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Report to the Joint Standing Committees on Public Health and the Environment
Connecticut General Assembly

USE OF METHYL TERTIARY BUTYL ETHER (MTBE)

AS A GASOLINE ADDITIVE

Submitted Pursuant to Special Act No. 99-14
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1.0 EXECUTIVE SUMMARY

1.1 INTRODUCTION

MTBE possesses an unusual dynamic with respect to the environment and public health; its use as an additive in reformulated gasoline is providing considerable air quality benefits, while at the same time causing significant contamination of water supplies in the state of Connecticut.

Through the Clean Air Act Amendments, Congress requires reformulated gasoline to have a minimum percentage of "oxygenate", an additive that promotes cleaner, more complete combustion. Congress also requires that areas, such as Connecticut, which do not comply with National Ambient Air Quality Standards must use reformulated gasoline and MTBE as the additive provided by gasoline suppliers to comply with the oxygenate requirement. Reformulated gasoline containing MTBE is readily available in sufficient quantities and at a reasonable cost to consumers.

Reformulated gasoline has provided substantial and measurable air quality benefits by reducing motor vehicle emissions of ozone-forming compounds in the summer, carbon monoxide in the winter, and toxic emissions year-round. Unfortunately, spills and leaks of even small quantities of gasoline have resulted in significant adverse impacts to ground water resources and drinking water supplies throughout the State.

Ideally, if an alternative oxygenate capable of maintaining the air quality benefits that MTBE has produced and which does not degrade ground water quality were available in sufficient quantities, gasoline should be reformulated to eliminate MTBE. However, no such alternative exists today. Further, there are significant legal, regulatory and practical hurdles to simply reducing the concentration of MTBE in the short term.

The Department of Environmental Protection (Department) and other agencies have worked diligently to better understand the concerns surrounding the use of MTBE, to articulate the air and water benefits and detriments, and to work with policy makers to find a feasible alternative to MTBE as soon as possible. Based on this work, the Department has concluded the following:

- The Clean Air Act Amendments mandate for minimum oxygen content in gasoline must be repealed or significantly modified to allow flexibility in identifying alternatives to MTBE.
- Connecticut as a market is too small to effectuate gasoline changes alone and must participate in a regional effort with northeastern states, industry, and other interested parties to find a feasible alternative to MTBE.
- A feasible alternative must yield equivalent air quality benefits, a much lesser potential impact on water quality, while being readily available at a reasonable cost.
- Currently, there is no feasible alternative because of high cost and low availability.

- ❖ Any requirement on refiners and suppliers to provide a feasible alternative should allow a reasonable timeframe for compliance.

1.2 THE REQUIREMENTS OF SPECIAL ACT 99-14

The Department has prepared this report pursuant to Special Act 99-14. Special Act 99-14 (which is attached as Appendix A) requires the Department to prepare a report on the gasoline additive MTBE, including therein:

1. An analysis of whether the use of MTBE as a gasoline additive should be continued, and, if necessary, an analysis of the process for seeking a waiver from the EPA in order to discontinue the use of MTBE in Connecticut;
2. An analysis of the effect of MTBE on Connecticut's water supply;
3. An update on the status of any action taken by other states regarding the use of MTBE; and
4. Specific recommendations on alternative or supplemental air pollution reduction programs such as alternative fuel vehicle incentive, mass transit, and employee commute programs.

1.3 AIR QUALITY

Oxygenates, such as MTBE, have provided significant air quality benefits by reducing carbon monoxide, hydrocarbons and oxides of nitrogen (which contribute to ozone formation), and toxic air emissions from motor vehicles as part of the federal reformulated gasoline program. Simply removing MTBE from gasoline or replacing it with an alternative has several environmental and economic drawbacks, which are more fully discussed later in this report.

This report analyzes alternative air pollution control measures to replace the emission reductions achieved through the use of MTBE. However, these alternative air pollution control measures do not appear to be nearly as effective or economically feasible as the reformulated gasoline program or other air pollution control measures being implemented in Connecticut.

1.4 WATER QUALITY

Releases of gasoline, primarily from leaking underground storage tanks, have contaminated ground water with MTBE at significant concentrations at thousands of locations in Connecticut. As a result, more than 230 drinking water wells have been identified with MTBE above levels that the Department of Public Health (DPH) considers a potential risk to public health (DPH action level). Even very small spills of gasoline on the ground and releases of fuel oil have resulted in the pollution of drinking water supplies above the DPH action level for MTBE.

Furthermore, since the MTBE concentration in gasoline increased in the mid-1990s to comply with oxygenate requirements of the Clean Air Act, the Department has observed very low levels of MTBE in ground water throughout the state, in areas where there have been no known gasoline spills. Although these low levels of MTBE are well below the DPH action level, as many as 15 to 30 percent of the drinking water wells tested by the Department have shown such trace levels.

1.5 OTHER STATE/REGIONAL ACTIVITY

Nationwide, efforts are currently underway to reduce MTBE use. Reductions in MTBE use should begin with congressional action or a renegotiation of federal fuel standards in the Clean Air Act. However, Congress tabled proposed legislation introduced in 1999 to reduce MTBE use by either eliminating the oxygenate requirement or outright banning MTBE from reformulated gasoline. Likewise, efforts by individual states to reduce MTBE use by applying to EPA for a waiver from the oxygenate mandate or from the reformulated gasoline program altogether have been unsuccessful to date. Even if states are able to control the use of MTBE in gasoline, a patchwork of different state fuel requirements in the Northeast could lead to instability in gasoline supply and price.

In November 1998, New Hampshire Governor Jeanne Shaheen, on behalf of the New England Governor's Conference, requested that the Northeast States for Coordinated Air Use Management (NESCAUM) develop a regional solution to reduce MTBE use in the Northeast. Based on NESCAUM's recommendations, the Northeast Regional Fuels Task Force was formed, with Connecticut elected as co-chairman, to develop a unified regional approach to reducing MTBE in gasoline while maintaining air quality benefits. The Task Force was recently expanded adding Mid-Atlantic states including Pennsylvania, Delaware, Virginia, West Virginia, and Washington D.C to the unified effort. The goals of the Task Force are to:

- Maximize the air quality and public health benefits of reformulated gasoline;
- Reduce and cap the amount of MTBE in gasoline to protect water resources;
- Promote a regionally consistent clean fuels program; and
- Minimize the impact of fuel quality changes on gasoline supply and price.

The reformulated gasoline program is a federal initiative. Accordingly, the Task Force recognizes that a federal solution is necessary, and plans to support legislation that is consistent with its goals. In the event a federal solution is not forthcoming, the Task Force is also pursuing a strategy that would work towards allowing states to reduce and cap MTBE usage while still complying with the oxygen mandate for reformulated gasoline in the Clean Air Act. The Task Force's principles for changes to the current reformulated gasoline program are:

1. Repeal the 2 percent oxygen mandate for reformulated gasoline in the Clean Air Act;
2. Phase-down and cap MTBE content in all gasoline;

3. Clarify state and federal authority to regulate, and/or eliminate, MTBE or other oxygenates if necessary to protect public health or the environment;
4. Maintain toxic emission reduction benefits achieved to date by the federal reformulated gasoline program;
5. Promote consistency in fuel specifications through the timely implementation of effective federal requirements; and
6. Provide adequate lead-time for the petroleum infrastructure to adjust in order to ensure adequate fuel supply and price stability.

1.6 RECOMMENDATIONS

The Department makes the following recommendations concerning the use of MTBE as a gasoline additive:

- The state should participate in a regional effort with northeastern states, industry, and other interested parties to find a feasible alternative to MTBE. Such replacement must be carefully evaluated to ensure that it is a feasible alternative. A feasible alternative must yield equivalent air quality benefits with a much lesser impact on water quality, and be readily available at a reasonable cost.

- The concentration of MTBE in gasoline should be reduced to lessen the adverse affects on ground water resources as soon as it is feasible to do so while remaining in compliance with the Clean Air Act Amendments. The state should, working through the Northeast Regional Fuels Task Force, support federal legislation that would be necessary to accomplish such reductions.

- To further protect ground water resources and drinking water supplies from gasoline contamination, the Department should reevaluate the state underground storage tank (UST) program regulations to determine whether additional spill and leak detection measures can be incorporated. To decrease the contamination threat posed by leaking underground storage tanks, serious consideration should be given to providing resources to fund additional positions in the underground storage tank enforcement program to increase Connecticut's inspection and enforcement capabilities.

- All gasoline retailers should be required to provide information concerning the proper storage, handling, and use of gasoline to the general public to lessen the environmental impact of accidental small spills and leaks. This program should be funded by the petroleum industry.

- The Department should proceed with promulgation of regulations required by Section 22a-354i of the Connecticut General Statues for land use controls in Aquifer Protection Areas. The regulation, as presently proposed, would prohibit the installation of new underground gasoline storage tanks near large public water supply wells in sand and gravel aquifer systems (roughly estimated to include 2 percent of Connecticut)

Similar recommendations were offered in two independent studies released over the past year by NESCAUM and the Blue Ribbon Panel appointed by the EPA.

2.0 BACKGROUND

2.1 WHAT IS MTBE?

MTBE is a commonly used acronym for the chemical compound methyl tertiary-butyl ether. At room temperature, MTBE is a volatile, flammable, colorless liquid that is highly soluble in water. It is produced by the chemical reaction of methanol, generally manufactured from natural gas, and isobutylene. MTBE has a very distinct taste and odor, similar to turpentine.

MTBE has been used as a gasoline additive since 1979. However, MTBE was not widely used as a gasoline additive in Connecticut until the mid-1980s and was not discovered in our ground water until 1987. Initially, it was added to gasoline as a replacement for tetraethyl lead to increase the octane rating of the fuel. This action has resulted in a significant reduction in ambient air levels of lead. As an octane enhancing additive, MTBE is blended into conventional gasoline at concentrations ranging from approximately 3 to 5 percent, by volume. More recently, MTBE has also been used as an oxygenate, an additive that increases the oxygen content of gasoline. Oxygenates are added to gasoline to produce more complete fuel combustion, resulting in reductions of carbon monoxide and ozone forming emissions. As an oxygenate, MTBE is currently blended into gasoline at concentrations ranging from 2.0 to 2.7 percent weight oxygen, the equivalent of 11 to 15 percent MTBE, by volume.

2.2 WHY IS MTBE USED IN CONNECTICUT?

The 1990 Clean Air Act Amendments require *federal* fuel programs to be implemented in certain areas that do not meet National Ambient Air Quality Standards (NAAQS) for carbon monoxide and ozone. These programs contain fuel specifications that require a minimum concentration of oxygenate, measured by percent weight, in the gasoline. Oxygenates were not only federally required for their emission benefits, but were also included to help increase national energy security and to promote "renewable" fuel resources such as ethanol. Although the *type* of oxygenate required by these programs is not specified, MTBE has been the oxygenate of choice among gasoline suppliers throughout the entire country, except the Midwest. In 1998 alone, it is estimated that 1.35 billion gallons of gasoline containing over 145 million gallons of MTBE[1] were sold in Connecticut as a partial result of the oxygenate requirements in these programs.

In the winter of 1992-1993, the federal wintertime *oxygenated fuel* program was implemented in two regions of Connecticut that did not meet National Ambient Air Quality Standards (NAAQS) for carbon monoxide. This program, required only during the winter season, specifies gasoline contain a minimum oxygen content of 2.7 percent, by weight. To meet this specification, oxygenated gasoline sold in Connecticut contained

[1] Based on 1998 monthly gasoline sales data from the State of Connecticut Department of Revenue Services.

approximately 15 percent MTBE, by volume. By the winter of 1999-2000, this program was no longer required anywhere in Connecticut to meet NAAQS for carbon monoxide.

Starting January 1995, Phase I of the federal reformulated gasoline program was implemented in the entire state of Connecticut. This program is required in certain areas that do not meet National Ambient Air Quality Standards (NAAQS) for ozone. Required year round, the reformulated gasoline program specifies gasoline contain a minimum oxygen content of 2.0 percent, by weight. To meet this specification, the oxygenated gasoline sold in Connecticut contains approximately 11 percent MTBE, by volume. Beginning January 2000, Phase II of the reformulated gasoline was implemented in certain areas of continued non-compliance for the ozone standard, including the entire state of Connecticut. The Phase II program maintains the requirement that gasoline contain a minimum oxygen content of 2.0 percent, by weight.

Appendices B and C provide greater detail regarding the specifications of these federal fuel programs.

3.0 EFFECTS OF MTBE ON CONNECTICUT'S WATER SUPPLY

The most significant effect of MTBE on the water resources and drinking water supplies in Connecticut has been the pollution of ground water caused by spills or leaks of gasoline or fuel oil. The release of gasoline from leaking underground storage tanks, as well as minor accidental spills of small amounts of gasoline, have caused ground water contamination at thousands of locations in the state. Even leaking residential fuel oil tanks can cause MTBE pollution of ground water and has, in several instances, affected drinking water wells at concentrations that pose a health concern.

MTBE was first detected in drinking water wells in Connecticut in 1987. Since that time, the Department has identified 232 private and 4 public water supply wells from 90 different locations in the state polluted with MTBE at concentrations that the Connecticut Department of Public Health (DPH) has determined may pose an unacceptable risk to public health ("DPH action level"). This represents less than 0.1 percent of all the drinking water wells in Connecticut and about 10 percent of all the polluted wells that are known to have been contaminated above any DPH action level. Many other private wells in proximity to 236 wells identified above have had or have MTBE detected below the DPH action level. In addition, the DPH has identified 51 public water supply systems with MTBE at concentrations less than the action level.

Further, since approximately 1995, about the time concentrations of MTBE in gasoline were increased from approximately 3 percent to 11 percent by volume, the Department has observed that 15 percent to 30 percent of all drinking water wells tested by the department throughout the state contain low to trace levels of MTBE. Such trace levels occur sporadically and cannot be related to any specific release or spill of gasoline or fuel oil. These observed low levels of MTBE ranged from less than 0.5 µg/l (micrograms per liter) to approximately 10 µg/l, considerably below the DPH action level of 70 µg/l. While the source of such widespread trace levels of MTBE in ground water is not completely understood, it may be related to the infiltration of rain or runoff that contains low concentrations of MTBE.

In some states, MTBE has been detected at problematic concentrations in surface water supply reservoirs. However, in Connecticut this has not been an issue as motor boats are prohibited on reservoirs.

3.1 SOURCES OF MTBE CONTAMINATION IN GROUND WATER

The primary source of the MTBE pollution of ground water at significant concentrations is the release of gasoline from leaking underground storage tanks. Leaking underground gasoline tanks have occurred at more than 2,000 gas stations or other commercial and industrial sites in the state and the highest, persistent concentrations of MTBE have been observed in ground water polluted by such releases. Releases from underground gasoline storage tanks have occurred in every municipality in the state and account for more than

90 percent of the drinking water wells that have been polluted by MTBE above the DPH action level in Connecticut.

Leaks and spills of gasoline have also polluted ground water with other compounds, including benzene, toluene, ethylbenzene and xylenes. Consequently, of the drinking water wells polluted by MTBE above DPH standards from underground gasoline tanks, approximately 70 percent were also contaminated above DPH standards for benzene or other gasoline components.

In addition to leaking underground gasoline tanks, drinking water has been polluted by MTBE at concentrations above the DPH action level by accidental spills of gasoline on the ground. For example, drippage on the ground at gas stations, spills related to traffic accidents, even very small spills at businesses or residences, have polluted ground water and water supplies. Generally, the concentration of MTBE resulting from small spills on the ground surface is lower than the concentrations related to underground storage tank releases and the duration is shorter, but the resulting pollution can still exceed DPH action levels.

MTBE contamination of ground water and MTBE polluted drinking water wells have also resulted from leaking residential fuel oil tanks. Although MTBE is not an additive in fuel oil, current research by the University of Connecticut's Environmental Research Institute suggests that as fuels are distributed in the state, MTBE is transferred from gasoline to fuel oil when distribution vehicles are used for both petroleum products.

3.2 MITIGATION OF MTBE CONTAMINATION IN GROUND WATER

The Department has three programs that function to address the water pollution problems created by components of gasoline including MTBE. The underground storage tank program and enforcement of the associated regulations are the primary tools for preventing or minimizing the occurrence of leaks and spills. The Petroleum Clean Up Account provides funding for the remediation of ground water and soil polluted by leaking underground storage tanks. Finally, the potable water program ensures that people with water supplies contaminated with MTBE at or above the action level are provided with a safe alternative drinking water supply. The following sections summarize the three programs.

3.2.1 Underground Storage Tank Enforcement Program

There are currently 18,561 active commercial underground storage tanks (USTs), including 4,308 commercial heating fuel tank facilities in Connecticut. Over ten years ago, EPA had established the deadline of December 22, 1998 for UST owners to upgrade or close antiquated tank systems that are prone to failure and leakage. Of the 14,253 Connecticut USTs that fall into this category, only 8,620 USTs (60.5 percent) have been *documented* as in compliance with the deadline requirements to date. It is estimated that roughly 30 percent (1,690) of the 5,633 USTs currently not documented are *actually* out

of compliance with the December 22, 1998 deadline requirements. These tanks pose the greatest threat to the environment because components have exceeded life expectancies and are prone to failure and leakage.

3.2.2 Petroleum Clean Up Account

The Petroleum Clean Up Account is the primary tool for funding the remediation of ground water and soil polluted by leaking underground storage tanks (USTs). In fiscal year 1999, 19 million dollars was reimbursed to tank owners for the remediation of motor fuel releases. Reimbursement is restricted to underground motor fuel tanks and does not provide funding for many of the sources of MTBE related contamination that are not from leaking USTs. As a result of the significant volumes of MTBE in gasoline and its ability to spread rapidly in ground water, the presence of MTBE in gasoline increases the costs of remediation by an estimated 20 to 30 percent compared to sites where no MTBE is present.

3.2.3 Potable Water Program

The potable water program pursuant to Section 22a-471 of the Connecticut General Statutes is the mechanism by which the Department ensures that people whose water supplies are affected by MTBE at or imminently above the DPH action level are provided an alternative safe supply of drinking water. Under that statute, the Department provides an interim supply of potable drinking water to any residence affected by pollution above the DPH action level. The Department can then require that any party responsible for the pollution provide both an interim and a permanent safe supply of water. In accordance with Section 22a-471, the Commissioner of Public Health determines the level of pollution in ground water that may pose an unacceptable risk to the health of people using the water for drinking. For MTBE, that level was, from 1987 until March of 1999, 100 µg/l (micrograms per liter or parts per billion). In March, the DPH lowered the action level to 70 µg/l. A summary explaining the derivation of this action level by the Environmental Epidemiology Section of the DPH is included as Appendix D.

Since the 1970s, the Department has identified more than 2,100 wells in the state that have been polluted by various compounds at levels of potential health concern and have ensured that interim or permanent supplies of potable water have been provided to all persons affected by those polluted wells. On average, the Department discovers approximately 100 new contaminated wells annually, of which, on average, 15 to 18 are polluted with MTBE.

For residential properties served by the 236 wells contaminated by MTBE, all are now or were provided bottled water as a temporary measure upon discovery of the contamination, and most were provided treatment systems to reduce or eliminate the MTBE in the household while a long term water supply solution was pursued. Permanent alternatives for safe drinking water in these cases has varied from connection to public water supply systems, to continued use of activated carbon treatment systems.

In some cases, particularly those wells affected by small spills or those where remediation efforts have been aggressive and prompt after discovery of the release, the MTBE concentrations in the drinking water supplies have been reduced to acceptable levels so that the original source of water is usable.

3.3 SUMMARY

- MTBE has contaminated ground water at significant concentrations where underground gasoline storage tanks have leaked in the last 12 to 15 years. Since 1987, 236 drinking water wells have been affected at concentrations above an action level as a result primarily of leaking underground storage tanks and secondarily of incidental spills of gasoline on the ground surface and leaking residential fuel oil tanks.

- Most of the water supply wells polluted by MTBE in Connecticut were also polluted by other gasoline components. However, 30 percent of the affected water supplies were polluted with MTBE alone.

- In approximately the last five years, MTBE has been observed in ground water at trace to low concentrations in an estimated 15 to 30 percent of the drinking water wells in the state. The widespread occurrence of low concentrations of MTBE in ground water is not associated with gasoline leaks or spills and may be related to MTBE in rain and surface runoff.

- An alternative safe supply of drinking water has been provided to every household whose water supplies were polluted with MTBE above the DPH action level.

- While regulations are in place that are designed to reduce or eliminate the occurrence of ground water pollution from underground storage systems, even small releases that cannot be detected by current technologies can result in pollution of ground water by MTBE at significant concentrations. Further, the Department has only sufficient staff resources to inspect less than 5 percent of regulated underground storage tank facilities annually.

- The presence of MTBE in gasoline has resulted in a larger body of ground water pollution resulting from spills of gasoline and has increased significantly the cost of remediating the effects of gasoline on water resources and drinking water supplies.

4.0 EFFECTS OF MTBE ON AIR QUALITY

Oxygenates, such as MTBE, are an integral part of the reformulated gasoline program to reduce motor vehicle emissions. At an average concentration of 11 percent, by volume, MTBE is the most prevalent single compound in reformulated gasoline. The presence of MTBE is responsible for the direct reduction of carbon monoxide emissions by promoting more complete combustion. MTBE also indirectly reduces ozone forming and toxic air emissions by displacing or diluting the more volatile and toxic compounds normally found in gasoline. To better understand the complex relationship between MTBE and reformulated gasoline, it is necessary to examine the air quality benefits of MTBE within the context of the reformulated gasoline program.

4.1 BENEFITS OF REFORMULATED GASOLINE

Table 1 presents emission reduction performance standards defined in the Clean Air Act for reformulated gasoline and actual emission reductions estimated for the Northeast states in 1998.[2] Also included is an estimate of carbon monoxide emission reductions for Connecticut using EPA's mobile emission model. The values reported in the table represent the percent reduction in total emissions from motor vehicles using reformulated gasoline when compared to 1990 baseline (conventional) gasoline specifications defined in the Clean Air Act.

Table 1
Emission Reductions from Reformulated Gasoline in the Northeast States

Air Pollutants	**Phase I RFG (1995 – 1999)**		**Phase II RFG (2000 +)**
	Performance Standards	1998 Actual Reductions	Performance Standards
VOCs	17%	21%	27%
NOx	1.5%	5%	6.8%
Air Toxics	17%	35%	22%
Carbon Monoxide	Not specified	17.6% [3]	Not specified

[2] National Blue Ribbon Panel on Oxygenates in Gasoline, 1999, *Achieving Clean Air and Clean Water*, p. 24. "Actual" emission reductions were calculated using EPA's Complex model and fuel composition data from reformulated gasoline blends sold in the Northeast in 1998.
[3] Value was calculated by Department staff using EPA's Mobile 5b Model.

As shown in Table 1, the federal reformulated gasoline program, in practice, has provided even greater than anticipated air quality benefits for volatile organic compounds (VOCs), oxides of nitrogen (NOx), and air toxics. Most significant is the substantial margin of compliance for air toxics, where actual emission reductions of 35 percent have been achieved in the Northeast, though the applicable performance standard requires only a 17 percent reduction. The presence of oxygenates, such as MTBE, is partially responsible for significantly over-achieving this standard by enhancing the combustion effectiveness of the fuel and by diluting the components found in baseline gasoline that are more toxic and/or produce toxic emissions.

Although use of MTBE in gasoline creates motor vehicle emissions of MTBE and increases formaldehyde (a toxic air pollutant) emissions by approximately 10 percent[4], overall emissions of toxic compounds are greatly reduced. NESCAUM performed a relative risk comparison for MTBE in ambient air which demonstrated that use of MTBE in reformulated gasoline decreases its overall cancer potential by displacing more potent carcinogenic materials in gasoline. This risk comparison estimated that MTBE is approximately 7 times less potent than benzene and 25 times less potent than 1,3-butadiene, toxic components found in gasoline and motor vehicle emissions.[5]

Because oxygenates, particularly MTBE, currently provide a significant margin of compliance for air toxic emission reductions, there are concerns that efforts to remove the oxygenate mandate or ban MTBE will eliminate this benefit of the reformulated gasoline program. According to NESCAUM, reducing or eliminating MTBE without additional regulatory steps, could lead to "backsliding" of current air toxic benefits with reductions decreasing from 35 to 22 percent (a 37 percent increase in toxic air emissions) while still meeting the performance requirements of the reformulated gasoline program.[6]

Appendix E presents a more detailed discussion of how oxygenates and reformulated gasoline specifically reduce motor vehicle emission and the relevance of motor vehicle emission reductions to overall state air pollution control strategies.

4.2 IMPACTS OF REMOVING MTBE FROM REFORMULATED GASOLINE

Irrespective of the oxygenate requirement, reformulated gasoline must continue to meet the minimum emission performance standards defined in section 211(k) of the Clean Air Act and presented in Table 1. Because MTBE accounts for a significant portion of reformulated gasoline (approximately 11 percent by volume), it is difficult to accurately quantify the effects of removing MTBE without knowing what gasoline components would be used to replace it. Simply removing MTBE without modifying other aspects of the fuel blend would create a gasoline that increases overall carbon monoxide, air toxics,

[4] Value calculated by Department staff using EPA's Complex Model.
[5] NESCAUM, 1998, *Relative Cancer Risk of Reformulated Gasoline and Conventional Gasoline Sold in the Northeast*, Table ES-1 Method 3 Cancer Potency Ratios, p. ES-5.
[6] NESCAUM, 1999, *RFG/MTBE Findings and Recommendations, Attachment III: Air Quality, Fuel Supply and Cost Impacts of MTBE and its Alternatives*, p.9.

and ozone forming emissions that may not meet minimum performance standards of the reformulated gasoline program.

The compound(s) chosen to replace MTBE would be influenced largely by the regulatory strategy implemented to allow the reduction or removal of MTBE from reformulated gasoline. If the 2.0 percent, by weight, oxygenate requirement is preserved in the reformulated gasoline program, then other oxygenates, such as ethanol, would likely be used to replace MTBE. However, if the oxygenate requirement is eliminated, then other petroleum based compounds become available to replace MTBE. The following section provides a detailed evaluation of compounds that could potentially replace MTBE in reformulated gasoline.

5.0 ALTERNATIVE FUEL ADDITIVES TO REPLACE MTBE

Several petroleum and non-petroleum based compounds exist that may replace MTBE in reformulated gasoline. Potential replacements for MTBE consist of other oxygenates, such as alcohols and ethers, and petroleum based components, such as alkylates and aromatics. Ideally, the replacement for MTBE would have favorable environmental, public health, performance, supply, and economic characteristics. Its replacement would not pose a threat to water resources or public health, would provide clean air benefits, have a high octane rating, and be economically feasible to produce in large quantities and blend into reformulated gasoline. Unfortunately, none of the potential replacements for MTBE appear to satisfy all these criteria and end up presenting a difficult compromise between environmental, public health, and supply/economic concerns. The following sections present the advantages and disadvantages that exist with each of the potential replacements for MTBE.

5.1 USE OF OTHER OXYGENATES

5.1.1 Ethanol

With the 2.0 percent, by weight, oxygenate requirement still in place, ethanol is the most likely additive to replace MTBE in reformulated gasoline[7]. Currently, ethanol produced from corn is the predominant oxygenate used in reformulated gasoline sold in the Midwest, due to the proximity to production facilities and tax incentives in these states. Although ethanol behaves much more favorably in groundwater than MTBE and has fewer public health concerns, issues concerning its effect on air quality, supply and distribution infrastructure, and economics need to be carefully considered before ethanol is chosen to replace MTBE in the Northeast.

Ethanol has several advantages over MTBE with regard to protecting water resources. When ethanol/gasoline blends are released into the environment, ethanol, like MTBE, is readily absorbed by ground and surface water. However, because ethanol is highly biodegradable, it normally degrades into harmless byproducts before the plume can reach any potential receptors. Additionally, unlike MTBE, ethanol does not present taste and/or odor issues when present in water at concentrations lower than the drinking water standard. One potential disadvantage of using ethanol in reformulated gasoline is that ethanol may retard biodegradation of benzene, a known carcinogen, allowing benzene plumes to spread further when gasoline is spilled.[8] Additional research is necessary to further evaluate the competition for bioremediation between ethanol and benzene.

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[7] NESCAUM, 1999, *RFG/MTBE Findings and Recommendations, Attachment III: Air Quality, Fuel Supply and Cost Impacts of MTBE and its Alternatives*, p. 4.

[8] National Blue Ribbon Panel on Oxygenates in Gasoline, 1999, *Achieving Clean Air and Clean Water*, p. 80, *and references therein.*

With respect to air quality, ethanol has several disadvantages when compared to MTBE. Use of ethanol in gasoline has shown to increase VOC emissions and will likely increase overall toxic air emissions when compared to reformulated gasoline containing MTBE. Small quantities of ethanol are capable of significantly increasing the volatility of gasoline, creating increased evaporative VOC emissions. Although lower volatility base fuel can be used for creating reformulated gasoline with ethanol, there are concerns that commingling this fuel with ethanol-free gasolines in vehicle fuel tanks could result in unanticipated increases in evaporative emissions. Use of ethanol in reformulated gasoline will directly increase emissions of acetaldehyde, a toxic combustion by-product of ethanol, and will most likely increase overall toxic air emissions of reformulated gasoline when compared to MTBE by diluting lesser quantities of toxic compounds found in gasoline. Additional research is necessary to characterize the impact of increased emissions of these components on ambient concentrations. The significant "toxic dilution benefit" of oxygenates is decreased with ethanol because only 5.7 percent ethanol, by volume, is necessary (compared to 11 percent MTBE) to meet the minimum oxygen content requirement of reformulated gasoline.

Ethanol is considered the most viable near-term alternative to MTBE, mainly because it is the only oxygenate that could possibly be produced in quantities sufficient to replace MTBE over the next three years.[9] However, several obstacles exist that could make the transition to ethanol based reformulated gasoline difficult. NESCAUM estimates that 800 million gallons of ethanol per year would be required to replace MTBE in the Northeast. Production capacity in the United States does not currently exist to meet the near-term demand if both California *and* the Northeast were to substitute ethanol for MTBE[10]. Also, unlike MTBE, which is blended with gasoline at the refinery, ethanol cannot be transported long distances via pipeline due to its unique chemical properties. Ethanol is highly soluble in water which is commonly found in pipelines and storage tank/gasoline distribution systems. Once mixed with water, ethanol will separate out of the gasoline mixture. Due to this potential for phase separation, ethanol is typically blended at the fuel terminal, instead of the refinery. With current ethanol production occurring almost entirely in the Midwest, ethanol would have to be transported to the Northeast via truck, rail, or ship.

One possible solution to these supply and distribution obstacles is to construct biomass based ethanol production facilities in the Northeast. Studies show that sufficient biomass waste exists in the Northeast to produce an adequate supply of ethanol and significant life-cycle reductions of greenhouse gases could be realized with biomass based ethanol[11]. However, it should be noted that currently there are no commercial biomass to ethanol production facilities operating in the Northeast and that several years and considerable investments are necessary before enough ethanol could be produced to overcome the supply and distribution barriers.

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[9] NESCAUM, 1999, *RFG/MTBE Findings and Recommendations, Attachment III: Air Quality, Fuel Supply and Cost Impacts of MTBE and its Alternatives*, p. 5.

[10] NESCAUM, 1999, *RFG/MTBE Findings and Recommendations, Summary of Findings and Program Recommendations*, p. 11.

[11] NESCAUM, 1999, *supra* note 10, p. 12, *and references therein.*

Refinery modeling performed by the U.S. Department of Energy and the California Energy Commission estimate that replacing MTBE with ethanol will increase the cost of reformulated gasoline by 2.5 cents per gallon. However, this estimate assumes that refineries will produce reformulated gasoline to meet only the minimum regulatory requirements for toxic air emissions, which could increase toxic air emissions in the Northeast by up to 40 percent.[12] For this reason, NESCAUM strongly recommends additional refinery modeling to determine the costs associated with maintaining the current air quality benefits of reformulated gasoline while phasing down MTBE.

5.1.2 ETBE, TAME, and DIPE

Ethyl tertiary butyl ether (ETBE), tert amyl methyl ether (TAME), and diisopropyl ether (DIPE) are other ethers that have been used as oxygenates in gasoline. However, due to the limited use of these compounds, there is little scientific information or field data available regarding potential health effects or their behavior in the environment. Because they are ethers, it is anticipated that they exhibit the same characteristics as MTBE when released into the environment. For this reason, these compounds do not appear to offer any advantages over MTBE with respect to reducing groundwater contamination.

5.2 USE OF PETROLEUM BASED ALTERNATIVES

5.2.1 Alkylates

Alkylates are a mixture of high octane, low vapor pressure compounds that are produced from crude oil through a catalytic cracking process. Combustion of alkylates is believed to produce relatively small quantities of motor vehicle air toxic emissions.[13] Alkylates also have very low solubility in water and, therefore, are likely not to pose the same risks to water resources as MTBE. Due to their desirable features, alkylates are favored components for blending gasoline and are already high in demand. At present, production of alkylates at East Coast and Gulf Coast refineries is near capacity. Consequently, several years would be required for refineries to modify their facilities to produce sufficient quantities of alkylates to replace the volume and octane lost if MTBE is phased down in gasoline. Due to the changes in refinery infrastructure necessary to increase the production of alkylates, the use of this additive to replace MTBE could lead to a significant increase in the price of reformulated gasoline.

Because alkylates have long been used in gasoline, it is not anticipated that a modest increase in concentration of this additive in gasoline would increase the overall human health risks already associated with exposure to gasoline. However, despite their historical use in gasoline, human and aquatic toxicity risk data associated with exposure

[12] NESCAUM, 1999, *RFG/MTBE Findings and Recommendations, Attachment III: Air Quality, Fuel Supply and Cost Impacts of MTBE and its Alternatives*, p. 26.
[13] NESCAUM, 1999, *supra* note 12, p. 16.

to alkylates are limited.[14] The potential health effects, combustion by-products, and environmental fate and transport of alkylates should be thoroughly evaluated before substantially increasing their use in gasoline.

5.2.2 Aromatics

Aromatics is the term given to the group of gasoline hydrocarbons that includes benzene, toluene, and xylenes. These compounds have long been used in gasoline blends because they are relatively high in octane. However, aromatics have a wide range of potential health effects, ranging from known carcinogens (benzene) to lower potency central nervous system and liver toxicants (toluene). According to NESCAUM, the use of aromatics to replace MTBE in reformulated gasoline will substantially increase toxic emissions. For this reason, increased blending of aromatics is not considered a favorable alternative to the volume contribution of MTBE or other oxygenates.

[14] National Blue Ribbon Panel on Oxygenates in Gasoline, 1999, *Achieving Clean Air and Clean Water*, p. 82.

6.0 ALTERNATIVE AIR POLLUTION CONTROL OPTIONS

Special Act 99-14 requires the Department to analyze alternative air pollution reduction programs that could potentially be implemented to offset the increase in emissions associated with the reduction/removal of oxygenates from reformulated gasoline. As discussed earlier, reformulated gasoline offers many air quality benefits by reducing motor vehicle emissions of ozone forming compounds, air toxics, and carbon monoxide. Oxygenates are responsible for directly reducing carbon monoxide emissions and indirectly reducing air toxic and ozone forming emissions by diluting harmful components found in conventional gasoline. Because removing oxygenates, such as MTBE, from reformulated gasoline would increase mobile source emissions, additional air pollution control measures would be required to offset this change to prevent an increase in overall emissions.

In this section, the Department analyzed five alternative air pollution reduction programs and compared the emission reductions and cost effectiveness of each option to mobile source control strategies currently being implemented in Connecticut. Alternative fuel transit buses, an early vehicle retirement program, and three different transportation control measures were evaluated. For each option, public program cost, anticipated reductions of ozone forming emissions and a cost/benefit ratio in dollars per ton of emissions removed are determined.

6.1 ALTERNATIVE FUEL TRANSIT BUS FLEETS

This option evaluates the replacement of heavy-duty diesel vehicles with vehicles that operate on Compressed Natural Gas (CNG). Due to the limited number of existing CNG refueling stations in the state and the considerable investment needed for construction of new facilities, CNG is most applicable for large fleets that are refueled in a central location. Transit buses are well suited for CNG because they are used predominantly in urban areas, travelling in relatively short distances and allowing for refueling at centrally located stations.

Results from a recent study of alternative fuel transit buses funded by the U.S. Department of Energy indicate that CNG fueled buses reduce emissions of oxides of nitrogen (NOx) by approximately 10 grams per mile when compared to conventional diesel fueled engines.[15] CNG buses have the additional benefit of providing significant emission reductions of harmful particulate matter, although this is not used as a basis for this comparison in this report.

The following analysis considers the replacement of 375 CT Transit diesel buses operating in Hartford, New Haven, and Stamford with buses using CNG. The incremental cost increase for replacement, storage, and maintenance of CNG buses, when

[15] U.S. Department of Energy, 1996, *Alternative Fuel Transit Buses, Final Results from the National Renewable Energy Laboratory Vehicle Evaluation Program,* Table 6, p. 22.

compared to diesel, were determined using data from the U. S. Department of Energy report.[16] The reduction in NOx emissions from operating the CNG buses is anticipated to be 0.45 tons per day (112.5 tons per year).[17] Assuming a 17 year useful life for new CNG buses, the program has an annual incremental cost of $3,010,000 and a cost/benefit ratio of $26,500 for every ton of ozone forming emissions removed.

6.2 EARLY VEHICLE RETIREMENT

This option would remove older automobiles, typically a source of high emissions, from the operating fleet. Though many older high-emitting vehicles are removed from the fleet through normal attrition, some of these vehicles remain in operation and continue to produce greater emissions for a longer period of time than the average vehicle. The Early Vehicle Retirement program seeks to remove these vehicles from the fleet by providing incentives for owners to retire the vehicles sooner than they would have in the absence of the program. This program is considered a short-term option because as the vehicle fleet becomes newer, with better emission control technology, the air quality benefits from removing older cars will be reduced.

The Department previously prepared and submitted a report to the legislature analyzing potential early vehicle retirement programs.[18] The analysis presented below is based on data presented in that report. For this analysis, it was assumed that the remaining life of a vehicle targeted for this program is two years. Assuming a program size of 3,200 vehicles, the reduction in emissions (VOC and NOx) is 256 tons over the two year period. Assuming these vehicles are driven daily, the reduction in ozone forming emissions is 0.35 tons per day. With the cost per vehicle set at $820, the total program cost is $2,620,000 and the cost/benefit ratio is $10,250 for every ton of ozone forming emissions removed. [19]

6.3 TRANSPORTATION CONTROL MEASURES

Transportation control measures (TCMs) are intended to reduce vehicular travel, measured in vehicle miles traveled (VMT) and, thereby, reduce mobile source emissions. The following three TCMs were considered using data presented in a study prepared for the Greater Hartford Rideshare Corporation.[20]

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[16] U.S. Department of Energy, 1996, *Alternative Fuel Transit Buses, Final Results from the National Renewable Energy Laboratory Vehicle Evaluation Program*, Tables 2, 3, 4, and 5, p. 18-20.
[17] U.S. Department of Energy, 1996, *supra* note 16, Table 6, p. 22, assumes 250 working days per year
[18] Connecticut Department of Environmental Protection, 1994, *Early Vehicle Retirement Program Analysis*
[19] Connecticut Department of Environmental Protection, 1994, *supra* note 18, p. 12.
[20] COMSIS Corporation with Fitzgerald & Halliday, Inc. and Bartram & Cochran, 1994, *Connecticut TCM Evaluation Study Final Report*

6.3.1 Statewide Mandatory Employee Commute Option

This option involves the implementation of programs by employers to encourage employees to find alternative methods of commuting to work that would result in a increase of average vehicle occupancy rates and decrease in VMT. A mandatory employee commute program was in place for southwestern Connecticut from 1994 through December 1995. A voluntary program still exists in Connecticut and is administered by the State Department of Transportation.

Employee commute option programs can include compressed work weeks, telecommuting, preferential parking and numerous other options. It focuses on reducing vehicle trips among travelers arriving at work between 6 am and 10 am. Under this option, it was assumed that the requirement will be mandatory and implemented on a statewide basis for employers with 100 or more employees. Evaluation of this option assumes a 20 percent reduction in vehicle miles traveled will occur.

The reduction in emissions (VOC and NOx) is anticipated to be 5.02 tons per day (1255 tons per year). The reduction in vehicle miles traveled (VMT) is anticipated to be 373.6 million miles per year.[21] With an annual program cost of $28,100,000 [22], the cost/benefit ratio is $22,400 for every ton of ozone forming emissions removed and $0.08 for every mile reduction in VMT.

6.3.2 Parking Fees

This option would implement a $1.00 increase in parking fees for work trips. This would be implemented in suburban areas as well as the main city core. The fee increase would encourage the use of transit and carpooling thus decreasing VMT.

The reduction in emissions (VOC and NOx) is anticipated to be 1.44 tons per day (360 tons per year).[23] With an annual program cost of $13,000,000 [24], the cost/benefit ratio is $36,100 for every ton of ozone forming emissions removed and $0.07 for every one mile reduction in VMT.

6.3.3 Transit Service (Suburb to Suburb)

A majority of the daily work commute trips taking place do not begin or end in a region's core cities. An analysis was conducted for the Greater Hartford Rideshare Corporation of the Hartford Region's suburb to suburb commuter market. The core cities for the Hartford Region are Hartford, West Hartford, and East Hartford. Many of the daily work

[21] COMSIS Corporation with Fitzgerald & Halliday, Inc. and Bartram & Cochran, 1994, *Connecticut TCM Evaluation Study Final Report* , p. III-6, assumes 250 working days per year.
[22] COMSIS Corporation with Fitzgerald & Halliday, Inc. and Bartram & Cochran, 1994, *Connecticut TCM Evaluation Study Final Report Technical Appendix*, p. VI-7.
[23] COMSIS Corporation, 1994, *supra* note 21, p. III-18, assumes 250 working days per year.
[24] COMSIS Corporation, 1994, *supra* note 22, p. VI-18.

commute trips do not begin or end in these core cities. For this option, the analysis estimated that, to capture 10 percent of the total suburb to suburb work-trip activity through the use of vanpools, a $60 per month subsidy for each rider would be required

Recent evaluations have called into question the actual emission reductions created by vanpooling. Most members of a vanpool drive their personal car to a common area to board the van. Emissions from vehicles have been shown to be higher during the first few miles of travel before the engine reaches its peak operating efficiency. Therefore, vanpools generally do not eliminate the short trips that occur when the car's emissions are highest. However, vanpools do reduce the overall vehicle miles traveled (VMT).

The reduction in emissions (VOC and NOx) is anticipated to be 0.588 tons per day (147 tons per year). The reduction in VMT is anticipated to be 43.7 million miles per year in the Hartford study area.[25] With an annual program cost of $10,000,000 [26], the cost/benefit ratio is $68,000 for every ton of ozone forming emissions removed and $0.23 for every mile reduction in VMT.

[25] COMSIS Corporation, 1994, *supra* note 21, p. III-11, assumes 250 working days per year.
[26] COMSIS Corporation, 1994, *supra* note 22, p. VI-14.

6.4 COMPARISON OF OPTIONS

Table 2 summarizes the emission reductions and cost effectiveness of the five alternative air pollution control strategies discussed above. Also included are data on several currently implemented mobile source control programs in Connecticut's State Implementation Plan (SIP).

Table 2
Comparison of Mobile Source Emission Reduction Options

Air Pollution Control Options		**Reduction of Ozone Forming Emissions (tons/day)**	**Cost Effectiveness ($/ton)**
Mobile Source Options in SIP	Phase I Reformulated Gasoline (RFG)	30.1 [27]	$2,000 [28]
	Phase II RFG, incremental benefits and costs	17.7 [29]	$1,000 [30]
	Vehicle Inspection & Maintenance Program	28.2 [31]	$900 - $1,700 [30]
Alternative Air Pollution Control Options	Alternative Fuel Fleets – CNG Transit Buses	0.45	$26,500
	Early Vehicle Retirement	0.35	$10,250
	Statewide Mandatory Employee Commute	5.02	$22,400
	Parking Fees	1.44	$36,100
	Transit Service – Suburb to Suburb	0.59	$68,000

[27] Connecticut Department of Environmental Protection, 1994, *Connecticut Ozone Reduction Strategy for 1996, 15 Percent Reasonable Progress Plan*, p. 18, reductions in ozone forming emission from these programs includes VOCs only.
[28] Approximate value according to EPA staff. An economic evaluation of Phase I RFG was never performed because the fuel specifications were determined through the regulatory-negotiation process.
[29] Calculated using Phase I RFG reductions and the 27% VOC reduction performance specification for Phase II RFG.
[30] Environmental Protection Agency, 1994, *Regulation of Fuels and Fuel Additives: Standards for Regulation of Fuel and Fuel Additives (AMS-FRL-4817-8)*, p. 61.
[31] Calculated by Department staff for 1999 using EPA's Mobile 5B Model, includes VOC emission reductions only.

6.5 CONCLUSIONS

The alternatives evaluated provide relatively small emission reductions and are considerably less cost effective than currently implemented mobile source control options. Previous mobile source control evaluations benchmark $5,000 per ton of ozone forming emissions removed as cost effective.[32] Based on data presented in Table 2, reformulated gasoline provides significant reductions of ozone forming emissions in addition to being one of the most cost effective options. Typically, fuel programs have an inherent advantage over other mobile source control options because they can immediately impact the entire motor vehicle population with little or no investment in changes to existing infrastructure.

It is impossible to accurately predict the effect of removing MTBE on the overall emission and economic benefits of the reformulated gasoline program without knowing exactly what components would replace it. Based on the magnitude of air quality benefits offered by reformulated gasoline, it is unlikely that adopting any of the alternative options discussed above would be cost-effective or match the air quality benefits provided by oxygenates in reformulated gasoline.

[32] Environmental Protection Agency, 1994, *Regulation of Fuels and Fuel Additives: Standards for Regulation of Fuel and Fuel Additives (AMS-FRL-4817-8)*, p. 59.

7.0 RECENT DEVELOPMENTS

This section of the report provides an overview of recent activity related to MTBE. Specifically, this section includes brief summaries of the EPA's Blue Ribbon Task Force on MTBE, NESCAUM's report on reformulated gasoline and MTBE, formation of the Northeast Regional Fuels Task Force, and a public outreach program called "Gas Care".

7.1 BLUE RIBBON PANEL ON OXYGENATES IN GASOLINE

In November 1998, EPA appointed a Blue Ribbon Panel to investigate the air quality benefits and water quality concerns associated with using oxygenates in gasoline, and provide advice and recommendations on ways to continue improvements to air quality while protecting water resources. The Panel was comprised of leading experts from the public health and science communities, automotive fuel industry, water utilities, and local and State governments, including NESCAUM. The Panel's charge was to: 1) examine the role of oxygenates in attaining clean air goals; 2) assess the effects of oxygenates on public health and the environment; and 3) evaluate the relative air quality benefits, cost, and availability of oxygenates and potential alternatives. In September 1999, the Panel published the results of its investigation in a report titled "Achieving Clean Air *and* Clean Water". A summary of the main points of the report is provided below. A copy of the executive summary from the Blue Ribbon Panel report is included as Appendix F.

Findings

The Panel concluded that the federal reformulated gasoline program has provided substantial air quality benefits by reducing motor vehicle emissions of volatile organic compounds, carbon monoxide, and air toxics. Although there is some disagreement about the precise role of oxygenates in attaining the air quality benefits, the investigation confirmed that the use of oxygenates was beneficial for air quality. MTBE use has reduced carbon monoxide emissions and provided air toxic benefits through the reduction of aromatics in fuels. However, analyses of water supply data indicate that the widespread use of MTBE in reformulated gasoline has resulted in an increasing number of MTBE detections in drinking water supplies. Additionally, the Panel reports that, due to MTBE's persistence and mobility in water, MTBE is more likely to contaminate ground and surface than other components of gasoline.

Recommendations

The Panel recommended a substantial reduction in MTBE usage to minimize current and future threats to drinking water supplies. To achieve this, the Panel recommended that Congress act quickly to eliminate the 2 percent, by weight, oxygen mandate in reformulated gasoline and clarify federal and state authority to regulate gasoline additives that pose a threat to drinking water supplies. In phasing down MTBE use, the Panel

recommends action be taken to prevent the backsliding of current toxic emission reductions benefits provided by reformulated gasoline.

The Panel also provided recommendations for enhancing protection of drinking water supplies and evaluating gasoline additives to prevent any adverse effects to public health and the environment with future changes to the reformulated gasoline program. To protect drinking water resources, the Panel recommends federal and state underground storage tank programs be enhanced to accelerate enforcement of recent federally required tank system upgrades and evaluate and improve existing tank system and leak detection technology. Recommendations are also made to restrict recreational use of surface waters serving as drinking water supplies and educate the public on the proper handling of gasoline through outreach programs. To prevent unanticipated adverse effects of future gasoline additives, the Panel recommends that full multi-media assessment (air, water, and soil) be performed prior to the introduction of any new gasoline additive.

7.2 NESCAUM RFG/MTBE FINDINGS AND RECOMMENDATIONS

At the request of Governor Shaheen of New Hampshire acting on behalf of the New England Governors, Northeast States for Coordinated Air Use Management (NESCAUM) performed an investigation into the use and effectiveness of MTBE and alternatives that may exist to meet the goals of the federal reformulated gasoline program. Based on their findings, recommendations were made regarding the best course of action for maximizing air quality benefits while minimizing the threat to public health. The following summarizes main points from the NESCAUM report. A copy of NESCAUM's "Summary of Findings and Program Recommendations" is included as Appendix G.

Findings

NESCAUM concluded that the reformulated gasoline program is a proven and cost effective air pollution control strategy and is necessary for the northeast states to achieve and maintain National Ambient Air Quality Standards for ozone and carbon monoxide. In addition, reformulated gasoline supplied to the Northeast has overcomplied with toxic air emission performance standards by more than 75 percent, in part due to the presence of MTBE. However, state water sampling data indicate that MTBE is now one of the most commonly detected compounds in the Northeast, with MTBE often present in drinking water without detectable levels of any other toxic gasoline components. The report concludes that the presence of MTBE at concentrations above drinking water standards combined with exposure to MTBE in ambient air may, in some cases, be sufficient to exceed health protective thresholds.

Recommendations

Due to the widespread adverse impact of MTBE on water resources, NESCAUM recommends the use of MTBE be reduced in gasoline sold in the Northeast region. To maintain public health benefits of the reformulated gasoline program while reducing the

adverse impacts of MTBE on water resources, NESCAUM outlines a multi-component strategy that includes regulatory initiatives, rigorous scientific assessment of MTBE alternatives, and public education and outreach.

NESCAUM proposed a three year phase-down and cap on MTBE by elimination of the 2 percent, by weight, oxygen mandate in the Clean Air Act and regulatory action to clarify the authority of EPA and states to regulate fuel additives. Additionally, NESCAUM recommends that EPA seek regulatory revisions to prevent "backsliding" of toxic emission reductions currently afforded by the use of MTBE. NESCAUM believes a federal solution is warranted and optimal because the reformulated gasoline program is a federal initiative. In absence of an appropriate federal response, NESCAUM recommends a regional solution be pursued in the Northeast.

Coinciding with the phase down of MTBE, NESCAUM recommends a regional assessment of opportunities to enhance gasoline storage tank programs. Efforts should be directed at expanding the program to include smaller underground tanks and above ground tanks and enhancing monitoring and enforcement activities. NESCAUM also recommends that a more timely and complete scientific assessment be performed on MTBE alternatives before they are introduced for wide scale use. The evaluation should include testing to determine the impact of the additive on public health and the environment as well as refinery modeling to analyze the effect on fuel supply and cost. Finally, NESCAUM recommends that public education and outreach program be expanded on the proper handling of gasoline to reduce small commercial and residential gasoline spills.

7.3 NORTHEAST REGIONAL FUELS TASK FORCE

In November 1999, NESCAUM established the Northeast RFG/MTBE Task Force to oversee and coordinate implementation of the action plan outlined in their August 1999 report. To effectively address the wide array of issues surrounding MTBE, NESCAUM solicited membership from each of the Northeast states, encouraging participation from Air, Water, and Waste (Underground Storage Tank) divisions as well as state Departments of Public Health. At the request of several participating states, the mission of the Task Force was expanded to include *all* issues concerning the quality of gasoline and diesel fuels in the region and the group was renamed the Northeast Regional Fuels Task Force. The State of Connecticut has taken a lead role in this effort by electing to have the Department's Chief of the Air Management Bureau serve as co-chairman of the Task Force.

The Task Force held its first meeting on December 16th and 17th, 1999. The two primary objectives of the meeting were to develop a preliminary workplan for the Task Force and meet with representatives from the oil industry and the EPA to share information, discuss issues, and clarify positions regarding the role of MTBE in gasoline. From this meeting, the following objectives were developed for the Task Force:

- Maximize the air quality and public health benefits of reformulated gasoline;
- Reduce the amount of MTBE in the gasoline supply to protect water resources;
- Promote a regionally consistent clean fuels program; and
- Minimize impact of fuel quality changes on gasoline supply and price.

To achieve these objectives, the Task Force determined the following principles are needed for effective legislation:

- Lift the 2 percent oxygen mandate for reformulated gasoline in the Clean Air Act;
- Phase down and cap MTBE content in gasoline at pre-reformulated gasoline levels;
- Maintain the toxic emission reduction benefits achieved by the federal reformulated gasoline program;
- Clarify state and federal authority to regulate MTBE to protect public health and/or the environment;
- Promote consistency through federal action while providing states with measured authority to act independently upon a demonstration that further reductions in MTBE are needed to protect water resources; and
- Provide adequate lead time to minimize supply disruptions and price spikes

The Task Force generally supports recently proposed federal legislation by Rep. Greenwood from Pennsylvania, H.R. 3449, that addresses all of the above principles. A summary of this bill is provided in section 8.1 of this report. Because the reformulated gasoline program is a federal initiative, the Task Force believes a federal solution is warranted and optimal. In the event a federal "fix" does not come to fruition, the Task Force is also pursuing a strategy that would enable states to reduce and cap MTBE usage while still complying with the oxygen mandate for reformulated gasoline.

In the interest of developing a larger and stronger unified effort, the Task Force was recently expanded to include mid-Atlantic states. The Task Force is currently comprised of members from the New England states, New York, New Jersey, Pennsylvania, Maryland, Delaware, Virginia, West Virginia, and Washington D.C.

7.4 PUBLIC OUTREACH

Both NESCAUM and EPA's Blue Ribbon Panel recognize that small-scale gasoline spills account for a significant portion of the total gasoline accidentally released into the environment every year. These spills, caused mainly by consumers and small businesses, are the result of improper handling of gasoline at gas station pumps, during transport, and while refueling small engines found in lawn/garden equipment and non-road recreational vehicles such as boats and snowmobiles. Even small spills can produce adverse environmental effects, including air, water, and soil contamination. Because MTBE is present in high concentrations in reformulated gasoline and is more water soluble and resistant to biodegradation than other gasoline constituents, small surface spills (less than 10 gallons) can cause MTBE contamination of groundwater and wells.

Concurrent with the release of the Blue Ribbon Panel report, The Alliance for Proper Gasoline Handling, a consortium of public and private sectors, announced a new campaign called "Gas Care" aimed at increasing public awareness of consumers and small businesses about the proper handling of gasoline. The goal of the campaign is "… to help reduce the significant environmental harm caused by millions of small accidental gasoline spills that occur every year." Members of the alliance include public agencies such as USEPA, NESCAUM, California Air Resources Board, and other government agencies as well as private interests ranging from the gasoline producers, fuel associations, and equipment manufacturers.

The following specific goals were outlined for the program:

- Educate the public about the proper handling and care of gasoline, focusing mainly on non-road applications;
- Promote a unified environmental commitment from all parties involved through a coordinated message and outreach effort;
- Enable participating companies to promote the message of the alliance within the framework of their existing marketing strategies; and
- Provide public motivation to handle gasoline responsibly and realize the consequences of improper use.

8.0 RECENT REGULATORY ACTIVITY REGARDING MTBE USE

8.1 FEDERAL LEGISLATIVE ACTIVITY

Recent studies by EPA's Blue Ribbon Panel and NESCAUM indicate that reducing MTBE use is complicated by the Clean Air Act requirement that reformulated gasoline contain at least 2 percent oxygen, by weight. Consequently, in the past year, there have been a number of federal bills introduced aimed at changing this provision. California legislators have been interested in a California-only fix while others are interested in provisions to support renewable fuels, such as ethanol. At this time, the federal debate continues without a consensus on how to provide states with the necessary flexibility to address concerns related to MTBE groundwater contamination. Although the approach and timeline is uncertain, a federal change in the fuel requirements is likely.

The following is a summary of two MTBE bills recently introduced in Congress that have gained national attention:

- **H.R. 3449** - Introduced by Rep. Greenwood of Pennsylvania, this bill has received strong interest on the part of the Northeast Regional Fuels Task Force since it addresses the major issues outlined in NESCAUM's RFG/MTBE Findings and Recommendations. This bill contains provisions for waiving the 2 percent oxygen requirement in reformulated gasoline, reducing the maximum allowable concentration of MTBE to 5 percent (by volume) for all gasolines by January 2005, and raising the reformulated gasoline air toxics emission reduction requirement to 27 percent to preserve the existing air quality benefits provided by use of oxygenates. The bill also contains a provision to allow states the flexibility to further reduce the MTBE content in gasoline if it can be demonstrated that such a measure is necessary to protect human health or the environment. To ensure continued supply and price stability for reformulated gasoline, the bill states that reasonable schedules should be set for the phase-in of these revisions to allow refineries to make the necessary investments and changes to infrastructure.

- **S. 1886** – This bill was introduced by Sen. Inhofe of Oklahoma and co-sponsored by Sen. Feinstein of California and Sen. Smith of New Hampshire. The bill contains provisions to permit states to waive the oxygenate requirement and encourage development of voluntary standards to prevent and control releases of MTBE from underground storage tanks. While states will be able to opt out of the oxygenate requirement, all other existing provisions of the reformulated gasoline program would still apply. The bill authorizes EPA to study whether gasoline distributors should adopt voluntary standards to prevent gasoline leaks from underground storage tanks.

8.2 STATE ACTIVITY

8.2.1 California

In March 1999, citing substantial threats to the groundwater and drinking water supplies, Governor Davis directed that MTBE be completely phased out of gasoline in California by the end of 2002. In October 1999, the state passed legislation (SB 989) which requires that MTBE no longer be sold in California gasoline by December 31, 2002. It is anticipated this action will be litigated by international opponents under the North American Free Trade Agreement (NAFTA).

During the summer of 1999, the California Air Resources Board (CARB) requested a waiver from the 2.0 percent oxygen requirement in the reformulated gasoline program using a provision from section 211(k)(2)(B) of the Clean Air Act. Under this section, EPA can grant a waiver if they believe "…compliance with such requirement would prevent or interfere with the attainment by the area of national primary ambient air quality standards". CARB has submitted an analysis showing that flexibility with the oxygen requirement would allow Phase 3 California reformulated gasoline to have greater NOx emission reductions than are possible under the existing oxygenate mandate. CARB claims that these additional NOx reductions are necessary in order to meet attainment goals in the Los Angeles area. Due to the complexity of the analyses, six months of data exchange between CARB and EPA were necessary to complete the application process. By mid-year 2000, EPA is expected to complete its assessment of whether the oxygen mandate prevents or interferes with NOx attainment in California, the critical factor in deciding whether to allow the waiver.

In December 1999, CARB finalized Phase 3 California reformulated gasoline standards that are to take effect January 1, 2003. The new fuel will contain no MTBE and requires more stringent standards for two major gasoline pollutants, sulfur and benzene. At the same time, the regulation relaxes fuel distillation standards (which affect how cleanly gasoline burns) and allows flexibility with RVP (fuel volatility) standards. Relaxing these standards will allow ethanol to replace MTBE in California gasoline in the event that the state cannot obtain a waiver from the federal oxygenate requirement.

8.2.2 Maine

In 1991 Maine voluntarily opted into the federal reformulated gasoline program for seven counties in the southern portion of the state. Unlike Connecticut, Maine was not required to implement the program under the Clean Air Act. In October 1998, Governor King sent a letter to EPA indicating the state's decision to opt out of the reformulated gasoline program. The decision was based on findings from a state Bureau of Health study that showed increased levels of MTBE in reformulated gasoline were statistically linked to increased risk of groundwater contamination. Although current levels of MTBE contamination were not an immediate threat to public health, the report raised concerns

about the continued impact of reformulated gasoline on groundwater quality. Maine decided to opt out of the reformulated gasoline program altogether based on a belief that state officials lacked the authority to regulate MTBE levels in gasoline while remaining in the program.

In February 1999, EPA approved Maine's request to opt out of the program provided that Maine: 1) identify an alternative control strategy to achieve equivalent VOC reductions of the RFG program; 2) establish a schedule for implementing the control strategy; and 3) submit an explanation regarding the impact on the State Implementation Plan for ozone.

To reduce VOC levels, the state chose to implement a low volatility conventional fuel program. For the seven former reformulated gasoline counties in Maine, the Reid Vapor Pressure (RVP) specification for gasoline was lowered to a maximum of 7.8 pounds per square inch (psi) for the period May 1 to September 15, 1999 summer ozone season. For the year 2000 and beyond, a RVP specification not to exceed 7.2 psi was established for the summer ozone season. According to EPA, 7.2 RVP fuel achieves VOC reductions equivalent to Phase I reformulated gasoline, but without any emission reductions of NOx and air toxics. Since the low RVP fuel has been introduced in southern Maine, fuel quality data suggest that MTBE levels in gasoline have been reduced by more than 85 percent. However, there was a corresponding 25 percent increase in aromatics, which are responsible for producing toxic air emissions.[33]

Based on meetings with the fuel industry, environmental organizations, and other state departments, Maine's Department of Environmental Protection recently re-evaluated their decision to implement 7.2 RVP gasoline for the year 2000 and beyond. According to Maine studies, 7.2 RVP fuel would be a "boutique" fuel in the sense that Maine would be the only state in the Northeast requiring it and the fuel would likely only be supplied by one refiner. Due to concerns about the non-competitiveness of 7.2 RVP fuel and the increased potential for supply shortfalls and price spikes, Maine decided that 7.8 RVP fuel should continue to be sold until a Northeast regional fuel could be defined. Maine is currently working with EPA to continue using 7.8 RVP gasoline and use other control options to replace the emission reductions that would have been achieved with the lower RVP fuel.

Overall, public concern over MTBE contamination of water supplies has abated since opting out of the reformulated gasoline program. In keeping with its commitment to maximize the public health and air quality benefits of the reformulated gasoline program, the state indicated a strong desire to rejoin the federal program, or adopt a regional cleaner burning gasoline, provided that the MTBE content of the fuel is reduced adequately.

[33] Data provided by State of Maine Department of Environmental Protection.

8.2.3 New Hampshire

In June 1999, the state legislature adopted Senate Bill 70, "An Act relative to prevention of MTBE contamination of drinking water and groundwater". The legislation was the result of concerns over MTBE contamination of groundwater, uncertainty of the health and environmental impacts of alternative clean fuel formulations, and the lack of state authority to regulate MTBE content in reformulated gasoline.

The legislation requires the commissioner of the Department of Environmental Services to request a "temporary" waiver from EPA from the federal reformulated gasoline program until January 1, 2002, reverting to conventional gasoline during the interim. Currently, four counties in southeastern New Hampshire are required to sell reformulated gasoline to comply with federal air quality requirements in the Clean Air Act. The state submitted the request for the waiver to EPA Region 1 in July 1999. The EPA regional office responded that such authority for a "temporary" waiver did not clearly exist and that the state did not provide a plan to replace the emission reductions required in the State Implementation Plan (SIP). Subsequently, a letter was sent by Governor Shaheen to Administrator Carol Browner of EPA in September 1999 requesting the "temporary" waiver. No response to this letter has been received from EPA at the time this report was issued.

Other requirements of the Senate Bill 70 include the study of MTBE alternatives, the continued monitoring of public and private drinking water supplies, and the adoption of primary and secondary drinking water standards and ambient groundwater quality standards to protect public health. In January 2000, the state lowered its primary drinking water standard for MTBE from 70 µg/l to 13 µg/l based on a review of scientific record and computer modeling of laboratory animal studies. A secondary drinking water standard for MTBE was established at 20 µg/l to protect the public against unacceptable taste and odors from MTBE. Because all groundwater in the state is considered potential drinking water, the ambient groundwater quality standard for MTBE was also set at 13 µg/l.

8.2.4 New York

In November 1999, Governor Pataki directed the State Department of Environmental Protection and State Department of Health to lower the surface, ground, and drinking water standard for MTBE from 50 µg/l to 10 µg/l. Taking effect in December 1999, New York's new standard for MTBE became the most stringent in the nation. According to state legislators, the move to lower the MTBE standard was driven by concerns about MTBE contamination of state water resources and the associated public health risks.

8.2.5 Illinois

On December 15, 1999 the Chicago City Council approved a resolution calling on state and federal agencies to ban the use of MTBE as a gasoline additive in the city of Chicago. This measure will allow Chicago to maintain its current federal ethanol-blended reformulated gasoline program. There were concerns that when Phase II of the reformulated gasoline program (with its more stringent VOC reductions) became effective on January 1, 2000, refiners would have difficulty continuing to blend ethanol without using expensive, low volatility blendstocks and might begin using MTBE instead.

On December 30, 1999, Governor George Ryan sent letters to Vice President Al Gore and EPA Administrator Carol Browner requesting to delay implementation of the Phase II reformulated gasoline program because it could adversely affect the Illinois' ethanol industry. The letter cited concerns that gasoline containing 10 percent ethanol, by volume, would not meet VOC reductions required by the Phase II program during summer months. The letter states that if refiners are forced to replace ethanol with MTBE during the summer months, state corn farmers may lose up to $13 million per year.

8.2.6 Iowa

Iowa passed legislation in 1999 (HF 772) that caps the amount of MTBE used in gasoline at 2 percent by volume. Because neither oxygenated fuels nor reformulated gasoline are required in Iowa, MTBE was primarily being used in gasoline as an octane boosting additive.

8.2.7 Arizona

The Arizona Department of Environmental Quality (DEQ) recently issued a report stating that it will not move to eliminate MTBE from gasoline despite detections of the oxygenate in state groundwater. Instead, DEQ will focus on efforts to protect groundwater from MTBE contamination through stricter enforcement of storage tank laws. The report also calls for more comprehensive monitoring of storage tanks and prioritization of clean up efforts where contamination has occurred.

9.0 RECOMMENDATIONS REGARDING THE CONTINUED USE OF MTBE AS A GASOLINE ADDITIVE

MTBE possesses an unusual dynamic with respect to the environment and public health; its use as an additive in reformulated gasoline is providing considerable air quality benefits, while at the same time causing significant contamination of water supplies in the state of Connecticut. Due to concerns about the widespread impact of MTBE on state water resources, the Connecticut Department of Environmental Protection supports the consensus recommendation that MTBE use as a gasoline additive be substantially reduced and capped. As evidenced by substantial study, there is no easy solution to this complex and rapidly evolving issue.

Fuel supply and distribution is predicated on a regional and national framework such that Connecticut, alone, cannot efficiently and effectively regulate fuel. Because the reformulated gasoline program is a product of federal law, a federal approach to reducing MTBE use is optimal and warranted. Indeed, numerous attempts were made in Congress during 1999 to amend the Clean Air Act to eliminate the 2 percent, by weight, oxygen mandate or outright ban MTBE from reformulated gasoline. However, these attempts to modify federal legislation have not yet resulted in any federal regulatory change. Although Congress could repeal the oxygen mandate, there has been a historical reluctance to open the Clean Air Act for amendments.

Presently, the only potential option for states in ozone non-attainment areas to reduce MTBE use is to obtain a waiver from the 2 percent oxygen mandate in the Clean Air Act under section 211(c)(3)(C). An analysis by the Connecticut Office of the Attorney General of the process to receive a waiver is presented as Appendix H. To obtain a waiver, the state must demonstrate that control or prohibition of a specific fuel or additive is necessary to meet National Ambient Air Quality Standards. Because MTBE has shown to provide many air quality benefits, such a conclusion is difficult, if not impossible to justify. Even California, with its unique air quality issues and vast resources in air pollution control and expertise, has been unable to obtain such a waiver from the oxygenate requirement to date.

Based on concerns regarding these substantial obstacles to reducing MTBE usage in gasoline, the Northeast Regional Fuels Task Force was recently formed. The goals of the Task Force are to maximize the air quality and public health benefits of the reformulated gasoline program, reduce and cap the amount of MTBE in gasoline to protect water resources, promote a clean fuels program that is consistent throughout the Northeast region, and minimize the impact of fuel quality changes on gasoline supply and price. The Task Force believes that a federal solution is the most appropriate course of action and generally supports legislation, such as the bill by Rep. Greenwood from Pennsylvania, that is consistent with their goals.

Based on the findings of this report, the Department makes the following recommendations concerning the use of MTBE as a gasoline additive:

- The state should participate in a regional effort with northeastern states, industry, and other interested parties to find a feasible alternative to MTBE. Such replacement must be carefully evaluated to ensure that it is a feasible alternative. A feasible alternative must yield equivalent air quality benefits with a much lesser impact on water quality, and be readily available at a reasonable cost.

- The concentration of MTBE in gasoline should be reduced to lessen the adverse affects on ground water resources as soon as it is feasible to do so while remaining in compliance with the Clean Air Act Amendments. The state should, working through the Northeast Regional Fuels Task Force, support federal legislation that would be necessary to accomplish such reductions.

- To further protect ground water resources and drinking water supplies from gasoline contamination, the Department should reevaluate the state underground storage tank (UST) program regulations to determine whether additional spill and leak detection measures can be incorporated. To decrease the contamination threat posed by leaking underground storage tanks, serious consideration should be given to providing resources to fund additional positions in the underground storage tank enforcement program to increase Connecticut's inspection and enforcement capabilities.

- All gasoline retailers should be required to provide information concerning the proper storage, handling, and use of gasoline to the general public to lessen the environmental impact of accidental small spills and leaks. This program should be funded by the petroleum industry.

- The Department should proceed with promulgation of regulations required by Section 22a-354i of the Connecticut General Statues for land use controls in Aquifer Protection Areas. The regulation, as presently proposed, would prohibit the installation of new underground gasoline storage tanks near large public water supply wells in sand and gravel aquifer systems (roughly estimated to include 2 percent of Connecticut)

APPENDIX A

Special Act No. 99-14
An Act Concerning the Use of MTBE as a Gasoline Additive.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

The Commissioner of Environmental Protection shall consider the implications of the use of methyl tertiary butyl ether (MTBE) as a gasoline additive in this state as a means of meeting the requirements of the federal Clean Air Act and the regulations adopted as a result of the act and, on or before February 1, 2000, shall report to the joint standing committees of the General Assembly having cognizance of matters relating to public health and the environment recommending whether the continued use of MTBE is appropriate. Such report shall consider any reports and recommendations made by the Northeast States Commission for Coordinated Air Use Management and shall include (1) an analysis of whether the use of MTBE as a gasoline additive should be continued, and if necessary, an analysis of the process for seeking a waiver from the United States Environmental Protection Agency in order to discontinue the use of MTBE in this state, (2) an analysis of the effect of MTBE on the state's water supply, (3) an update on the status of any action taken by other states regarding the use of MTBE, and (4) specific recommendations on alternative or supplemental air pollution reduction programs such as alternative fuel vehicle incentives, mass transit and employee commute programs.

Approved June 23, 1999

APPENDIX B

SUMMARY OF FEDERAL FUEL PROGRAMS IN THE CLEAN AIR ACT

Wintertime Oxygenate Program

In carbon monoxide non-attainment areas designated by U.S. Environmental Protection Agency (EPA), the federal Clean Air Act mandates oxygenated gasoline during the time of year that high ambient /concentrations of carbon monoxide occur.[1] Under this provision, the Clean Air Act establishes a minimum oxygen content of 2.7 percent, by weight, in all gasoline sold or dispensed. Because Connecticut had two such designated carbon monoxide non-attainment areas, an oxygenated gasoline program was established through the adoption of §22a-174-28 of the Regulations of Connecticut State Agencies (RCSA). This regulation went into effect in the Hartford-Middletown-New Britain (Central) and Southwestern Connecticut areas the winter of 1992/1993. To meet the 2.7 weight percent oxygen requirement, gasoline sold in Connecticut during the winter months contained either 15 percent MTBE or a minimum of 7.5 percent ethanol, by volume. During the time this program was in effect, approximately 95 percent of the oxygenated fuels sold in Connecticut contained MTBE.[2]

What is Carbon Monoxide?

Carbon monoxide (CO) is a colorless, odorless, poisonous gas formed due to the incomplete combustion of carbon-containing fuels. Although it is by far the most plentiful air pollutant, CO is converted to carbon dioxide by natural processes in the atmosphere preventing buildup of high concentrations. Despite this, during winter months CO can reach dangerous levels in local areas with heavy auto traffic and little wind. CO affects the body when inhaled by replacing oxygen in red blood cells. The subsequent lack of oxygen at low concentrations can impair cognitive brain functions and reflexes. At higher concentrations, the lack of oxygen can affect the heart and even lead to death due to general asphyxiation.

The Connecticut Department of Environmental Protection's efforts to control carbon monoxide, in concert with federal fuel requirements, resulted in significant emission reductions and reductions in the ambient levels of carbon monoxide. By the 1993-1994 winter season, the oxygenated program was no longer necessary in the Central Control Area and, as of September 1999, the sale of oxygenated gasoline is no longer required in Southwestern Connecticut as a wintertime control measure. EPA has designated the entire State of Connecticut as in attainment for carbon monoxide, and, therefore, the state no longer has oxygenated fuel requirement for the control of carbon monoxide emissions.

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[1] See USC Title 42, sec. 7545(m) provided as Appendix C.

[2] Connecticut Department of Public Health, 1996, *Methyl Tertiary Butyl Ether (MTBE): A Review of Exposures and Potential Health Effects*, p. 3.

Phase I Reformulated Gasoline

Beginning January 1, 1995, the Clean Air Act required implementation of Phase I reformulated gasoline (RFG) programs in the nine worst ozone non-attainment areas in the country, including most of Connecticut. [3] The primary objective of reformulated gasoline is to reduce emissions of ozone-forming compounds, such as volatile organic compounds (VOCs) and oxides of nitrogen (NOx), and air toxics. Reformulated gasoline also reduces carbon monoxide emissions. The Clean Air Act requires that Phase I reformulated gasoline reduce emissions of VOCs by 17 percent, air toxics by 17 percent, and NOx by 1.5 percent when compared to 1990 nationwide baseline data.[4] To help meet these performance requirements, the federal law mandates that reformulated gasoline contain a minimum oxygen content of 2.0 percent, by weight, year round. To meet the oxygen requirement of reformulated gasoline, gasoline typically contains either 11 percent MTBE or 5.7 percent ethanol, by volume. In areas where the wintertime oxygenated program is in effect, reformulated gasoline must continue to meet the minimum 2.7 weight percent oxygen requirement during the applicable control period. Figure 1 compares the oxygen requirements between oxygenated and reformulated gasoline and the amounts of MTBE or ethanol that are used to satisfy the oxygen requirements. Approximately 95 percent of the reformulated gasoline sold in Connecticut contains MTBE as the oxygenate.[5]

What is Ozone?

Ozone is a highly reactive form of oxygen and is the principle component of smog. It is formed by chemical reactions of two primary components of automobile exhaust, VOCs and NOx, in the presence of sunlight. Because ozone formation is highly dependant on air temperature, high ambient concentrations of ozone are typically only a problem during summer months. Ozone irritates the mucous membranes of the respiratory system, causing coughing, choking, and impaired lung function. It aggravates chronic respiratory diseases such as asthma and bronchitis and is believed capable of hastening death of persons in already weakened health.

What are Air Toxics?

Benzene, 1,3-butadiene, polycyclic organic matter (POM), acetaldehyde, and formaldehyde are the five toxic air pollutants regulated under the reformulated gasoline program. Benzene is a known human carcinogen while the other four are classified as probable human carcinogens. Because benzene is a component of gasoline, emissions occur not only due to incomplete combustion, but also through the evaporation of unburned gasoline. Acetaldehyde, formaldehyde, and 1,3-butadiene are not present in fuel but are by-products of incomplete combustion. Acetaldehyde and formaldehyde are also formed through chemical reactions of other pollutants in the atmosphere.

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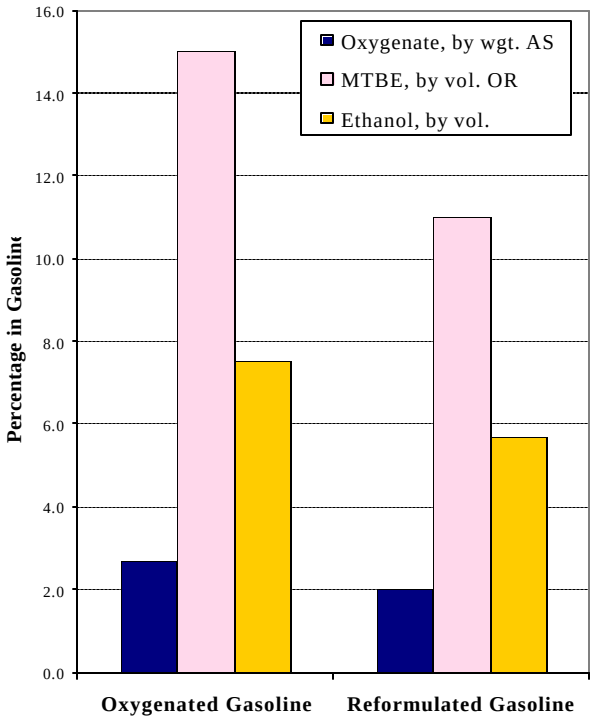
[3] USC Title 42, section 7545(k) provided as Appendix C.

[4] In practice, actual emission reductions in the Northeast are estimated to be 21 % for VOCs, 5% for NOx, and 35% for Air Toxics. National Blue Ribbon Panel on Oxygenates in Gasoline, 1999, *Achieving Clean Air and Clean Water*, p. 24.

[5] Connecticut Department of Public Health, 1996, *supra* note 2, p. 3.

States not specifically required by their ozone non-attainment status for inclusion in the federal reformulated gasoline program may opt voluntarily into the program. States such as Maine fit this category and consequently had the ability to opt back out of the program. Connecticut, on the other hand, is under different legal constraints because of our ozone non-attainment status. Reformulated gasoline is required in all but the furthest eastern and northwestern portions of the state. In an October 28, 1991 letter to EPA, Governor Weicker opted all of Connecticut into the reformulated gasoline program to simplify gasoline distribution throughout the state, requiring the same fuel to be sold statewide. This action also provided additional air quality benefits which were included in attainment planning and demonstrations.

Figure 1
Comparison of Gasolines and Oxygenates



Seventeen states and the District of Columbia have participated in the Phase I reformulated gasoline program from 1995 through 1999, representing about 30 percent of the total gasoline sold in the country. According to EPA, ozone forming emissions from automobiles have been reduced by 64,000 tons per year (equivalent to removing 10 million cars that burn conventional gasoline from the road). Benzene, a known cancer causing compound, has been reduced by 43 percent as a result of the program.[6] According to a study performed by Northeast States for Coordinated Air Use Management (NESCAUM), reformulated gasoline sold in the Northeast in 1996 reduced the cancer risk associated with exposure to automobile emissions by approximately 12 percent compared to conventional gasoline.[7]

[6] EPA 420-F-99-042, 1999, *Phase II Reformulated Gasoline: The Next Major Step Toward Clean Air*.
[7] NESCAUM, 1998, *Relative Cancer Risk of Reformulated Gasoline and Conventional Gasoline Sold in the Northeast*, p. ES-6.

Phase II Reformulated Gasoline

Beginning January 1, 2000, the Clean Air Act requires a second phase of the reformulated gasoline program to replace Phase I in areas of continued non-compliance for the ozone National Ambient Air Quality Standard. This includes the entire state of Connecticut. The Phase II program requires emission reductions of VOCs by 27 percent, air toxics by 22 percent, and NOx by 6.8 percent when compared to 1990 baseline levels. Phase II also requires the same 2.0 percent, by weight, oxygen mandate required for the Phase I reformulated gasoline program. Because the oxygenate requirement remains unchanged, it is not anticipated that the concentration of MTBE in reformulated gasoline will increase as a result of the Phase II program.

According to EPA, the Phase II program will improve air quality beyond Phase I levels by removing an additional 41,000 tons of ozone forming pollutants per day (equivalent to removing 6 million cars that burn conventional gasoline from the road). NESCAUM projects Phase II reformulated gasoline will provide a 20 percent reduction in the relative cancer risk associated with exposure to automobile emissions compared to conventional gasoline.[8]

[8] NESCAUM, 1998, *Relative Cancer Risk of Reformulated Gasoline and Conventional Gasoline Sold in the Northeast*, p. ES-6.

APPENDIX C

CLEAN AIR ACT FUEL REQUIREMENTS

From the U.S. Code Online via GPO Access
Laws in effect as of January 6, 1997]
[Document not affected by Public Laws enacted between January 6, 1997 and November 30, 1998]
[CITE: **42USC7545**]

TITLE 42--THE PUBLIC HEALTH AND WELFARE
CHAPTER 85--AIR POLLUTION PREVENTION AND CONTROL
SUBCHAPTER II--EMISSION STANDARDS FOR MOVING SOURCES
Part A--Motor Vehicle Emission and Fuel Standards

Sec. 7545. Regulation of fuels
(a) Authority of Administrator to regulate
The Administrator may by regulation designate any fuel or fuel additive (including any fuel or fuel additive used exclusively in nonroad engines or nonroad vehicles) and, after such date or dates as may be prescribed by him, no manufacturer or processor of any such fuel or additive may sell, offer for sale, or introduce into commerce such fuel or additive unless the Administrator has registered such fuel or additive in accordance with subsection (b) of this section.

(b) Registration requirement
(1) For the purpose of registration of fuels and fuel additives, the Administrator shall require-- (A) the manufacturer of any fuel to notify him as to the commercial identifying name and manufacturer of any additive contained in such fuel; the range of concentration of any additive in the fuel; and the purpose-in-use of any such additive; and (B) the manufacturer of any additive to notify him as to the chemical composition of such additive. (2) For the purpose of registration of fuels and fuel additives, the Administrator may also require the manufacturer of any fuel or fuel additive-- (A) to conduct tests to determine potential public health effects of such fuel or additive (including, but not limited to, carcinogenic, teratogenic, or mutagenic effects), and (B) to furnish the description of any analytical technique that can be used to detect and measure any additive in such fuel, the recommended range of concentration of such additive, and the recommended purpose-in-use of such additive, and such other information as is reasonable and necessary to determine the emissions resulting from the use of the fuel or additive contained in such fuel, the effect of such fuel or additive on the emission control performance of any vehicle, vehicle engine, nonroad engine or nonroad vehicle, or the extent to which such emissions affect the public health or welfare.Tests under subparagraph (A) shall be conducted in conformity with test procedures and protocols established by the Administrator. The result of such tests shall not be considered confidential. (3) Upon compliance with the provision of this subsection, including

assurances that the Administrator will receive changes in the information required, the Administrator shall register such fuel or fuel additive.

(c) Offending fuels and fuel additives; control; prohibition
(1) The Administrator may, from time to time on the basis of information obtained under subsection (b) of this section or other information available to him, by regulation, control or prohibit the manufacture, introduction into commerce, offering for sale, or sale of any fuel or fuel additive for use in a motor vehicle, motor vehicle engine, or nonroad engine or nonroad vehicle (A) if in the judgment of the Administrator any emission product of such fuel or fuel additive causes, or contributes, to air pollution which may reasonably be anticipated to endanger the public health or welfare, or (B) if emission products of such fuel or fuel additive will impair to a significant degree the performance of any emission control device or system which is in general use, or which the Administrator finds has been developed to a point where in a reasonable time it would be in general use were such regulation to be promulgated. (2)(A) No fuel, class of fuels, or fuel additive may be controlled or prohibited by the Administrator pursuant to clause (A) of paragraph (1) except after consideration of all relevant medical and scientific evidence available to him, including consideration of other technologically or economically feasible means of achieving emission standards under section 7521 of this title. (B) No fuel or fuel additive may be controlled or prohibited by the Administrator pursuant to clause (B) of paragraph (1) except after consideration of available scientific and economic data, including a cost benefit analysis comparing emission control devices or systems which are or will be in general use and require the proposed control or prohibition with emission control devices or systems which are or will be in general use and do not require the proposed control or prohibition. On request of a manufacturer of motor vehicles, motor vehicle engines, fuels, or fuel additives submitted within 10 days of notice of proposed rulemaking, the Administrator shall hold a public hearing and publish findings with respect to any matter he is required to consider under this subparagraph. Such findings shall be published at the time of promulgation of final regulations. (C) No fuel or fuel additive may be prohibited by the Administrator under paragraph (1) unless he finds, and publishes such finding, that in his judgment such prohibition will not cause the use of any other fuel or fuel additive which will produce emissions which will endanger the public health or welfare to the same or greater degree than the use of the fuel or fuel additive proposed to be prohibited. (3)(A) For the purpose of obtaining evidence and data to carry out paragraph (2), the Administrator may require the manufacturer of any motor vehicle or motor vehicle engine to furnish any information which has been developed concerning the emissions from motor vehicles resulting from the use of any fuel or fuel additive, or the effect of such use on the performance of any emission control device or system. (B) In obtaining information under subparagraph (A), section 7607(a) of this title (relating to subpenas) shall be applicable. (4)(A) Except as otherwise provided in subparagraph (B) or (C), no State (or political subdivision thereof) may prescribe or attempt to enforce, for purposes of motor vehicle emission control, any control or prohibition respecting any characteristic or component of a fuel or fuel additive in a motor vehicle or motor vehicle engine-- (i) if the Administrator has found that no control or prohibition of the characteristic or component of a fuel or fuel additive under paragraph (1) is necessary and has published his finding in the Federal Register, or (ii) if the Administrator has prescribed under paragraph (1) a control or prohibition applicable to such characteristic or component of a fuel or fuel additive, unless State prohibition or control is identical to the prohibition or control prescribed by the Administrator. (B) Any State for which

application of section 7543(a) of this title has at any time been waived under section 7543(b) of this title may at any time prescribe and enforce, for the purpose of motor vehicle emission control, a control or prohibition respecting any fuel or fuel additive. (C) A State may prescribe and enforce, for purposes of motor vehicle emission control, a control or prohibition respecting the use of a fuel or fuel additive in a motor vehicle or motor vehicle engine if an applicable implementation plan for such State under section 7410 of this title so provides. The Administrator may approve such provision in an implementation plan, or promulgate an implementation plan containing such a provision, only if he finds that the State control or prohibition is necessary to achieve the national primary or secondary ambient air quality standard which the plan implements. The Administrator may find that a State control or prohibition is necessary to achieve that standard if no other measures that would bring about timely attainment exist, or if other measures exist and are technically possible to implement, but are unreasonable or impracticable. The Administrator may make a finding of necessity under this subparagraph even if the plan for the area does not contain an approved demonstration of timely attainment.

(d) Penalties and injunctions
(1)Civil penalties Any person who violates subsection (a), (f), (g), (k), (l), (m), or (n) of this section or the regulations prescribed under subsection (c), (h), (i), (k), (l), (m), or (n) of this section or who fails to furnish any information or conduct any tests required by the Administrator under subsection (b) of this section shall be liable to the United States for a civil penalty of not more than the sum of $25,000 for every day of such violation and the amount of economic benefit or savings resulting from the violation. Any violation with respect to a regulation prescribed under subsection (c), (k), (l), or (m) of this section which establishes a regulatory standard based upon a multiday averaging period shall constitute a separate day of violation for each and every day in the averaging period. Civil penalties shall be assessed in accordance with subsections (b) and (c) of section 7524 of this title.
(2) Injunctive authority The district courts of the United States shall have jurisdiction to restrain violations of subsections (a), (f), (g), (k), (l), (m), and (n) of this section and of the regulations prescribed under subsections (c), (h), (i), (k), (l), (m), and (n) of this section, to award other appropriate relief, and to compel the furnishing of information and the conduct of tests required by the Administrator under subsection (b) of this section. Actions to restrain such violations and compel such actions shall be brought by and in the name of the United States. In any such action, subpoenas for witnesses who are required to attend a district court in any district may run into any other district.

(e) Testing of fuels and fuel additives
(1) Not later than one year after August 7, 1977, and after notice and opportunity for a public hearing, the Administrator shall promulgate regulations which implement the authority under subsection (b)(2)(A) and (B) of this section with respect to each fuel or fuel additive which is registered on the date of promulgation of such regulations and with respect to each fuel or fuel additive for which an application for registration is filed thereafter. (2) Regulations under subsection (b) of this section to carry out this subsection shall require that the requisite information be provided to the Administrator by each such manufacturer-- (A) prior to registration, in the case of any fuel or fuel additive which is not registered on the date of promulgation of such regulations; or (B) not later than three years after the date of promulgation

of such regulations, in the case of any fuel or fuel additive which is registered on such date. (3) In promulgating such regulations, the Administrator may-- (A) exempt any small business (as defined in such regulations) from or defer or modify the requirements of, such regulations with respect to any such small business; (B) provide for cost-sharing with respect to the testing of any fuel or fuel additive which is manufactured or processed by two or more persons or otherwise provide for shared responsibility to meet the requirements of this section without duplication; or (C) exempt any person from such regulations with respect to a particular fuel or fuel additive upon a finding that any additional testing of such fuel or fuel additive would be duplicative of adequate existing testing.

(f) New fuels and fuel additives

(1)(A) Effective upon March 31, 1977, it shall be unlawful for any manufacturer of any fuel or fuel additive to first introduce into commerce, or to increase the concentration in use of, any fuel or fuel additive for general use in light duty motor vehicles manufactured after model year 1974 which is not substantially similar to any fuel or fuel additive utilized in the certification of any model year 1975, or subsequent model year, vehicle or engine under section 7525 of this title. (B) Effective upon November 15, 1990, it shall be unlawful for any manufacturer of any fuel or fuel additive to first introduce into commerce, or to increase the concentration in use of, any fuel or fuel additive for use by any person in motor vehicles manufactured after model year 1974 which is not substantially similar to any fuel or fuel additive utilized in the certification of any model year 1975, or subsequent model year, vehicle or engine under section 7525 of this title. (2) Effective November 30, 1977, it shall be unlawful for any manufacturer of any fuel to introduce into commerce any gasoline which contains a concentration of manganese in excess of .0625 grams per gallon of fuel, except as otherwise provided pursuant to a waiver under paragraph (4). (3) Any manufacturer of any fuel or fuel additive which prior to March 31, 1977, and after January 1, 1974, first introduced into commerce or increased the concentration in use of a fuel or fuel additive that would otherwise have been prohibited under paragraph (1)(A) if introduced on or after March 31, 1977 shall, not later than September 15, 1978, cease to distribute such fuel or fuel additive in commerce. During the period beginning 180 days after August 7, 1977, and before September 15, 1978, the Administrator shall prohibit, or restrict the concentration of any fuel additive which he determines will cause or contribute to the failure of an emission control device or system (over the useful life of any vehicle in which such device or system is used) to achieve compliance by the vehicle with the emission standards with respect to which it has been certified under section 7525 of this title. (4) The Administrator, upon application of any manufacturer of any fuel or fuel additive, may waive the prohibitions established under paragraph (1) or (3) of this subsection or the limitation specified in paragraph (2) of this subsection, if he determines that the applicant has established that such fuel or fuel additive or a specified concentration thereof, and the emission products of such fuel or additive or specified concentration thereof, will not cause or contribute to a failure of any emission control device or system (over the useful life of any vehicle in which such device or system is used) to achieve compliance by the vehicle with the emission standards with respect to which it has been certified pursuant to section 7525 of this title. If the Administrator has not acted to grant or deny an application under this paragraph within one hundred and eighty days of receipt of such application, the waiver authorized by this paragraph shall be treated as granted. (5) No action of the Administrator under this section may be stayed by any court pending judicial review of such action.

(g) Misfueling

(1)No person shall introduce, or cause or allow the introduction of, leaded gasoline into any motor vehicle which is labeled ``unleaded gasoline only," which is equipped with a gasoline tank filler inlet designed for the introduction of unleaded gasoline, which is a 1990 or later model year motor vehicle, or which such person knows or should know is a vehicle designed solely for the use of unleaded gasoline. (2) Beginning October 1, 1993, no person shall introduce or cause or allow the introduction into any motor vehicle of diesel fuel which such person knows or should know contains a concentration of sulfur in excess of 0.05 percent (by weight) or which fails to meet a cetane index minimum of 40 or such equivalent alternative aromatic level as prescribed by the Administrator under subsection (i)(2) of this section.

(h) Reid Vapor Pressure requirements

(1)Prohibition Not later than 6 months after November 15, 1990, the Administrator shall promulgate regulations making it unlawful for any person during the high ozone season (as defined by the Administrator) to sell, offer for sale, dispense, supply, offer for supply, transport, or introduce into commerce gasoline with a Reid Vapor Pressure in excess of 9.0 pounds per square inch (psi). Such regulations shall also establish more stringent Reid Vapor Pressure standards in a nonattainment area as the Administrator finds necessary to generally achieve comparable evaporative emissions (on a per-vehicle basis) in nonattainment areas, taking into consideration the enforceability of such standards, the need of an area for emission control, and economic factors. (2) Attainment areas The regulations under this subsection shall not make it unlawful for any person to sell, offer for supply, transport, or introduce into commerce gasoline with a Reid Vapor Pressure of 9.0 pounds per square inch (psi) or lower in any area designated under section 7407 of this title as an attainment area. Notwithstanding the preceding sentence, the Administrator may impose a Reid vapor pressure requirement lower than 9.0 pounds per square inch (psi) in any area, formerly an ozone nonattainment area, which has been redesignated as an attainment area. (3) Effective date; enforcement The regulations under this subsection shall provide that the requirements of this subsection shall take effect not later than the high ozone season for 1992, and shall include such provisions as the Administrator determines are necessary to implement and enforce the requirements of this subsection. (4) Ethanol waiver For fuel blends containing gasoline and 10 percent denatured anhydrous ethanol, the Reid vapor pressure limitation under this subsection shall be one pound per square inch (psi) greater than the applicable Reid vapor pressure limitations established under paragraph (1); Provided, however, That a distributor, blender, marketer, reseller, carrier, retailer, or wholesale purchaser- consumer shall be deemed to be in full compliance with the provisions of this subsection and the regulations promulgated thereunder if it can demonstrate (by showing receipt of a certification or other evidence acceptable to the Administrator) that-- (A) the gasoline portion of the blend complies with the Reid vapor pressure limitations promulgated pursuant to this subsection; (B) the ethanol portion of the blend does not exceed its waiver condition under subsection (f)(4) of this section; and (C) no additional alcohol or other additive has been added to increase the Reid Vapor Pressure of the ethanol portion of the blend. (5) Areas covered The provisions of this subsection shall apply only to the 48 contiguous States and the District of Columbia.

(i) Sulfur content requirements for diesel fuel

(1)Effective October 1, 1993, no person shall manufacture, sell, supply, offer for sale or supply, dispense, transport, or introduce into commerce motor vehicle diesel fuel which contains a concentration of sulfur in excess of 0.05 percent (by weight) or which fails to meet a cetane index minimum of 40. (2) Not later than 12 months after November 15, 1990, the Administrator shall promulgate regulations to implement and enforce the requirements of paragraph (1). The Administrator may require manufacturers and importers of diesel fuel not intended for use in motor vehicles to dye such fuel in a particular manner in order to segregate it from motor vehicle diesel fuel. The Administrator may establish an equivalent alternative aromatic level to the cetane index specification in paragraph (1). (3) The sulfur content of fuel required to be used in the certification of 1991 through 1993 model year heavy-duty diesel vehicles and engines shall be 0.10 percent (by weight). The sulfur content and cetane index minimum of fuel required to be used in the certification of 1994 and later model year heavy-duty diesel vehicles and engines shall comply with the regulations promulgated under paragraph (2). (4) The States of Alaska and Hawaii may be exempted from the requirements of this subsection in the same manner as provided in section 7625 \1\ of this title. The Administrator shall take final action on any petition filed under section 7625 \1\ of this title or this paragraph for an exemption from the requirements of this subsection, within 12 months from the date of the petition.

\1\ So in original. Probably should be section ``7625-1".

(j) Lead substitute gasoline additives

(1)After November 15, 1990, any person proposing to register any gasoline additive under subsection (a) of this section or to use any previously registered additive as a lead substitute may also elect to register the additive as a lead substitute gasoline additive for reducing valve seat wear by providing the Administrator with such relevant information regarding product identity and composition as the Administrator deems necessary for carrying out the responsibilities of paragraph (2) of this subsection (in addition to other information which may be required under subsection (b) of this section). (2) In addition to the other testing which may be required under subsection (b) of this section, in the case of the lead substitute gasoline additives referred to in paragraph (1), the Administrator shall develop and publish a test procedure to determine the additives' effectiveness in reducing valve seat wear and the additives' tendencies to produce engine deposits and other adverse side effects. The test procedures shall be developed in cooperation with the Secretary of Agriculture and with the input of additive manufacturers, engine and engine components manufacturers, and other interested persons. The Administrator shall enter into arrangements with an independent laboratory to conduct tests of each additive using the test procedures developed and published pursuant to this paragraph. The Administrator shall publish the results of the tests by company and additive name in the Federal Register along with, for comparison purposes, the results of applying the same test procedures to gasoline containing 0.1 gram of lead per gallon in lieu of the lead substitute gasoline additive. The Administrator shall not rank or otherwise rate the lead substitute additives. Test procedures shall be established within 1 year after November 15, 1990. Additives shall be tested within 18 months of November 15, 1990, or 6 months after the lead substitute additives are identified to the Administrator, whichever is later. (3) The Administrator may impose a user fee to recover the costs of testing of any fuel additive referred to in this subsection. The fee shall be paid by the

person proposing to register the fuel additive concerned. Such fee shall not exceed $20,000 for a single fuel additive. (4) There are authorized to be appropriated to the Administrator not more than $1,000,000 for the second full fiscal year after November 15, 1990, to establish test procedures and conduct engine tests as provided in this subsection. Not more than $500,000 per year is authorized to be appropriated for each of the 5 subsequent fiscal years. (5) Any fees collected under this subsection shall be deposited in a special fund in the United States Treasury for licensing and other services which thereafter shall be available for appropriation, to remain available until expended, to carry out the Agency's activities for which the fees were collected.

(k) Reformulated gasoline for conventional vehicles
(1)EPA regulations Within 1 year after November 15, 1990, the Administrator shall promulgate regulations under this section establishing requirements for reformulated gasoline to be used in gasoline-fueled vehicles in specified nonattainment areas. Such regulations shall require the greatest reduction in emissions of ozone forming volatile organic compounds (during the high ozone season) and emissions of toxic air pollutants (during the entire year) achievable through the reformulation of conventional gasoline, taking into consideration the cost of achieving such emission reductions, any nonair-quality and other air-quality related health and environmental impacts and energy requirements. (2) General requirements The regulations referred to in paragraph (1) shall require that reformulated gasoline comply with paragraph (3) and with each of the following requirements (subject to paragraph (7)): (A) NOx emissions The emissions of oxides of nitrogen (NOx) from baseline vehicles when using the reformulated gasoline shall be no greater than the level of such emissions from such vehicles when using baseline gasoline. If the Administrator determines that compliance with the limitation on emissions of oxides of nitrogen under the preceding sentence is technically infeasible, considering the other requirements applicable under this subsection to such gasoline, the Administrator may, as appropriate to ensure compliance with this subparagraph, adjust (or waive entirely), any other requirements of this paragraph (including the oxygen content requirement contained in subparagraph (B)) or any requirements applicable under paragraph (3)(A). (B) Oxygen content 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 chapter. 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 the attainment by the area of a national primary ambient air quality standard. (C) Benzene content The benzene content of the gasoline shall not exceed 1.0 percent by volume. (D) Heavy metals The gasoline shall have no heavy metals, including lead or manganese. The Administrator may waive the prohibition contained in this subparagraph for a heavy metal (other than lead) if the Administrator determines that addition of the heavy metal to the gasoline will not increase, on an aggregate mass or cancer-risk basis, toxic air pollutant emissions from motor vehicles. (3) More stringent of formula or performance standards The regulations referred to in paragraph (1) shall require compliance with the more stringent of either the requirements set forth in subparagraph (A) or the requirements of subparagraph (B) of this paragraph. For purposes of determining the more stringent provision, clause (i) and clause (ii) of subparagraph (B) shall be considered independently. (A) Formula (i) Benzene The benzene content of the reformulated gasoline shall not exceed 1.0 percent by volume. (ii) Aromatics The aromatic hydrocarbon content of the reformulated gasoline shall not exceed 25 percent by volume. (iii) Lead The reformulated gasoline shall have no lead content.

(iv) Detergents The reformulated gasoline shall contain additives to prevent the accumulation of deposits in engines or vehicle fuel supply systems. (v) Oxygen content The oxygen content of the reformulated 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 chapter. (B) Performance standard (i) VOC emissions During the high ozone season (as defined by the Administrator), the aggregate emissions of ozone forming volatile organic compounds from baseline vehicles when using the reformulated gasoline shall be 15 percent below the aggregate emissions of ozone forming volatile organic compounds from such vehicles when using baseline gasoline. Effective in calendar year 2000 and thereafter, 25 percent shall be substituted for 15 percent in applying this clause, except that the Administrator may adjust such 25 percent requirement to provide for a lesser or greater reduction based on technological feasibility, considering the cost of achieving such reductions in VOC emissions. No such adjustment shall provide for less than a 20 percent reduction below the aggregate emissions of such air pollutants from such vehicles when using baseline gasoline. The reductions required under this clause shall be on a mass basis. (ii) Toxics During the entire year, the aggregate emissions of toxic air pollutants from baseline vehicles when using the reformulated gasoline shall be 15 percent below the aggregate emissions of toxic air pollutants from such vehicles when using baseline gasoline. Effective in calendar year 2000 and thereafter, 25 percent shall be substituted for 15 percent in applying this clause, except that the Administrator may adjust such 25 percent requirement to provide for a lesser or greater reduction based on technological feasibility, considering the cost of achieving such reductions in toxic air pollutants. No such adjustment shall provide for less than a 20 percent reduction below the aggregate emissions of such air pollutants from such vehicles when using baseline gasoline. The reductions required under this clause shall be on a mass basis. Any reduction greater than a specific percentage reduction required under this subparagraph shall be treated as satisfying such percentage reduction requirement. (4) Certification procedures (A) Regulations The regulations under this subsection shall include procedures under which the Administrator shall certify reformulated gasoline as complying with the requirements established pursuant to this subsection. Under such regulations, the Administrator shall establish procedures for any person to petition the Administrator to certify a fuel formulation, or slate of fuel formulations. Such procedures shall further require that the Administrator shall approve or deny such petition within 180 days of receipt. If the Administrator fails to act within such 180-day period, the fuel shall be deemed certified until the Administrator completes action on the petition. (B) Certification; equivalency The Administrator shall certify a fuel formulation or slate of fuel formulations as complying with this subsection if such fuel or fuels-- (i) comply with the requirements of paragraph (2), and (ii) achieve equivalent or greater reductions in emissions of ozone forming volatile organic compounds and emissions of toxic air pollutants than are achieved by a reformulated gasoline meeting the applicable requirements of paragraph (3). (C) EPA determination of emissions level Within 1 year after November 15, 1990, the Administrator shall determine the level of emissions of ozone forming volatile organic compounds and emissions of toxic air pollutants emitted by baseline vehicles when operating on baseline gasoline. For purposes of this subsection, within 1 year after November 15, 1990, the Administrator shall, by rule, determine appropriate measures of, and methodology for, ascertaining the emissions of air pollutants (including calculations, equipment, and testing tolerances). (5) Prohibition Effective beginning January 1, 1995, each of the following shall be a violation of this subsection: (A) The sale or dispensing by any person of conventional gasoline to ultimate consumers in any covered area. (B) The sale or dispensing by any refiner, blender, importer, or marketer of conventional

gasoline for resale in any covered area, without (i) segregating such gasoline from reformulated gasoline, and (ii) clearly marking such conventional gasoline as ``conventional gasoline, not for sale to ultimate consumer in a covered area''. Any refiner, blender, importer or marketer who purchases property segregated and marked conventional gasoline, and thereafter labels, represents, or wholesales such gasoline as reformulated gasoline shall also be in violation of this subsection. The Administrator may impose sampling, testing, and recordkeeping requirements upon any refiner, blender, importer, or marketer to prevent violations of this section. (6) Opt-in areas (A) Upon the application of the Governor of a State, the Administrator shall apply the prohibition set forth in paragraph (5) in any area in the State classified under subpart 2 of part D of subchapter I of this chapter as a Marginal, Moderate, Serious, or Severe Area (without regard to whether or not the 1980 population of the area exceeds 250,000). In any such case, the Administrator shall establish an effective date for such prohibition as he deems appropriate, not later than January 1, 1995, or 1 year after such application is received, whichever is later. The Administrator shall publish such application in the Federal Register upon receipt. (B) If the Administrator determines, on the Administrator's own motion or on petition of any person, after consultation with the Secretary of Energy, that there is insufficient domestic capacity to produce gasoline certified under this subsection, the Administrator shall, by rule, extend the effective date of such prohibition in Marginal, Moderate, Serious, or Severe Areas referred to in subparagraph (A) for one additional year, and may, by rule, renew such extension for 2 additional one-year periods. The Administrator shall act on any petition submitted under this paragraph within 6 months after receipt of the petition. The Administrator shall issue such extensions for areas with a lower ozone classification before issuing any such extension for areas with a higher classification. (7) Credits (A) The regulations promulgated under this subsection shall provide for the granting of an appropriate amount of credits to a person who refines, blends, or imports and certifies a gasoline or slate of gasoline that-- (i) has an oxygen content (by weight) that exceeds the minimum oxygen content specified in paragraph (2); (ii) has an aromatic hydrocarbon content (by volume) that is less than the maximum aromatic hydrocarbon content required to comply with paragraph (3); or (iii) has a benzene content (by volume) that is less than the maximum benzene content specified in paragraph (2). (B) The regulations described in subparagraph (A) shall also provide that a person who is granted credits may use such credits, or transfer all or a portion of such credits to another person for use within the same nonattainment area, for the purpose of complying with this subsection. (C) The regulations promulgated under subparagraphs (A) and (B) shall ensure the enforcement of the requirements for the issuance, application, and transfer of the credits. Such regulations shall prohibit the granting or transfer of such credits for use with respect to any gasoline in a nonattainment area, to the extent the use of such credits would result in any of the following: (i) An average gasoline aromatic hydrocarbon content (by volume) for the nonattainment (taking into account all gasoline sold for use in conventional gasoline-fueled vehicles in the nonattainment area) higher than the average fuel aromatic hydrocarbon content (by volume) that would occur in the absence of using any such credits. (ii) An average gasoline oxygen content (by weight) for the nonattainment area (taking into account all gasoline sold for use in conventional gasoline-fueled vehicles in the nonattainment area) lower than the average gasoline oxygen content (by weight) that would occur in the absence of using any such credits. (iii) An average benzene content (by volume) for the nonattainment area (taking into account all gasoline sold for use in conventional gasoline-fueled vehicles in the nonattainment area) higher than the average benzene content (by volume) that would occur in the absence of using any such credits. (8) Anti-dumping rules (A) In general

Within 1 year after November 15, 1990, the Administrator shall promulgate regulations applicable to each refiner, blender, or importer of gasoline ensuring that gasoline sold or introduced into commerce by such refiner, blender, or importer (other than reformulated gasoline subject to the requirements of paragraph (1)) does not result in average per gallon emissions (measured on a mass basis) of (i) volatile organic compounds, (ii) oxides of nitrogen, (iii) carbon monoxide, and (iv) toxic air pollutants in excess of such emissions of such pollutants attributable to gasoline sold or introduced into commerce in calendar year 1990 by that refiner, blender, or importer. Such regulations shall take effect beginning January 1, 1995. (B) Adjustments In evaluating compliance with the requirements of subparagraph (A), the Administrator shall make appropriate adjustments to insure that no credit is provided for improvement in motor vehicle emissions control in motor vehicles sold after the calendar year 1990. (C) Compliance determined for each pollutant independently In determining whether there is an increase in emissions in violation of the prohibition contained in subparagraph (A) the Administrator shall consider an increase in each air pollutant referred to in clauses (i) through (iv) as a separate violation of such prohibition, except that the Administrator shall promulgate regulations to provide that any increase in emissions of oxides of nitrogen resulting from adding oxygenates to gasoline may be offset by an equivalent or greater reduction (on a mass basis) in emissions of volatile organic compounds, carbon monoxide, or toxic air pollutants, or any combination of the foregoing. (D) Compliance period The Administrator shall promulgate an appropriate compliance period or appropriate compliance periods to be used for assessing compliance with the prohibition contained in subparagraph (A). (E) Baseline for determining compliance If the Administrator determines that no adequate and reliable data exists regarding the composition of gasoline sold or introduced into commerce by a refiner, blender, or importer in calendar year 1990, for such refiner, blender, or importer, baseline gasoline shall be substituted for such 1990 gasoline in determining compliance with subparagraph (A). (9) Emissions from entire vehicle In applying the requirements of this subsection, the Administrator shall take into account emissions from the entire motor vehicle, including evaporative, running, refueling, and exhaust emissions. (10) Definitions For purposes of this subsection-- (A) Baseline vehicles The term ``baseline vehicles" mean representative model year 1990 vehicles. (B) Baseline gasoline (i) Summertime The term ``baseline gasoline" means in the case of gasoline sold during the high ozone period (as defined by the Administrator) a gasoline which meets the following specifications:

BASELINE GASOLINE FUEL PROPERTIES	
API Gravity.....	57.4
Sulfur, ppm.....	339
Benzene, %.....	1.53
RVP, psi.....	8.7
Octane, R+M/2.....	87.3
IBP, F.....	91
10%, F.....	128
50%, F.....	218
90%, F.....	330
End Point, F.....	415
Aromatics, %.....	32.0
Olefins, %.....	9.2
Saturates, %.....	58.8

(ii) Wintertime The Administrator shall establish the specifications of ``baseline gasoline'' for gasoline sold at times other than the high ozone period (as defined by the Administrator). Such specifications shall be the specifications of 1990 industry average gasoline sold during such period. (C) Toxic air pollutants The term ``toxic air pollutants'' means the aggregate emissions of the following:

Benzene
1,3 Butadiene
Polycyclic organic matter (POM)
Acetaldehyde
Formaldehyde.

(D) Covered area The 9 ozone nonattainment areas having a 1980 population in excess of 250,000 and having the highest ozone design value during the period 1987 through 1989 shall be ``covered areas'' for purposes of this subsection. Effective one year after the reclassification of any ozone nonattainment area as a Severe ozone nonattainment area under section 7511(b) of this title, such Severe area shall also be a ``covered area'' for purposes of this subsection. (E) Reformulated gasoline The term ``reformulated gasoline'' means any gasoline which is certified by the Administrator under this section as complying with this subsection. (F) Conventional gasoline The term ``conventional gasoline'' means any gasoline which does not meet specifications set by a certification under this subsection.

(l) Detergents
Effective beginning January 1, 1995, no person may sell or dispense to an ultimate consumer in the United States, and no refiner or marketer may directly or indirectly sell or dispense to persons who sell or dispense to ultimate consumers in the United States any gasoline which does not contain additives to prevent the accumulation of deposits in engines or fuel supply systems. Not later than 2 years after November 15, 1990, the Administrator shall promulgate a rule establishing specifications for such additives.

(m) Oxygenated fuels
(1)Plan revisions for CO nonattainment areas (A) Each State in which there is located all or part of an area which is designated under subchapter I of this chapter as a nonattainment area for carbon monoxide and which has a carbon monoxide design value of 9.5 parts per million (ppm) or above based on data for the 2-year period of 1988 and 1989 and calculated according to the most recent interpretation methodology issued by the Administrator prior to November 15, 1990, shall submit to the Administrator a State implementation plan revision under section 7410 of this title and part D of subchapter I of this chapter for such area which shall contain the provisions specified under this subsection regarding oxygenated gasoline. (B) A plan revision which contains such provisions shall also be submitted by each State in which there is located any area which, for any 2-year period after 1989 has a carbon monoxide design value of 9.5 ppm or above. The revision shall be submitted within 18 months after such 2-year period. (2) Oxygenated gasoline in CO nonattainment areas Each plan revision under this subsection shall contain provisions to require that any gasoline sold, or dispensed, to the ultimate consumer in the carbon monoxide nonattainment area or sold or dispensed directly or indirectly by fuel refiners or marketers to persons who sell or dispense to ultimate consumers, in the larger of-- (A) the Consolidated Metropolitan Statistical Area (CMSA) in which the area is located, or (B) if the

area is not located in a CMSA, the Metropolitan Statistical Area in which the area is located, be blended, during the portion of the year in which the area is prone to high ambient concentrations of carbon monoxide to contain not less than 2.7 percent oxygen by weight (subject to a testing tolerance established by the Administrator). The portion of the year in which the area is prone to high ambient concentrations of carbon monoxide shall be as determined by the Administrator, but shall not be less than 4 months. At the request of a State with respect to any area designated as nonattainment for carbon monoxide, the Administrator may reduce the period specified in the preceding sentence if the State can demonstrate that because of meteorological conditions, a reduced period will assure that there will be no exceedances of the carbon monoxide standard outside of such reduced period. For areas with a carbon monoxide design value of 9.5 ppm or more of \2\ November 15, 1990, the revision shall provide that such requirement shall take effect no later than November 1, 1992 (or at such other date during 1992 as the Administrator establishes under the preceding provisions of this paragraph). For other areas, the revision shall provide that such requirement shall take effect no later than November 1 of the third year after the last year of the applicable 2-year period referred to in paragraph (1) (or at such other date during such third year as the Administrator establishes under the preceding provisions of this paragraph) and shall include a program for implementation and enforcement of the requirement consistent with guidance to be issued by the Administrator.

\2\ So in original. Probably should be ``as of".

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(3)Waivers (A) The Administrator shall waive, in whole or in part, the requirements of paragraph (2) upon a demonstration by the State to the satisfaction of the Administrator that the use of oxygenated gasoline would prevent or interfere with the attainment by the area of a national primary ambient air quality standard (or a State or local ambient air quality standard) for any air pollutant other than carbon monoxide. (B) The Administrator shall, upon demonstration by the State satisfactory to the Administrator, waive the requirement of paragraph (2) where the Administrator determines that mobile sources of carbon monoxide do not contribute significantly to carbon monoxide levels in an area. (C)(i) Any person may petition the Administrator to make a finding that there is, or is likely to be, for any area, an inadequate domestic supply of, or distribution capacity for, oxygenated gasoline meeting the requirements of paragraph (2) or fuel additives (oxygenates) necessary to meet such requirements. The Administrator shall act on such petition within 6 months after receipt of the petition. (ii) If the Administrator determines, in response to a petition under clause (i), that there is an inadequate supply or capacity described in clause (i), the Administrator shall delay the effective date of paragraph (2) for 1 year. Upon petition, the Administrator may extend such effective date for one additional year. No partial delay or lesser waiver may be granted under this clause. (iii) In granting waivers under this subparagraph the Administrator shall consider distribution capacity separately from the adequacy of domestic supply and shall grant such waivers in such manner as will assure that, if supplies of oxygenated gasoline are limited, areas having the highest design value for carbon monoxide will have a priority in obtaining oxygenated gasoline which meets the requirements of paragraph (2). (iv) As used in this subparagraph, the term distribution capacity includes capacity for transportation, storage, and blending. (4) Fuel dispensing systems Any person selling oxygenated gasoline at retail pursuant to this subsection shall be required under regulations promulgated by the Administrator to label the fuel dispensing system with a notice that the gasoline is

oxygenated and will reduce the carbon monoxide emissions from the motor vehicle. (5) Guidelines for credit The Administrator shall promulgate guidelines, within 9 months after November 15, 1990, allowing the use of marketable oxygen credits from gasolines during that portion of the year specified in paragraph (2) with higher oxygen content than required to offset the sale or use of gasoline with a lower oxygen content than required. No credits may be transferred between nonattainment areas. (6) Attainment areas Nothing in this subsection shall be interpreted as requiring an oxygenated gasoline program in an area which is in attainment for carbon monoxide, except that in a carbon monoxide nonattainment area which is redesignated as attainment for carbon monoxide, the requirements of this subsection shall remain in effect to the extent such program is necessary to maintain such standard thereafter in the area. (7) Failure to attain CO standard If the Administrator determines under section 7512(b)(2) of this title that the national primary ambient air quality standard for carbon monoxide has not been attained in a Serious Area by the applicable attainment date, the State shall submit a plan revision for the area within 9 months after the date of such determination. The plan revision shall provide that the minimum oxygen content of gasoline referred to in paragraph (2) shall be 3.1 percent by weight unless such requirement is waived in accordance with the provisions of this subsection.

(n) Prohibition on leaded gasoline for highway use
After December 31, 1995, it shall be unlawful for any person to sell, offer for sale, supply, offer for supply, dispense, transport, or introduce into commerce, for use as fuel in any motor vehicle (as defined in section 7554(2) \3\ of this title) any gasoline which contains lead or lead additives.

\3\ So in original. Probably should be section ``7550(2)".

(o) Fuel and fuel additive importers and importation
For the purposes of this section, the term ``manufacturer" includes an importer and the term ``manufacture" includes importation.

Findings and Sense of Congress on Ethanol Usage Pub. L. 100-203, title I, Sec. 1508, Dec. 22, 1987, 101 Stat. 1330-29, provided that: ``(a) Findings.--Congress finds that-- ``(1) the United States is dependent for a large and growing share of its energy needs on the Middle East at a time when world petroleum reserves are declining; ``(2) the burning of gasoline causes pollution; ``(3) ethanol can be blended with gasoline to produce a cleaner source of fuel; ``(4) ethanol can be produced from grain, a renewable resource that is in considerable surplus in the United States; ``(5) the conversion of grain into ethanol would reduce farm program costs and grain surpluses; and ``(6) increasing the quantity of motor fuels that contain at least 10 percent ethanol from current levels to 50 percent by 1992 would create thousands of new jobs in ethanol production facilities. ``(b) Sense of Congress.--It is the sense of Congress that the Administrator of the Environmental Protection Agency should use authority provided under the Clean Air Act (42 U.S.C. 7401 et seq.) to require greater use of ethanol as motor fuel."

APPENDIX D

Summary of DPH Derivation of MTBE Action Level

The Department of Pu blic Health, Division of Environmental Epidemiology and Occupational Health (EEOH) updated the Action Level for methyl tertiary-butyl ether (MTBE) in 1999. This revision is part of EEOH's ongoing effort to ensure that the Action Levels incorporate the latest toxicology and health risk information. Based upon EEOH's assessment of MTBE exposures and health risks, the Action Level was lowered from 100 ug/l to the current level, 70 ug/l. The Action Level was revised using standard risk assessment methods in which "no effect levels" in long-term animal studies are identified and then uncertainty or safety factors are applied to ensure that the general public cannot be exposed to unhealthy levels. The analysis also took into account other sources of MTBE exposure (e.g., in gas station during refueling) so that the total daily exposure is still below any effects threshold.

EEOH's assessment identified a 1990 study in rats (Robinson, et al., J.Am.Coll. Toxicol. 9:525-540) as key data for showing the dose response for MTBE toxicity in various organs and systems (nervous system, kidney, liver, blood) after 3 months of oral exposure. The effects were generally mild at the lower doses studied with a no effect level of 100 mg/kg/d demonstrated. This finding is consistent with other research in rats and mice by oral and inhalation exposure (Klan et al., 1992; Lington, et al., 1997; Bird et al., 1997) indicating that the 100 mg/kg/d no effect level is a useful point of departure for establishing an acceptable level of exposure in humans.

The no effect level was divided by a cumulative 1000 fold uncertainty factor which comprised of: 10x for extrapolation from a subchronic study to chronic human exposure; 10x for extrapolation from animals to humans; 10x to account for inter-individual differences in sensitivity between human receptors. The resulting dose (0.1 mg/kg/d) is the level to which humans can be exposed without risk of MTBE toxicity as described by Robinson et al. and other researchers. MTBE's potential to cause cancer was also brought into the analysis as described below.

The standard approach for setting drinking water criteria, as exemplified by USEPA's establishment of Maximum Contaminant Levels (MCLs), is to not allow all of the acceptable exposure to come from water ingestion, but to take into consideration other pathways through which humans can be exposed to the chemical. USEPA calls this factor the Relative Source Contribution (RSC), which represents the percentage of the total exposure that is expected to come from water ingestion as opposed to other sources. The RSC is multiplied by the acceptable daily dose (0.1 mg/kg/d in the case of MTBE) to lower the dose coming from water ingestion alone. This is intended to ensure that the total daily dose is kept at or below 0.1 mg/kg/d. The standard default RSC is 0.2 based upon the assumption that only 20% of the dose will come from water ingestion and 80% will come from other sources (e.g., exposure at gas stations, exposure in city air, exposure around the home from chemical that volatilizes from water). EEOH evaluated

whether this default RSC is appropriate for MTBE by calculating how much MTBE exposure is possible from each pathway. This exposure assessment found that the standard default factor of 0.2 is appropriate. Applying this factor to the acceptable exposure level of 0.1 mg/kg/d yields 0.02 mg/kg/d, which is the amount of MTBE daily exposure that can come from water ingestion.

Next, standard assumptions regarding water consumption (2 liters per day per 70 kg body weight) were used to convert the acceptable daily dose to a water concentration as follows:

$$\text{acceptable water concentration (ug/l)} = \frac{(0.02\ \text{mg/kg/d}) * (70\ \text{kg body wt.}) * (1000\ \text{ug/mg chemical})}{2\ \text{liters water ingestion/day}} = 700\ \text{ug/liter}$$

This water concentration is protective against MTBE's non-cancer toxic effects on kidney, liver, nervous system and blood. It is also intended to be protective of sensitive individuals and children since it includes a 10 fold uncertainty factor for this purpose. However, there is evidence that MTBE can produce cancer at high dose in rats and mice by inhalation (Bird, et al. J.Appl.Toxicol. 17: Suppl. 1, 45-56, 1997) and in rats by oral dosing (Belpoggi, et al., 1995). This evidence has been reviewed by numerous review panels [e.g., National Toxicology Program, the International Agency for Research on Cancer (IARC), California Proposition 65's Review Committee] which have decided that the relevance of the animal cancer studies to low dose human exposures to MTBE is uncertain. These panels have chosen not to consider MTBE as a likely human carcinogen. Rather than completely discount MTBE's animal cancer data, EEOH incorporated an additional 10 fold uncertainty factor for potential carcinogenicity to further lower the acceptable water concentration. This lowers the CTDPH Action Level to 70 ug/l, a level which takes into consideration both the cancer and non-cancer effects of MTBE. The uncertainty factor approach for addressing the MTBE cancer risk question has also been used by a number of other states.

The 70 ug/l Action Level is well below the water concentrations where MTBE has caused complaints of odor/taste or health symptoms in Connecticut, and is even further below the levels required to produce adverse effects in animal studies. Three different studies of human volunteers inhaling MTBE under controlled laboratory conditions (Cain et al., Inhalation Toxicol. 8:21-48, 1996; Prah, et al., Inhalation Toxicol. 6:521-538, 1994; Johansen, et al., Toxicol. Lett. 82/83: 713-718, 1995) confirm that MTBE is not highly toxic in humans and that 70 ug/l affords adequate protection.

APPENDIX E

REFORMULATED GASOLINE, OXYGENATES AND MOBILE SOURCE EMISSIONS

Mobile Source Emissions

An inventory of air pollution sources is taken by the Department every three years in areas of non-attainment as required by the Clean Air Act. The most recent comprehensive inventory for Connecticut was compiled using 1996 data. For the purpose of each inventory, pollution sources are categorized as either mobile or stationary. Mobile sources are divided into highway sources, such as cars and trucks, and off-highway sources, such as construction equipment, lawnmowers, and all-terrain vehicles. Stationary sources are non-moving sources such as power plants and industrial facilities and are divided into point and area source categories. A point source refers to a source at a fixed point, such as a smokestack or storage tank. An area source refers to a series of small sources that together can affect air quality in a region, such as a community of homes using fuel oil for heating and hot water.

Figure 1
1996 CT Summertime VOC Emissions

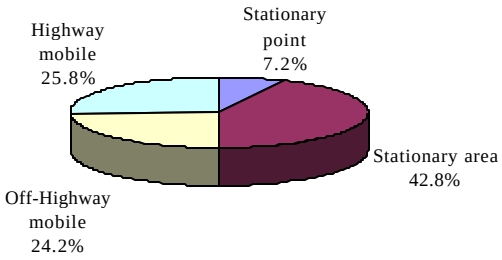


Figure 2
1996 CT Summertime NOx Emissions

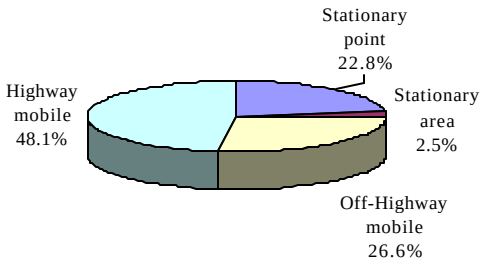
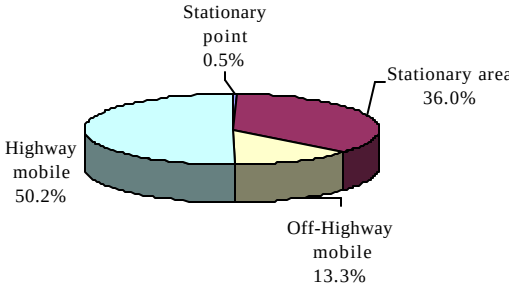


Figure 3
1996 CT Wintertime CO Emissions



Mobile sources are consistently the largest combined source of air pollution in the Northeast. Highway mobile sources, mainly gasoline burning automobiles, represent the majority of total mobile source emissions. Based on 1996 inventory data for anthropogenic (man-made) emission sources in Connecticut (Figures 1 and 2), 25 percent of the volatile organic compounds (VOCs) and nearly 50 percent of the oxides of nitrogen (NOx) emissions, the principal precursors of ozone, are emitted by highway mobile sources. On-road motor vehicles are also responsible for over 50 percent of the total carbon monoxide emissions in the wintertime (Figure 3). EPA estimates that half of the public risk from airborne hazardous air pollutants (air toxics) is associated with exposure to automobile emissions.[1]

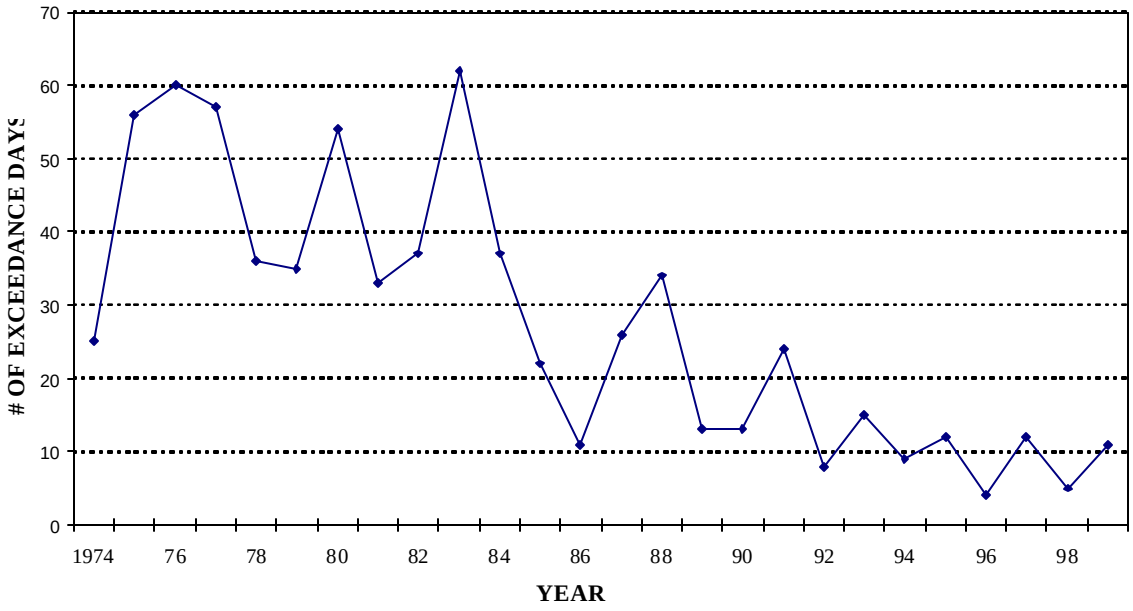
[1] NESCAUM, 1999, *RFG/MTBE Findings and Recommendations, Summary of Findings and Program Recommendations,* p.7, *and references therein*.

Ozone Forming Emissions (VOCs and NOx)

Volatile organic compounds (VOCs) and oxides of nitrogen (NOx) are the principle components in the formation of ground level ozone, or smog. Based on data reported for the Northeast in 1998, reformulated gasoline has reduced motor vehicle emissions of VOCs and NOx by 21 percent and 5 percent, respectively, when compared to conventional gasoline.[2] Reformulated gasoline, with MTBE as the oxygenate, typically contains approximately 11 percent MTBE, by volume. This volume of oxygenate helps reduce ozone forming emissions by diluting sulfur and aromatic compounds found in baseline gasoline that increase VOC and NOx emissions. The presence of MTBE also helps reduce evaporative VOC emissions from reformulated gasoline by lowering the overall vapor pressure of the mixture.

The entire State of Connecticut is currently classified as non-attainment for ozone. Reductions in VOCs and NOx emissions from the reformulated gasoline program are a significant part of Connecticut's State Implementation Plan (SIP) control strategy to reach ozone attainment in the future. Figure 4 presents the trend of one-hour ozone standard exceedances in Connecticut over the past 25 years. Although the number of exceedances has been steadily trending downward, it is clear that continued efforts to reduce ozone forming emissions are necessary in order to meet National Ambient Air Quality Standards.

Figure 4
Statewide Trend of Ozone Exceedances (1-Hr Standard)



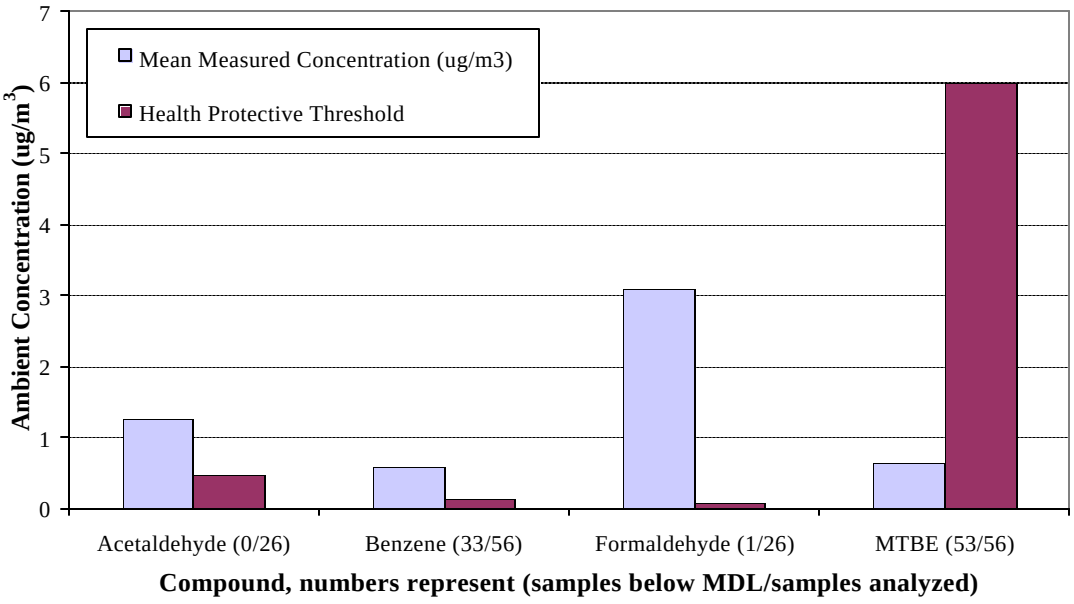
[2] NESCAUM, 1999, *RFG/MTBE Findings and Recommendations, Summary of Findings and Program Recommendations,* p.9, *and references therein*.

Air Toxics

Benzene, 1,3-butadiene, polycyclic organic matter (POM), acetaldehyde, and formaldehyde are the five toxic air pollutants of concern in the reformulated gasoline program. The performance standards for air toxics in the reformulated gasoline program are based on the *aggregate* mass emissions of these five pollutants. As shown in section 4.2 of the report, actual air toxic emission reductions are considerably greater than the performance standards required in the Clean Air Act. Although reformulated gasoline containing MTBE increases formaldehyde emissions by approximately 10 percent when compared to conventional gasoline[3], the overall or aggregate emissions of the five air toxics is greatly reduced.

National Ambient Air Quality Standards do not exist for the five air toxics listed in the reformulated gasoline program. These air toxics are part of the group of hazardous air pollutants that are defined in Title III of the 1990 Clean Air Act Amendment. As part of the Cumulative Exposure Project, EPA has developed conservative health protective thresholds which represent levels determined to be protective against carcinogenic effects for these toxic air pollutants.[4] Figure 5 compares the measured mean concentrations[5] with health protective thresholds for several air toxics associated with mobile sources recorded in Connecticut during the period of June through August 1999. Data presented

Figure 5
1999 Connecticut Ambient Air Toxic Data



[3] Value calculated Department staff using EPA's Complex Model.
[4] NESCAUM, 1999, *RFG/MTBE Findings and Recommendations, Attachment I: The Health Effects of Gasoline Constituents*, p. 19 and references therein.
[5] For instances where the measured sample concentration was below the laboratory method detection limit (MDL), one-half of the MDL was used for calculating the mean value.

were collected from Photochemical Assessment Monitoring Stations (PAMS) located throughout the state. Although not classified as a human carcinogen, the health protective threshold for MTBE shown here was used in EPA's Cumulative Exposure Project and is intended to be protective against carcinogenic effects.[6]

As shown in Figure 5, mean ambient concentrations of several air toxics already exceed health protective thresholds in Connecticut, despite the significant reductions of air toxic emissions currently provided by the reformulated gasoline program. At the same time, the mean ambient concentration of MTBE, a much less potent compound, is significantly below the health protective threshold. Because oxygenates, particularly MTBE, currently provide such a substantial margin of overcompliance for air toxic emission reductions, there are concerns that efforts to remove the oxygenate mandate or ban MTBE will eliminate this benefit of the reformulated gasoline program. Refinery modeling performed by the U.S. Department of Energy estimates that reducing or eliminating MTBE without additional regulatory steps to prevent "backsliding" of current air toxic benefits, could lead to a 40 percent increase in toxic air emissions while still meeting the performance requirements of the reformulated gasoline program.[7]

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[6] Caldwell, Jane C., Woodruff T.J., Morello-Frosche, R., Axelrod, D.A. *Application of health information to hazardous air pollutants modeled in EPA's Cumulative Exposure Project*. Toxicology and Industrial Health, Volume 14, No. 3, p. 429-454, 1998.

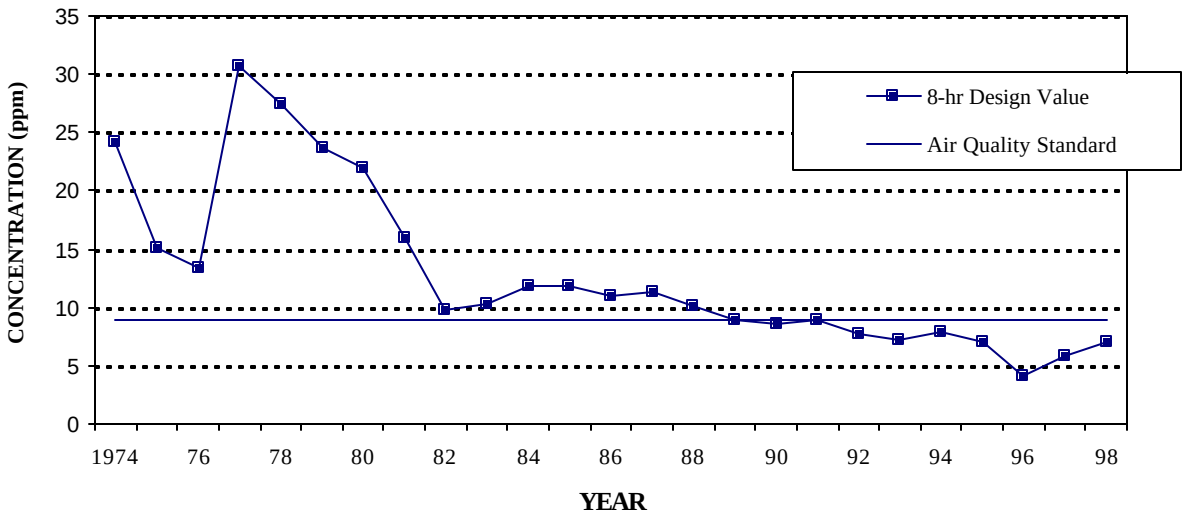
[7] NESCAUM, 1999, *RFG/MTBE Findings and Recommendations, Attachment III: Air Quality, Fuel Supply and Cost Impacts of MTBE and its Alternatives*, p.6.

Carbon Monoxide

Reformulated gasoline provides significant reductions of carbon monoxide emissions (17.6 percent) when compared to conventional gasoline.[8] Although there is no performance standard for carbon monoxide in the reformulated gasoline program, the 2.0 percent, by weight, oxygenate requirement was included in the program in part to help reduce these emissions. Oxygenates, such as MTBE, are directly responsible for reducing carbon monoxide emissions from motor vehicles by promoting more complete combustion through the addition of oxygen in the fuel. The carbon monoxide emission benefits from reformulated gasoline are most significant in older carbureted vehicles containing only oxidation catalysts. Consequently, these emission benefits will decline as older vehicles are replaced with newer ones containing current technology such as fuel injection, adaptive learning, and three-way catalysts. By 2005, EPA projects that carbon monoxide emission benefits from reformulated gasoline will be one-half of year 2000 levels as a result of vehicle fleet turnover.[9]

With the re-designation of the Southwest Control Area in 1999, the entire State of Connecticut is currently in attainment of National Ambient Air Quality Standards (NAAQS) for carbon monoxide. Compliance with NAAQS for carbon monoxide requires that the second highest recorded 8-hour average per year (known as the "design" value) does not exceed 9 parts per million (ppm). Figure 6 presents the trend of maximum 8-hour design values over the last 25 years.

Figure 6
Statewide Trend of Ambient Carbon Monoxide Levels



[8] Value calculated by Department staff using EPA's Mobile 5B Model
[9] NESCAUM, 1999, *RFG/MTBE Findings and Recommendations, Attachment III: Air Quality, Fuel Supply and Cost Impacts of MTBE and its Alternatives*, p.11, *and references therein*.

EPA estimates that about one-fourth of the carbon monoxide emission reductions from reformulated gasoline would be lost if oxygenates, such as MTBE, are removed.[10] *Based on this estimate, analyses of current attainment demonstrations for Connecticut indicate that oxygenates could be removed from reformulated gasoline without exceeding carbon monoxide standards.*

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[10] National Blue Ribbon Panel on Oxygenates in Gasoline, 1999, *Achieving Clean Air and Clean Water*, p.29, *and references therein.*

APPENDIX F

The Blue Ribbon Panel on Oxygenates in Gasoline

Executive Summary and Recommendations

Final, July 27, 1999

Introduction

The Federal Reformulated Gasoline Program (RFG) established in the Clean Air Act Amendments of 1990, and implemented in 1995, has provided substantial reductions in the emissions of a number of air pollutants from motor vehicles, most notably volatile organic compounds (precursors of ozone), carbon monoxide, and mobile-source air toxics (benzene, 1,3-butadiene, and others), in most cases resulting in emissions reductions that exceed those required by law. To address its unique air pollution challenges, California has adopted similar but more stringent requirements for California RFG.

The Clean Air Act requires that RFG contain 2% oxygen, by weight. Over 85% of RFG contains the oxygenate methyl tertiary butyl ether (MTBE) and approximately 8% contains ethanol - a domestic fuel-blending stock made from grain and potentially from recycled biomass waste. There is disagreement about the precise role of oxygenates in attaining the RFG air quality benefits although there is evidence from the existing program that increased use of oxygenates results in reduced carbon monoxide emissions, and it appears that additives contribute to reductions in aromatics in fuels and related air benefits. It is possible to formulate gasoline without oxygenates that can attain similar air toxics reductions, but less certain that, given current federal RFG requirements, all fuel blends created without oxygenates could maintain the benefits provided today by oxygenated RFG.

At the same time, the use of MTBE in the program has resulted in growing detections of MTBE in drinking water, with between 5% and 10% of drinking water supplies in high oxygenate use areas[1] showing at least detectable amounts of MTBE. The great majority of these detections to date have been well below levels of public health concern, with approximately one percent rising to levels above 20 ppb. Detections at lower levels have, however, raised consumer taste and odor concerns that have caused water suppliers to stop using some water supplies and to incur costs of treatment and remediation. The contaminated wells include private wells that are less well protected than public drinking water supplies and not monitored for chemical

[1] Areas using RFG (2% by weight oxygen) and/or Oxyfuel (2.7% by weight Oxygen)

contamination. There is also evidence of contamination of surface waters, particularly during summer boating seasons.

The major source of groundwater contamination appears to be releases from underground gasoline storage systems (UST). These systems have been upgraded over the last decade, likely resulting in reduced risk of leaks. However, approximately 20% of the storage systems have not yet been upgraded, and there continue to be reports of releases from some upgraded systems, due to inadequate design, installation, maintenance, and/or operation. In addition, many fuel storage systems (e.g. farms, small above-ground tanks) are not currently regulated by U.S. EPA. Beyond groundwater contamination from UST sources, the other major sources of water contamination appear to be small and large gasoline spills to ground and surface waters, and recreational water craft - particularly those with older motors - releasing unburned fuel to surface waters.

The Blue Ribbon Panel

In November, 1998, U.S. EPA Administrator Carol M. Browner appointed a Blue Ribbon Panel to investigate the air quality benefits and water quality concerns associated with oxygenates in gasoline, and to provide independent advice and recommendations on ways to maintain air quality while protecting water quality. The Panel, which met six times from January - June, 1999, heard presentations in Washington, the Northeast, and California about the benefits and concerns related to RFG and the oxygenates; gathered the best available information on the program and its effects; identified key data gaps; and evaluated a series of alternative recommendations based on their effects on:

- air quality
- water quality
- stability of fuel supply and cost

The Findings and Recommendations of the Blue Ribbon Panel

Findings Based on its review of the issues, the Panel made the following overall findings:

- The distribution, use, and combustion of gasoline poses risks to our environment and public health.

- RFG provides considerable air quality improvements and benefits for millions of US citizens.

- The use of MTBE has raised the issue of the effects of both MTBE alone and MTBE in gasoline. This panel was not constituted to perform an independent comprehensive health assessment and has chosen to rely on recent reports by a number of state, national, and international health agencies. What seems clear, however, is that MTBE, due to its persistence and mobility in water, is more likely

to contaminate ground and surface water than the other components of gasoline.

- MTBE has been found in a number of water supplies nationwide, primarily causing consumer odor and taste concerns that have led water suppliers to reduce use of those supplies. Incidents of MTBE in drinking water supplies at levels well above EPA and state guidelines and standards have occurred, but are rare. The Panel believes that the occurrence of MTBE in drinking water supplies can and should be substantially reduced.

- MTBE is currently an integral component of the U.S. gasoline supply both in terms of volume and octane. As such, changes in its use, with the attendant capital construction and infrastructure modifications, must be implemented with sufficient time, certainty, and flexibility to maintain the stability of both the complex U. S. fuel supply system and gasoline prices.

The following recommendations are intended to be implemented as *a single package* of actions designed to simultaneously maintain air quality benefits while enhancing water quality protection and assuring a stable fuel supply at reasonable cost. The majority of these recommendations could be implemented by federal and state environmental agencies without further legislative action, and we would urge their rapid implementation. We would, as well, urge all parties to work with Congress to implement those of our recommendations that require legislative action.

Recommendations to Enhance Water Protection

Based on its review of the existing federal, state and local programs to protect, treat, and remediate water supplies, the Blue Ribbon Panel makes the following recommendations to enhance, accelerate, and expand existing programs to improve protection of drinking water supplies from contamination.

Prevention

1. EPA, working with the states, should take the following actions to enhance significantly the Federal and State Underground Storage Tank programs:

    1. Accelerate enforcement of the replacement of existing tank systems to conform with the federally-required December 22, 1998 deadline for upgrade, including, at a minimum, moving to have all states prohibit fuel deliveries to non-upgraded tanks, and adding enforcement and compliance resources to ensure prompt enforcement action, especially in areas using RFG and Wintertime Oxyfuel.
    2. Evaluate the field performance of current system design requirements and technology and, based on that evaluation, improve system requirements to

minimize leaks/releases, particularly in vulnerable areas (see recommendations on Wellhead Protection Program in 2. below)

3. Strengthen release detection requirements to enhance early detection, particularly in vulnerable areas, and to ensure rapid repair and remediation
4. Require monitoring and reporting of MTBE and other ethers in groundwater at all UST release sites
5. Encourage states to require that the proximity to drinking water supplies, and the potential to impact those supplies, be considered in land-use planning and permitting decisions for siting of new UST facilities and petroleum pipelines.
6. Implement and/or expand programs to train and license UST system installers and maintenance personnel.
7. Work with Congress to examine and, if needed, expand the universe of regulated tanks to include underground and aboveground fuel storage systems that are not currently regulated yet pose substantial risk to drinking water supplies.

2. EPA should work with its state and local water supply partners to enhance implementation of the Federal and State Safe Drinking Water Act programs to:

    1. Accelerate, particularly in those areas where RFG or Oxygenated Fuel is used, the assessments of drinking water source protection areas required in Section 1453 of the 1996 Safe Drinking Water Act Amendments.
    2. Coordinate the Source Water Assessment program in each state with federal and state Underground Storage Tank Programs using geographic information and other advanced data systems to determine the location of drinking water sources and to identify UST sites within source protection zones.
    3. Accelerate currently-planned implementation of testing for and reporting of MTBE in public drinking water supplies to occur before 2001.
    4. Increase ongoing federal, state, and local efforts in Wellhead Protection Areas including:
        - enhanced permitting, design, and system installation requirements for USTs and pipelines in these areas;
        - strengthened efforts to ensure that non-operating USTs are properly closed;
        - enhanced UST release prevention and detection
        - improved inventory management of fuels.

3. EPA should work with states and localities to enhance their efforts to protect lakes and reservoirs that serve as drinking water supplies by restricting use of recreational water craft, particularly those with older motors.

4. EPA should work with other federal agencies, the states, and private sector partners to implement expanded programs to protect private well users, including, but not limited to:
    1. A nationwide assessment of the incidence of contamination of private wells by components of gasoline as well as by other common contaminants in shallow groundwater;
    2. Broad-based outreach and public education programs for owners and users of private wells on preventing, detecting, and treating contamination;
    3. Programs to encourage and facilitate regular water quality testing of private wells.

5. Implement, through public-private partnerships, expanded Public Education programs at the federal, state, and local levels on the proper handling and disposal of gasoline.

6. Develop and implement an integrated field research program into the groundwater behavior of gasoline and oxygenates, including:
    1. Identifying and initiating research at a population of UST release sites and nearby drinking water supplies including sites with MTBE, sites with ethanol, and sites using no oxygenate;
    2. Conducting broader, comparative studies of levels of MTBE, ethanol, benzene, and other gasoline compounds in drinking water supplies in areas using primarily MTBE, areas using primarily ethanol, and areas using no or lower levels of oxygenate.

<u>Treatment and Remediation</u>

7. EPA should work with Congress to expand resources available for the up-front funding of the treatment of drinking water supplies contaminated with MTBE and other gasoline components to ensure that affected supplies can be rapidly treated and returned to service, or that an alternative water supply can be provided. This could take a number of forms, including but not limited to:
    1. Enhancing the existing Federal Leaking Underground Storage Tank Trust Fund by fully appropriating the annual available amount in the Fund, ensuring that treatment of contaminated drinking water supplies can be funded, and streamlining the procedures for obtaining funding.
    2. Establishing another form of funding mechanism which ties the funding more directly to the source of contamination.
    3. Encouraging states to consider targeting State Revolving Funds (SRF) to help accelerate treatment and remediation in high priority areas.

8. Given the different behavior of MTBE in groundwater when compared to other components of gasoline, states in RFG and Oxyfuel areas should reexamine and

enhance state and federal "triage" procedures for prioritizing remediation efforts at UST sites based on their proximity to drinking water supplies.

9. Accelerate laboratory and field research, and pilot projects, for the development and implementation of cost-effective water supply treatment and remediation technology, and harmonize these efforts with other public/private efforts underway.

Recommendations for Blending Fuel for Clean Air *and* Water

Based on its review of the current water protection programs, and the likely progress that can be made in tightening and strengthening those programs by implementing Recommendations 1 - 9 above, the Panel agreed broadly, although not unanimously, that even enhanced protection programs will not give adequate assurance that water supplies will be protected, and that changes need to be made to the RFG program to reduce the amount of MTBE being used, while ensuring that the air quality benefits of RFG, and fuel supply and price stability, are maintained.

Given the complexity of the national fuel system, the advantages and disadvantages of each of the fuel blending options the Panel considered (see Appendix A), and the need to maintain the air quality benefits of the current program, the Panel recommends an *integrated package* of actions by both Congress and EPA that should be *implemented as quickly as possible*. The key elements of that package, described in more detail below, are:

- Action agreed to broadly by the Panel to reduce the use of MTBE substantially (with some members supporting its complete phase out), and action by Congress to clarify federal and state authority to regulate and/or eliminate the use of gasoline additives that threaten drinking water supplies;

- Action by Congress to remove the current 2% oxygen requirement to ensure that adequate fuel supplies can be blended in a cost-effective manner while quickly reducing usage of MTBE; and

- Action by EPA to ensure that there is no loss of current air quality benefits.

The Oxygen Requirement

10. The current Clean Air Act requirement to require 2% oxygen, by weight, in RFG must be removed in order to provide flexibility to blend adequate fuel supplies in a cost-effective manner while quickly reducing usage of MTBE and maintaining air quality benefits.

The panel recognizes that Congress, when adopting the oxygen requirement,

sought to advance several national policy goals (energy security and diversity, agricultural policy, etc) that are beyond the scope of our expertise and deliberations.

The panel further recognizes that if Congress acts on the recommendation to remove the requirement, Congress will likely seek other legislative mechanisms to fulfill these other national policy interests.

Maintaining Air Benefits

11. Present toxic emission performance of RFG can be attributed, to some degree, to a combination of three primary factors: 1) mass emission performance requirements, 2) the use of oxygenates, and 3) a necessary compliance margin with a per gallon standard. In Cal RFG, caps on specific components of fuel is an additional factor to which toxics emission reductions can be attributed.

Outside of California, lifting the oxygen requirement as recommended above may lead to fuel reformulations that achieve the minimum performance standards required under the 1990 Act, rather than the larger air quality benefits currently observed. In addition, changes in the RFG program could have adverse consequences for conventional gasoline as well.

Within California, lifting the oxygen requirement will result in greater flexibility to maintain and enhance emission reductions, particularly as California pursues new formulation requirements for gasoline.

In order to ensure that there is no loss of current air quality benefits, EPA should seek appropriate mechanisms for both the RFG Phase II and Conventional Gasoline programs to define and maintain in RFG II the real world performance observed in RFG Phase I while preventing deterioration of the current air quality performance of conventional gasoline.[2]

There are several possible mechanisms to accomplish this. One obvious way is to

[2]The Panel is aware of the current proposal for further changes to the sulfur levels of gasoline and recognizes that implementation of any change resulting from the Panel's recommendations will, of necessity, need to be coordinated with implementation of these other changes. However, a majority of the panel considered the maintenance of current RFG air quality benefits as separate from any additional benefits that might accrue from the sulfur changes currently under consideration.

enhance the mass-based performance requirements currently used in the program. At the same time, the panel recognizes that the different exhaust components pose differential risks to public health due in large degree to their variable potency. The panel urges EPA to explore and implement mechanisms to achieve equivalent or improved public health results that focus on reducing those compounds that pose the greatest risk.

Reducing the Use of MTBE

8. The Panel agreed broadly that, in order to minimize current and future threats to drinking water, the use of MTBE should be reduced substantially. Several members believed that the use of MTBE should be phased out completely. The Panel recommends that Congress act quickly to clarify federal and state authority to regulate and/or eliminate the use of gasoline additives that pose a threat to drinking water supplies.

Initial efforts to reduce should begin immediately, with substantial reductions to begin as soon as Recommendation 10 above - the removal of the 2% oxygen requirement - is implemented[3]. Accomplishing any such major change in the gasoline supply without disruptions to fuel supply and price will require adequate lead time - up to 4 years if the use of MTBE is eliminated, sooner in the case of a substantial reduction (e.g. returning to historical levels of MTBE use).

The Panel recommends, as well, that any reduction should be designed so as to not result in an increase in MTBE use in Conventional Gasoline areas.

13. The other ethers (e.g. ETBE, TAME, and DIPE) have been less widely used and less widely studied than MTBE. To the extent that they have been studied, they appear to have similar, but not identical, chemical and hydrogeologic characteristics. The Panel recommends accelerated study of the health effects and groundwater characteristics of these compounds before they are allowed to be placed in widespread use.

In addition, EPA and others should accelerate ongoing research efforts into the inhalation and ingestion health effects, air emission transformation byproducts, and environmental behavior of all oxygenates and other components likely to increase in the absence of MTBE. This should include research on ethanol, alkylates, and aromatics, as well as of gasoline compositions containing those components.

[3] Although a rapid, substantial reduction will require removal of the oxygen requirement, EPA should, in order to enable initial reductions to occur as soon as possible, review administrative flexibility under existing law to allow refiners who desire to make reductions to begin doing so.

14. To ensure that any reduction is adequate to protect water supplies, the Panel recommends that EPA, in conjunction with USGS, the Departments of Agriculture and Energy, industry, and water suppliers, should move quickly to:

    1. Conduct short-term modeling analyses and other research based on existing data to estimate current and likely future threats of contamination;
    1. Establish routine systems to collect and publish, at least annually, all available monitoring data on:
        - use of MTBE, other ethers, and Ethanol,
        - levels of MTBE, Ethanol, and petroleum hydrocarbons found in ground, surface and drinking water,
        - trends in detections and levels of MTBE, Ethanol, and petroleum hydrocarbons in ground and drinking water;
    3. Identify and begin to collect additional data necessary to adequately assist the current and potential future state of contamination.

The Wintertime Oxyfuel Program

The Wintertime Oxyfuel Program continues to provide a means for some areas of the country to come into, or maintain, compliance with the Carbon Monoxide standard. Only a few metropolitan areas continue to use MTBE in this program. In most areas today, ethanol can and is meeting these wintertime needs for oxygen without raising volatility concerns given the season.

15. The Panel recommends that the Wintertime Oxyfuel program be continued (a) for as long as it provides a useful compliance and/or maintenance tool for the affected states and metropolitan areas, and (b) assuming that the clarification of state and federal authority described above is enacted to enable states, where necessary, to regulate and/or eliminate the use of gasoline additives that threaten drinking water supplies.

Recommendations for Evaluating and Learning From Experience

The introduction of reformulated gasoline has had substantial air quality benefits, but has at the same time raised significant issues about the questions that should be asked before widespread introduction of a new, broadly-used product. The unanticipated effects of RFG on groundwater highlight the importance of exploring the potential for adverse effects in all media (air, soil, and water), and on human and ecosystem health, before widespread introduction of any new, broadly-used, product.

16. In order to prevent future such incidents, and to evaluate of the effectiveness and the impacts of the RFG program, EPA should:
    4. Conduct a full, multi-media assessment (of effects on air, soil, and water)

of any major new additive to gasoline prior to its introduction.

5. Establish routine and statistically valid methods for assessing the actual composition of RFG and its air quality benefits, including the development, to the maximum extent possible, of field monitoring and emissions characterization techniques to assess “real world” effects of different blends on emissions
6. Establish a routine process, perhaps as a part of the Annual Air Quality trends reporting process, for reporting on the air quality results from the RFG program.
7. Build on existing public health surveillance systems to measure the broader impact (both beneficial and adverse) of changes in gasoline formulations on public health and the environment.

Appendix A

In reviewing the RFG program, the panel identified three main options (MTBE and other ethers, ethanol, and a combination of alkylates and aromatics) for blending to meet air quality requirements. They identified strength and weaknesses of each option:

MTBE/other ethers	A cost-effective fuel blending component that provides high octane, carbon monoxide and exhaust VOCs emissions benefits, and appears to contribute to reduction of the use of aromatics with related toxics and other air quality benefits; has high solubility and low biodegradability in groundwater, leading to increased detections in drinking water, particularly in high MTBE use areas. Other ethers, such as ETBE, appear to have similar, but not identical, behavior in water, suggesting that more needs to be learned before widespread use
Ethanol	An effective fuel-blending component, made from domestic grain and potentially from recycled biomass, that provides high octane, carbon monoxide emission benefits, and appears to contribute to reduction of the use of aromatics with related toxics and other air quality benefits; can be blended to maintain low fuel volatility; could raise possibility of increased ozone precursor emissions as a result of commingling in gas tanks if ethanol is not present in a majority of fuels; is produced currently primarily in Midwest, requiring enhancement of infrastructure to meet broader demand; because of high biodegradability, may retard biodegradation and increase movement of benzene and other hydrocarbons around leaking tanks.
Blends of Alkylates and Aromatics	Effective fuel blending components made from crude oil; alkylates provide lower octane than oxygenates; increased use of aromatics will likely result in higher air toxics emissions than current RFG; would require enhancement of infrastructure to meet increased demand; have groundwater characteristics similar, but not identical, to other components of gasoline (i.e. low solubility and intermediate biodegradability)

Appendix B

Members of the Blue Ribbon Panel

Dan Greenbaum, Health Effects Institute, Chair
Mark Buehler, Metropolitan Water District, So. California
Robert Campbell, CEO, Sun Oil
Patricia Ellis, Hydrogeologist, Delaware Department of Natural Resources and Environmental Conservation
Linda Greer, Natural Resources Defense Council
Jason Grumet, NESCAUM
Anne Happel, Lawrence Livermore Nat. Lab
Carol Henry, American Petroleum Institute
Michael Kenny, California Air Resources Board
Robert Sawyer, University of California, Berkeley
Todd Sneller, Nebraska Ethanol Board
Debbie Starnes, Lyondell Chemical
Ron White, American Lung Assoc.

Federal representatives (Non-Voting):

Robert Perciasepe, Air and Radiation, US EPA
Roger Conway, US Dept. of Agriculture
Cynthia Dougherty, Drinking Water, U.S. EPA
William Farland, Risk Assessment, US EPA
Barry McNutt, US DOE
Margo Oge, Mobile Sources, US EPA
Samuel Ng, Underground Tanks, US EPA
Mary White, ATSDR
John Zogorski, USGS

APPENDIX G

RFG/MTBE

Findings & Recommendations

NESCAUM
Northeast States for Coordinated Air Use Management

August 1999

Summary of Findings
&
Program Recommendations

OVERVIEW

The federal reformulated gasoline (RFG) program is an important air pollution control and public health protection strategy in the Northeast. Methyl tertiary butyl ether (MTBE) is an additive widely used in the blending of RFG to comply with the oxygen mandate in the Clean Air Act. MTBE emerged as the oxygenate of choice for many gasoline refiners because of its low cost and high-octane characteristics. MTBE is also added to some conventional gasoline blends as an octane enhancer, with higher levels used in premium grades.

Due to increased rates of detection in surface and groundwater, states in the Northeast and elsewhere are considering or instituting legislative and regulatory actions to reduce the use of MTBE in gasoline. Similar concerns among federal officials led to the convening of a Blue Ribbon Panel on Gasoline and Oxygenates to provide guidance to the federal government on this issue. The Panel's final report concludes, "MTBE, due to its persistence and mobility in water, is more likely to contaminate ground and surface water than other components of gasoline."[1]

The challenge facing elected officials and environmental regulators is to determine the appropriate use of a chemical compound that produces substantial public health benefits while simultaneously posing an unacceptable risk to water resources. The tension between public health and environmental resource protection posed by MTBE is relatively unusual. Generally, compounds that pose substantial environmental risk are similarly detrimental to public health. In this traditional dynamic, the obvious pathway for regulatory action is to diminish the use of such compounds to the greatest extent possible. In this case, however, the solution is not as simple since gasoline is a complex mixture of dozens of toxic constituents, many of which are known human carcinogens. As MTBE is reduced or eliminated from the fuel supply, gasoline producers will add other compounds with known and unknown public health risks to make up the lost volume and octane provided by MTBE.

The most economical near-term option available to refiners supplying the Northeast RFG market may be to increase levels of aromatic compounds including benzene, toluene and xylene. These are toxic compounds that will adversely affect public health. The challenge facing the northeast states and the nation is to identify a pathway that effectively mitigates the environmental risks posed by MTBE while maintaining the public health benefits of the current RFG program. The findings and recommendations that follow present a prescription for state and federal action to effectively characterize and aggressively mitigate the environmental risks posed by MTBE while seeking to maintain the public health benefits of RFG and prevent disruption of gasoline supply and resulting price increases.

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[1] *Findings and Recommendations on the Use of Oxygenates in Gasoline*, The Blue Ribbon Panel on Oxygenates in Gasoline, July 27, 1999.

STUDY APPROACH

This study was undertaken in response to a November 9, 1998 request by New Hampshire Governor Jeanne Shaheen on behalf of the New England Governor's Conference. Specifically Governor Shaheen requested that NESCAUM:

> "Review the use and effectiveness of MTBE as a pollution reducing component of RFG, consider what effective alternatives may exist that are consistent with statutory options or requirements, and make recommendations regarding the best course for the [Northeast] region to pursue in order to maximize air quality benefits and minimize public health threats."

In April 1999, NESCAUM produced a series of technical papers summarizing available information on the costs and benefits of the RFG program, characterizing the environmental prevalence and fate of MTBE in the region, and identifying program options for further evaluation. These technical papers have been revised in response to public comments received and additional analysis performed over the last four months. They are appended to this Summary as attachments: (I) Health Effects of Gasoline Constituents; (II) MTBE in Ground and Surface Waters of the NESCAUM Region; (III) Air Quality, Fuel Supply and Cost Impacts of MTBE and its Alternatives; and (IV) Impact of MTBE on Treatment and Remediation of Water Resources in the Northeast.

This summary report highlights the key findings of the Technical Papers. Based on the analysis documented in the attached appendices, NESCAUM recommends a comprehensive set of federal, regional and state actions in response to concerns raised about MTBE. A more detailed discussion of the background and history of the RFG program can be found in the Draft Issues and Options papers released in April 1999 and available at www.nescaum.org.

SUMMARY of RECOMMENDATIONS

NESCAUM proposes a multi-component strategy that includes:

1. Legislative and regulatory initiatives to reduce the amount of MTBE in gasoline;
    - Congressional action to lift federal oxygen mandate in RFG
    - Clarification of USEPA and state authority to regulate fuel additives
    - Three year phase down and cap on MTBE in all gasoline

2. USEPA action to prevent air quality backsliding;
    - Regulatory revisions to prevent toxic emissions increases from MTBE phase-down

3. Regional assessment of opportunities to enhance gasoline storage tank programs;
    - Expansion to smaller tanks and above ground tanks
    - Enhanced monitoring and enforcement

4. Regional multi-media monitoring and assessment program;
    - Develop regional baseline of methodologically consistent air and water quality data
    - Track the impacts of changes in gasoline formulation

5. Scientific assessment of MTBE alternatives;
    - Develop streamlined screening process and employ prior to wide-scale use
    - Complete testing of basic gasoline constituents as required under the CAA

6. Analysis of the fuel supply and price impacts of diminishing MTBE use; and
    - Refinery modeling of options that maintain RFG air quality benefits in the Northeast.

7. Public education and outreach to diminish the incidence of small commercial and residential gasoline spills.
    - Expand Alliance for Proper Gasoline Handling

Because RFG and the oxygenated fuels program are federal initiatives, NESCAUM believes that a federal solution is warranted and optimal. Absent an appropriate federal response, a regional solution will be pursued in the Northeast.

SUMMARY of KEY FINDINGS

Health Effects of Gasoline Constituents

- Conventional gasoline is a complex mixture containing highly toxic compounds, many of which are known or suspected human carcinogens. Exposure to these toxins in the air and water present potential health risks to the general public.

- The RFG program is a proven and cost-effective air pollution reduction strategy. The northeast states must maintain and improve upon existing clean burning gasoline programs in order to attain and maintain the National Ambient Air Quality Standards (NAAQS) for ozone and carbon monoxide. RFG also helps reduce public exposure to a host of hazardous air pollutants such as benzene, 1-3,butadiene, acetaldehyde and formaldehyde that currently exceed health protective thresholds in the Northeast.

- The aggregate public health benefits RFG provides by reducing air pollution substantially outweigh potential adverse public health impacts from exposure to increased levels of MTBE in the air and water. Tens of millions of northeast residents benefit from reduced exposure to mobile source air toxics, whereas exposures to MTBE at levels above health thresholds are rare.

- MTBE, at levels typically found in the region's air and water, does not pose a health threat to the general population. However, the presence of MTBE in excess of drinking water standards (about 1 percent of sampled wells in the Northeast), in combination with exposure to MTBE in outdoor air, may in some cases be sufficient to exceed health protective thresholds.

- Gasoline refiners that supply the Northeast have overcomplied with RFG toxic performance standards by more than 75 percent, in part due to the presence of MTBE. This substantial margin of overcompliance may be lost if MTBE is reduced or eliminated from RFG. In addition, toxic air emissions from conventional gasoline sold in the Northeast have declined 13 percent since 1990, and those emission benefits may also be diminished or lost if MTBE is phased out of RFG.

- Existing public health testing requirements for gasoline components and additives are inadequate. A streamlined risk screening process, which accounts for environmental fate, transport and toxicity must be performed prior to the widespread introduction of new additives or significantly increasing the level of current gasoline additives. Absent such analyses, it will be difficult to confidently protect public health and environmental quality from future changes in the fuel supply.

Water Quality Impacts

- MTBE poses unique risks to ground and surface water compared to other components of gasoline due to its mobility and resistance to biodegradation.

- The "turpentine-like" taste and odor of MTBE can make drinking water unacceptable to consumers.

- MTBE is now one of the most commonly detected VOCs in Northeast drinking water supplies. Wells with MTBE contamination often do not contain detectable levels of other toxic gasoline compounds. For example, in a USGS study of the Northeast, benzene was found in only 12 percent of wells with detectable levels of MTBE.

- The vast majority of MTBE detections (98%) are at levels well below the most stringent state health thresholds. Atmospheric deposition, storm water runoff and small-scale surface spills are the probable sources of this low-level contamination. None of these mechanisms are likely to cause long-term contamination of groundwater at concentrations approaching or exceeding drinking water standards.

- Leaking underground storage tanks represent the primary threat to drinking water because the volume of gasoline released can be significant and historically these leaks could go undetected for long periods of time.

- MTBE contamination adds $34 million to the cost of cleaning up gasoline spills in the Northeast. This expense accounts for one-third of the total cost of remediating gasoline-contaminated groundwater in the Northeast. Placed in context with annual expenditures on gasoline, MTBE cleanup costs are equal to raising the price of gasoline sold in the Northeast by 0.25 cents per gallon over the course of a year.

- Over the last decade, the northeast states have made substantial progress removing existing underground storage tanks and replacing them with upgraded tanks with release detection equipment and procedures. These efforts and further improvements have and will continue to greatly diminish the potential for contamination of water resources by gasoline.

- While gasoline releases will still occur from refueling and accidental spills, the risk to water resources from small leaks and spills should diminish substantially with lower levels of MTBE in gasoline since a linear relationship exists between the amount of MTBE in the gasoline and the concentration in contaminated water.

Fuel Supply and Costs

- A variety of petroleum and non-petroleum based compounds (aromatics, alkylates, toluene, ethanol, etc.) are available to replace MTBE. Each of these compounds present economic and environmental advantages and disadvantages compared to MTBE. The relative increase in these compounds will depend on the balance between environmental fate, persistence, public health impacts and economic considerations adopted through federal and state action.

- Changes to the RFG program are likely to have substantial impacts on the environmental characteristics of the conventional gasoline pool. Conventional gasoline makes up roughly one quarter of the fuel sold in the NESCAUM region and two thirds of the fuel sold nationally. Existing federal statute and regulations are inadequate to prevent a degradation of conventional fuel quality resulting from changes in the RFG program.

- Changes to gasoline formulation should be implemented on a regional or national basis, with adequate lead-time to diminish the possibility that such changes result in supply instability and unacceptable increases in gasoline prices. A one cent per gallon change in gasoline price is equivalent to $120 million in the region's economy over the course of one year.

AIR QUALITY IMPACTS OF RFG AND MTBE

Motor vehicles are the largest aggregate source of air pollution in the Northeast. As a sector, gasoline powered vehicles emit about one-third of smog-forming volatile organic compounds (VOCs) and oxides of nitrogen (NOx) in the region. Vehicles are also the primary source of carbon monoxide. The results of the U.S. Environmental Protection Agency's (USEPA's) recent Cumulative Exposure Project (CEP) suggest that about half of the public health risk from airborne hazardous air pollutants (HAPs) is associated with exposure to automobile emissions.[2] Figure 1 compares measured annual average ambient concentrations of several motor vehicle-related air HAPs in the Northeast to established health protective guidelines.[3] Monitoring data represent the highest and lowest annual average measurements of ambient concentrations for each compound. The health-protective standards represent levels determined to be protective against carcinogenic effects (as published by Caldwell *et al*. for the CEP analysis).[4] These data show that even the lowest measured outdoor concentration of acetaldehyde, benzene, 1,3-butadiene and formaldehyde in the Northeast region– the pollutants regulated under the RFG program -- exceed the cancer standards established for these compounds. Whereas, the highest measured levels of MTBE in the air are about one-half the health standard.

Figure 1

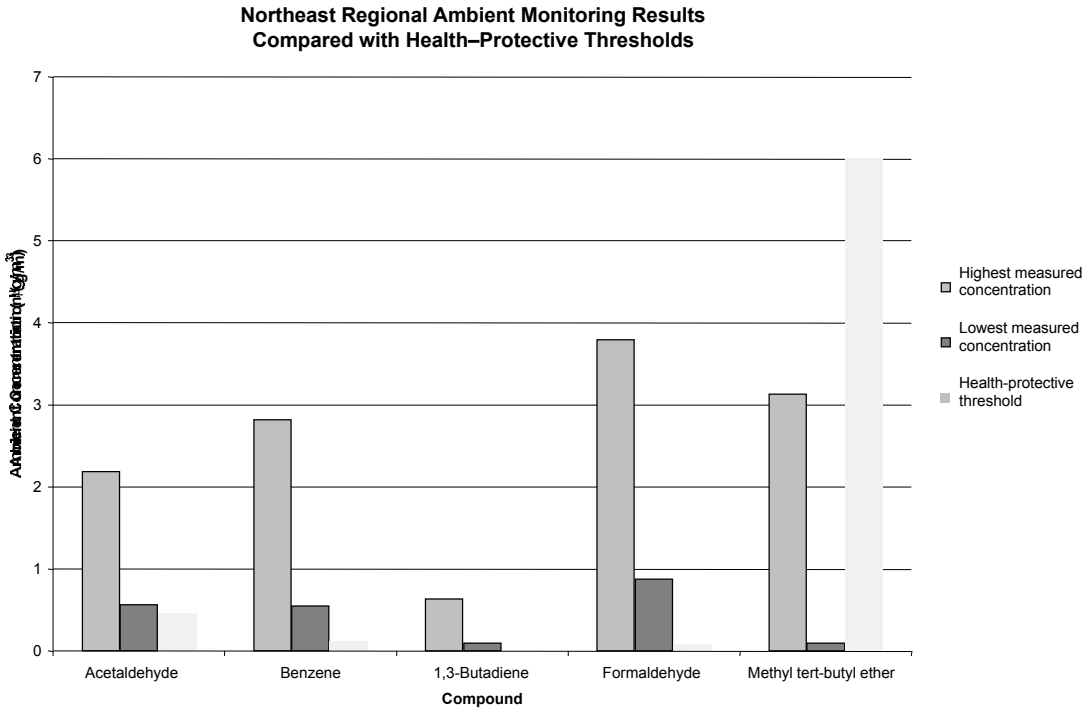

Table 1 shows the source sectors responsible for regional average emissions of acetaldehyde, benzene, 1,3-butadiene, and formaldehyde in the Northeast. This table was developed using the northeast states'

[2] *Public Health Implications of 1990 Air Toxics Concentrations across the United States*, Tracey J. Woodruff, et al, 1998.
[3] Quality assured ambient monitoring results provided to NESCAUM by respective Northeast States Air Quality Agencies. These data are collected in accordance with USEPA ambient monitoring requirements.
[4] Caldwell, Jane C., Woodruff, T.J., Morello-Frosche, R., Axelrad, D.A. Application of Health Information to Hazardous Air Pollutants Modeled in EPA's Cumulative Exposure Project. *Toxicology and Industrial Health*, vol. 14, No. 3, pp. 429-454, 1998.

emissions inventory compiled for the 1990 CEP analysis[5]. Approximately two-thirds of these HAPs are emitted by motor vehicles.

Table 1
Toxic Air Pollutants of Concern in the Northeast Region

	Mobile	Area	Point	Total
Acetaldehyde	62%	35%	3%	100%
Benzene	71%	28%	2%	100%
1,3-butadiene*	65%	25%	<1%	91%
Formaldehyde	68%	30%	2%	100%

* *Additional 9% of emissions attributed to secondary formation*

Cleaner-burning gasoline is an effective strategy for reducing emissions that contribute to smog, carbon monoxide, fine particulate matter, haze, acid deposition, and toxic problems in the region. Two attributes make cleaner-burning gasoline a particularly important and effective approach to air pollution control. First, the program benefits accrue immediately upon introduction of the fuel; as opposed to new vehicle standards where the full benefits are not achieved until significant fleet turnover has occurred (about 12 years for a 90% turnover). Second, the benefits – while different in magnitude - apply to all vehicles, regardless of age and technology.

The RFG program was designed to reduce ambient levels of ozone, a powerful respiratory irritant that adversely affects the health and well being of large segments of the population including children, the elderly and individuals engaged in outdoor activities. While ozone smog remains a persistent summertime problem in the Northeast, existing data suggest that the RFG program has contributed to reduced levels of smog where it has been used.[6] The ozone benefits of this program are expected to increase with the introduction of Phase II RFG which requires additional reductions in VOCs and especially NOx.

MTBE is also widely used in oxygenated gasoline (oxyfuel). Oxyfuel, which requires a minimum of 2.7 percent oxygen by weight, has been an effective wintertime carbon monoxide (CO) control strategy in the New York City metropolitan area and elsewhere. The presence of oxygenate in the gasoline serves to reduce CO emissions by promoting more complete fuel combustion. Due to the benefits of new motor vehicle standards and the use of cleaner burning oxyfuel, substantial progress has made in achieving the NAAQS for carbon monoxide. In August 1999, the state of Connecticut announced the decision to opt its portion of the New York City metropolitan area out of the oxygenated fuel program. New Jersey and New York are planning to request redesignation as carbon monoxide attainment areas. They will likely eliminate the use of oxyfuel in the wintertime once the area is formally designated as attaining the NAAQS for carbon monoxide. RFG also provides carbon monoxide benefits and is seen as a long-term strategy for maintaining compliance with the CO NAAQS. Should the RFG oxygen mandate be lifted, USEPA should ensure that carbon monoxide emissions from vehicles operating on RFG do not increase.

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[5] Unpublished data provided by USEPA, Office of Policy. Final emissions inventory used for Cumulative Exposure Project, Assessment of Population Exposure Nationwide computer dispersion modeling, provided 1998.

[6] *Cleaner-Burning Gasoline: An Assessment of its Impact on Ozone Air Quality in California*, California Air Resources Board, January 1998 (December 1998 Supplement) and *Ozone-Forming Potential of Reformulated Gasoline*, National Research Council, May 1999.

Air quality monitoring data demonstrate that Phase 1 of the RFG program has significantly contributed to reduced ambient levels of HAPs including benzene, a known human carcinogen.[7] As shown in Table 2, gasoline refiners have significantly overcomplied with the minimum statutory toxic reduction requirements of Phase 1 of the RFG program. Analyses conducted by the northeast states and others suggest that benzene is a primary source of public health risk from exposure to vehicular emissions. The RFG program imposes a 1 percent by volume cap on benzene; most refiners are using considerably less than the allowable level (on average about 0.6 %). When combusted in motor vehicles, aromatics also result in benzene emissions. Ambient monitoring data show that outdoor levels of this carcinogen have declined dramatically where RFG is used. On average, benzene concentrations have decreased by 43 percent in areas where RFG is used. Ambient levels of 1,3-butadiene and acetaldehyde have also decreased in these areas. The use of RFG with MTBE has, however, resulted in increased airborne emissions of MTBE and formaldehyde. Table 2 summarizes the emission benefits of federal RFG compared to 1990 conventional gasoline.

Table 2
Emissions Reductions from Federal RFG in the Northeast States

Pollutants	**Phase I RFG (1995 – 1999)**		**Phase II RFG (2000+)**
	Performance Standards	*Actual Emission Reductions (1998 average)*	*Performance Standards*
VOCs	17.1%	21%	27.4%
NOx	1.5%	5%	6.8%
Toxics (mass emissions)	16.5%	35%	21.5%

FUEL QUALITY

If MTBE use is phased down or banned without additional regulatory steps to secure current air toxics emissions performance of RFG, it is likely that mobile source air toxic emissions will increase. Refineries that supply the Northeast have overcomplied with Phase II RFG toxic performance standards by more than 75 percent, due in part to the presence of MTBE. This substantial margin of overcompliance may be lost if MTBE is reduced or eliminated from RFG. Analyses conducted by NESCAUM suggest that toxic air emissions from conventional gasoline sold in the Northeast have declined by 13 percent since 1990. Additional analysis is needed to determine whether changes to RFG formulations resulting from a phase-down of MTBE will diminish these benefits.

The use of oxygenates, such as MTBE and ethanol, contributes to reductions in air toxic emissions from motor vehicles through dilution and replacement of toxic gasoline constituents that are high in octane. Several sources of data strongly suggest that an increase in MTBE content results in a corresponding decrease in levels of aromatics, a major source of benzene emissions in motor vehicles. For example, the state of Maine recently implemented its own fuel program that does not require the use of oxygenates. The fuel properties reported by Maine's gasoline suppliers and distributors show a decrease

[7] *National Air Quality Emission Trends Report,* USEPA, 1995; *Analysis of Photochemical Assessment Monitoring Station Data to Evaluate a Reformulated Gasoline Effect*, Sonoma Technologies Inc, 1998

in MTBE use by 50 percent and a corresponding increase in aromatics of 70 percent over the levels of aromatics present in RFG sold in Maine in 1997. In addition, EPA conducted a statistical analysis of 1998 RFG fuel properties and found that for regular grade gasoline, when MTBE decreases, aromatics, benzene and olefins tend to increase.

Available refinery modeling predicts that over time ethanol is the most likely gasoline additive to replace MTBE, even if the oxygenate mandate is removed. However, several significant air quality issues need to be addressed before northeast states pursue policies that result in increased use of ethanol. Combustion of ethanol-blend gasoline results in substantial (50 to 70 percent) increases of acetaldehyde emissions and ambient levels of acetaldehyde are presently far in excess of health-based risk standards in the Northeast. Refineries are likely to use ethanol at 10 percent by volume in conventional gasoline to take advantage of the statutory one pound volatility waiver, which would lead to a substantial increase in VOC emissions. For this reason, NESCAUM recommends elimination of this volatility waiver for ethanol. Unless all gasoline sold in the region contains ethanol, the blending or commingling of ethanol with non-ethanol gasoline blends in vehicle gas tanks will result in a significant increase in VOC emissions due to increased fuel volatility. On the positive side, ethanol, and especially locally produced biomass ethanol, has the potential for reducing CO2 emissions, eliminating the need for waste disposal, and retaining $120 million per year in the Northeast economy.

Aromatics and alkylates are the two most likely non-oxygenate alternatives to MTBE. Aromatics is a term for a group of gasoline constituents that includes benzene, toluene and xylene. These compounds are relatively high in octane. The use of aromatics to replace MTBE will substantially increase toxic emissions from motor vehicles operated on RFG and conventional gasoline. Alkylate provides octane without apparent increases in toxic emissions, and may not pose a risk to water resources. However, due to these attractive features, alkylate is already in short supply. The health effects of alkylate are not well understood. A rigorous evaluation of the potency, combustion by-products and environmental fate and transport of alkylate and other likely replacements for MTBE should be conducted prior to any substantial increase in their use.

The desire to achieve substantial reductions in MTBE, coupled with potential legal constraints and concerns about the near-term viability of alternatives to MTBE, has led some states to opt out of the RFG program. To date, the states that have opted out of the RFG program have done so without economic hardship, but the gasoline sold in these states does not provide the air quality benefits of the RFG program. NESCAUM strongly recommends additional refinery modeling to estimate the costs associated with a phase down of MTBE while preserving current levels of air toxic reductions in the RFG and conventional gasoline pools.

It is technically possible to produce a gallon of gasoline with no MTBE that achieves benefits equivalent to and even greater than the present performance of RFG in the Northeast. It is likely, however, that an immediate ban on MTBE cannot be accomplished without substantial increases in gasoline prices, supply shortages, and a substantial increase in air toxic emissions. Hence, the decision to reduce MTBE use in the northeast states must be guided by practical considerations such as the environmental performance of MTBE replacements, alternative product availability, gasoline cost and price stability, and the lead-time required for such a transition. These issues are considered in detail in Attachment III.

FUEL SUPPLY and COST

The gasoline distribution network in the Northeast is regional in nature; program decisions in one jurisdiction have consequences in neighboring states. Nearly 75 percent of the 12 billion gallons of gasoline sold in the Northeast annually is RFG. MTBE is widely used in the Northeast market because it is relatively inexpensive, provides a good source of octane, has low volatility characteristics, and can be blended at the refinery and shipped to the region through gasoline pipelines. Over one billion gallons of MTBE are consumed in the Northeast annually. As a region, the Northeast gets about 40 percent of its gasoline from East Coast refineries, 40 percent from Gulf Coast refineries and the remaining 20 percent from foreign suppliers.

Ethanol, the primary alternative oxygenate, is commonly used in gasoline sold in the Midwest, given the proximity to production facilities and the preferential tax schemes in place in these states. NESCAUM estimates that approximately 800 million gallons per year (gpy) of ethanol would be needed in the region to replace all of the MTBE currently used. The viability of ethanol as an alternative oxygenate for the Northeast market may hinge on the resolution of considerable supply, distribution, cost and performance issues. Production capacity does not currently exist in the U.S. to meet near-term demand if both California and the Northeast move toward broad substitution of ethanol for MTBE.

The fact that ethanol is not currently produced in significant quantities in the Northeast and cannot be shipped to the region through gasoline pipelines represent important logistical barriers. Under existing conditions, ethanol would have to be shipped by barge, rail or tanker truck from production facilities in the Midwest to the Northeast and blended at bulk terminal facilities in the region. The transport of huge quantities of ethanol will, in and of itself, result in increased mobile source emissions in the region.

Developing new ethanol production capability in the Northeast could help overcome these supply and distribution hurdles. A 1994 study conducted by the Conference of Northeast Governors (CONEG) concluded that the region could support a biofuel-based ethanol production industry comparable to that of the existing corn-based industry.[8] The CONEG study indicates that the quantity of biomass material currently discarded in the NESCAUM states and potentially available from herbaceous and short rotation woody crops could produce more than 1.8 billion barrels of ethanol per year. The CONEG study concluded that waste paper, paper sludge and cheese whey were the best current feedstock candidates for ethanol production in the Northeast.

In the longer-term, forestry wood waste could support significant ethanol production in the Northeast. Potential ethanol production in the Northeast is estimated by CONEG to be as high as 900 million gpy. This amount is equivalent to approximately two-thirds of the existing corn-based industry and slightly in excess of the amount needed to replace all of the MTBE currently used in the NESCAUM region market. However, it must be noted that there are currently no commercial ethanol biomass production facilities operating in the Northeast. While promising commercial scale facilities are in the early construction/planning stages respectively in Louisiana and California, it would take several years and considerable investment before the northeast states could produce enough bio-mass ethanol to overcome the transportation barriers noted above.

Biomass-derived ethanol presents a wide range of potential environmental and economic benefits for the northeast states. A study conducted by Argonne National Laboratory's Center for Transportation

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[8] *The Potential for Producing Ethanol from Biomass in the Northeast,* Conference of Northeast Governors, 1994

Research concludes that the net fuel-cycle GHG reductions of ethanol produced from cellulosic feed stocks range from 80 to 130 percent, relative to gasoline.[9] Moreover, the conversion of waste streams that presently must be land filled or incinerated into a valuable commodity presents a host of significant economic and environmental benefits. The benefits of producing ethanol in the Northeast from agricultural and wood wastes are far reaching and largely beyond the considerations of air quality that underlie the Clean Air Act and RFG program. As such, appropriate policies to promote the substantial environmental and economic benefits of biomass ethanol are substantially outside the scope of the RFG program and the recommendations contained in this study.

The cost of producing RFG with reduced amounts of MTBE may vary widely. The USDOE has estimated cost changes, relative to Phase II RFG, for alternative fuel formulations ranging from a decrease of 1.5 cents if the oxygen mandate were lifted and MTBE remained in use to an increase of 10 cents per gallon for RFG with an immediate ban on MTBE.[10] Moreover, these cost estimates seek merely to reflect the costs of producing a fuel that complies with the minimum statutory requirements of the RFG program and hence allow for a 40 percent increase in air toxic emissions over present RFG performance in the Northeast. The macro economic impact of relatively small changes in gasoline prices is substantial. For the twelve billion gallons of RFG sold in the Northeast annually, a change of one cent per gallon is equivalent to $120 million. Since gasoline refining is limited in the Northeast, an increase in gasoline price will result in an outflow of resources from the regional economy.

The costs of gasoline formulation changes are highly time-sensitive. In their assessment of MTBE alternatives, the California Energy Commission concluded, "If the use of MTBE were discontinued immediately, the consequences would be dire for consumers and catastrophic for the California economy."[11] Analyses by California and the USDOE suggest that a minimum of three years will be needed to cost-effectively replace MTBE in reformulated gasoline.

STATE ACTIONS TO REDUCE MTBE USE

Several RFG states have already taken action to address concerns over growing MTBE contamination of their water resources. The following is a brief summary of the actions taken in Maine, New Hampshire, Connecticut and California.

State of Maine

On October 13, 1998, Governor King sent a letter to USEPA indicating Maine's decision to opt out of the federal RFG program. This decision was predicated on the findings of a state Bureau of Health study that the higher levels of MTBE in RFG were statistically linked to the risk of groundwater contamination. The report concluded that the current levels and persistence of MTBE in groundwater did not constitute an immediate public health crisis, but raised concerns that continuation of the federal RFG program would result in an exacerbation of the problem. Believing that the state lacked the authority to remain in the RFG program and adequately regulate MTBE levels in fuel, the decision was made to opt out of the RFG program altogether.

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[9] GHG reductions greater than 10% are theoretically possible because co-generation at the cellulosic ethanol conversion plant could displace fossil fuel-generated electricity.

[10] *Estimating Refining Impacts of revised Requirements for Gasoline: Summary Findings*, G.R. Hadder, Oak Ridge National Laboratory, 1999.

[11] *Supply and Cost of Alternatives to MTBE in Gasoline*, California Energy Commission Staff Report, 1998.

The RFG program opt out was approved by USEPA as of February 1, 1999 with the following conditions: (1) Maine must identify alternative control measure(s) to provide equivalent VOC reductions to the RFG program; (2) a schedule for implementing the replacement measure(s); and (3) Maine provide an explanation of the impact to the State Implementation Plan for ozone.

As a replacement measure, Maine has adopted a low volatility conventional gasoline initiative. No gasoline delivered in the former RFG counties (York, Cumberland, Sagadahoc, Adroscoggin, Kennebec, Knox and Lincoln) shall have a Reid Vapor Pressure (RVP) of greater than 7.8 pounds per square inch (psi) for the period May 1 to September 15, 1999. For the period May 1 to September 15, 2000 and subsequent years, the RVP of fuels in these counties shall not exceed 7.2 psi.

Preliminary fuel quality data suggest that the amount of MTBE in gasoline has been reduced by more than 50 percent as a consequence of this initiative. Consistent with Maine's action to substantially reduce MTBE, public concern over MTBE contamination has dissipated considerably. Based on Maine's desire to maximize the potential air quality and pubic health benefits of cleaner burning gasoline, the state has indicated an interest in future participation in the federal RFG program should a national or regional solution emerge to adequately reduce MTBE use.

New Hampshire

In June 1999, the New Hampshire legislature adopted an *Act relative to the prevention of MTBE contamination of drinking water and groundwater*. Citing concerns about MTBE contamination of drinking water, the uncertain health and environmental impacts of alternative clean fuel formulations, and current lack of state authority to regulate the MTBE content of RFG, the legislature instructed the Department of Environmental Services (DES) to seek a waiver to opt out of the RFG program until January 1, 2002. Consequently, the state will revert back to conventional gasoline during this interim.

The legislation also requires: continued monitoring of public and private drinking water supplies; a study of MTBE alternatives; and the adoption of primary and secondary drinking water standards for this additive. The Act further authorizes the Commissioner of DES to require lower MTBE concentrations in gasoline if readily available and reasonably priced substitute gasoline supplies exist and are approved for use in New Hampshire by the USEPA. Like Maine, New Hampshire has expressed a strong desire to rejoin the federal RFG program or a regional cleaner burning gasoline strategy should a national or regional solution emerge to adequately reduce MTBE use.

Connecticut

The Connecticut legislature recently passed a law requiring the Commissioner of Environmental Protection to report back to the General Assembly by February 1, 2000 with recommendations on "whether the continued use of MTBE is appropriate" (Senate Bill Number 630, "An Act Concerning the Use of MTBE as a Gasoline Additive," June 23, 1999). The legislation requires an investigation into four specific areas: (1) whether MTBE use should be continued and if not, an explanation of the waiver process, (2) the impact of MTBE on the state's water supply, (3) the status of other relevant state actions, and (4) recommendations on alternative or supplemental air pollution reduction programs, such as alternative vehicle incentives, mass transit and employee commute programs.

California

Citing a significant environmental threat to groundwater and drinking water, on March 1999, Governor Gray Davis directed a phase-out of MTBE use in California to be completed no later than December 31, 2002. California asked USEPA for an immediate waiver from the Clean Air Act's oxygen mandate and committed to maintaining the air quality emission standards of the RFG program. The governor also mandated a pump labeling program to inform consumers about gasoline containing MTBE. The Air Resources Board and Water Resources Control Board were directed to conduct an analysis of the environmental fate of ethanol in air and water. The Office of Environmental Health Hazard Assessment will prepare an analysis of the health risks of ethanol in gasoline and the products of incomplete combustion.

WATER QUALITY IMPACTS OF MTBE

Gasoline contamination has posed a threat to water resources since it was first introduced as a transportation fuel a century ago. Gasoline-related pollutants such as benzene, toluene, ethyl benzene, and xylenes (jointly referred to as the BTEX compounds) have long been monitored and regulated in drinking water. While it has been used as a gasoline additive for only about twenty years, MTBE is now one of the most frequently detected VOCs in Northeast drinking water supplies.

MTBE and other gasoline constituents can enter surface and ground water from leaking tanks, accidental spills, direct atmospheric deposition, and stormwater runoff. The presence of MTBE increases the threat of water contamination since this additive is highly soluble and therefore travels faster and further in soil and groundwater than other fuel constituents. Because MTBE is relatively resistant to biodegradation compared to other gasoline constituents, it persists longer in the soil and groundwater. These same characteristics also enable low level MTBE water contamination through non-point sources, which could include airborne deposition in rainfall. Boats and other gasoline-powered watercraft, particularly those powered by 2-stroke engines, are a major source of MTBE in surface water.

MTBE contamination of drinking water occurred prior to the introduction of federal RFG and oxygenated gasoline and this additive continues to be found in some drinking water in non-RFG areas. However, the incidence of MTBE-related water contamination appears to have increased substantially where RFG and oxygenated gasoline are used. MTBE has been found at low levels in about 15 percent of the drinking water tested in the Northeast. However, the vast majority of samples with detectable levels of MTBE contain less than 2 parts per billion (ppb) of this additive. Public health impacts, as well as taste and odor problems, are a concern where MTBE is present in drinking water at levels above 20 to 70 ppb. The results from a group of studies (summarized in Table 3) show that between 0.5 and 1.5 percent of water supplies tested in the Northeast contained MTBE at concentrations above the 35 ppb public health drinking water standard used in Maine (the most restrictive standard in the region).

Table 3
MTBE Concentrations in Northeast Water Supplies

Concentration Range (µg/L)	Maine Private Wells N = 946 (95% CI)	Maine Public Water Supplies N = 793 (95% CI)	USGS Studies N = 376 (95% CI)
< 0.2	85.0% ….	85.1% ….	82.2% ….
0.2 – 5	12.0% (10-14%)	13.6% (11-16%)	16.2% (13-20%)
5 – 35	1.9% (1.1-2.3%)	1.3% (0.6-2.3%)	1.0% (0.3-2.7%)
> 35	1.1% (0.5-1.9%)	0.0% (0.0-0.5%)	0.5% (0.06-1.9%)

Source: Presence of MTBE and other Gasoline Compounds in Maine's Drinking Water Supply: A Preliminary Report, 1998 N = Number of samples. 95% CI = 95 percent confidence interval. The USGS studies included parts of CT, MA, NJ, NH, NY, PA, and VT. Note that the smaller number of observations at higher MTBE concentrations (>5 µg/L) makes conclusions about differences between the Maine and USGS results less meaningful, as reflected by the considerable overlap in the 95% confidence intervals.

The threat of exposure to MTBE from contaminated private wells is greater because these systems are not routinely monitored as is the case with public drinking water supplies. MTBE concentrations above 35 ppb are typically associated with identifiable sources such as storage system releases or major accidental spills. However, an analysis conducted by the State of Maine suggests that relatively small spills of a few gallons can contaminate wells to levels near or above health guidelines.[12]

Table 4 shows that compared to MTBE, the BTEX compounds (with the possible exception of toluene) were infrequently detected and were typically well below health-based standards. Toluene may have been detected relatively more frequently at low levels, but more than 80% of toluene detections occurred in reprocessed samples that did not receive confirmatory sampling by trained field staff. In one study conducted by the United States Geological Survey (USGS) in the Northeast, MTBE was the most frequently detected compound of the twenty-five chemicals sampled.[13] The fact that wells with MTBE often do not contain detectable levels of BTEX compounds points to the unique threat to water resources posed by this additive. Benzene, for example, was detected in only 12 percent of the wells where MTBE was found. The vast majority of MTBE detections in our region (98%) are at levels well below the most stringent state health thresholds. Atmospheric deposition by rainfall is one possible source of the very low MTBE concentrations seen in the majority of detections, but this source is extremely unlikely to result in contamination at levels approaching or exceeding drinking water standards.

[12] *The Presence of MTBE and Other Gasoline Compounds in Maine's Drinking Water: A Preliminary Report*, Maine Dept. of Human Services, Maine Dept. of Environmental Protection, Maine Dept. of Conservation, 1998
[13] *Volatile Organic Compounds in Groundwater in the Connecticut, Housatonic, and Thames River Basins*, S.J. Grady 1993-95: USGS Fact Sheet 029-97.

Table 4
Detection Frequency of Gasoline Compounds in Public and Private Drinking Water in Maine

Pollutant	Private Wells	Public Water Supplies
Xylene	0.1%	1.6%
Toluene	2.1%	13.1%[14]
Ethylbenzene	0.1%	0.9%
Benzene	0.5%	2.0%
MTBE	15.8%	16.0%

Source: Presence of MTBE and other Gasoline Compounds in Maine's Drinking Water Supply – A Preliminary Report, 1998

For 885 public drinking water supplies tested in New Hampshire from 1995 to 1998, 6.2 percent had detectable levels of MTBE. The concentrations were typically below 5 ppb. No community or non-transient water supplies had MTBE levels above 20 ppb. Three transient supplies had concentrations greater than 20 ppb. A transient supply is one that is used intermittently or seasonally such as at a campground.

For surface waters, gasoline contamination tends to be closely related to the use of motorized watercraft. Studies have found that MTBE and BTEX occur simultaneously at relatively low levels in lakes where gasoline-powered watercraft are used. These levels tend to increase in the summer when watercraft usage is high and decrease or disappear in the winter when usage is low. MTBE volatilizes (evaporates) from surface waters, but at a rate slower than the BTEX compounds. Air deposition and stormwater runoff may also impact surface waters. A USGS study of seven streams in New Jersey detected MTBE in eighty-seven of the one hundred and twelve samples taken. However, the median concentration was 0.42 ppb and the maximum concentration 4.8 ppb.[15]

Releases from storage tank systems represent the primary threat to drinking water from gasoline-contamination because the volume of gasoline released can be significant and historically could go undetected for long periods of time. To address this threat, federal and state governments embarked on a major initiative to upgrade the underground storage tank (UST) infrastructure. Most underground tanks now employ double-wall construction and incorporate monitoring systems to detect and report leaks. This program should significantly reduce the incidence of groundwater contamination from gasoline and MTBE. While many of the northeast states have UST compliance rates over 95 percent, nationally approximately 20 percent of UST regulated storage tanks have not been upgraded even though the compliance deadline has passed.

The dynamic and ongoing improvements state UST programs must be considered in determining the degree of MTBE reduction that is necessary to protect groundwater resources. However, even when fully implemented, UST program improvements alone are unlikely to provide sufficient protection against MTBE contamination at current levels of use in RFG. A large population of gasoline storage

[14] Toluene may have been detected relatively more frequently at low levels, but more than 80% of toluene detections occurred in reprocessed samples that did not receive confirmatory sampling by trained field staff (see Water Quality White Paper for more detailed explanation of the uncertainty associated with this value).
[15] *Occurrence of Seasonal Variability of Volatile Organic compounds in Seven New Jersey Streams*, U.S. Geological Society Survey Water resources Investigations Report,98-4074, 1998.

tanks are not regulated under UST programs and tank failures will continue to occur, albeit at a significantly lower rate than in the past. In addition, gasoline releases can still occur from refueling and other activities associated with storage systems, even with state-of-the-art tanks. Further, accidental spills ranging from tanker truck turnovers to lawnmower overfills will remain a source of gasoline contamination of water and soil. If MTBE in RFG is substantially reduced, gasoline will pose less of a threat to water resources than at present or in the past. In particular, the risk to water resources from small leaks and spills should diminish substantially with lower levels of MTBE in gasoline since a nearly linear relationship exists between the amount of MTBE in the gasoline and the concentration in contaminated water.

IMPACT OF MTBE ON REMEDIATING GASOLINE SPILLS

Where pollutants are found in drinking water at concentrations above health-based standards, states must either treat the supply or provide an alternative source. Due to its toxic potency, benzene has historically been the water pollutant of primary concern at gasoline-contaminated groundwater sites. To put this in perspective, in Connecticut, the remediation standard for benzene is 1 ppb, 1000 ppb for toluene, and 100 ppb for MTBE. Because it is often found in groundwater without the BTEX compounds, has a low taste and odor threshold, and is persistent in groundwater, MTBE may replace benzene as the contaminant most often requiring remediation of drinking water supplies in some RFG areas.

NESCAUM conducted a survey of the northeast states in an effort to quantify the incremental increase in drinking water cleanup costs due to the presence of MTBE in gasoline. Additional information was taken from a national survey on MTBE impacts conducted by the University of Massachusetts (UMass) and USEPA which found marked differences in drinking water clean-up costs in areas with and without RFG.[16] The NESCAUM survey found that in 1997, the northeast states and responsible private parties spent about $172 million to remediate gasoline spills. Of this total $115 million was spent in RFG areas and $57 million in non-RFG areas. Due to its particular chemical properties and low taste and odor threshold, MTBE increases the overall cost of treating gasoline-contaminated water supplies. In RFG areas, about $34 million or 30 percent of the total clean-up costs were related to the presence of MTBE. By contrast, the survey found that only about 6 percent of the clean-up costs in non-RFG areas were related to the presence of MTBE.

To put these costs in context, a one-cent per gallon increase in the price of the 12 billion gallons of gasoline sold each year in the Northeast results in consumer costs of $120 million per year. Consequently, the differential remediation costs associated with the presence of MTBE in the Northeast are equivalent to a 0.25 cent per gallon increase in the price of gasoline. It should be noted that these expenditures reflect clean up costs prior to full compliance with UST regulations. Total gasoline remediation costs, including the amount attributable to MTBE, may decline commensurate with the reduction of leaking tanks.

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[16] *Study Reports LUST Programs are Feeling Effects of MTBE Releases*, Soil and Groundwater Clean up, August/September 1998, Robert Hitzig, Paul Kostecki, and Denise Leonard.

HEALTH EFFECTS OF GASOLINE CONSTITUENTS

For the population as a whole, the public health benefits RFG provides by reducing air pollution substantially outweigh adverse public health impacts from exposure to increased levels of MTBE in the air and water. Exposure to ambient levels of mobile source-related air toxics above health-based standards are widespread in the Northeast. At this time, MTBE contributes to substantial reductions in these air toxics through the RFG program. Conversely, ambient air and water quality monitoring in the Northeast indicate that incidents of exposure to MTBE above health thresholds are rare.

Alternative strategies for maintaining the air quality benefits of cleaner-burning gasoline while limiting the threat to water supplies will inevitably introduce different public health benefits and adverse impacts when compared against the status quo of RFG with MTBE. When assessing the likely health impacts of alternative formulations, two basic factors must be considered: the level of exposure and the potency of the toxins to which the public is exposed. Given the ubiquitous presence of motor vehicles, public exposure to all gasoline-related pollutants in the air is high. Compared to some other gasoline components, MTBE presents a higher potential for high exposure through groundwater due to its mobility and resistance to biodegradation. MTBE is significantly less potent than many other components in gasoline. The immediately available replacements for MTBE in the Northeast are aromatic hydrocarbons. The potency of these compounds is substantially greater than MTBE yet the potential for exposure due to groundwater contamination is substantially lower. Because exposure to these potent aromatic compounds in the air is already high, increases in the aromatic content of gasoline represent a public health threat.

MTBE has been shown to produce cancer in laboratory animals. To date, however, expert panels reviewing the results of scientific studies have considered these animal data insufficient to classify MTBE as a human carcinogen. In a situation of documented animal carcinogenicity and equivocal evidence of human carcinogenicity, the conservative public health approach used by the northeast states is to treat MTBE as a carcinogen for comparative risk purposes. However, it should be stressed that NESCAUM has not performed any independent analysis that demonstrates that MTBE is a human carcinogen. Available data do suggest that if it is a carcinogen, MTBE is a significantly less potent than other gasoline-related pollutants such as benzene or 1,3-butadiene.

With respect to non-cancer effects, some individuals report adverse health effects following short-term exposure to MTBE. The health effects reported, include: headaches, dizziness, and eye and throat irritation. However, limited studies to date have not been able to confirm that MTBE exposure is causally associated with significant increase in these symptoms in the general population. The federal Office of Science and Technology Policy concluded that "[a]necdotal reports of acute health symptoms among some individuals at very low levels of exposure to oxygenate cannot be adequately explained, but cannot be dismissed."[17] Further analyses of the short-term reaction to MTBE exposure is necessary, particularly in self-reporting sensitive members of the population to better qualify and quantify this potential effect.

[17] *Interagency Assessment of Oxygenated Fuels*, National Science and Technology Council, 1997.

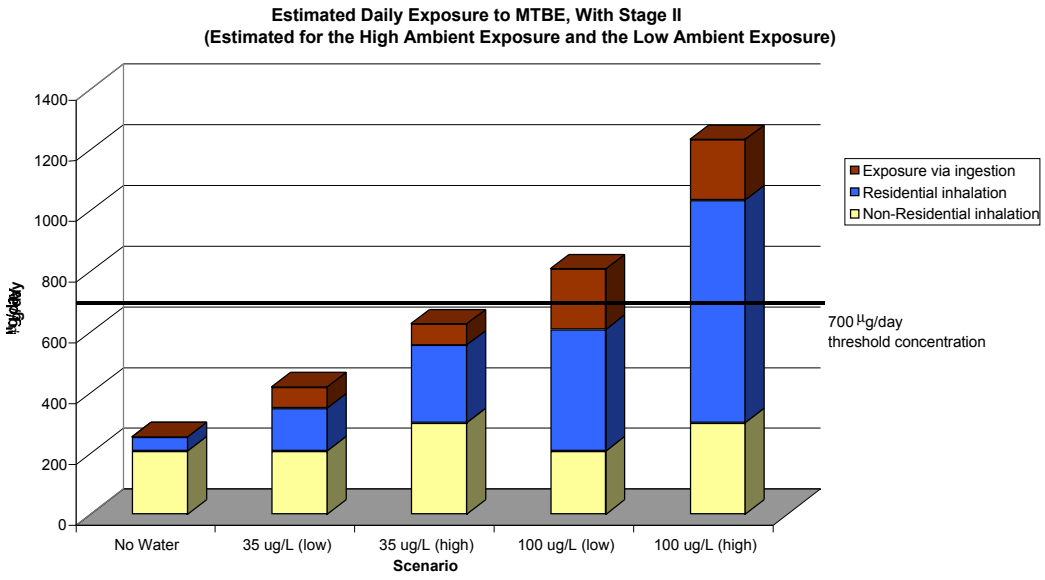
The general public is potentially exposed to MTBE and other gasoline constituents and combustion by-products through various pathways including breathing outdoor and indoor air and drinking or using contaminated water. Existing data suggest that typical ambient air concentrations of MTBE do not pose a chronic public health threat in the Northeast. The chronic threat posed by MTBE appears limited to those subpopulations exposed to elevated airborne MTBE concentrations and who live in households with drinking water containing concentrations greater than state public health guidelines. Northeast state health guidelines range from 35 to 70 micrograms per liter. By contrast, ambient air concentrations of benzene exceed health protective thresholds in all locations in the Northeast. The additional exposure for individuals living in households with drinking water containing concentrations of benzene greater that state public health guidelines (5 micrograms per liter) will increase the threshold exceedance by over two orders of magnitude. Based on the initial exposure assessment conducted by NESCAUM, the presence of Stage II vapor recovery systems at the gasoline refueling pump, would reduce the total MTBE exposure such that only the upper bound exposure scenario would exceed the health protective threshold.

Public health agencies in the Northeast states use available scientific evidence to develop health-protective thresholds for compounds in multiple environmental media. These health-protective thresholds are not absolute indicators of anticipated adverse health impact following exposure, but rather represent exposure concentrations that are expected to result in no adverse health effects with long-term exposure. Thresholds aid in screening environmental contaminants of potential concern in order to target additional emission reduction efforts and to identify areas requiring more refined assessment of potential health impact.

In order to understand the differences in exposure and the attendant health risk(s), NESCAUM evaluated several exposure scenarios.[18] Figure 2 indicates the relative importance of the various exposure routes. The figure includes exposure estimates for individuals with and without MTBE-contaminated water. High and low estimates are provided for two different levels of water contamination. The high/low values within each water contamination level represent the maximum and minimum measured MTBE concentrations in homes.[19,20] The use of these estimates is intended to bound the uncertainty regarding exposure to MTBE vapors inside the residence. In the program recommendations herein, NESCAUM recommends a regional monitoring and exposure assessment program. This program would support a more comprehensive exposure assessment and distributional exposure analysis, which would provide more precise estimates of the portion of the population at different risk levels in the Northeast.

[18] Please refer to the technical paper for more complete details regarding exposure scenarios evaluated.
[19] Huber, A.H. Human Exposure Estimates of Methyl Tertiary Butyl Ether (MTBE). Abstract and presentation for the Conference on MTBE and other Oxygenates, Falls Church, VA, July, 1993.
[20] Brown, S. L. 1997 Atmospheric and Potable water exposures to methyl tert-butyl ether (MTBE). *Regulatory Toxicology and Pharmacology* 25: 256-276.

Figure 2



The presence of MTBE-contaminated water is predicted to increase overall exposure by 50 to 300 percent, depending on the concentration of this pollutant in the water and the assumptions about outdoor and residential exposure. Figure 2 also shows the public health threshold (700 micrograms per day) designed to protect the average individual against adverse effects of MTBE exposure, including potential cancer effects, as described previously. These results suggest that the presence of contaminated water may be sufficient to increase average individual exposures to levels above the health protective threshold.

As discussed previously, monitoring and modeling studies indicate that mobile source-related pollutants are currently driving a significant portion of the overall public health risk from ambient air toxics. Results from the computer modeling conducted as part of the USEPA's CEP indicate the size and scope of the potential public health threat associated with exposure to airborne toxins in the outdoor air. Some toxins, including benzene and other gasoline-related pollutants, are predicted to exceed health protective thresholds in every census tract in the country. Consequently, it is critical that there be no backsliding with regard to air toxic emissions from gasoline as we look for ways to better protect water resources. It would be shortsighted to relinquish cost-effective toxic reductions from RFG as the need for greater overall toxic reductions becomes increasingly apparent.

PROGRAM RECOMMENDATIONS

Overview

NESCAUM proposes a multi-component strategy for the northeast states to cost-effectively reduce the adverse impacts of MTBE on water resources, while maintaining the public health benefits of the RFG program. The strategy includes: regulatory initiatives; a monitoring and assessment program: rigorous scientific assessments of the cost, supply, and health impacts of MTBE alternatives; and a public education and outreach campaign. In light of the fact that RFG and the oxygenated fuels program are federal initiatives, NESCAUM believes that a federal solution is warranted and optimal. To this end, the northeast states must continue to work with other interested parties to develop and implement an effective and equitable national solution. Absent an appropriate federal response, a regional solution will be pursued in the Northeast.

Legislative and Regulatory Initiatives to Reduce MTBE in Gasoline

As evidenced by the conclusions of the Federal Blue Ribbon Panel, there is broad agreement that the amount of MTBE used in reformulated gasoline should be reduced to lower the risk of water contamination. While the goal is straightforward, the process for achieving this objective is complex. Several statutory and regulatory impediments must be overcome to achieve the desired outcome. Because federal action is needed to change the Clean Air Act and modify existing USEPA regulations, the northeast states must remain active participants in the national debates. The following steps need to be taken to affect a reduction in MTBE use. Depending on the outcome of on-going negotiations in Congress, either the federal government or states may ultimately implement various elements of this strategy.

Removal of the Oxygen Mandate for the Federal RFG Program

The NESCAUM strategy to reduce MTBE use in the Northeast hinges on Congressional action to lift the Clean Air Act requirement that RFG contain a minimum of 2 percent oxygen by weight (11% MTBE by volume). While an across-the-board repeal of the oxygen requirement is most appropriate, the ability of states to receive a waiver of this requirement upon demonstrated need presents a second option. Unless the oxygen mandate is lifted, a reduction in the use of MTBE will force widespread use of ethanol in the Northeast. The cost-effectiveness of transporting and distributing ethanol in the Northeast remains uncertain.

Congressional Clarification of USEPA and State Regulatory Authority

Congress must clarify USEPA and individual state's authority to control or prohibit the use of fuel additives that pose an unacceptable risk to the environment. At present, USEPA and the states have authority to regulate fuel if necessary to protect public health from exposure to air pollution. However, authority is less clear when the need is environmental and not public health protection, as is the case with MTBE. States would be authorized to further regulate or eliminate MTBE by submitting a Section 211 waiver request to USEPA. NESCAUM recommends that USEPA use the criteria outlined by the federal Blue Ribbon Panel to evaluate state waiver requests regarding the control of MTBE.[21] For RFG

[21] The Panel Report Recommends a two-part test for use in acting on a state waiver request to restrict or eliminate MTBE: (1) states must demonstrate that their water resources are at risk from MTBE use and (2) states have taken the necessary measures to restrict or eliminate the presence of gasoline in the water resource. To maximize

areas granted a waiver, the Phase II RFG performance standards would remain federally enforceable. To minimize production, supply and cost impacts, states will seek to implement any further regulatory action regarding MTBE regionally according to a consistent schedule.

Three Year Phase-down and Cap on MTBE in Gasoline

USEPA and the states should work together to assess the necessary reductions in MTBE levels to mitigate the unacceptable risk to water resources. Within six months of Congressional action lifting the mandate, the USEPA should propose regulations to phase-down and cap the MTBE content of all fuels. The cap should be phased-in over a three-year period to minimize adverse economic impacts and must apply to all grades of gasoline sold in the U.S. year-round to ensure that overall MTBE use is reduced, not just diverted to the conventional gasoline pool. If USEPA fails to act in a timely manner, the northeast states will employ the federal authority described above to phase down and cap MTBE within three years.

After the phase-down is complete and the cap is in place, the northeast states will collaboratively assess whether additional federal, regional or state actions are necessary to protect water resources from MTBE contamination. Based on this assessment, individual states or the region may further regulate the MTBE content of gasoline. State or regional action must balance the benefits of uniformity in fuel quality requirements against the differential risk to water resources posed by MTBE in the NESCAUM member states.

USEPA Action to Prevent Air Quality Backsliding

The air toxic benefits currently realized from RFG (i.e., a 35% in mass emissions of the five regulated toxins in the Northeast market in 1998) must be sustained under the Phase 2 RFG program. To accomplish this goal, USEPA must revise the Phase 2 RFG performance standard for toxics to ensure that the 1998 annual average in the Northeast continues to be achieved after January1, 2000. In addition, toxic air emissions from conventional gasoline sold in the Northeast have declined 13% since 1990, and those emission benefits should also be preserved through additional federal regulation. Allowing the use of lower levels of MTBE in the near-term will assist gasoline refiners in meeting this standard in a cost-effective manner.

Regional Assessment of Gasoline Storage Tank Leak Protection Programs

Leaking gasoline storage systems represent the primary pathway for gasoline to enter groundwater supplies. There are approximately 1.1 million federally regulated underground storage tanks in the U.S.; the overwhelming majority contain petroleum.[22] In 1988, USEPA issued regulations establishing minimum standards for new tanks and requiring owners of existing tanks to up-grade, replace or close them. Full compliance with the UST requirements was to occur within ten years of promulgation. The UST regulations are designed to prevent releases of stored petroleum and chemical products into the

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uniformity and minimize economic impacts the Panel recommends that USEPA establish criteria for state waiver requests including but not limited to: (a) water quality metrics necessary to demonstrate the risk to water resources and air quality metrics to ensure no loss of benefits from the RFG program; (b) compliance with federal requirements to prevent leaking and spilling of gasoline; (c) programs for remediation and response; and (d) a consistent schedule for state demonstrations, USEPA review, and any resulting regulations of the volume of gasoline components in order to minimize disruption to the fuel supply system.

[22] *UST Program Facts: Implementing Federal Requirements for Underground Storage Tanks*, U.S. Environmental Protection Agency's Office of Underground Storage Tanks (EPA 510-B96-007, December 1996.

environment through tank upgrades and on-line monitoring of tank and piping integrity.

These programs cover commercial gasoline and chemical storage tanks with at least 10 percent of their combined volume underground. Non-commercial farm and residential underground tanks with a capacity of less than 1100 gallons are exempt from the UST program. Any tank with a capacity of less than 110 gallons is also exempt. Above ground tanks are not covered by UST requirements. Although substantial progress has been made in implementing UST programs, nationally, 20 percent of applicable tanks have not been upgraded. However, compliance rates in the Northeast are better than the national average. Data for the New England states show that 96 percent of regulated tanks and systems have been upgraded.[23]

NESCAUM recommends that the northeast states conduct an analysis of the need for and viability of regulating gasoline storage systems not covered under existing UST programs. This would include exempted underground systems and above ground gasoline storage tanks. If additional controls are deemed viable and cost-effective, the northeast states should expeditiously initiate rulemakings to regulate the expanded universe of gasoline storage systems. We also recommend an evaluation of the UST program in the region to assess opportunities for augmenting enforcement and compliance programs and expediting full implementation of these regulations. As part of the feasibility analysis the northeast states must assess the additional regulatory costs associated with any significant program expansions.

Regional Multi-Media Monitoring and Assessment Program

The northeast states should collaborate in the development of an enhanced air and water quality monitoring and assessment program. The primary goals of the initiative are to: (1) enhance our understanding about concentrations of gasoline-related toxins, including MTBE, in the region's air and water and (2) track the environmental impacts associated with reducing MTBE use and substituting other octane enhancing constituents in gasoline. The first step in undertaking this enhanced monitoring and assessment initiative is to identify public and private resource needs and availability.

A regional taskforce will be established to develop an environmental media monitoring and assessment plan, which will include appropriate data quality objectives, target pollutants, measurement methodologies, and analytical techniques. Effort will be made to ensure that proposed ambient monitoring efforts expand upon ongoing state activities, such as the photochemical assessment monitoring stations (PAMs) and water quality monitoring programs. The Commonwealth of Massachusetts has developed methodologies to accurately determine volatile petroleum hydrocarbons in soil, water, and air and to comparatively assess the risk of complex mixtures of petroleum hydrocarbons in air or water.[24,25] These methodologies will be used as starting points to establish the technical elements and scope of the environmental media monitoring and assessment plan.

There is little long-term data on historical levels of MTBE in the air and water in the Northeast. Most

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[23] *FY 99 Supplemental Activities Report*, U.S. Environmental Protection Agency Office of Underground Storage Tanks, May 1999.

[24] *Method for the Determination of Volatile Petroleum Hydrocarbons.* Massachusetts Department of Environmental Protection, Division of Environmental Analysis, Office of Research and Standards, Bureau of Waste Cleanup, January 1998.

[25] *Interim Final Petroleum Report: Development of Health-Based Alternative to the Total Petroleum Hydrocarbon (TPH) Parameter,* Massachusetts Department of Environmental Protection, Office of Research and Standards, 1994.

states in the Northeast are now testing for MTBE as part of their routine water quality monitoring programs and are initiating airborne measurement of this pollutant. NESCAUM recommends that all states in the region add MTBE to the current suite of VOCs analyzed as part of their public and private drinking water monitoring programs. Further, states should assess and enhance, as necessary, existing water quality monitoring efforts. It is essential that the northeast states adopt consistent measurement, analysis, and reporting requirements to enable the development of a regional database on waterborne MTBE contamination. In order to assess the long-term impacts of reduced MTBE concentrations in fuel, NESCAUM recommends that the region undertake a limited number of focused surface, ground, and drinking water quality monitoring projects. These projects should assess geologically diverse "high risk" locations (e.g., fuel stations, bulk distribution terminals, UST locations, and spill sites).

The Northeast states will initiate a process involving state environmental and public health officials to establish regionally consistent health-protective thresholds for MTBE in air and water that will be used to assess the public health impact of this compound. Additionally, the northeast states believe that USEPA should, at a minimum, develop an interim maximum contamination level (MCL) to establish a consistent national standard.

The regional monitoring and assessment program and the regionally-consistent health-protective thresholds will inform future regulatory and programmatic decisions, including the need to reduce MTBE beyond the levels established by federal or state caps. It will also help to quantify the public health benefits associated with the air toxic reduction element of the federal RFG program by providing both direct measurements and the data needed to validate computer models that predict public exposure to gasoline-related toxins. The data from this assessment will serve to verify the Northeast's commitment to no "backsliding" with regard to the air toxic benefits of the RFG program.

To the extent that ethanol or other oxygenates begin to penetrate the Northeast market in significant quantities, states should monitor for these alternative oxygenates. NESCAUM recommends that this compound be added to the list of target pollutants in the regional measurement and assessment program at this time. These data will help establish a viable baseline from which to compare future changes should ethanol be widely introduced in the coming years. In addition to direct contamination of groundwater, the presence of ethanol could result in collateral effects. For example, the magnitude of benzene contamination could increase because the microbes that currently biodegrade benzene may be preferentially attracted to ethanol where it is present. The availability of baseline data might help regulators better understand the relationship between ethanol and benzene.

Scientific Assessment of MTBE Alternatives

Should changes to the RFG program result in the decision to substantially increase the use of a gasoline constituent or additive, a rigorous multi-media assessment must be undertaken to proactively assess potential public health and environmental impacts. Specifically, research is needed on the health effects and environmental behavior of likely MTBE substitutes including ethanol, alkylates and various aromatic compounds. It is important to look both at these constituents alone and as part of the gasoline mixture.

The unanticipated degree of adverse impacts of MTBE on water resources provides a powerful example of the need to study the potential impacts of new gasoline products on air, water, and soil, as well as the need to understand the effect of dramatically increasing any current constituents of gasoline. Changes to the RFG program will by design or necessity result in substantial increases in the use of existing

gasoline constituents or the introduction of new additives. NESCAUM recommends that USEPA work with the states to develop a basic screening process that must be completed prior to the introduction of new fuel constituents. This screening process must include an assessment of environmental fate and transport and a structure-activity assessment. The existing toxicity testing requirements established under Section 211(b) of the Clean Air Act must be streamlined to enable more timely assessment of potentially adverse health impacts of gasoline constituents. NESCAUM recommends that USEPA require fuel manufacturers to use readily available and accepted protocols to assess the various toxicity endpoint established under the Standard and Alternative Tier II testing requirements. Moreover, NESCAUM recommends that more rigorous multi-media assessments be undertaken to assess potential long-term public health and environmental impacts of MTBE substitutes.

Analysis of the Fuel Supply and Price Impacts of Reduced MTBE Usage

Detailed refinery modeling and supply and distribution analyses should be completed to predict how changes in fuel formulations will affect the cost of producing gasoline for the Northeast market. While the U.S. Department of Energy (USDOE) has analyzed the cost and supply impacts of removing MTBE from RFG, no studies have been completed to assess the impacts associated with a maximum cap of MTBE levels. Further, USDOE modeling has assumed that refiners would only meet the minimum regulatory requirements for toxic air emissions. Existing modeling does not assess supply and distribution issues associated with MTBE alternatives. NESCAUM recommends that additional studies be conducted to look at the cost impacts of producing RFG for the Northeast that meets the proposed 35 percent toxic performance standard for Phase 2 RFG.

To better understand the cost of phasing down or eliminating the use of MTBE in gasoline in the Northeast while preserving the substantial margin of overcompliance experienced to date from the RFG program, NESCAUM recommends four additional refinery modeling runs as described in the footnote.[26] All analyses should include both the RFG and conventional gasoline pools.

[26] **Reference Case**: The 35% reduction in air toxics as achieved under the MTBE-based RFG program in the Northeast in 1998. Include PADD I and PADD III refineries. Separate the RFG and CG pools, and regular and premium grades. When ethanol is used during a particular season, it must be used for the entire pool in order to avoid commingling.

Cases

1. All parameters used in the reference case, but no oxygenates in either the RFG or the CG pools. This case represents a worse case scenario. It assumes that the oxygenate mandate is lifted, ethers are banned, and ethanol is, for whatever reason, not available. This case will quantify the tradeoff between motor vehicle toxic emissions, gasoline price, and oxygenates.
2. All parameters used in the reference case, an MTBE cap of 3%, and 5%, by volume for the pool average, including RFG and CG, regular and premium. Refineries are free to use various amounts of MTBE in different pools or grades.
3. All parameters used in the reference case, but lift the oxygenate mandate. US DOE performed a similar scenario but only for an immediate case without investment. This case differs from the DOE scenario because it allows for investment, and will include PADD III as well as PADD I.
4. All parameters used in the reference case, maintain the oxygenate mandate, ban ethers, for PADDs I and III. US DOE has already completed an analysis of this scenario, but only for PADD I, and the reference case has changed significantly.

Public Education and Outreach Initiative to Diminish Gasoline Spillage

Enormous amounts of gasoline are spilled each year at the gas station pump, during transport, and while refueling small engines such as those used to power lawn and garden equipment and recreational vehicles such as boats and snowmobiles. These spills have a host of adverse impacts including air, water and soil contamination. The presence of high concentrations of MTBE in RFG has increased the threat to groundwater supplies from these small-scale spills.

The northeast states, in conjunction with other interested parties, have embarked on a sustained public outreach campaign designed to reduce the number and magnitude of spills associated with the improper handling of gasoline. This campaign promotes better care among consumers and cost-effective technological solutions to minimize the occurrence of small-scale spills. To this end, NESCAUM has established a partnership -- The Alliance for Proper Gasoline Handling -- to initiate a national education and outreach campaign. In addition to the NESCAUM states, the alliance currently includes representatives from the oil industry, oxygenate manufacturers, USEPA, California Air Resources Board and environmental advocates. These efforts must be sustained and expanded in the coming years.

CONCLUSION

This study demonstrates that federal and state decisions regarding gasoline fuel quality can have a significant impact on environmental quality, public health and the region's economy. The recommendations presented in this report chart a course for state and federal action to aggressively mitigate the environmental risk posed by MTBE while maintaining the public health benefits of the RFG program. In addition, the proposed effort to better characterize the environmental and public health impacts of gasoline constituents and MTBE alternatives will begin to provide the knowledge needed to responsibly direct future changes in the fuel supply.

The keystone of these recommendations is securing the flexibility and clear authority to regulate gasoline constituents and additives that pose and unacceptable risk to natural resources. Toward this end, the northeast states must continue to advocate for Congressional action to lift the oxygen standard within the federal RFG program and expand Section 211authority for regulating gasoline additives. History demonstrates that regional coordination among the northeast states results in protective and cost-effective environmental policies. Given the opportunity to act on these recommendations, the northeast states will again succeed in helping to provide the citizens of the region with the air and water quality protection they deserve.

APPENDIX H

MEMORANDUM

To: Carmine DiBattista
Chief, Bureau of Air Management
Department of Environmental Protection
79 Elm Street
Hartford, CT

From: Judith A. Merrill
Assistant Attorney General
Office of the Attorney General
55 Elm Street, 2nd Floor
Hartford, CT 06106
808-5250

Date: February 24, 2000

Subject: Waiver from EPA to Establish Connecticut Specific Fuel Standards

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You have asked for an opinion as to what procedure may be used to obtain a waiver from EPA to allow you to regulate MTBE.

I. Background

As part of the Clean Air Act Amendments of 1990, Congress established the reformulated gasoline program. 42 USC § 7545(k). Certain states, such as Connecticut, which are seriously out of compliance with National Ambient Air Quality Standards (NAAQS) regarding carbon monoxide, must use gasoline which has been reformulated so that the oxygen content equals or exceeds 2% by weight. 42 USC § 7545(m). MTBE has been added to gasoline as an oxygenate to produce more complete fuel combustion, reduce carbon monoxide and ozone forming emissions, and reduce air toxics as a result of these requirements. While it may serve these purposes, concerns have arisen that, as a result of gasoline spills from various sources, MTBE, which is highly soluble, is contaminating water supplies. This latter concern has caused the Connecticut General Assembly to require the DEP to report to it on MTBE, addressing, *inter alia*, "if necessary, an analysis of the process for seeking a waiver from EPA to discontinue use of MTBE in the state." S.A. 99-14.

I. Statutory Provisions

Section 211 of the Clean Air Act, 42 USC § 7545, addresses regulation of fuels. 42 USC § 7545(c) addresses the control and prohibition of fuels and fuel additives. The Administrator of the EPA is permitted to control or prohibit fuels or fuel additives only when "(A) ... any *emission product* of such fuel or fuel additive causes, or contributes, to *air pollution* which may reasonably be anticipated to endanger the public health or welfare, or (B) if *emission products* of such fuel or fuel additive will impair to a significant degree the performance of any emission control device or system..." 42 USC § 7545(c)(1). A State may in certain circumstances control or prohibit the use of a fuel or fuel additive. 42 USC § 7545(c)(4). If the Administrator has not controlled or prohibited a fuel or fuel additive, the State may control or prohibit it "for the purposes of motor vehicle emission control," but only if the control or prohibition appears in the state implementation plan (SIP) and the Administrator finds "that the State control or prohibition is necessary to achieve the national primary or secondary ambient *air quality standard* [NAAQS] which the plan implements."

II. Discussion

Both the Administrator and the States are limited to controlling or prohibiting fuels or fuel additives only if they adversely impact air quality. You must meet two conditions to obtain a waiver under the Clean Air Act: first, you must include the regulation in your SIP; second, you must submit evidence sufficient to allow the Administrator to conclude that the control or prohibition is necessary to achieve NAAQS.

It is, of course, unlawful for anyone to discharge gasoline to the waters of the state, including gasoline containing MTBE in violation of Conn. Gen. Stat. Sec. 22a-430.

I hope that the foregoing is helpful. It is the opinion of the author and is not a formal opinion of the Attorney General.