban", May 6 ,2003, submitted as an enclosure to DEP’s September 29, 2004 letter (Docket OAR-2004-0429-0009).

York claimed that it has verified the lack of need for an oxygenate through laboratory testing of two automobiles both with and without oxygenated fuel. This study describes a test program conducted at New York's Automotive Emissions Laboratory (AEL), in which two vehicles, a 1998 Plymouth Breeze and a 1997 Oldsmobile Achieva, were tested multiple times using an MTBE-oxygenated RFG, an ethanol-oxygenated RFG, and a non-oxygenated "equivalent RFG". The program report concluded that data from over 200 emission tests on these two vehicles do not indicate any consistent increase in any of the regulated emission species (HC, CO, NOx) for either the ethanol-oxygenated RFG or the non-oxygenated "equivalent RFG" relative to the MTBE-oxygenated RFG.

Conversely, in the attached report entitled, "Demonstration that the U.S. Environmental Protection Agency must grant California a waiver from the Federal reformulated gasoline oxygen mandate on remand from the U.S. Court of Appeals for the Ninth Circuit," California states that "ARB has consistently acknowledged that the 2.0 wt. % minimum oxygen requirement in the federal RFG program reduces CO emissions from the existing fleet of vehicles on the road today."[8]

D. Information on likely oxygenated RFG composition subsequent to Connecticut's ban on MTBE

DEP has provided EPA with very little information on the likely emission-related properties of its RFG subsequent to an MTBE ban.[9] These properties will determine the exhaust and evaporative emissions associated with RFG use in a non-waiver scenario.

Connecticut stated in its September 29, 2004 letter that refiners are blending 10 (volume) percent ethanol to meet the oxygen requirement as a result of their MTBE ban. This is equivalent to approximately 3.5 weight percent oxygen. Blending at approximately 5.7 volume percent ethanol is required to meet the 2 weight percent RFG oxygen requirement. Beyond this, Connecticut has provided no further information on the composition of ethanol-oxygenated RFG subsequent to its MTBE ban.

The program report for New York's vehicle testing study, cited earlier, included

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[8] See Docket OAR-2004-0429-0004.

[9] These emission-related properties are the parameters used in emission models to estimate emission differences resulting from fuel formulation differences. The Complex Model inputs affecting VOC and NOx emissions are RVP, oxygen wt%, aromatics vol%, olefin vol%, sulfur ppm, E200 and E300. (E200 and E300 are the percent of gasoline evaporated at 200F and 300F, respectively.) The alternative Tech 4 models which EPA developed for its California waiver analysis use RVP, oxygen wt%, aromatics vol%, olefin vol%, sulfur ppm, T50 and T90 as inputs . (T50 and T90 are the temperatures at which 50% and 90% of the gasoline are evaporated, and are highly correlated with E200 and E300.). As discussed later, these models should be applicable to a portion of Connecticut's on-road fleet, as well.

certificates of analysis showing properties for the gasolines used in the study. The report states “AEL believes that the study fuel specifications approximate the fuel blending situation that refiners will face upon implementation of the NY MTBE ban.” Since the ethanol-oxygenated RFG formulation in this study was not blended with 10 volume percent ethanol and was not specific to Connecticut, EPA assumes that DEP would not consider it to be representative of Connecticut’s “no waiver” ethanol-oxygenated RFG.

E. Information on likely RFG composition subsequent to a waiver of the oxygen content requirement

DEP did not explicitly address this issue in the text of either submission letter. Except as noted in the previous section and in footnote 7, DEP provided no description of the potential composition of RFG were a waiver granted.

IV. INFORMATION NEEDED TO EVALUATE NOX, VOC AND CO EMISSIONS CHANGES RESULTING FROM AN OXYGEN CONTENT WAIVER

A. Background

RFG, in order to comply with statutory and regulatory requirements, must meet certain emissions performance and content standards. The emission performance standards are specified as percent reductions in NOx, VOC and toxics emissions relative to emissions with a statutory baseline gasoline having properties representative of 1990 gasoline. These reductions are calculated by the Complex Model, which estimates the emissions that 1990 technology vehicles would achieve when using both the statutory baseline gasoline and any RFG formulation that is being evaluated. The Complex Model calculates a percent reduction between the baseline gasoline and the RFG at issue. (The properties which are inputs to the Complex Model have previously been identified in a footnote.) RFG is also subject to oxygen and benzene content standards. It must contain, on average, at least 2.1 weight percent oxygen and no more than 0.95 volume percent benzene. In addition to the requirements imposed by the RFG standards, both RFG and conventional gasoline (CG) are also affected by the Mobile Source Air Toxics (MSAT) regulations. These regulations cap Complex Model toxics emissions at their 1998-2000 levels on a refinery-specific basis.[10] The Tier 2 gasoline sulfur requirements, when fully implemented, will require an average sulfur level of 30 ppm or less in both RFG and CG.[11]

RFG producers must meet these emission-related regulatory constraints, and also must supply RFG and CG that meets octane and other driveability-related requirements. Refiners attempt to produce gasoline and other products in the most economically advantageous manner, subject to these constraints. The manner in which a given refinery meets this objective depends on the configuration of the refinery, the cost and availability of various blending components (e.g. MTBE, ethanol, and alkylate which have good octane characteristics), and other technical and economic factors. Consequently:

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[10] Since much RFG overcomplied with toxics performance requirements, MSAT imposes a tighter constraint on RFG composition than the RFG performance standard for many suppliers.

[11] The sulfur level in RFG is currently constrained by RFG performance standards, but the Tier 2 sulfur content requirement imposes a tighter constraint.

- RFG emission performance and content standards alone do not determine RFG's composition. Other factors may provide additional constraints on certain emission-related properties.

- RFG composition without a waiver is not uniform across refiners and refineries. Complex Model emission performance varies and much RFG overcomplies, particularly with the NOx and toxics standards. Emissions performance for Connecticut's RFG cannot be fully evaluated without estimates of all the relevant fuel properties which are inputs to the Complex Model.

- The same factors that lead to variety in RFG composition and emissions performance without a waiver would lead to variety in RFG composition and emissions performance with a waiver.

- Even though RFG must meet the same Complex Model performance standards with or without an oxygen waiver, the actual emissions performance may be different with and without a waiver because the composition of the fuel is likely be different with and without a waiver.

B. Emissions Models

Emission performance, as measured by the Complex Model, is a function of several fuel parameters. The relationship between emissions and gasoline properties was determined by statistical regression analysis, using several thousand vehicle emission tests from a number of different studies. Development of the Complex Model, or any comparable model, such as California's Predictive Model, requires a number of decisions, some of which are subjective. Additionally, there are choices in the statistical techniques that can be used to develop these models. Thus, different models, showing different relationships between fuel properties and emissions for the same pollutant, can reasonably result from the same data set.

EPA developed updated models for NOx and exhaust VOC in order to evaluate California's RFG oxygen content waiver request, using data which California used to develop its Predictive Model. Much of these data were also used to develop EPA's Complex Model. These alternative models could be applied to a Connecticut waiver analysis. While these EPA models differ from the Complex Model, particularly with respect to the relationship of NOx and oxygen, these models require the same basic fuel property information as inputs.

In order to evaluate the effect of a change in fuel properties on vehicle emissions, it is common practice to separate the vehicle fleet into several technology groups. It is widely believed, and supporting data indicate, that different technology groups respond differently to fuel property or composition changes. In the California waiver evaluation, vehicles were divided into three technology groups: older technology vehicles (pre-1986

model years), mid-age technology vehicles (model years 1986 through 1995) and newer vehicles (model year 1996+). These older, mid-age, and newer technology vehicles were referred to as Tech 3, Tech 4, and Tech 5 vehicles respectively.

EPA's alternative NOx and exhaust VOC models, like the Complex Model, are designed to predict emissions from only a portion of the gasoline mobile source fleet. In its California waiver analysis, the alternative NOx and exhaust VOC models which were developed represented the Tech 4 portion of California's light duty vehicle fleet. Based on California's EMFAC7G emission model, Tech 4 vehicles are expected to be the second largest contributor of the three tech groups to California's NOx emission inventory and the largest to its exhaust VOC inventory in 2005. (While the Tech 5 vehicles may have the largest contribution of these three tech groups to the NOx inventory, there were insufficient data to produce Tech 5 fuel effects emission models comparable to the Tech 4 models, and engineering reasons to assume that Tech 5 vehicles may not be substantially affected by certain fuel parameter changes).

EPA assumed in the California waiver analysis that newer "Tech 5" vehicles (model years 1996+) would not respond to changes in oxygen content or other fuel parameter changes. EPA assumed, as does DEP, that fuel control systems in modern fuel injected vehicles will compensate for the additional oxygen in gasoline.[12]

EPA used the "Tech 3" model portion of California's phase 3 predictive model representing model year 1981-85 technology, to estimate emissions changes that would occur in older vehicles. EPA also had emission weighting factors, which were part of California's phase 3 predictive model and which estimated the relative contribution to emissions in year 2005 of these three technology groups. This allowed EPA to combine separate percent change emission estimates for each of these technology groups into a single percent change estimate, and apply this percent change to an on-road gasoline NOx and exhaust VOC emission inventory (in tons per day). This allowed EPA to estimate overall on-road gasoline NOx and exhaust VOC no-waiver to waiver emission differences in tons per day.

EPA believes that an approach utilizing these models, with weighting factors appropriate for Connecticut, could be used by Connecticut to perform the appropriate emissions modeling for on-road vehicles in a waiver application.

In its analysis of the California waiver, EPA assumed that changes in emissions from off-highway or non-road engines would be a function of oxygen content only, using

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[12] While the assumption regarding no effect certainly does not apply to the relationship between gasoline sulfur content and NOx performance for these newer Tech 5 vehicles, in its California waiver analysis EPA was comparing waiver and non-waiver fuel formulations which had very small differences in sulfur content. Thus, the assumption that the sulfur content had no effect on "Tech 5" emissions introduced little or no error in that analysis.

factors (in percent change in emissions per weight percent of fuel oxygen added) published in EPA Report No. NR-003, as the basis for its estimate of percent changes in non-road emissions. Barring new information, it would be reasonable to apply these same non-road factors in a Connecticut analysis.

In its California analysis, EPA had emission inventory information for both on-road and non-road mobile sources. Thus, knowing oxygen content and other fuel properties, and oxygenated/non-oxygenated market share for each waiver case, EPA was able to estimate the percent difference in emissions between waiver and non-waiver scenarios, apply this difference to the inventory to estimate a tons/day difference and combine the on-road and non-road changes.

For the reasons described in EPA's California waiver analysis[13], EPA assumes that carbon monoxide emissions would be primarily affected by fuel oxygen content, with CO emissions increasing as oxygen content decreases. For California, EPA modeled on-road CO changes using "percent reduction per weight percent oxygen increase factors" published in a California Air Resources board staff report.[14] EPA used factors from NR-003, cited earlier, to model off-road CO changes. The on-road percent changes may be somewhat California-specific, since they were derived from California's EMFAC emission factors model. It is probably more appropriate to quantify the CO emission changes in Connecticut using the Mobile model.

In summary,

- There are models which may be superior to the Complex Model for evaluation of on-road vehicle emissions differences in Connecticut with and without an oxygenate waiver.

- These alternative models require essentially the same fuel property information as the Complex Model, and emission performance for Connecticut's RFG cannot be evaluated using these models without estimates of all the fuel property inputs.

- It is reasonable to estimate off-road exhaust emission and on-road CO changes from oxygen changes alone and the methods to estimate these emission changes could (if the requisite information were available) be used in evaluating a waiver request in Connecticut.

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[13] EPA Docket A-2000-10, Docket Number II-B-2.

[14] California Air Resources Board (CARB) Staff Report: Initial Statement of Reasons; Proposed California Phase 3 Reformulated Gasoline Regulations; released October 22, 1999.

C. RFG Properties and Composition

Knowledge of the likely formulation of RFG in Connecticut with and without an oxygen content waiver is critical to EPA's evaluation of whether or not the oxygen content mandate interfere's with attainment of the ozone or particulate matter NAAQS. Because this information has not been provided, EPA is not able to conclude what effect a waiver would have on vehicle emissions in the Connecticut RFG area. Some information exists regarding the composition and properties of ethanol-oxygenated RFG [15] supplied to Connecticut during the ozone season subsequent to Connecticut's MTBE ban. This RFG does not, on average, meet the ultimate 30 ppm sulfur requirement which the Tier 2 gasoline sulfur regulations will impose on both conventional and reformulated gasoline, but reflects transitional sulfur requirements which become more stringent over a multi-year period. Even though these data do not represent full implementation of the Tier 2 sulfur requirement, they are likely to be somewhat informative of the composition of the RFG that will be supplied to Connecticut in the future in the absence of an oxygen content waiver.[16] However, these data do not predict the composition and properties of the RFG that would be supplied to Connecticut if a waiver were granted. Consequently, this information, by itself, is insufficient to evaluate the impact of an oxygen content waiver.

Connecticut's submissions provide no source of real world data or predicted data that is informative of the composition of the RFG that would be supplied to Connecticut if EPA waived the oxygen content requirement. In its waiver submission, California relied on refinery modeling studies to predict the properties of California Phase 3 RFG (CaRFG3) and, similarly, EPA relied on expansions of these same refinery modeling studies to evaluate California's submission. These studies predicted the properties of the CaRFG3 that would be produced if an oxygen content waiver were granted, as well as the properties of the oxygenated CaRFG3 that would be produced without a waiver. This modeling was conducted on those refineries supplying RFG to California, so is

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[15] RFG surveys are conducted each year by the RFG Survey Association, an association of refiners, importers and oxygenate blenders. Gasoline samples are collected at retail stations in RFG covered areas, under a survey plan which EPA approves, and analyzed for emission-related properties. Independent contractors perform the sample collection and analysis. These surveys are required by 40 CFR 80.67, for suppliers who choose to meet RFG standards on an average basis, rather than on a "per gallon" basis. These surveys are intended to ensure that the RFG supplied to each covered area meets standards. Specific requirements pertaining to these surveys can be found in 40 CFR 80.68.

[16] EPA has published average property information from RFG surveys through 2003. Although 2004 averages have not been published, EPA would have provided data from 2004 surveys to Connecticut DEP as soon as it was available, had it been requested. Ozone-season RFG surveys in CT were conducted between June and late August. EPA receives data approximately 30 days after each survey is completed and received all ozone season survey data for CT prior to October, 2004.

California-specific.[17] Furthermore, California reformulated gasoline standards, which are applicable to RFG sold in federal RFG areas in California, differ from federal RFG standards. Thus, the predictions of the California fuel properties from this modeling are not applicable to the analysis of the Connecticut waiver since different modeling constraints would be applied for the California case versus the Connecticut case. For example, modeling indicated that it was infeasible for California refiners to make RFG oxygenated at 10% ethanol, while Connecticut is likely to receive 10% ethanol during the ozone season.[18] The California modeling does predict that substantial amounts of ethanol-oxygenated gasoline would be used in California, even with a waiver of the federal RFG oxygen content requirement. Although the California analysis is certainly not directly applicable to Connecticut, the expected use of ethanol in California demonstrates that, lacking information to the contrary, EPA cannot assume that ethanol will not be used in Connecticut in a waiver situation. Ethanol may be used to make up, in part, for the volume and octane which MTBE provided even if EPA waived the oxygen content requirement. Other studies support such a conclusion.[19]

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[17] In fact, refinery modelers typically use completely different models to estimate the composition of gasoline produced for the Connecticut area versus gasoline produced for the California market.

[18] The modeling which EPA commissioned for the California waiver analysis represented the characteristics of the California refinery system. Additionally, the modeling required that California Phase 3 RFG meet California standards for NOx and hydrocarbons based on California's Phase 3 predictive model, rather than the Complex Model. Thus, the RFG modeled for the California waiver analysis was required to meet a much more stringent NOx standard than the Federal standard. Additionally, since the predictive model, unlike the Complex Model, indicates that NOx emissions will increase as oxygen content increases, California's NOx performance requirements impose a practical limit on weight percentage of oxygen that can be used in California blends. Consequently, EPA has little confidence that the forecasts of emission-related fuel parameters which these models produced would be applicable to Connecticut.

[19] The NESCAUM report submitted as enclosure B of NY's January 6, 2003 submission (Docket OAR-2003-0004) states on page 9, vol.2 "If the oxygen requirement were waived or lifted, it is highly likely that some amount of ethanol would still be blended into RFG..."

V. EMISSIONS-RELATED CONCLUSIONS BASED ON CONNECTICUT'S SUBMISSION

A. Effect of a waiver on NOx emissions based on Connecticut's submission

1. Multiple gasoline properties affect NOx emissions

With regard to DEP's comments regarding the complex Model, EPA does agree that the Complex Model may over-estimate the NOx emission performance of certain 10 vol. % (about 3.5 wt% oxygen) ethanol-oxygenated RFG blends, because the Complex Model does not show a NOx increase with increasing oxygen. According to EPA's models developed during the California waiver analysis and readily available to Connecticut DEP, all other properties being equal, as oxygen content increases, NOx emissions will also increase for Tech 4 vehicles. Thus, if two RFG blends with different oxygen content were formulated to have the exact same Complex Model NOx performance (e.g. 6.8 percent reduction from 1990 baseline, the averaged standard), EPA would suspect that the "true" NOx performance of the blend with the higher oxygen content would be worse than that of the blend with the lower oxygen content. The problem with this simplistic argument is that there are many properties and components of RFG other than oxygen content which would likely be different in a waiver versus no-waiver scenario, and these other properties and components also affect NOx emissions. (This is discussed in the previous section of this TSD.) Thus, neither the magnitude nor direction of a NOx change can be predicted using the data submitted by DEP since the argument above is based only on oxygen content. [20]

[20] Although oxygen increases taken alone (i.e., all other properties being equal) directionally increase NOx emissions in EPA's alternative models for Tech 4 vehicles, real world situations clearly show that other RFG properties can and do change the magnitude and even the direction of this change. In EPA's evaluation of California's waiver request using the alternative models, NOx emissions clearly go down where average oxygen content of the gasoline pool is lower (i.e., all of the waiver scenarios). However, in other real world situations fuels can exhibit better NOx performance even with higher oxygen content due to differences in other properties that affect NOx emissions. To further illustrate this point, EPA has examined "real world" VOC-controlled RFG survey data collected during the 2003 ozone season and computed two sets of average fuel properties, one from an RFG area with lower oxygen content and one from an area with higher oxygen content. EPA utilized averages from surveys conducted in the New York-New Jersey-Long Island-Connecticut area to represent the lower oxygen content RFG, and averages from Louisville, Kentucky surveys to represent the higher oxygen content RFG. EPA computed the NOx performance for these two "average fuels" using EPA's alternative NOx models.

2. NOx emissions from on-road vehicles with and without a waiver.

Given property estimates for Connecticut's "waiver" and "no-waiver" gasolines, a complete waiver submission would presumably use EPA's alternative "Tech 4" NOx models to estimate the emissions change for a portion of the on-road fleet, since these models were developed with data that are not California-specific. *As explained earlier, the information which DEP has submitted is insufficient to even determine the expected direction of the "Tech 4" "no waiver" to "waiver" NOx emission change.*

An assumption similar to that made for the California analysis, i.e., that the "no waiver" to "waiver" fuel property differences would have no effect on exhaust emissions in "Tech 5" vehicles, would likely be appropriate for Connecticut as long as there was little difference in the sulfur content of the "no waiver" and "waiver" fuels. While this is somewhat uncertain prior to the implementation of the 30 ppm Tier 2 standard, this should be the case with that standard in place. *Consequently, it would likely be appropriate to assume that "Tech 5" "no waiver" to "waiver" emission differences would be zero*.

It would probably be adequate to use the "Tech 3" NOx model portion of California's phase 3 predictive model to estimate NOx emission changes for older vehicles. This model, although it was created by California to represent a portion of their fleet, was not based solely on California vehicles. This model requires the same fuel parameter inputs as the alternative "Tech 4" NOx models which EPA developed. Thus, it cannot be used to determine the probable direction of the NOx emission change without estimates of Connecticut's "no waiver" and "waiver" RFG parameters.

EPA applied California-specific emission weighting factors for Tech 3, 4 and 5 vehicles in its California analysis. They represent the California fleet in 2005 and were estimated using a California-specific emission factors model. Weighting factors more applicable to the federal fleet and/or to the Connecticut fleet could be developed with EPA's Mobile model. However, DEP did not submit the fuel parameter information to calculate the Tech 3 or Tech 4 emission changes, nor did it develop weighting factors for the various Tech groups. Therefore, it is not possible, given the data submitted, to draw any reasonable conclusions about the magnitude or the direction of NOx emissions changes in on-road vehicles for the Connecticut waiver/no-waiver comparison.

The NOx performance of the Louisville, KY "average fuel" is better than that of the New York "average fuel" based on the EPA alternative model, even though the oxygen content of the Louisville "average fuel" was higher. (See Docket OAR-2003-0004 Document II-B-1.)

3. NOx emissions from non-road vehicles with and without a waiver

EPA assumes that granting an oxygen content waiver would result in some decrease in the average oxygen content of Connecticut's RFG.[21] In that case, there would be some percent decrease in non-road NOx emissions with an oxygen content waiver. However, EPA cannot estimate how much non-oxygenated RFG would be used if a waiver were granted in Connecticut. Consequently, EPA can only qualitatively estimate a directional decrease in NOx for non-road vehicles and engines with a waiver.

DEP has not submitted any NOx emission inventory information as part of its waiver request. While the non-road percent change NOx factors are large, EPA assumes that the non-road gasoline NOx emissions inventory for Connecticut is small compared to the on-road gasoline NOx emissions inventory. Consequently, even if EPA concludes that non-road gasoline NOx emissions will be lower with a waiver, EPA cannot determine with confidence, based only on a qualitative assessment, whether total mobile source gasoline NOx emissions would be lower with or without a waiver.

B. Effect of a waiver on VOC emissions based on Connecticut's submission

Evaluating the potential impact of ethanol-oxygenated gasoline on NOx emissions between a waiver and no-waiver scenario only calls for considering changes in exhaust emissions. Analysis of VOC impacts is considerably more complex. In addition to the changes in on-road and non-road exhaust emissions, one must also consider evaporative VOC emission changes that may occur as a result of "as-blended" RVP differences between various gasoline formulations. [22] There are also other emission effects that may occur as a result of ethanol use. Commingling of ethanol and non-ethanol gasolines in vehicle fuel tanks causes increases in RVP which can result in higher evaporative VOC emissions. Additionally, use of ethanol-oxygenated gasoline is believed to increase VOC permeation emissions.

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[21] Although without the appropriate analysis, it cannot be said with any certainty that the waiver would result in the production of non-oxygenated RFG. At least one refiner has strongly supported granting New York's request for a waiver (Docket OAR-2003-0004) . The letter of support from Tosco Corporation enclosed with New York's January 6, 2003 submission clearly indicates that less oxygen would be utilized in New York RFG if a waiver were granted. One would presume that support for a waiver from the refining community would indicate that at least some refiners would blend RFG without oxygen or the waiver would have no effect on RFG production.

[22] "As-blended" RVP refers to the RVP resulting from blending at a refinery or terminal. It is distinct from the RVP that may exist in commingled fuel in a vehicle fuel tank.

1. VOC on-road and non-road exhaust emissions

As previously noted, for its California waiver analysis EPA developed alternative exhaust hydrocarbon models, estimating changes in exhaust hydrocarbon emissions as a function of various fuel parameters. For Tech 4 vehicles (Model Year 1986-1995), these models predict that as oxygen content increases from zero, with other parameters constant, exhaust hydrocarbon (HC) will first decrease and then increase.[23] According to these different models, therefore, decreasing oxygen content from a 3.5% "no waiver" level, in the absence of other parameter changes, could either reduce or increase exhaust HC emissions from Tech 4 vehicles, depending on the "waiver" oxygen content. However, these HC models are a function of several parameters, i.e., the same parameters that are inputs to the alternative NOx models identified earlier. As discussed and demonstrated earlier with respect to NOx, knowing only that oxygen content is likely to decrease with a waiver, and even knowing the pool average oxygen content with a waiver, does not provide enough information to determine the net effect on emissions, because changes in other parameters could offset emission changes due to oxygen. Consequently, without further information, EPA cannot predict even the direction of the exhaust VOC emission differences between "no waiver" and "waiver" RFG in Tech 4 vehicles.

EPA believes that the assumptions discussed earlier for Tech 3 and Tech 5 NOx emissions are valid for Tech 3 and Tech 5 exhaust HC as well; that exhaust HC will probably not be substantially affected by oxygen content or other parameters for Tech 5 vehicles, and the "Tech 3" exhaust HC portion of California's Phase 3 Predictive Model may be the best available model to predict fuel-related exhaust HC changes in older vehicles. However, this Tech 3 model requires the same fuel parameter inputs as the alternative "Tech 4" HC models which EPA developed.

In its California analysis, EPA used Tech 3, Tech 4 and Tech 5 exhaust HC weighting factors. As with NOx, these weighting factors were derived with California's mobile source emissions model, and incorporated into the predictive model. The emission weighting factors which were applied in the California analysis are California-specific; they represent the California fleet in 2005 and were estimated using a California-specific emission factors model. Weighting factors more applicable to the federal fleet and/or to the Connecticut fleet could be developed with EPA's Mobile model. However, DEP did not submit the fuel parameter information to calculate the Tech 3 or Tech 4 emission changes nor did it develop weighting factors for the various Tech groups. Therefore, it is not possible, given the data submitted to make conclusions about either the magnitude or the direction of exhaust VOC emissions from on-road vehicles for the waiver/no-waiver comparison.

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[23] While for certain discussions, it may be useful to make a distinction between VOC emissions and HC emissions, for purposes of the discussion here, there is no difference between references to VOC and HC emissions. Generally speaking, we use the term HC as the appropriate convention when referring to emissions models.

As we did in the California analysis, EPA assumes that non-road exhaust VOC emission changes are largely a function of oxygen content, and that exhaust VOC emissions would increase as oxygen content decreases.[24] Thus EPA would expect an increase in non-road exhaust VOC emissions with a waiver. It would probably be appropriate to model these emissions for Connecticut using the factors which EPA used in the California analysis. These factors are incorporated into EPA's NONROAD2004 model, and this model could be used directly to estimate nonroad exhaust emission levels, in tons per day, for the RFG areas in Connecticut in the absence of a waiver. However, since DEP has not addressed the issue of non-oxygenated market share with a waiver and has not provided an estimate of pool average oxygen content with a waiver, it is not possible to estimate the magnitude of the "no waiver" to "waiver" emission change in non-road VOC exhaust emissions.

2. Evaporative VOC emissions due to RVP increases

Non-exhaust emissions of VOC (except permeation) are modeled as a function of RVP only.[25] In other words, if estimates are available of RVP changes between the waiver and non-waiver scenarios, existing models can be used to predict non-permeation changes in evaporative emissions of VOC. The RVP level in ozone season RFG is tightly constrained by the need to comply with Complex Model VOC performance standards.[26]

As described earlier, an RVP boost and associated increase in VOC emissions can occur within the gas tanks of cars when fuel containing ethanol is commingled with fuel that does not contain ethanol. Connecticut asserts that commingling will increase when ethanol is substituted for MTBE as an oxygenate in RFG. Presumably Connecticut is referring to the commingling of ethanol-oxygenated RFG purchased within the Connecticut RFG area with non-ethanol gasolines purchased outside of the Connecticut RFG area. Connecticut does not attempt to quantify this effect. While this may occur in a no-waiver scenario, Connecticut does not address the central question

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[24] Available data and models do not accommodate consideration of additional fuel properties.

[25] That is, RVP is the only fuel parameter input assumed to affect evaporative emissions. The evaporative emission estimates produced by EPA's Mobile model are also affected by ambient temperature inputs and other area-specific factors. In its California waiver analysis, EPA used a formula, derived with California's EMFAC7G model, to estimate the VOC emission differences resulting from RVP differences. It would be appropriate to use a non-California model such as the Mobile model or the Complex model to model any relevant RVP-related "no waiver" to "waiver" evaporative emissions changes in Connecticut.

[26] See 40 CFR 80.41(e) and (f).

of how much ethanol-oxygenated and non-oxygenated RFG would exist within the Connecticut RFG area if an oxygen content waiver were granted.

EPA believes that the maximum adverse commingling impact occurs when ethanol and non-ethanol gasolines are sold in significant quantities in the same geographic area (e.g. the Connecticut RFG area). In its California waiver analysis, EPA concluded that this condition could exist if California were granted an oxygen content waiver, because the refinery modeling indicated that some refiners would blend ethanol in RFG even if the waiver was granted, while other refiners would not. As noted previously, DEP has not addressed the issue of possible use of ethanol in Connecticut RFG if a waiver were granted. EPA believes that some refiners supplying RFG to Connecticut would blend ethanol into RFG even if a waiver was granted, due to the octane ethanol provides and to make up for the lost gasoline volume from MTBE resulting from New York's MTBE ban. As discussed previously, there is no basis for EPA to assume that under a waiver, all RFG will be free of ethanol. Consequently, the maximum adverse commingling impact could occur in Connecticut if EPA grants an oxygen content waiver, leading to corresponding increases in RVP and evaporative VOC emissions. This maximum adverse commingling impact condition would not exist in Connecticut without a waiver, since without a waiver only ethanol-oxygenated RFG would be sold within the Connecticut RFG areas.

In summary, while some commingling could occur in the non-waiver scenario as cars travel back and forth from Connecticut's RFG areas (where ethanol is used) to other areas (where it may or may not be used), such commingling would likely be much less prevalent than would be the case with an oxygen waiver. In the absence of modeling showing how much ethanol will be used in Connecticut's RFG if the oxygen content requirement were removed, EPA believes it most likely that commingling will be more prevalent with a waiver than without a waiver. It follows that VOC evaporative emissions resulting from commingling would likely be greater if a waiver were granted than if it were not, however without further explanation it is not possible to estimate the magnitude of this impact.

3. Evaporative VOC emissions due to permeation

EPA assumes that increased ethanol use would cause some increase in permeation-related VOC emissions. However, DEP has not provided a quantitative estimate of the increase in emissions that could occur. Ethanol may still be used in some significant quantities even if a waiver were granted. EPA assumes that the "no waiver" to "waiver" difference in permeation effect would be dependent on the amount of ethanol used if a waiver were granted.

The change in permeation emissions between the non-waiver and waiver conditions depends on the extent to which ethanol RFG would be used were a waiver granted, and DEP has not provided estimates of ethanol use in RFG with a waiver. Additionally, estimates of permeation emission changes would have to be combined

with estimates of exhaust and other evaporative VOC emission changes in order to estimate the total "no waiver" to "waiver" VOC change. DEP has not provided such estimates or the underlying fuel property information needed to make such estimates. Thus, even with the best available quantitative estimate of permeation emission differences between ethanol-oxygenated and non-ethanol gasoline, EPA could still not determine the net effect of the oxygen waiver on VOC emissions with the information submitted by DEP. In summary, EPA believes that permeation-related VOC emissions would likely be less with a waiver, because we assume that less ethanol will be used with a waiver than without. However, without further information it is not possible to estimate the magnitude of this impact.

C. Effect of a waiver on CO emissions

DEP did not address emissions of CO, although increases in CO can contribute to increases in ozone Because of the lack of information on ethanol market share should a waiver be granted, there is insufficient information for a quantitative estimate of "waiver" to "no waiver" CO emission changes for Connecticut, since EPA cannot determine the average oxygen content for the "no waiver" case or cases from the available information. Directionally, EPA assumes that average oxygen content will decrease with a waiver. CO emissions should increase for Tech 3 , Tech 4 and non-road, and remain the same for Tech 5. While EPA can estimate this directional impact, without further information it is not possible to estimate the magnitude of this impact.

D. Ethanol transport-related emissions

While there will be emissions resulting from the transport of ethanol to terminals, the difference in emissions would depend, in part, on the amount of ethanol used in Connecticut with and without a waiver. DEP has not provided that information. Therefore, EPA concludes that without further information it is not possible to estimate the magnitude of this impact.

VI. CONCLUSIONS OF EPA'S ANALYSIS OF DEP'S SUBMISSION

The information that DEP has provided fails to demonstrate what effect a waiver would have an on ozone or particulate matter levels in Connecticut. This is because: 1) there are three pollutants whose emission rates could be altered by a waiver (NOx, CO and VOC) and all three affect ozone formation to varying degrees; 2) the lack of information on fuel qualities with and without a waiver and the lack of other relevant and necessary information precludes even a directional estimate of the impact of a waiver on NOx and VOC emissions; 3) the best estimate of the net impact of a waiver on CO emissions is that CO emissions would be greater with a waiver than without, but the difference cannot be quantified; 4) no analysis has been provided or performed, and the information before the agency does not allow an analysis to be performed, on the combined effect of these emissions changes on ozone.

In addition, (1) NOx emissions affect PM, (2) the lack of information on fuel qualities with and without a waiver and the lack of other relevant and necessary information precludes even a directional estimate of the impact of a waiver on NOx, (3) no analysis has been provided or performed, and the information before the agency does not allow an analysis to be performed, on the effect of any NOx emissions changes on particulate matter. [27]

[27] The table in Appendix A summarizes EPA's qualitative consideration of Connecticut's waiver request.

APPENDIX A: SUMMARY OF EPA'S ANALYSIS OF DEC'S SUBMISSION

The following table summarizes EPA's assessment of the directional change in "no waiver" to "waiver" emissions for each on-road vehicle technology group, and for non-road gasoline vehicles and engines. "I" indicates an increase, "D" a decrease, "0" little or no change, and "?" means insufficient information to determine.

	NOx	Exhaust VOC	as blended evap VOC	commingling VOC [28]	Permeation VOC	CO
Tech 3 on-road	?	?	?	I or ?	D	I
Tech 4 on-road	?	?	?	I or ?	D	I
Tech 5 on-road	0	0	?	I or ?	D	0
non-road	D	I	?	I or ?	D	I

[28] If ethanol is used in Connecticut's RFG to a significant extent with a waiver, then EPA expects commingling VOC emissions to increase. If ethanol is not used extensively with a waiver, then the direction of this VOC change is uncertain. EPA believes that significant ethanol use with a waiver is likely.