S. HRG. 106–953

CLEAN AIR ACT: ENVIRONMENTAL BENEFITS AND IMPACTS OF ETHANOL

HEARING

BEFORE THE

SUBCOMMITTEE ON CLEAN AIR, WETLANDS, PRIVATE PROPERTY, AND NUCLEAR SAFETY

OF THE

COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS
UNITED STATES SENATE

ONE HUNDRED SIXTH CONGRESS

SECOND SESSION

JUNE 14, 2000

Printed for the use of the Committee on Environment and Public Works

U.S. GOVERNMENT PRINTING OFFICE
71–515 PS WASHINGTON : 2001

For sale by the U.S. Government Printing Office
Superintendent of Documents, Congressional Sales Office, Washington, DC 20402

COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS

ONE HUNDRED SIXTH CONGRESS
SECOND SESSION

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C O N T E N T S

ADDITIONAL MATERIAL

CLEAN AIR ACT: ENVIRONMENTAL BENEFITS AND IMPACTS OF ETHANOL

U.S. SENATE,
COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS,
SUBCOMMITTEE ON CLEAN AIR, WETLANDS, PRIVATE PROPERTY, AND NUCLEAR SAFETY,
Washington, DC.

The subcommittee met, pursuant to notice, at 9:28 a.m. in room 406, Dirksen Senate Building, Hon. James M. Inhofe (chairman of the subcommittee) presiding.

Present: Senators Inhofe, Bond, Voinovich, Lieberman, Graham, and Boxer.

OPENING STATEMENT OF HON. JAMES M. INHOFE, U.S. SENATOR FROM THE STATE OF OKLAHOMA

Senator INHOFE. Today's hearing will address the environmental benefits and impacts of ethanol under the Clean Air Act. This subcommittee will address MTBE. We addressed it last fall in the other principal oxygenate, so today we will turn our attention to ethanol.

In 1990, Congress made a mistake by mandating oxygenates in gasoline. We ended up creating a water quality issue because of the use of MTBE. I think it is important to note that, 3 years before Congress acted, scientists at EPA identified the potential problem, although the Agency failed to notify Congress during the debate in 1990, the debate on the Clean Air Act.

Today Congress is being asked to do the same thing, create a new mandate, and I hope that we have learned our lessons from the mistakes in the past, because the EPA certainly has not learned from their mistakes. I say this because last week the Administration issued a report called "The Analysis of Policy Scenarios for Reducing or eliminating MTBE." This report clearly shows that the Administration would rather play games and pander to constituent groups than enter into a serious policy discussion about a real environmental problem.

This report comes 9 months after the Blue Ribbon Panel recommendations and 3 months after the Administration announced their legislative principles. This report is in response to questions we asked the day the principles were released. This is simple background information that the Administration should have considered before issuing their principles. Because of their delays, I think it will be very difficult to enact legislation on this issue this late in the year, particularly since, instead of a rifle shot approach to addressing the real environmental issue, the Administration is advo-

cating what is essentially a broad-based rewriting of the fuel section of the Clean Air Act.

I believe if we rewrite title two it should be done next year during authorization. This year we should be concentrating on fixing the MTBE issue.

We stated this repeatedly several times that we're going to be very busy reauthorizing and we are going to do it in a much shorter period of time than people thought, so those things that we're doing prior to next year are going to be just the relatively small things, and we want to have hearings that will set the stage for the ultimate consideration in the next 2 years.

While I will not go into detail about all of the problems with the report today, I will just list a few concerns.

They "cherry pick" from the recommendations of their own Blue Ribbon Panel, implying that they have followed the recommendations.

We have chart on up there. These are some of the recommendations. If you pay attention to that last paragraph that is highlighted, it says, "In addition"—this is the Blue Ribbon Panel—"in addition, the EPA and others should accelerate ongoing research efforts into the inhalation and ingestion of human effects, air emissions, transformation byproducts, and environmental behavior of all oxygenates and other components likely to increase in the absence of MTBE."

When discussing benefits, they—and I'm referring to the EPA—only discuss the benefits of reformulated gas, not the benefits of oxygenates. The benefits of reformulated gas are not an issue, but the benefits of oxygenates—in particular, ethanol—are clearly an issue. They do not discuss any of the environmental problems associated with ethanol, such as the effect of benzene, the increased emissions of NO_x, the increased emission levels of aldehydes, the potential health problems associated with ethanol.

They call their approach "cost effective," even though they admit that costs will almost double, and their costs are extremely conservative.

When a product is mandated, creating a monopoly, the prices do not remain constant. They rise, which is what will happen to the price of ethanol.

Most importantly, they ignore every independent scientist who has looked at the use of ethanol and called for more tests and studies before it is mandated. Specifically, the EPA's own Blue Ribbon Panel recommendations and the report to the California Environmental Policy Council last December, which was a comprehensive health and environmental assessment of ethanol, both reports called for more studies on ethanol—those reports, as well as the Blue Ribbon Panel.

On a final note, over the last few days the EPA has started blaming the oil companies for the high cost of gasoline, particularly the reformulated gas phase two in the midwest, which uses ethanol. This is like the story of the small child that doesn't regret eating the whole cake but awfully upset that he has a stomach ache.

The EPA is not taking responsibility for its actions. The EPA has forced numerous controls and mandates on gasoline formulas, and

it is proposing another one, ethanol; yet, it wants to deny the real outcome of its policies to the consumers, higher fuel prices.

We will be looking at the price of fuel issue more tomorrow when the EPA testifies during our hearing on the sulfur diesel regulations.

We have a number of witnesses today, and we have changed—in deference and as a favor to you guys, we've changed panel No. 2 with panel No. 1 so you can go first, because all of the sudden we had a number of Senators who wanted to get in on this, and so we felt that it would be better to let you folks take care of your testimony and respond to questions of this committee, and then we'll handle the Senators as panel No. 2, and we'll have a number of Senators that will show up, most of them, oddly enough, from corn States.

We have Mr. Dan Greenbaum, president, Health Effects Institute; Mr. Blake Early, environmental consultant, American Lung Association; Dr. Michael Graboski, director, Colorado Institute of Fuels and High Altitude Engine Research; Mr. Bob Slaughter, director, public policy, the National Petrochemical & Refiners Association; Mr. Jack Huggins, vice president, ethanol operations of Williams Energy Services; Mr. Jason Grumet, executive director, Northeast States for Coordinated Air Use Management from Boston; Mr. Stephen Gatto, president and CEO, BC International; and Mr. Gordon Proctor, director, Ohio Department of Transportation.

We are going to have in attendance several Members of the Senate. I know that Senator Voinovich will be here, but not until 10 because of a conflicting meeting that he has. So what we're going to do is go ahead and begin. Because of the number of witnesses that we have today, we're going to ask you to follow the red/yellow/green light, like my granddaughter does, and conclude your remarks in 5 minutes.

Now, your entire statement will be submitted for the record, but if you could confine your opening remarks to 5 minutes it would be appreciated very much.

[The prepared statement of Senator Inhofe follows:]

STATEMENT OF HON. JIM INHOFE, U.S. SENATOR FROM THE STATE OF OKLAHOMA

Today's hearing will address the environmental benefits and impacts of ethanol under the Clean Air Act. This Subcommittee addressed MTBE last fall, the other principle oxygenate, so today we will turn our attention to ethanol.

In 1990, Congress made a mistake by mandating oxygenates in gasoline. We ended up creating a water quality issue because of the use of MTBE. I think it is important to note that 3 years before Congress acted, scientists at EPA identified the potential problem, although the Agency failed to notify Congress during the debate in 1990.

Today, Congress is being asked to do the same thing, create a new mandate. I hope Congress has learned from the mistake, because the EPA certainly has not learned from their mistake. I say this because last week the Administration issued a report called "Analysis of Policy Scenarios for Reducing or Eliminating MTBE." This report clearly shows that the Administration would rather play games and pander to constituent groups than enter into a serious policy discussion about a real environmental problem.

This report comes 9 months after the Blue Ribbon Panel recommendations and 3 months after the Administration announced their legislative principles. This Report is in response to questions we asked the day the principles were released. This is simple background information that the Administration should have considered before issuing their principles. Because of their delays, I think it will be very difficult to enact legislation on this issue this late in the year. Particularly since in-

stead of a rifle-shot approach to addressing a real environmental issue, the Administration is advocating what is essentially a broad-based rewriting of the fuels section of the Clean Air Act. I believe if we rewrite Title 2 is should be next year during reauthorization, this year we should just concentrate on fixing the MTBE issue.

While I will not go into detail about all of the problems with the report today, I will just list a few key concerns.

1. They cherry pick from the recommendations of their own Blue Ribbon Panel, implying that they have followed the recommendations. I pulled out two additional recommendations that they ignored regarding the need for additional research on ethanol before its use is expanded. All together the panel recommended 14 steps. The Administration is only following 3.

2. When discussing benefits, they only discuss the benefits of RFG, not the benefits of oxygenates. The benefits of RFG are not an issue, but the benefits of oxygenates, in particular ethanol are clearly an issue.

3. They do not discuss any of the environmental problems associated with ethanol, such as the effect on benzene, the increased emissions of NO^{xX}, the increased emissions levels of aldehydes, and potential health problems associated with ethanol.

4. They call their approach cost-effective even though they admit that the costs will almost double, and their costs are extremely conservative. When a product is mandated, creating a monopoly, the prices do not remain constant, they rise, which is what will happen to the price of ethanol.

5. Most importantly, they ignore every independent scientist who has looked at the use of ethanol and has called for more tests and studies before it is mandated. Specifically the EPA's own Blue Ribbon Panel recommendations and the Report to the California Environmental Policy Council last December, which was a comprehensive health and environmental assessment of ethanol. Both reports called for more studies on ethanol.

On a final note, over the last few days the EPA has started blaming the oil companies for the high cost of gasoline, particularly the RFG phase 2 in the Midwest, which uses ethanol. This is like the story of the small child that doesn't regret eating the whole cake, but is awfully upset that he has a stomach ache. The EPA is not taking responsibility for its actions. The EPA has forced numerous controls and mandates on gasoline formulas, and it is proposing another one, ethanol, yet it wants to deny the real outcome of its policies to the consumers, higher fuel prices. We will be looking at the price of fuel issue more tomorrow when the EPA testifies during our hearing on the sulfur diesel regulations.

RECOMMENDATIONS FROM THE EPA'S BLUE RIBBON PANEL ON OXYGENATES IN GASOLINE REPORT

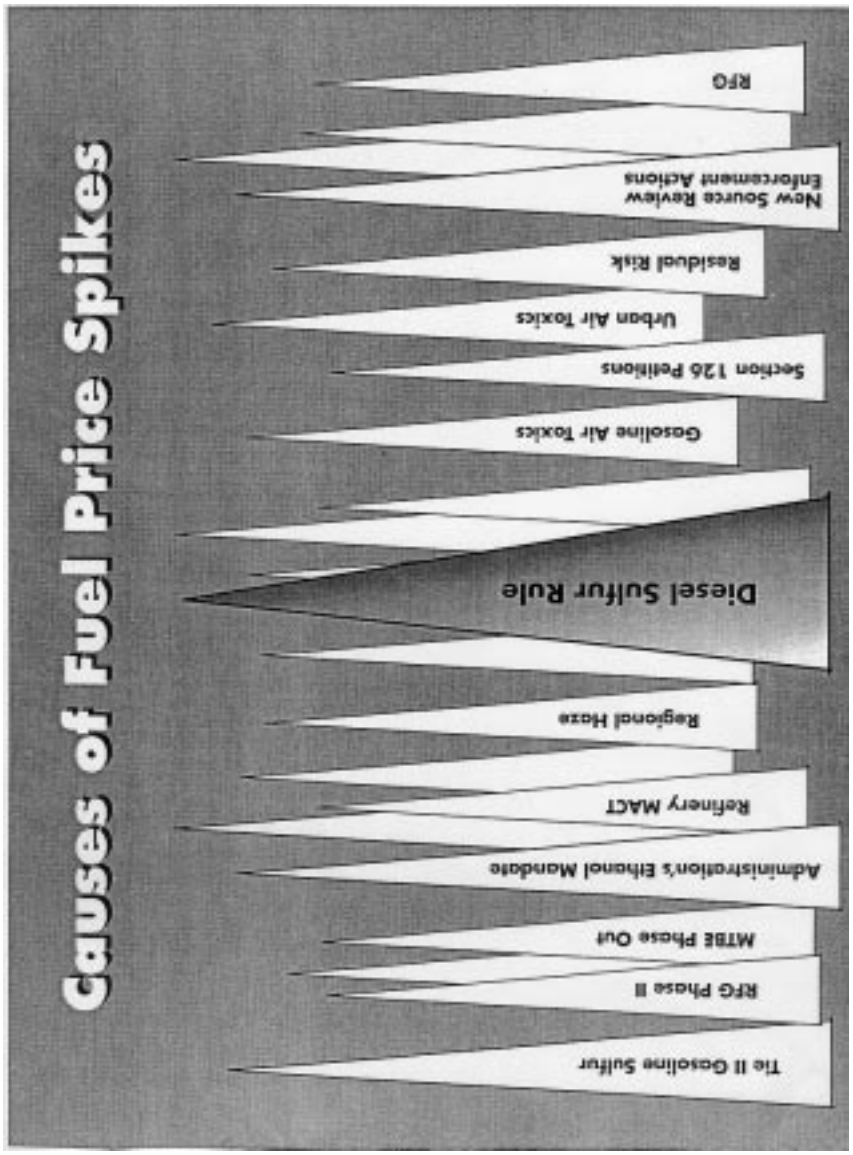
6. Develop and implement an integrated field research program into the groundwater behavior of gasoline and oxygenates, including:

a. 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;

b. 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.

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.



Senator INHOFE. We will start with Mr. Greenbaum, who is first on our list.

STATEMENT OF DAN GREENBAUM, PRESIDENT, HEALTH EFFECTS INSTITUTE, CAMBRIDGE, MA

Mr. GREENBAUM. Thank you, Mr. Chairman.

It is a pleasure to be here today to speak to you about the health effects of ethanol. I speak to you today, as you mentioned, as the president of the Health Effects Institute, which is an independent institute funded both by Government and industry to provide im-

partial science on the health effects of air pollution, and also as the former Chair of the Blue Ribbon Panel——

Senator INHOFE. If you would suspend for just a moment, I apologize. We have another one of our Members here.

Do you have an opening remark, Senator Bond, that you would like to make prior to hearing the witnesses?

Senator BOND. Why don't we let this witness finish and then I'll try to make my remarks brief.

Senator INHOFE. All right.

Senator BOND. I don't want to interrupt Mr. Greenbaum's presentation.

Senator INHOFE. Mr. Greenbaum, I apologize. Go ahead.

Mr. GREENBAUM. Thank you, Senator.

I am pleased to be here today.

In 1996 HEI published a comprehensive review of the health effects of ethanol and MTBE. For the record, I have submitted copies of our report, and I'll summarize our findings in my brief comments today.

We, as a Nation, have substantial scientific evidence on the health effects of ingesting ethanol. We know that at high levels pregnant mothers ingesting ethanol can see their infants suffer from fetal alcohol syndrome, and that consumption of ethanol in the form of alcoholic beverages has been shown to increase the risk of certain cancers, leading the national toxicology program in its recent report on carcinogens to designate alcoholic beverage consumption as a known human carcinogen.

For all of these effects, there are not firmly defined thresholds below which effects are not expected, although some scientists have identified an apparent threshold for the fetal effects of about one-half ounce of alcohol per day. That's important, because, although we know much about these effects of ethanol at high levels, it is likely that exposure of citizens to ethanol while refilling their fuel tanks or through ethanol-contaminated drinking water will be substantially below levels at which effects have been seen.

In the case of inhalation, our estimate is that the dose of ethanol delivered to the body would probably be below the level of ethanol normally produced internally within the body.

The use of ethanol, however, also results in changes in the exhaust and evaporative emissions from vehicles, especially acetaldehyde and volatility. Acetaldehyde, which is designated as reasonably anticipated to be a human carcinogen, would, according to a recent California analysis, increase in the atmosphere in 2003 in ethanol-used fuel when compared to the use of fuel oxygenated with MTBE; however, there would be an overall decrease in the acetaldehydes when compared to 1997 levels due to tightening California fuel requirements. These results are reassuring, but similar analyses have not been performed for the rest of the Nation.

At the same time, the addition of ethanol to gasoline can result in an increase in the volatility of fuel and in the potential for increased formation of ozone. The base fuel can be reformulated to lower its inherent RVP to offset this effect, although even with that there are some continuing questions about the possible impacts of commingling ethanol-blended fuels with non-ethanol fuels.

Beyond these effects, the use of ethanol as an oxygenate provides the ability, as do other oxygenates, to replace more-toxic substances such as benzene; however, the Blue Ribbon Panel found that it is also possible to achieve these improvements using non-oxygenated reformulated fuels.

One further key question is the potential for ethanol to contaminate groundwater. Here, although we still have many questions in general, two general conclusions can be drawn. First, the high degradability of ethanol would suggest that the chances of an ethanol spill or leak getting, to any significant degree, into drinking water, itself, are small. At the same time, the degradability of ethanol appears to retard the degradation of other components, resulting in the likelihood that plumes of these other substances and the risk of water contamination would increase somewhat. Precise estimates of this risk do not exist.

In conclusion, we know much about the significant health effects of drinking ethanol, but should recognize that likely exposure of the public to ethanol either through breathing or ingestion would likely be low. At the same time, there are continuing questions, and it is based on these questions that the Blue Ribbon Panel recommended first that EPA and others accelerate ongoing research efforts into the health effects, air emissions, and environmental behavior of all oxygenates and other components likely to increase in the absence of MTBE, and second recommended that EPA, in conjunction with USGS and others, move quickly to analyze and monitor both the use of MTBE and ethanol and the levels of these substances in ground, surface, and drinking water.

The decision to greatly increase any one component of the fuel supply is a major one, with potential widespread implications for exposure and public health. Although the current information on ethanol and its effects is somewhat reassuring, it is critical that accelerated efforts be made to fill key information gaps before widespread increases in use of any additive have been accomplished.

Thank you for the opportunity to submit this testimony. I would be pleased to answer any questions.

Senator INHOFE. Thank you, Mr. Greenbaum.

Now, Senator Bond, if you would like to make your opening statement——

Senator BOND. Thank you very much, Mr. Chairman.

Senator INHOFE. Before you came in, I mentioned that there are, I think, four Senators now who will constitute panel No. 2, and you certainly are welcome to join that as well as this.

OPENING STATEMENT OF HON. CHRISTOPHER S. BOND, U.S. SENATOR FROM THE STATE OF MISSOURI

Senator BOND. I wanted to come. I have some wonderful remarks that I will submit for the record. I will trust that if I promise to do that, I'm sure that everybody will read them about the economic benefits of ethanol.

Senator INHOFE. Could I get an advanced copy of that?

Senator BOND. We want you to have that in hand.

I want to express my appreciation to the members of the panel. I appreciated the testimony from Mr. Greenbaum and the work of the Blue Ribbon Committee.

We don't recommend drinking ethanol. It is probably not a good idea to drink gasoline, either. We do appreciate the results of the Blue Ribbon study.

We are here because I think everybody agrees or should agree that MTBE contamination in the water is a problem. It is the second most commonly found chemical in the groundwater. For those who continue to advocate MTBE, who say, "Let's don't phase it out completely," I suggest we go out to the States and see what they are doing in response to their constituents and their water contamination.

Eight States have taken action to limit or phaseout MTBE to protect their water resources. Even in Missouri, where we think we don't use MTBE, we have found some of it sneaked into our State and contaminated water in school districts and other places, and I hope that Congress will act to get rid of MTBE and make sure that we do not further endanger our water supply or, by making changes, endanger our air quality.

We do believe that ethanol is an environmentally friendly alternative to MTBE that adds value to our farmers' products, moves us away from the energy hostage situation.

Mr. Chairman, we all know that the Federal oxygen content requirement was adopted in 1990 for several reasons. Congress understood that oxygenates provide a source of clean octane, displacing toxic compounds such as benzene and reducing ozone-forming exhaust emissions of hydrocarbons and carbon monoxide, and EPA has stated the program is equivalent to taking 16 million vehicles off the road each year. We have also recognized the energy security importance of it.

I have read the studies that I will not try to explain to you, because it is difficult enough for me to understand them, but when you take a look at the potency-weighted toxicity, ethanol and other products, you will see, I believe, the studies confirmed that ethanol does provide significant benefits in lowering the toxics in gasoline.

We have problems with the lack of an energy policy in this Administration, and there are some who want to blame the increase in energy prices on the changes that we've mandated in gasoline. I think they are far more deeply rooted than that and go to a failure to develop energy sources.

I think ethanol can and will continue to play an important role in our environmental, economic, and energy security. The ethanol, which contains approximately 35 percent oxygen, enhances combustion, contributes to more-efficient burn of gasoline, reducing carbon monoxide emissions, which is a contributor to harmful ozone formation by as much as 30 percent.

The use of ethanol reduces emissions of all major pollutants regulated by EPA, including ozone, carbon monoxide, particulate matter, PM_{10}, and nitrogen oxides.

I think it is an effective tool, as I mentioned, for reducing air toxics, and it can significantly reduce greenhouse gas emissions, and I know that you will hear from our colleagues later on.

We do have new ethanol facilities coming on line in Missouri. We are very proud of them. Not only do they provide jobs and value for the economy, but they are making significant contributions, and I will discuss all those further in the statement I am submitting

for the record, but I want to emphasize that this is a safe, biodegradable fuel that does not pose an environmental threat to water or soil. I was pleased that the California Environmental Policy Council awarded it a clean bill of health.

Mr. Chairman, I thank you for your time, and I appreciate the indulgence of our witnesses.

[The prepared statement of Senator Bond follows:]

STATEMENT OF HON. CHRISTOPHER S. BOND, U.S. SENATOR FROM THE STATE OF MISSOURI

Good morning Senator Inhofe, members of the subcommittee, and those in attendance today. It is a pleasure to be here. My time that I can stay at this hearing is short so I want to get straight to the point.

MTBE water contamination can be found throughout the country. I have been told that today, MTBE contamination is the second most commonly found chemical in groundwater. For those who continue to advocate for MTBE I say forget what is happening here inside the beltway, go out to the states and see what they are doing in response to their constituents and the water contamination.

Eight states have taken action to limit or phase-out MTBE use in an effort to protect their water resources, and legislation to ban MTBE has been introduced in another 16 states. I do believe that Congress should act to come up with a solution to the MTBE debacle that does not sacrifice the air quality gains of the current program and does not jeopardize our Nation's valuable water supplies.

I know that Missouri, and I believe this country, requires a renewable, environmentally friendly alternative to MTBE that helps create local jobs, which adds value to our farmer's product and which moves us away from this energy hostage situation where our reliance on foreign-produced oil makes our producers, consumers and economy subject to the whims of international cartel autocrats. In my opinion, that alternative is ethanol.

Mr. Chairman, we all know that the Federal oxygen content requirement was adopted in 1990 for several reasons. First, those of us in Congress understood that oxygenates provide a source of clean octane—displacing toxic compounds such as benzene and reducing ozone-forming exhaust emissions of hydrocarbons and carbon monoxide. EPA has stated the program is equivalent to taking 16 million vehicles off the road each year. Congress also recognized the energy security benefits of substituting a certain percentage of imported petroleum with domestically produced renewable fuel such as ethanol. Promoting renewables that are domestically produced, such as ethanol, is a critical element toward regaining our independence from foreign oil. It is unfortunate that the Clinton administration has done nothing to promote a sound energy policy for this country, and in my opinion came to this debate late. Finally, the Congress hoped the Federal oxygen requirement could provide new market opportunities for farmers by stimulating new demand for ethanol. I believe these objectives remain as valid today as they were in 1990.

I firmly believe that ethanol does play and will continue to play in our Nation's environmental, economic and energy security. I know that ethanol, an organic, nontoxic, biodegradable substance, is the right thing to pursue in the case of the MTBE debate. Unfortunately, some are trying to use the sins of MTBE as a reason to pull the plug mid-stream on clean-burning ethanol.

Ethanol is widely marketed across the country to increase octane and reduce emissions through its clean burning properties as an oxygenate. Ethanol, which contains approximately 35 percent oxygen, enhances combustion and therefore contributes to a more efficient burn of gasoline, reducing carbon monoxide emissions, a contributor to harmful ozone formation, by as much as 30 percent. The use of ethanol reduces emissions of all the major pollutants regulated by the Environmental Protection Agency (EPA), including ozone, carbon monoxide (CO), particulate matter (PM_{10}), and nitrogen oxides (NO_X). Ethanol is also an effective tool for reducing air toxics. As a renewable fuel, ethanol can dramatically reduce greenhouse gas emissions. It is clear to me and many others that ethanol is good for the environment, both our water and our air. I believe that my fellow colleagues Senators Grassley, Durbin, and Harkin will be able to outline additional environmental benefits later in this hearing.

Let me touch briefly on another reason we enacted the oxygen content requirement—the economy. Ethanol provides significant benefits to the economy, particularly in farming communities across rural America. Earlier this year, I participated in the first ethanol plant grand-opening in Missouri. This facility is a 15 million gal-

lon per year facility located in Macon, Missouri and owned by farmers across the state. The ethanol facility not only provides new jobs, but a value-added market for their commodities. In light of today's record low prices, value-added ethanol processing provides a much-needed economic opportunity. According to a letter from Secretary Dan Glickman of the United States Department of Agriculture which assumes an MTBE phaseout and the oxygen content requirement staying in place, "The MTBE phase-out is projected to have a positive effect on U.S. trade, with the average U.S. agricultural net export value increasing by over $200 million per year. The U.S. import value of MTBE would decline by $1.1 billion per year and almost $12 billion cumulatively from 2000–2010. The agricultural export increase combined with the MTBE import decrease would improve the U.S. balance of trade by $1.3 billion per year." In addition, according to Secretary Glickman, "The increase in farm and ethanol production caused by replacing MTBE with ethanol is projected to create 13,000 jobs across the economy by 2010. Over a third of the new jobs, 4,300, would be created in the ethanol sector itself. Another 6,400 jobs are created in the trade, transportation, and service sectors. Farm sector jobs increase by 575. Jobs in other industries, food processing, and energy sectors increase by 1,600." Mr. Chairman, colleagues, witnesses, and those in the audience—we know a lot about ethanol. Ethanol is a safe, biodegradable fuel that does not pose an environmental threat to water or soil, is good for air quality, and has been awarded a "clean bill of health" by the California Environmental Policy Council.

So, let us be very clear about the issue we are addressing. The issue is MTBE contamination of our valuable water supplies, not ethanol. Ethanol will allow us to address several important policy objectives: clean air, clean water, balance of trade, economic development, etc. Ethanol is the solution and I will work with other Members of Congress to see that that notion prevails.

Senator INHOFE. Thank you. We have been joined by two of our members of the committee. We had already started with Mr. Greenbaum. He has given his testimony, and we are going to go ahead and get the rest of them, but first we'd like to hear any statements that the two of you have. We probably should start with Senator Graham, ranking minority member of the committee.

OPENING STATEMENT OF HON. BOB GRAHAM, U.S. SENATOR FROM THE STATE OF FLORIDA

Senator GRAHAM. Thank you, Mr. Chairman. I will be very brief.

I appreciate your holding the hearing on this issue. The question of ethanol has become an issue, including in the current Presidential elections, and this opportunity to get some expert testimony on its environmental effects I think will contribute to that debate.

With that, I am going to yield my time to my colleague and to the experts.

Senator INHOFE. Senator Lieberman.

OPENING STATEMENT OF HON. JOSEPH I. LIEBERMAN, U.S. SENATOR FROM THE STATE OF CONNECTICUT

Senator LIEBERMAN. Thanks, Mr. Chairman. Thanks, Senator Graham.

Mr. Chairman, I do have a statement I'd like to submit for the record and just very briefly share the concern that has been expressed here.

Obviously, we started to use MTBE as a way of cleaning up the air, and it has had that effect, but it has also had a surprising effect on water supplies, both wells and surface waters, and the statistics were indicated by Senator Bond and others. This is a real source of concern to us in the Northeast.

We look to ethanol hopefully as a possible replacement that will continue the positive effects on air quality that MTBE has had, but reduce or eliminate the concerns about effect on water quality.

I do think that we are coming to a point where Congress has got to do something tangible and direct to reduce or eliminate the use of MTBE in our gasoline supply.

In the northeast, we have two particular concerns about the use of ethanol which I know will be addressed here today, and I want to mention them briefly. The first is that ethanol is much more volatile than MTBE. In our part of the country, summer temperatures we fear will exacerbate this volatility, increasing evaporation of ethanol and creating emissions that may actually worsen our normal summertime smog and ozone problems which are already significant.

The second concern about ethanol use is the lack of a regional production and distribution infrastructure so that, for the short-term future, anyway, we presume that ethanol would have to be transported into our region, and that has complexities attached to it, as well. So I hope that the witnesses will address those two concerns as we move, perhaps in this session of Congress, to a consensus approach on this issue which reflects what science and fact tell us about MTBE and also tries to develop the potential of ethanol as a substitute.

I apologize, Mr. Chairman. I am going to stay a while, but I've got a markup in another committee so I can't stay as long as I'd like. I hope, which is against conventional thinking, that the markup will go quickly and I will return soon to hear the testimony.

Thank you very much.

Senator INHOFE. Thank you, Senator Lieberman.

[The prepared statement of Senator Lieberman follows:]

STATEMENT OF HON. JOSEPH LIEBERMAN, U.S. SENATOR FROM THE STATE OF CONNECTICUT

Thank you, Chairman Inhofe, for holding this hearing to examine the environmental benefits and impacts of using ethanol to replace MTBE in gasoline. This is an extremely important matter in my home State of Connecticut, as it is throughout the Northeast and across the country, and it is one that we need to work quickly to address.

As most of us are aware, recent testing of drinking water sources has revealed that a surprising number of wells across the country have been contaminated by MTBE, a common gasoline additive. A study by EPA's Blue Ribbon Panel on MTBE reported that between 5 and 10 percent of community drinking water supplies have detectable levels of MTBE. Private wells and surface waters have also been contaminated. The United States Geological Survey reports that MTBE was the second most commonly detected volatile organic compound in water from urban wells. In Connecticut and the rest of the northeast, these problems are as bad as they are anywhere. The reformulated gasoline that we use is mandated to contain oxygenates, and that mandate has primarily been met by adding MTBE. I am absolutely convinced that we, as a Congress, must do something to reduce or eliminate the use of MTBE in our gasoline supply because of the contamination of the Nation's drinking water supply that MTBE has caused.

Despite its negative impacts on drinking water, MTBE has had some positive effects on air quality. We are here today to hear testimony on the potential environmental benefits and impacts of an MTBE replacement that may afford similar air quality benefits: ethanol. I have a number of concerns about replacing MTBE with ethanol. First, ethanol is much more volatile than MTBE. In the Northeast, summer temperatures will exacerbate this volatility, increasing evaporation of ethanol and creating emissions that may worsen summertime smog and ozone problems, which are already a significant concern for Connecticut and the Northeast. My second concern about increasing the use of ethanol in the Northeast is the lack of ethanol production and distribution infrastructure in our region. Ethanol would have to be transported into the region. Due to its affinity for water, ethanol cannot be piped into the Northeast premixed with gasoline. At the moment, viable alternatives to

corn ethanol, such as biomass ethanol, are not in widespread existence. I do not know whether the Northeast could cope with a mandate to use much greater volumes of ethanol without facing outrageous increases in gas prices because of small supply. Finally, while the renewable nature of ethanol as a fuel source is desirable, I know there are those that argue that the energy that goes into producing ethanol the fossil fuels that are needed for harvesting, producing, and transporting ethanol undercut the presumed environmental benefits.

These are the very real concerns we in the Northeast have. I hope we are able to use our time today productively, to learn more about the benefits and the risks of using ethanol as a major feedstock in gasoline. Thank you and I look forward to hearing from our witnesses.

Senator INHOFE. I'm sure the next witness will address some of the things that you mentioned in your opening statement.

Mr. Early is here representing the American Lung Association.

Mr. Early.

STATEMENT OF BLAKE EARLY, ENVIRONMENTAL CONSULTANT, AMERICAN LUNG ASSOCIATION, WASHINGTON, DC

Mr. EARLY. Good morning, Mr. Chairman and members of the committee. It is good to see you and I am happy to be here on behalf of the American Lung Association to discuss the role of ethanol under the Clean Air Act.

Data clearly indicates that ethanol in gasoline helps to reduce tailpipe emissions of carbon monoxide, and this is particularly important in areas that exceed the ambient air quality standard for CO. This is a problem in the winter time, and we have an oxy-fuel program that the Lung Association fully supports that involves using ethanol in many portions of the country to reduce carbon monoide tailpipe emissions to address exceedences of the ambient air quality standard for CO.

The number of those areas is falling. It's one of the real success stories of the Clean Air Act. That's due, in large part, to better pollution controls on automobiles, but there is no question that ethanol in the fuel helps achieve that, as well.

Ethanol also provides a clean source of octane for fuel. It doesn't have any aromatics in it, and it has moderately low levels of sulfur. We believe that refiners are going to be using a lot of ethanol as they replace MTBE in reformulated gasoline and they replace or they lower sulfur in conventional gasoline in accordance with EPA's new sulfur rules for gasoline.

But the important thing to stress here is that the use of ethanol does not guarantee the reductions of other pollutants other than carbon monoxide.

Looking at my testimony in figure B–2—this is data presented to the Blue Ribbon Panel, on which the Lung Association served—you can see that the air toxics reductions achieved in Chicago, where ethanol dominates the RFG program, were among the least reductions in the Nation. It is pretty clear that the use of ethanol doesn't necessarily guarantee you reductions of air toxics. There are many factors that influence that.

Looking further at the figures in my testimony labeled 15, 16, and 17, you look again at Chicago and the sulfur levels in RFG. In 1996 and 1997 the sulfur levels in RFG using ethanol were among the highest in the Nation. Then, in 1997, for reasons that nobody really knows, the sulfur levels in RFG in Chicago dropped 40 percent, from 500 parts per million to approximately 300 parts

per million. It is very clear that ethanol was not the cause of that. This data illustrates the point that the use of ethanol or the use of oxygenates doesn't guarantee any particular reduction.

What we have learned is the best way to guarantee certain performance from a fuel is to mandate that performance and allow refiners to meet that any way they can. We believe that that will involve using ethanol.

Now, the one problem with ethanol which Senator Lieberman has already mentioned is its impact on volatility. The ethanol industry is fond of talking about the tailpipe carbon monoxide reductions, and they often quote the National Research Council report from last year. They only quote part of the report.

The Council also recognized that evaporation from ethanol was a serious problem, and I'm going to quote a sentence from their report. The National Research Council said, "The increase in the evaporated emissions from the ethanol-containing fuels was significantly larger than the slight benefit obtained from the lowering of carbon monoxide exhaust emissions using the ethanol-containing fuel." So you have ethanol reducing CO tailpipe emissions but increasing volatility. And, in fact, volatility is one of the biggest problems in smog creation today. For new cars, volatility from the car is 50 percent or more of total emissions from a car, so you have to focus on both volatility and the evaporation of hydrocarbons from the car, as well as the tailpipe.

Even low volatility RFG with ethanol can cause evaporation, and that is because alcohol fuels, including ethanol, increase the permeation of the fuel through the system of the car—the hoses, the gaskets, the rubber portions and plastic portions of the car. The ethanol fuel penetrates those more rapidly and enhances it.

Last, ethanol gasoline, when mixed with a nonethanol gasoline, increases the evaporative tendencies of the whole, so when consumers go out and they purchase an ethanol-containing fuel—doesn't matter whether it is RFG or conventional—and then they purchase a non-ethanol-containing fuel, the evaporative emissions go up.

I see my time is up. In conclusion, we don't think that mandating ethanol is really a solution to cleaner gasoline. Set performance standards, and those standards must include offsetting the impact of ethanol on both RFG and conventional gasoline when refiners choose to use it. That must be an important element to the fixes that Congress adopts because ethanol in conventional gasoline, since its use is going to rise—and I cover that in my testimony—is going to worsen the volatility of fuels throughout the country and not just RFG.

Thank you, Mr. Chairman.

Senator INHOFE. Thank you, Mr. Early.

Dr. Graboski.

STATEMENT OF MICHAEL GRABOSKI, DIRECTOR, COLORADO INSTITUTE FOR FUELS AND HIGH ALTITUDE ENGINE RESEARCH, DEPARTMENT OF CHEMICAL ENGINEERING, COLORADO SCHOOL OF MINES, LAKEWOOD, CO

Mr. GRABOSKI. I'm Mike Graboski and I'm the director of the Colorado Institute for Fuels and High Altitude Engine Research. I am a Ph.D. chemical engineer and faculty member at the Colorado

School of Mines in Golden, CO. My research areas and technology areas are involved in both gasoline and diesel fuels and emissions from gasoline and diesel vehicles. I'm here today on behalf of the National Corn Growers Association, but here to talk to you about what I know about oxygenates and ethanol fuels as an independent expert in this area.

I want to use my time briefly today to talk to you a little bit about some analysis work that I have been doing. In my analysis, I have been looking at the effects of removing oxygenates from reformulated gasoline on emissions of ozone-forming volatile compounds, the effects on carbon monoxide, the effects on toxics air pollutants, and on particulate matter.

I would like you to refer to my written testimony for several figures that I have provided you in terms of my discussion.

The first thing I want to talk about is the effect of oxygenates on toxics emissions, and I think it is important that, since we are talking about the RFG program, in all cases we are talking about gasolines that are complying gasolines, so they all meet the performance standards set forth in the RFG rules and they are all complying, which means that the volatility issues really are not volatility issues because all of these gasolines meet the volatility specifications under the Clean Air Act.

Based upon 1998 EPA reformulated gasoline compliance survey, I have attempted to estimate nationally how refiners are going to produce phase II reformulated gasolines if they had to use ethanol and if they are allowed to do this without oxygen, and I have compared the resulting potency-weighted toxic emissions to those from RFG–II-containing MTBE.

Because various air toxics pose different cancer risks, potency weighting allows us to compare one toxic compound with another, and using potency weightings we can add all the toxics emissions together and compare the relative toxicity of one fuel formulation with another.

Potency weighting uses benzene as the referencing, giving it a value of one, and weighing all other compounds against benzene. So, for example, if a compound is found to be twice as toxic as benzene, it has a potency weighting of two.

In the handout that I provided you, figure one shows how I'd expect refiners to produce RFG–II fuels if they were allowed to not only meet the RFG–II spec but also satisfy the 1998 average toxic reduction of about 28.1 percent nationally from RFG–I.

Based upon public statements from refiners, I would expect new alkylate production and use to replace most of the lost gasoline volume resulting from the removal of MTBE with aromatics being used to balance the octane, and if ethanol is used then ethanol would substitute for some of this alkylate.

Figure one that I provided you shows that oxygenated fuels with ethanol provide a greater reduction in potency weighted toxics compared to MTBE fuel, where benzene again is used as the reference weight.

The non-oxygenated fuel in figure one has an increased aromatic content, which is consistent with national gasoline surveys and with the phase one data provided by EPA. And increased aromatics are necessary to meet octane requirements.

In this case, the only way for the refiner to produce the same benzene-equivalent potency-weighted toxics is if olefins are also reduced, but there is no economic incentive to do this. Therefore, we can reasonably expect refiners to increase aromatics when oxygenates are remove from the gasoline pool and if refiners make non-oxygenate RFG with the same mass toxics reduction as oxygenated gasoline, there is going to be a negative increase on public health because potency-weighted toxics will increase.

I want to talk about removing oxygen from summer ozone and the effect on particulates, and I will briefly summarize. I looked at on-road and off-road emissions in Philadelphia, Wilmington, and Trenton using EPA inventories and models, and what I estimated is that, by removing oxygenates from RFG, one will increase not only off-road emissions but on-road emissions, and the net effect could be that as much as 35 percent of the additional ozone benefits attributable to RFG–II compared to RFG–I could be lost because of the fact that oxygenates reduce off-road emissions and we're not considering this in our analysis.

Finally, I have been looking at the effect of oxygenates on particulate matter, and what I have been able to determine is that removing oxygenates from RFG is going to increase the inventory of fine particulate matter in RFG areas. Some analyses show that half of the fine particulate emissions come from motor vehicles in those areas, and oxygenates might reduce 30 to 40 percent of the fine particulate emission from vehicles.

So I would conclude that removing oxygenate from RFG is likely to result in an increase in direct emissions of particulate matter from tailpipes, and again this is an issue that is not being considered.

So I would hope that in your deliberations, as time goes on, that we look at these benefits of oxygenates, and any legislative actions take them into account to make sure that public health is protected.

Thank you.

Senator INHOFE. Thank you, Dr. Graboski.

Mr. Slaughter, it is nice to have you back before this committee. You are recognized.

STATEMENT OF BOB SLAUGHTER, DIRECTOR, PUBLIC POLICY, NATIONAL PETROCHEMICAL & REFINERS ASSOCIATION, WASHINGTON, DC

Mr. SLAUGHTER. Thank you, Senator. Thanks, Mr. Chairman and members of the subcommittee. As you know, I am representing the National Petrochemical & Refiners Association. We basically represent all U.S. refiners plus petrochemical manufacturers who have similar processes. A lot has already been said about the points I was going to make today.

I want to point out that NPRA is in substantial agreement with Mr. Greenbaum and Mr. Early's testimony, and, just because we don't all that often end up in complete accord with the findings of an EPA panel and the American Lung Association, I want to point that out. I think it is significant and ought to be noted.

We do have substantial difficulties with mandates in fuels. We think the RFG oxygen mandate has been problematic and concerns

have been raised. We think that mandates always raise fuel costs, and therefore they are a burden on consumers. People really don't like mandates. They prefer freedom of choice.

As Mr. Early pointed out, performance standards allow choices and spur innovations, and they are always preferable to mandates, which tend to stifle new ideas and competition, and they are very hard to get rid of, and they cost money.

A mandate for alternative fuels in the transportation sector is really an ethanol mandate in disguise because consumers, fuel providers, and auto manufacturers prefer liquid fuels. Ethanol is the only viable alternative liquid fuel in the future.

The oxygenate program in RFG, of course, has led to some concerns about water quality, and, as I said before, NPRA is largely in accord with the recommendations of the Blue Ribbon Panel and urges Congress to act on them.

One of the problems, though, with mandates is that they are hard to get rid of, and here you have a situation in which people in California and the Northeast, where most of the MTBE is used, seem to agree with the recommendations of the EPA panel as to how to address this situation. But, unfortunately, people who largely don't live in California or the Northeast are blocking action on the recommendations because they want an ethanol mandate to replace the current one.

I think every new mandate proposal has to be looked at in this regard, because that's really what will be behind it.

It is not that NPRA is anti-ethanol, because many of our members and maybe most of our members are blending ethanol and selling it in their products. Ethanol use has really increased in the past decade. DOE and the California Energy Commission say that if MTBE is phased out, national usage of ethanol will double just through increases in California and the Northeast, alone. This happens without an ethanol mandate.

There have been several statements made this morning to the effect—and I do think it is true—that ethanol usage is going to increase in gasoline. It has a very bright future as a blending component for gasoline in the foreseeable future and in the near future without a mandate and the attendant problems that a mandate causes.

I might point out, you know—Senator Lieberman, unfortunately, has left, but he raised some questions about ethanol usage in the Northeast, its practicality and its impact on the environment. Some of the people who are pushing national ethanol mandates—and I think this would also be the case in California—are saying, ''Well, that's all right. We'll do a credit trading program, and if you don't want to use it you can pay not to use it.'' That doesn't really make a lot of sense to us that you should have to pay to avoid use of a product which is problematic in your particular area.

So I would urge people like Senator Lieberman, Senator Boxer, and others in those areas that might have problems with the volatility characteristics of ethanol, to take a close look at this credit trading idea, because it really is a payment to avoid usage of the product, and it will basically be a payment to people who produce ethanol in other areas of the country for part of the gasoline used in your area. I think it is a suspect idea.

Ethanol has good characteristics and bad characteristics. That has been pointed out today. It improves combustion, but it does have some problems in air with volatility and in water.

This first chart shows the different gasolines that are made in the central and east United States in the summer now. You will see there are 10 of them—10 different types of gasoline—this chart was provided to us by our member, CITGO—that have to be provided in these areas.

If you put an ethanol mandate as an overlay on top of that, you are going to force these people basically to ship special blendstock into all of these areas to blend the ethanol at the terminal. That means significantly more cost for that blendstock, a shipment of ethanol by rail or truck, plus the blending facilities needed at the terminal, which will have to be passed on to consumers. That's tremendous increase in complexity in an already very complex and almost inscrutable system.

I just want to point out that refiners already have a full plate. Mr. Chairman, I know you are very much aware of that. These are the 12 programs that the refiners are going to have to implement and comply with over the next 10 years. They are extremely expensive. Diesel sulfur reductions and gasoline sulfur reductions, alone, are going to cost roughly $15 billion in the next 10 years. And an ethanol mandate is another product specification change that will basically complicate all of those compliance programs and cost additional money and overburden a refining industry that already is showing some signs of strain.

So we urge Members of the Subcommittee and Members of the Senate to take a very close look at this mandate proposal. We think it is very premature and will end up, again, being bad policy for U.S. consumers and the fuel supply.

Thank you.

Senator INHOFE. Thank you, Mr. Slaughter.

Where would all these increased costs of these regulations be passed on?

Mr. SLAUGHTER. Consumers will bear them, Mr. Chairman.

Senator INHOFE. Thank you.

Mr. Huggins with Williams.

STATEMENT OF JACK HUGGINS, VICE PRESIDENT, ETHANOL OPERATIONS, WILLIAMS ENERGY SERVICES, PEKIN, IL

Mr. HUGGINS. Good morning, Mr. Chairman and members of the committee. I am very pleased to be here to discuss ethanol's continued participation in the Federal reformulated gasoline program, generally, and RFG oxygen content requirement, specifically. I appreciate the opportunity to provide comments on behalf of the domestic ethanol industry.

First, let me tell you something about my company. Williams is a global energy and communications company headquartered in Tulsa, OK. We have about 23,000 employees and operate about $25 billion in assets.

Through our various energy businesses, we own and operate nearly 60,000 miles of natural gas and liquid pipelines located throughout the United States.

Williams is a producer of natural gas, a large processor of natural gas and natural gas liquids, and our energy marketing and trading group is one of the largest in the country.

We own two refineries in the United States and operate a refinery in Lithuania.

We transport, terminal and retail gasoline and other petroleum products.

Our bioenergy group, of which I am a part, is the second-largest producer of ethanol in the country, with plants in Illinois, Nebraska, and, most recently, a new project announced in Wisconsin.

Given our extensive involvement in both the petroleum industry and the ethanol industry, we believe we have a unique perspective on the issues being discussed today.

I think it is important to underscore that the reformulated gasoline program, with its oxygen content requirement, has worked quite effectively. Air quality has improved. Indeed, about 75 million people are breathing cleaner air because of RFG. EPA reports that RFG is reducing ozone-forming hydrocarbon emissions by 41,000 tons annually and toxic pollutants such as benzene by 24,000 tons annually. That's equivalent to taking 16 million vehicles off the road each year.

A study by the Northeast States for Coordinated Air Use Management shows that today's RFG reduces the cancer risk from gasoline by about 20 percent.

It is critically important to recognize that these benefits are significantly greater than required by the Clean Air Act's performance standards for hydrocarbons and toxics, at least in part because of the Federal oxygen requirement.

In the midwest markets, where ethanol has been used extensively, the air quality record is excellent and can serve as a model for the rest of the country. In fact, the Chicago branch of the American Lung Association fully supports this program.

Air quality gains provided by RFG with oxygenates should not be sacrificed as MTBE use is reduced. The RFG program assures air quality benefits through the combined application of emissions performance standards and an oxygen requirement. As a result, the RFG program has provided toxic reductions in excess of those required by the performance standards, alone.

The oxygen standard has also provided reductions in carbon monoxide, for which there is no performance standard at all.

The real world emissions benefits of oxygen are especially beneficial with higher-emitting vehicles and off-road and off-cycle driving. The EPA should be instructed to compare the potency weighted toxic effects of oxygenated and non-oxygenated RFG.

It is critical that the carbon monoxide benefits of oxygenates not be ignored. The oxy-fuel program works, and CO has been dramatically reduced nationwide.

The primary concern with maintaining the oxygen standard appears to be the industry's ability to supply the increased demand for ethanol, but such concerns are unfounded.

It is important to understand that, because ethanol has twice the oxygen content of MTBE, it will only take half as much ethanol to satisfy the oxygenate requirements of RFG. Currently, MTBE use in RFG is approximately 250,000 barrels per day. That level of oxy-

gen can be met by 128,000 barrels per day of Ethanol. Current ethanol production is 100,000 barrels per day.

A recent report prepared by AUS consultants for the Governors' Ethanol Coalition demonstrates that the ethanol industry can double production within 2 years, quicker than the proposed 3-year MTBE phase-out. Information demonstrating ethanol's ability to meet the expanded requirements is included in the paper I have presented to this group.

The logistics of the expansion of ethanol markets can be met by water movement, rail movement, and pipeline movement. Williams has met with major refiners on both the East Coast and West Coast, and we contemplate moving vessel loads of ethanol to Los Angeles, to New York, and New Haven, and further distribution by pipeline. There are also pipeline possibilities from Chicago to the East Coast.

In conclusion, the domestic ethanol industry understands that Congress is faced with a daunting challenge—how to protect water supplies by reducing the use of MTBE without sacrificing air quality or increasing fuel prices.

We see ethanol as a solution. Increasing ethanol use in this program will allow MTBE to be phased out cost effectively while protecting precious water resources and air quality.

Stimulating rural economies by increasing demand for grain use in ethanol production will help farmers left behind by our booming economy. Encouraging new ethanol production from biomass feedstocks will provide additional environmental benefits and take a positive step toward a sustainable energy future and global climate change.

The bottom line is that we need to protect both air quality and water quality, and with ethanol we can.

Senator INHOFE. Thank you very much, Mr. Huggins.

Mr. Grumet with the Northeast States for Coordinated Air Use Management.

STATEMENT OF JASON S. GRUMET, EXECUTIVE DIRECTOR, NORTHEAST STATES FOR COORDINATED AIR USE MANAGEMENT, BOSTON, MA

Mr. GRUMET. Thank you, Mr. Chairman. Again, my name is Jason Grumet, and I am with NSCAUM, the Northeast States for Coordinated Air Use Management—not an easy one, Mr. Chairman. For 30 years, however, with that acronym, the Northeast States have been working together to try to promote consistent policies to air pollution control, and on behalf of those States I want to thank you for the opportunity to be here today.

Mr. Chairman, in order to talk about where we are going, I'd like to begin by talking about where we are, the status quo, and the dire impacts on the Northeast's economy and environment if Congress does not legislate to lift the oxygen mandate this summer, and then I'd like to talk about the different approaches that are under consideration today and the different impacts those approaches would have for ethanol policy and ethanol use.

The good news, Mr. Chairman, is that MTBE as a fuel additive is going away, and I think we can thank Senator Boxer and Gov-

ernors Davis and Pataki and Roland and many others for the advocacy to remove MTBE as a fuel additive.

The real debate right now is simply whether we proceed with a severe curtailment of MTBE back to the historic pre-1990 levels with the possibility of banning the product altogether, or whether we just ban the product right now. But within that narrow band I think it is clear to us in the Northeast that MTBE will no longer be a fuel additive in our region in any quantity. That would be the good news, Mr. Chairman.

The bad news is that, if we keep the oxygen mandate in the absence of MTBE, we have just, in fact, required a de facto ethanol mandate and, in fact, it is an ethanol mandate of the very worst kind, Mr. Chairman, because it is a summer time ethanol mandate borne primarily on the Northeast colonies that I represent, on the backs of California and Texas.

This would have profoundly negative impacts on our environment and our economy in that these are the regions of the country that have severe ozone problems, and, as we've heard from a number of speakers, ethanol, in fact, undermines our ability to attain the ozone standard. I think that is evidenced by the fact that we have a waiver on one of the most important environmental criteria in gasoline, that being the volatility, in order to tolerate extended uses of ethanol.

Second, it is a mandate of the worst kind because it is a mandate on the very fringes of the country where ethanol is not produced. One only needs to pick up the newspaper to look at the dramatic increases in price that have come in reformulated gasoline in those States that use ethanol, and that's certainly a problem that we care very deeply about. It's certainly a problem that we don't want to exacerbate.

If we were to require summertime use of ethanol in Philadelphia and Boston and Hartford and New York City, not only would we have the same problems that are being faced in Milwaukee and Chicago with regard to providing the low blend stock base fuel with which you can blend the very volatile ethanol, we would have the additional cost of transporting that fuel to the Northeast. So, as I think you can see, from our standpoint a summertime ethanol mandate would be an absolute disaster.

With regard to who benefits from that, however, since someone always benefits from someone else's misery, I would argue that it is not the farmers who would benefit from maintaining the oxygen mandate, but rather it is one or two large, multinational agribusinesses, the only companies in this country who have the infrastructure capacity to move hundreds of millions of gallons of ethanol from where it is produced to where it would be mandated to be used.

We simply cannot tolerate Congressional inaction in the northeast and, frankly, we can't fathom legislative efforts which would seek to take this de facto ethanol mandate and make it an aspect of law. Legislative efforts to require maintenance of the oxygen mandate we feel do not hold any promise to provide the bipartisan and national consensus necessary to address this problem.

Within and beneath the shadow of what we truly believe is a looming disaster for the northeast, we are trying very ardently to

work and bring new collaborative efforts forward to try to help you address this issue. I think most people are aware the Northeast States several months ago joined with the American Petroleum Institute, several refiners, the NPRA, and the Lung Association to advance a set of principles that we believed were the bedrock necessity to move forward on this legislative effort, and I want to thank you, Mr. Chairman, for introducing legislation very recently which I believe is very true to these basic principles.

I'd also like to thank Senator Smith's staff for bringing forth a discussion draft I think is true to those basic principles, and the legislation brought forward by Senators Lugar and Daschle, which I also think reflects the basic principles that the Northeast States and the Lung Association have argued as necessary to address lifting the mandate while maintaining air quality.

We find ourselves where we expected we would be in this moment in the debate, and that is having consensus about all issues, generally, except one, and that being the treatment of ethanol.

At the outset, I would suggest that, if it were possible to advance legislation that took care of all the Northeast State's interests, as your bill I believe does, and provided no consideration of ethanol, that would be wonderful and we would strongly endorse such an effort. However, if, by maintaining our unyielding and entrenched adherence to our interests to the exclusion of the interests of other regions of the country, we, in fact, are collusive in encouraging legislative inaction, and shame on us, because what we would have just done is ensured the worst possible kind of mandate for the Northeast States.

So, again, the worst possible outcome for the Northeast States is Congressional inaction. We firmly believe that ethanol policy must transition from policies of market protection to policies of product quality; however, we are not willing to play a game of legislative chicken with the northeast environment and economy on the line.

We, therefore, have made several supportive statements of a properly designed renewable fuel standard or clean alternative fuels program that would ensure that ethanol use is able to continue, but also does so in a way that does it in the right place and the right time.

Thank you, Mr. Chairman.

Senator INHOFE. Thank you, Mr. Grumet.

During question and answer time I will be asking each one to respond to my legislation, so I appreciate that.

Mr. Gatto.

STATEMENT OF STEPHEN GATTO, PRESIDENT AND CHIEF EXECUTIVE OFFICER, BC INTERNATIONAL, DEDHAM, MA

Mr. GATTO. Thank you, Mr. Chairman. My name is Stephen Gatto. I'm the president and CEO of BC International Corporation, a company that is utilizing new technologies to manufacture ethanol from cellulosic biomass wastes such as wood waste, rice straw, and a variety of urban wastes and nonenergy-intensive dedicated crops.

I am here today to address many of the issues raised regarding the ethanol industry's ability to meet the demand and infrastruc-

ture in all areas of the country, and biomass has a unique opportunity to address that.

Before I begin, I'd like to thank Chairman Inhofe, Ranking Member Senator Graham, and subcommittee members for providing me with the opportunity to testify today. In particular, I'd like to thank Senator Boxer for her support of the biomass ethanol, in particular. And I'd also like to compliment the subcommittee for the work it has been doing to address the MTBE in gasoline and explore the ethanol alternative.

This is a very exciting period for the biomass ethanol industry. BC International is currently involved in the completion of a 23 million gallon ethanol facility located down in Jennings, Louisiana. It is the first of a kind ethanol facility to take biomass waste. In particular, we will be using sugar cane residue as our feedstock. We expect that this plant will be fully operational within less than 2 years, and we are also developing plants in Gridley and Chester, California, that will use rice straw and wood waste to produce ethanol. In addition, we are exploring the opportunities of developing plants in the Northeast.

Potential capacity for our initial facilities is expected to be over 150 million gallons of ethanol per year; however, the biomass ethanol industry's ability to grow exponentially depends, in part, on the Nation's commitment to providing renewable fuels with sustainable markets such as a market for ethanol as a gasoline additive.

The tremendous advances made in the past decade enabling the construction of these biomass facilities has been made possible due to the research at the University of Florida. This research led to the development of an organism that, for the first time, allows you to take all of the things that we typically throw away and pile up in landfills and use it effectively and efficiently.

This research, along with the ongoing Department of Energy and BC International research, will further increase the efficiency of production and transportation of biomass ethanol, and, in particular, we're talking about facilities that get located where the demand is needed—in particular, building a facility in the Northeast for Northeast use.

I am before you today to pledge my support for the Renewable Fuels Act of 2000 introduced on May 4th by Senators Daschle and Lugar. I firmly believe that the renewable fuel standard contained in this bill—specifically, the provision that credits cellulosic biomass ethanol with 1.5 times as much value as starch-based ethanol for the purposes of compliance with the standard—would help develop the meaningful domestic renewable fuels industry across the country, not just in the Midwest.

The use of ethanol, particularly biomass ethanol, provides a win/win environmental and economic solution to the MTBE problem. Ethanol use contributes to improved air quality and does not pose the same dangers to our water resources as does MTBE, proven by decades of ethanol use in the Midwest.

This is why gasoline suppliers in California and in the Northeast such as Tosco and Getty feel confident displacing most of their MTBE with ethanol.

Ethanol is also favorable because, unlike petroleum-based alternatives, such as alkylates, ethanol means increased use if indigenous renewable resources and reduced reliance on imported oil.

Equally important, our technology enables us to turn regional waste problems into economic growth opportunities in rural communities.

To take a closer look at some of the projects that further demonstrate the extensive benefits of ethanol, in Gridley, California, in particular, BCI is planning to build a biomass ethanol plant that will use agricultural waste from the rice straw farms in Sacramento and areas north of the Sacramento area. Use of rice straw waste will help reduce the need to burn open field rice straw, to the tune of roughly 1.5 million tons annually, resulting in significantly decreased local air pollution.

Later this summer, BC International plans to begin construction of a similar plant down in Jennings, Louisiana, and it will use sugar cane waste as a feedstock, helping to alleviate a major disposal problem now faced by many of the sugar-growing communities, especially in Louisiana and Florida.

In the Northeast, and particularly in Maine, as long-term contracts for electricity from biomass energy facilities expire or are bought out, a number of sawmill facilities, which currently provide feedstocks to these biomass electric facilities, are faced with impending pressures and possible closure. And, likewise, the sawmill operators face disposal costs in the tens of millions of dollars if we cannot find an alternative to disposing of this material. BC International is currently exploring the development of facilities in the Northeast to address this problem.

In addition, the potential impact of biomass ethanol on our available fuel supply and economy is enormous. According to the National Renewable Energy Lab study, an average of 2.45 billion metric tons of cellulosic biomass could be available on an annual basis for ethanol production in the United States. This is enough biomass to produce over 270 billion gallons of ethanol, approximately two times the level of current U.S. gasoline supply.

Having said all this, the question arises: what will these benefits cost gasoline customers? Simply stated, the use of ethanol in gasoline does not and will not significantly impact the price of gasoline. Results of the 1999 study completed by the California Energy Commission shows that using ethanol would cost approximately the same and potentially less over the long term as replacing MTBE with alkylates. Long term, the creation of a market for biomass ethanol will drive technology advancements and result in further cost reductions.

With the introduction of Senators Daschle and Lugar's bill, we are seeking to reduce the reliance on imported fuel by growing a domestic and renewable fuels industry. The bill's provision to support biomass ethanol ensures that a renewable industry will continue to expand beyond the limited capacity of the starch-based ethanol industry.

I firmly believe that this vision will make for a better, more sustainable economy, cleaner air and water for our children and our grandchildren.

For more details on any items that I've mentioned, please refer to the full written text of my testimony.

I thank you again for the opportunity.

Senator INHOFE. Thank you, Mr. Gatto.

Last, we have Mr. Proctor, who is the director of transportation in the State of Ohio.

STATEMENT OF GORDON PROCTOR, DIRECTOR, OHIO DEPARTMENT OF TRANSPORTATION, COLUMBUS, OH

Mr. PROCTOR. Thank you, Chairman Inhofe, members of the committee. I am Gordon Proctor, director of the Ohio Department of Transportation. Thank you very much for this invitation to testify, and I would especially like to thank Senator Voinovich for helping make this possible.

The committee today is discussing the role of ethanol as a motor fuel and a fuel additive. Coming from an agricultural State, I understand the importance of ethanol's use to the agricultural industry. I'm also aware of ethanol's role as a fuel oxygenate and as a domestically produced energy source. I'm not here to speak against ethanol or the strategy of promoting its use.

As a State director of transportation, however, I would point out to the committee an unintended consequence that has befallen Ohio as a result of the increasing ethanol consumption.

Under the funding formula adopted in the Transportation Equity Act for the 21st Century, T–21, Ohio's Federal appropriation is determined in large part by our contribution to the highway trust fund. At the time of this enactment, this was a welcome move for Ohio and one that Ohio supported. However, there was a consequence that neither Ohio nor apparently the appropriators anticipated. The consequence was the dramatic increase in the use of ethanol caused by national market forces. I am neither an ethanol nor petroleum expert, but apparently, because of continued depressed corn prices and because of the continued Federal tax reduction on ethanol, the use of ethanol-blended gasoline in Ohio has soared from 19 percent to more than 40 percent of all gallons sold at the pump. Because ethanol-blended fuel is taxed differently than petroleum fuels, the increase in ethanol use has significantly decreased the amount of revenue credited to Ohio in the highway trust fund.

As you may know, there is a 5.4 cent per gallon Federal tax break on each gallon of ethanol-blended gasoline, and, in addition, $0.031 of the tax that is collected on ethanol is credited to the general fund and not to the highway trust fund. So, in other words, Ohio's contribution to the highway trust fund is reduced by 8.5 cents for each gallon of ethanol-blended fuel sold in Ohio. I expect ethanol use will continue to rise and will continue to reduce Ohio's trust fund contributions.

The sums involved are substantial. For Ohio, these reduced contributions to the highway trust fund reduced Ohio's Federal highway funding by $185 million annually. To put that number in perspective, it equals 21 percent of Ohio's total Federal obligation ceiling, it equals two-thirds of our State's entire new construction budget, and it equals what ODOT budgets for routine bridge repair and replacement each year.

The situation appears to be unique to Ohio because we are both a large consumer of ethanol and a donor State. For donee States, other provisions in T–21 appear to mitigate the effect of rising ethanol use, because those States' appropriations are not tied directly to their highway trust fund contributions.

Let me emphasize, I am very appreciative of Congress' efforts on behalf of T–21 and the unprecedented appropriation it has provided.

Let me also emphasize that Ohio has received the minimum appropriations guaranteed under the Act. I do not want to imply otherwise.

What Ohio has not realized, however, is a commensurate increase of growing highway trust fund dollars, because, while consumption of fuel in Ohio has risen, our contributions to the highway trust funds have been stunted by the way ethanol is taxed.

The situation exacerbates Ohio's donor State status. We in Ohio have the tenth-largest highway network, we have the fifth-highest volume of traffic, we have the fourth-largest interstate network, and we have the second-largest inventory of bridges in the country. While our traffic and congestion has risen, our Federal receipts have not risen commensurately because of the unintended consequence of the ethanol issue.

I would ask for your consideration in two ways. First, I would ask, in any future consideration of highway funding formulas, that the use of ethanol be taken into account. Although it is national policy to encourage ethanol use, the cost of this policy is not spread uniformly.

Second, I would request, at the appropriate time and in the appropriate legislation, that the $0.031 of the ethanol tax that is credited to the general fund be redirected to the highway trust fund. At least that effort would continue directing the highway tax receipts into the highway trust fund, where they would accrue to Ohio.

Mr. Chairman, thank you for this opportunity. I am grateful for the committee's time and attention.

Senator INHOFE. Thank you, Mr. Proctor.

We want to hear opening statements from the two Senators who just arrived. First, if it is all right, Senator Boxer, I want to enter something into the record. I would like to enter into the record an article about the economics of the ethanol subsidy which appeared in the "Energy Journal" entitled, "The Economics of Energy Market Transformation Programs," by researchers from Princeton University and the University of California. They looked at the cost/benefit ratio of ethanol and compared it to other programs and found—and this is a quote from the report—"a corn ethanol has not yielded positive benefits to date, and it appears unlikely that it will do so in the future."

We would recognize Senator Boxer for any opening remarks she might make up to 5 minutes.

OPENING STATEMENT OF HON. BARBARA BOXER, U.S. SENATOR FROM THE STATE OF CALIFORNIA

Senator BOXER. Thank you very much, Mr. Chairman, for holding this hearing. I understand that after this good panel we are

going to hear from Senators Harkin, Durbin, and Grassley, and I'm——

Senator INHOFE. That's correct. Before you arrived, I announced that we changed those panels around so that the Senators will have the last panel.

Senator BOXER. Right. I'm very pleased about that. I have a conflict that starts at 11, but I just wanted to thank you very much for including them, as well, because I think they have a lot of expertise in these areas.

I also was very pleased to hear from Stephen Gatto from BC International and his plans concerning the opening of a biomass ethanol plant in Gridley and Chester, California. As he explained, the plant would use the agricultural waste from rice, rice straw, and turn that straw into ethanol, and this would solve a serious waste problem for Sacramento's rice farmers, who have no way to dispose of the waste, and make a great contribution, I think, to the transportation sector, to clean air, and, frankly, clean water, which I'm going to talk about in a moment.

I'd like to place into the record a letter written to me by California Biomass Interests, which discusses their plans and the way they see that this biomass can, in fact, help us with the problems that we face.

Senator INHOFE. Without objection.

Senator BOXER. I am also very pleased to learn that this hearing will be followed by a full committee markup—is it next week on MTBE?

Senator BOXER. I'm very pleased about that. And I just want to state at the start, I don't have any prejudices about, you know, what we should put in the gasoline to help clean up the air. I just know that we need to clean up the air, and I'm going to be strong on that point. We shouldn't back down from that goal.

And we also shouldn't trade clean air for poison water. I mean, that's just not even something that makes any sense at all. So what has motivated me from the beginning is not any particular interest except what I would call the environmental interest.

Now, clearly, we wouldn't be here today if we weren't having a horrible problem with MTBE. I have been calling for the elimination of MTBE for over 3 years, and I introduced legislation to ban it. Frankly, it is poisoning the water supply in California. It is as simple as I can state it.

I called on the EPA administrator for many years to ban it. Finally, on March 21, 2000, she did propose to write a rule to phaseout MTBE, and that was after I'd brought a resolution to the Senate which was, fortunately, a victorious one, to phaseout MTBE. So the Senate went on record as saying we should get rid of MTBE, then the administrator, a year later, said, "We're going to phase it out." As far as I am concerned, we ought to move it even faster, and I want to explain why.

Since Santa Monica, CA, lost 71 percent of its drinking water supply to MTBE contamination, we have found MTBE leaking into groundwater at approximately 10,000 sites in California. Drinking water wells in beautiful Lake Tahoe and Glenville have been closed due to MTBE contamination. MTBE leaking from underground tanks near drinking water wells in Cambria, California, now

threatens that small community's entire water supply. And we all know by now that MTBE is not just a California problem. Frankly, when I raised this issue 3 years ago, we had just found MTBE in just a couple of States. I said, "Let's learn from California's problems here. Let's get rid of it."

Well, we haven't done it, and so now we see MTBE as a problem in Maine, where it is estimated that between 1,000 and 4,300 private wells may contain MTBE. MTBE is a problem for New Hampshire. Our full committee chairman knows that—he has been very helpful, by the way, working with me on this matter—where MTBE has been detected in more than 100 public wells and water supplies, and that's a small State, so that's a lot of detection.

MTBE is such a severe problem in New York that New York recently followed California's lead by banning MTBE. Suffolk County, New York, for example, estimates that 80 percent of its wells showed detectable levels of MTBE. In fact, a recent study of 31 States found that approximately one-third of the drinking water supplies in those States, 31 States, may already be contaminated with MTBE.

I'd like to place that study, a particular study, in the record. That shows the contamination in these 31 States—without objection.

Senator INHOFE. Without objection.

Senator BOXER. Thank you.

As we move forward with legislation that would finally phaseout MTBE, we do need to be sure that any replacement is safe and reliable and is affordable. I look forward to learning more about that as I study all of your comments. I was here for many of them. And I want to compliment the Chair, because he really has put together a panel that doesn't agree on much, which is a healthy thing because we get to see all the different views.

I'm about to finish my remarks, if I could have an additional minute.

I am hopeful that replacing MTBE with ethanol will help restore what I consider to be some sanity in our Nation's energy policy. Because ethanol is a renewable resource made from readily available feedstock like corn, increasing ethanol use would help reduce dependence on foreign oil. I see it as a win/win. I really do. And it would help our farmers by boosting their low corn prices. And, as I mentioned before, ethanol can be made from waste like rice, straw, wood trimmings, and trash, as Mr. Gatto has explained.

So the greater use of ethanol can turn an environmental problem, waste, into an environmental benefit, energy, and the economic benefits for our farmers and clean air and getting rid of a poison, which is clearly a poison and is drastically harming our people—at least in California I can say that.

So, Mr. Chairman, again thank you for putting together this panel that has a very broad range of views. I think it is good. I know your views and mine aren't exactly the same on this, but I can only say to you from the bottom of my heart, I don't have any agenda other than making sure that the air is clean, the water is clean, and we keep on moving forward, and people can afford to get the gasoline.

You know, the question of whether it will add four cents or six cents a gallon is an important issue, but I think the overriding problem here is that we are poisoning our water, and that costs a lot to fix, and you can't really measure the kind of ill health effects you might have if we continued with MTBE, so thank you very much for your time.

Senator INHOFE. Thank you, Senator Boxer.

Senator Voinovich, you are recognized for an opening statement.

OPENING STATEMENT OF HON. GEORGE V. VOINOVICH, U.S. SENATOR FROM THE STATE OF OHIO

Senator VOINOVICH. Thank you, Mr. Chairman.

I appreciate your conducting this hearing today on ethanol, particularly as the full committee tries to address the issue of MTBE contamination of groundwater and drinking water systems. It is kind of an interesting time because we see this high increase in the cost of gasoline and the debate going on about whether oxygenates are really important or not important and whether the use of ethanol is being exploited in some parts of the country. There are lots of accusations and things just rolling all over the country, so I think it is kind of a good time to have all these folks in front of us today.

As you know, Mr. Chairman, I have been a strong supporter of ethanol for its environmental benefits toward reducing carbon monoxide, particulate matter, and toxins. In addition, I believe its benefits to the agriculture community through the use of corn, and when I was Governor I sent many letters to Congress urging them to keep ethanol. And I do support the use of ethanol to reduce this country's dependence on foreign oil.

Like MTBE, another oxygenate used in RFG, ethanol helps lower emissions of volatile organic compounds, toxins, carbon monoxide, and particulate matter, and, according to the EPA, reformulated gasoline is responsible for 17 percent reductions in VOC emissions and 30 percent reductions in toxic emissions. Oxygenates such as ethanol also reduce the use of aromatics in gasoline, many of which are known as potential human carcinogens. Unlike MTBE, however, ethanol does not contaminate groundwater and drinking water systems.

In addition, the production of ethanol is helping our Nation's farmers. The Department of Agriculture estimates that about 555 million bushels of corn are used to produce about 1.4 billion gallons of fuel, ethanol.

It is kind of interesting, Mr. Chairman, that last year or this year we are trying to do something about the farm economy. There is no question that the use of ethanol is having a positive impact on that farm economy, and, quite frankly—and I hate to say this—if they weren't benefiting from this way, I'm sure some of them would be in here asking for some more help from the Federal Government.

When you start looking at these things, there are many aspects of it that you have to take into consideration.

I also believe that one of the important benefits of using ethanol is that it is domestically produced. I don't believe that ethanol is going to take the place of conventional gasoline, but I do think it

is important to reduce this country's reliance on foreign oil, which is, at this stage of the game, 55 percent, and, as the Department of Energy predicts, by 2020 it will be up to 65 percent. We have a real crisis in this country, and ethanol may be one of the things that we can use, along with, perhaps, Mr. Chairman, subsidizing marginal producers of oil in this country who have been out of business because of the low cost per barrel.

There are a lot of things that we need to do, but this, I think, is one of the things that should be on the smorgasbord of this country's energy policy.

I also believe that we also have to take into consideration—Gordon Proctor, I am glad that you are here today. I want you to know, Mr. Chairman and Senator Boxer, Gordon is one of the outstanding highway directors in the United States of America, and brings to us a real interesting perspective. Senator Boxer, I think you should be real interested in it. It is that the more use of ethanol, the less money goes into the highway trust fund. And today Ohio is hurting because we are the biggest user of ethanol in the country. I don't know how that has happened, but we are. As a result of that, we are not getting the growth in that highway trust fund.

If we are going to keep the oxygenate and if we are going to be using ethanol, then we need to look at the highway trust fund and maybe change one of the provisions that says that $0.031 of that tax goes into the general fund, because if we don't, places like California and Ohio and others that are going to be using ethanol are going to be not getting their fair share of that trust fund because it is going into the general fund.

So I think that this is a wonderful hearing to have at this time, and hopefully, as you're listening to the witnesses and reading their testimony, we'll have a better idea of how we ought to figure out what we ought to do in regard to this.

Thank you, Mr. Chairman.

Senator INHOFE. Thank you, Senator Voinovich.

[The prepared statement of Senator Voinovich follows:]

STATEMENT OF HON. GEORGE V. VOINOVICH, U.S. SENATOR FROM THE STATE OF OHIO

Mr. Chairman, I appreciate you conducting this hearing today on ethanol, particularly as the full committee tries to address the issue of MTBE contamination in groundwater and drinking water systems.

I have been a strong supporter of the use of ethanol for its environmental benefits toward reducing carbon monoxide, particulate matter and toxics. In addition, I believe it benefits the agricultural community through the use of corn. And, I support the use of ethanol as a way to help reduce our dependence on foreign oil.

Mr. Chairman, I particularly want to welcome Gordon Proctor, director of the Ohio Department of Transportation. Mr. Proctor was a member of my transportation team when I was Governor of Ohio and was a leader in quality management. Mr. Proctor also was instrumental in implementing the TRAC system in Ohio for prioritizing transportation projects. The TRAC system enables the state to recognize and fund those projects that are the most needed. I was delighted that Governor Taft elevated him to Director of ODOT. He is one of the most respected transportation directors in this country. I look forward to his testimony today on the effects of ethanol consumption on the Highway Trust Fund.

Ethanol has been beneficial to the environment and the agricultural community. It has been used successfully to improve air quality in areas that use Reformulated Gasoline (RFG). It has also reduced carbon monoxide emissions under the Oxygenated Fuels program in carbon monoxide nonattainment areas.

Like MTBE, another oxygenate used in RFG, ethanol helps lower emissions of volatile organic compounds (VOCs), toxics, carbon monoxide and particulate matter. According to EPA, RFG is responsible for 17 percent reductions in VOC emissions and 30 percent reductions in toxic emissions. Oxygenates, such as ethanol, also reduce the use of aromatics in gasoline, many of which are known or potential human carcinogens.

Unlike MTBE, however, ethanol does not contaminate groundwater and drinking water systems.

In addition, the production of ethanol is helping our nation's farmers. The U.S. Department of Agriculture estimates that about 555 million bushels of corn are used to produce about 1.4 billion gallons of fuel ethanol.

I also believe one of the important benefits of using ethanol is that it is domestically produced. While I do not believe that ethanol will take the place of conventional gasoline, I believe it is important to support its growth as a tool to help reduce this country's reliance on foreign oil and gasoline imports. Today, our oil imports have risen to about 55 percent.

However, as chairman of the Transportation and Infrastructure Subcommittee, I believe we need to keep in mind the effects that any increased ethanol use would have on the Highway Trust Fund.

Currently ethanol receives a Federal tax credit of 5.4 cents per gallon of gasohol or 54 cents of pure ethanol. OMB currently estimates that the annual revenue loss due to the 5.4-cent tax credit is $800 million. In addition, 3.1 cents of the tax that is collected on ethanol is credited the general fund and not to the Highway Trust Fund.

I strongly believe that as we proceed forward with addressing MTBE, if ethanol use is increased which I support then we need to ensure that States do not lose Federal highway funding because of their use of ethanol to help meet air quality standards.

Mr. Chairman, I look forward to today's testimony.

Senator INHOFE.We'll have a couple rounds of questions now.

I'd like to just ask for a brief answer from each member of the panel. I know you all heard my opening statement, which cited the Blue Ribbon Panel's call for more research and the California Report's call for more research, and I realize that some of you already stated today that more research is necessary, but, just so we can get it on the record, I'd like to go down the line and just ask if you believe that more research should be conducted on ethanol before making these decisions.

We'll start with Mr. Greenbaum. Just yes or no is fine.

Mr. GREENBAUM. Mr. Chairman, I reminded the panel in my testimony of the recommendations of the Blue Ribbon Panel calling for additional research. I think it is important, however, to not suggest that no action be taken on the mandate and on the oxygenate issue and on getting rid of MTBE while we wait for that, so we need to balance that. But clearly we need to do more research on ethanol.

Senator INHOFE. Yes, sir.

Mr. Early.

Mr. EARLY. Mr. Chairman, we would support more research on ethanol and all substitutes for MTBE, as Senator Boxer suggested.

Senator INHOFE. Yes. Doctor?

Mr. GRABOSKI. I agree. Yes.

Senator INHOFE. Mr. Slaughter.

Mr. SLAUGHTER. We're in favor of pervasive research on what would be going into a pervasive product. We're definitely in favor of it.

Senator INHOFE. All right. Mr. Huggins.

Mr. HUGGINS. I think we have had thousands of years of research on ethanol. Brazil uses ethanol in all of their fuel. More re-

search is nice, but I think we need to decide what we want to learn from that research.

Senator INHOFE. OK.

Mr. GRUMET. Certainly more research is always helpful, but we face a choice of varying approaches to mandating ethanol, and, in the face of the dire circumstances of those choices, I don't think we have the luxury of sitting back and awaiting that research before Congress acts.

Senator INHOFE. Yes.

Mr. GATTO. I think that a lot is known about ethanol. We drink it when we drink wine. We drink it when we drink beer and alcohol. To talk about the peculiarities of how it will behave compared to gasoline, which we all know what the reactions would be for whatever reason of human ingestion, or what have you, of that product, we need to make sure that we're looking at this in an apples and apples comparison.

I do believe that, to the extent that anything is going into the gasoline supply, all things such as alkylates need to be tested and looked at, as does gasoline, as a whole.

Senator INHOFE. All right.

Mr. Proctor.

Mr. PROCTOR. Mr. Chairman, I couldn't qualify or couldn't be qualified to comment on the health effects of the research, but, in terms of research into making it economical, to integrate it into the infrastructure of the transportation system, we would certainly be supportive of such research.

Senator INHOFE. All right.

During the opening statements, three of you—Mr. Early, Mr. Slaughter, and Mr. Grumet—all referred to legislative principles. I'd like to just briefly, in a one-sentence form on each section, summarize the bill that I have introduced. I think some of you are familiar with it, but I'll just go ahead and read this.

Section one, Governors may waive out of oxygenate mandate; the anti-backsliding program for toxics in reformulated gas areas; development of additional standards for storage tanks; administrator may ban oxygenates; MTBE is phased down to pre-1990 levels; Governors may ban MTBE; MTBE producers are given assistance with new permits; and regulations must assure adequate fuel supply.

For the three of you who addressed legislative principles, could you respond to the legislation that I am drafting.

Mr. Early.

Mr. EARLY. Well, Mr. Chairman, clearly your legislation captures many of the principles and we think is a very good starting point for legislation. It is, I think, important that that legislation focuses on the most important issues that we need to address as we move forward to phasing MTBE out of the fuel supply.

Senator INHOFE. Thank you.

Mr. Slaughter.

Mr. SLAUGHTER. Yes, Mr. Chairman, your legislation, as I understand it, comports with NPRA's position on how to address the problems with the oxygenation mandate.

Senator INHOFE. Thank you.

Mr. Grumet.

Mr. GRUMET. Thank you, Mr. Chairman.

Mr. Chairman, I would agree. I think your legislation is an excellent contribution to the discussion. I think it very clearly reflects many of the principles that we have been promoting.

I would make a couple of specific comments.

The legislation does not focus on impacts that could affect the conventional gasoline supply, which is two-thirds of the Nation's fuel supply, and that is an issue that has been of more substantive discussion of late.

It also doesn't address the fact that the environmental requirements for ethanol are less protective than the environmental requirements for gasoline because of the RVP waiver.

Finally, the legislation, like most legislation, is dependent upon an intricate choreography of EPA rulemakings, and I think we want to interact with your staff about whether there are ways to back stop some of those obligations.

The last thing I would say, Mr. Chairman, is that I think you would agree the Northeast States have a long history of principled advocacy in the face of political impossibility. However, I think that, in this case, that absolutism is somewhat chastened by two factors. One is the dire impacts that will face the Northeast environment and economy if legislation does not move forward, and the second is the evolution of what appears to us to be some very constructive compromise. I think that the efforts in the full committee with Senator Smith to look at ways to acknowledge the growth in ethanol that is going to happen, as Mr. Early and Mr. Slaughter indicated, and find a way to enable that ethanol to be sold in ways that are consistent with environmental and economic principles and the extent to which we can bring a broader suite of fuels into that competition really holds promise.

We have learned that legislation requires the courage to compromise, and I think we stand here with you.

Senator INHOFE. It is. I wish this were an easy solution, but there isn't one out there, and so we're just looking to see what will grab a consensus.

Senator Boxer.

Senator BOXER. I just had one question.

Mr. Chairman, I was interested to hear the principles of your legislation, and I think that you have come a long way to recognizing some of the things that we have been talking about in terms of MTBE, but I just would like to state that when I started this several years ago, when we started to see the horrible problems from MTBE, I looked at the thought of, well, going back to just how much we used at certain years and so on, and then I thought, well, a poison is a poison is a poison, and a little bit of poison isn't good and a lot of poison is worse.

So for me to stand up in front of my constituency and say, "I did a lot for you. I took some of the poison out of the water"—I would much prefer to stand up and say, "I got rid of the poison."

I guess that's where I differ with you, Mr. Chairman.

Mr. Greenbaum, I have a question for you. I also think research is good on everything that is a commonly used thing, and clearly we are going to move to ethanol one way or the other, but ethanol

has been out there since, as I understand it, the 1970's; is that correct? About 12 percent of the gasoline supplies have it right now?

Mr. GREENBAUM. Yes.

Senator BOXER. So the question I have is, we know what has happened with MTBE. We know it has shut down water supplies. People can't drink it. They won't touch it. It is ruining Lake Tahoe. We know all these things. What stories do we have about ethanol in the places where it is used? For example, in Ohio, Senator Voinovich says—what is it, 40 percent of your fuel has got ethanol in it?

Mr. PROCTOR. Yes.

Senator BOXER. What stories do we have? Did it ever poison a well? Did it ever explode? Did it ever leak? What are the problems? And what are these problems that you have seen that causes you to believe we need more research?

I love more research, but what are the problems we have that would cause to human health and the environment that you think we need to look further at?

Mr. GREENBAUM. First off, let me be clear that the Blue Ribbon Panel's recommendations clearly called for action, and action soon, because of the need to deal with——

Senator BOXER. Action to ban MTBE, phase it down?

Mr. GREENBAUM. We called for the action to substantially reduce it, and members of the panel called for phasing out the use of MTBE, flexibility in blending the fuel—i.e., removing the mandate so you could do it cost effectively around the country—and tightened air quality standards. So we wanted action.

Research, at the same time, needed to be done, because while you're doing the phase-in of whatever takes the place, you need to know what the effects are going to be.

Senator BOXER. That's not my question.

Mr. GREENBAUM. So therefore——

Senator BOXER. I agree with the research, but——

Mr. GREENBAUM.—I was not saying——

Senator BOXER.—I'm just asking you is there any—have we ever had a public health problem such as we've had with MTBE with ethanol? Have we ever had a leakage, a poisoning of the water, shut down of drinking water?

Mr. GREENBAUM. But let me be clear. I was getting to that, and I did intend to answer that. We've never—what the panel found is that we've never, in the areas where we have used it, asked the question in the right way. The issue will not be ethanol contaminating groundwater, itself, and contaminating drinking water wells. The issue will be, if there is one, that it might increase benzene and other things in gasoline getting to wells where it has been used.

What we called for—and I reiterated it in my testimony—is very clearly getting out there in the areas where we have been using it and start monitoring and testing whether we have seen an increase, for example, in benzene contaminations in the areas of the country where it has been used compared to areas where it wasn't used.

We have never done that. That isn't done. And you could do that right now, even if you foresaw a 4- or 5-year time table out there

for increased use of it, but I think you need to—that's the kind of information we called for getting.

Senator BOXER. I really appreciate that. So, in other words, you want to see how it reacts with other compounds and if it has a bad effect on that, but you don't know that it does?

Mr. GREENBAUM. It will be ethanol, itself, that will be the——

Senator BOXER. It isn't the ethanol, itself; it's the effect on other things that you want to look at.

How long would it take to study that?

Mr. GREENBAUM. Well, I——

Senator BOXER. I think that's very important for us to know.

Mr. GREENBAUM. Yes. We called for immediately getting into the data bases that we currently have. I think it is a matter of 2 to 4 years of getting out there, getting the data, putting it——

Senator BOXER. OK.

Mr. GREENBAUM. We do not call for all of that research to be done before any action is taken.

Senator BOXER. I totally understand. I totally get it.

Mr. GREENBAUM. But we have said that it needed to move forward, and it hasn't moved forward, and I think it is very important that any action that Congress takes spur that activity, as well as anything else that it chooses to do.

Senator BOXER. Thank you.

Thank you, Mr. Chairman.

Senator INHOFE. All right. We're going to be having three Senators as the next panel, and I thought, since two of them, Senator Harkin and Senator Grassley, are from Iowa, I'm going to read excerpts of two editorials that appeared in a couple Iowa newspapers—one, the Des Moines Register, and the other is the Quad City Times. And I'm going to ask each one of you to respond to these, so you may want to make a couple of notes as I'm reading these editorials. I thought this would be a way to set up the next panel.

From the Des Moines Register: "An ethanol mandate would deny Iowans a choice of fuels and short circuit the process of ethanol establishing its own worth in the marketplace. The justification is to marginally boost the price of corn. Cleaner air is offered as a reason, too, but that's an afterthought. If that were the goal, other measures would be far more effective." I'm skipping around now. "Let Iowans make their own choices and let ethanol prove itself in the marketplace."

Then, in the Quad City Times: "Chuck Grassley and Tom Harkin may have—" this is a bipartisan statement here, by the way—"Chuck Grassley and Tom Harkin may have the best of intentions, but their proposal to boost ethanol use in Iowa is seriously misguided. The Cato Institute estimates that every dollar of profit now earned by ADM's ethanol operation is costing taxpayers $30 in lost revenues.

"As for claims that ethanol helps the environment, the National Academy of Science, the Congressional Budget Office, the Department of Energy, and even the USDA have each reported that ethanol, which is less efficient than gasoline, provides no significant environmental benefit and may even add to air pollution.

"There is an abundance of evidence that indicates ethanol is not all that it is cracked up to be—not for consumers, not for the environment, and not for farmers."

They conclude, "Ethanol might be worth some level of Government support, but it never will be so valuable as to justify scrapping our system of free enterprise."

I know that's a lot I'm throwing at you there, but I'd just like to get a comment. We'll start at the opposite end, Mr. Proctor, and any comment you'd make about the two editorials that appeared in Iowa.

Mr. PROCTOR. Mr. Chairman, I guess it does refer to economic and tax policy tied into the use of ethanol and that economic and tax policy is tied into our transportation funding system, so, as there have been unintended consequences when MTBE was mandated there were health consequences, there are unintended financial consequences tied into the intervention into the market. I guess we would just caution that Congress be aware of what those tax implications are and be fully aware of them.

I do not in any way, shape, or form want to imply that health issues and highway funding issues are equal. They're not. We understand the importance of the health issues. We're just asking that Congress be aware that there are ripple effects when there are going to be changes in the fuel structure in the transportation sector in this country, and those consequences may not be apparent until all the calculations are done through the highway funding formulas.

Senator INHOFE. Yes, sir.

Mr. Gatto.

Mr. GATTO. I agree that there is an economic impact, and I think it is important to point out, as I believe was noted by the Congressional Budget Office, that about $6 of return to the Treasury was a result of ethanol in this country for every $1 spent on the credit.

I think we need to keep this in perspective. There's a battle——

Senator INHOFE. Excuse me. What was your comment about the $30?

Mr. GATTO. I think that the Cato Institute's information fails to look at all of the specifics in this particular arena.

Senator INHOFE. I see.

Mr. GATTO. Especially the CBO report that looks at the impacts, positive impacts, especially of ethanol.

I think it is important to keep in mind that this is a battle over market share, not necessarily what is best for the environment or best for imported oil. Anything that we can do today, looking at the high prices, especially in the Midwest, to reduce our dependence on imported oil I think goes a long way to addressing the public's concerns and issues as we go forward into this century.

Senator INHOFE. Mr. Grumet.

Mr. GRUMET. Thank you, Mr. Chairman.

As I mentioned in my prepared remarks, Mr. Chairman, we firmly believe that it is time to make a transition from market protection to product quality in designing the future of the ethanol industry, because, of course, this leaves us with a logical inconsistency that ethanol is so good that it can't compete.

That said, Mr. Chairman, I think the headline, "Let Ethanol Prove Itself" is worth reflecting upon. Ethanol has proved a lot about itself. In fact, I think ethanol has demonstrated that it maintains a full house of national environmental benefits. Upon closer scrutiny, that full house is three aces and a pair of twos—energy security and national defense, ace in the hole. Ag policy is an ace. Climate change, especially if we use biomass ethanol, is an ace. Urban air quality is a pair of twos.

The problem that we have, Mr. Chairman, is that the ethanol mandate suggests that we focus our ethanol policy on that pair of twos. We believe ethanol is going to grow by leaps and bounds without any further protection. That makes us wonder why it is necessary to have further protection at the same time it also makes us less resistant to a security blanket for ethanol which would give the ethanol community the security it needs to be part of a legislative solution.

Senator INHOFE. All right.

Mr. HUGGINS. First I'd like to talk about the pricing. We've heard a lot about that. I happen to live in Illinois. I live in Peoria. I'm 150 miles from Chicago that has been in all the press. Chicago prices since April have risen 34 percent. Peoria prices have risen 30 percent. We don't have RFG in Peoria. We have conventional gasoline. In fact, if you go into a gas station you can buy mid-grade with ethanol for $1.75. You buy conventional unleaded for $1.79. Ethanol is not the problem with the prices there. And, in fact, RFG is not the problem with the prices there. There are other problems, and I wish I could tell you what they were, but it is clearly not ethanol and it is not RFG with ethanol.

Senator INHOFE. Good.

Mr. HUGGINS. Relative to the Des Moines Register, at that time the State of Iowa was looking at passing a requirement that all fuel sold in Iowa contain ethanol, a law similar to Minnesota's, but Minnesota had a large part of the State required oxygenate to satisfy the carbon monoxide problem they have. Iowa doesn't have that problem, so it would have been a mandate without any environmental reason.

I think what we are looking at with the Clean Air Act is significantly different because, in fact, oxygenates have been proven and RFG has been proven to help air quality tremendously. I think if we are going to change that formula, that's where we put the research. Is it like lead, where you drop lead and increase aromatics? Is it like oxygenates, you drop oxygenates and increase alkylates? Those are the fuels you should suggest.

Ethanol has been blended in fuel in this country—well, the Model T was designed to run on ethanol, so it has been around a long time and it is in all the fuel in Brazil. So let's focus the research on where it needs to be done.

And, relative to the cost of ethanol, we have got studies that suggest that, in fact, ethanol is a gainer for the Treasury. We talk about Government support and Government interference in the market. My son was in Desert Storm. There is massive Government interference in that market, because that is the only reason we were there, so governments will interfere with markets in a variety of ways.

Senator INHOFE. Mr. Slaughter.

Mr. SLAUGHTER. Yes, Mr. Chairman. You know, the ethanol subsidy program, which has cost billions of dollars over the years it has been in effect, has always involved a shifting of costs, and I think that's one of the things that was alluded to in the articles that you read.

Interestingly enough, I believe I heard today that the State of Ohio, which has very large usage of ethanol, is not totally happy with the fact that they are paying for that through the highway trust fund reduction that is affecting their State, and what is being talked about with this national scheme is that the cost will be distributed across the United States and everyone will have to pay for the ethanol, regardless of whether or not they use it. So I think the logic of the two articles that you've read is fairly compelling.

Senator INHOFE. All right.

Mr. GRABOSKI. I would disagree with the statement that there are no environmental benefits to the use of ethanol that came from at least one of these articles. You know, the Clean Air Act addresses performance standards and it addresses general standards, and all we've talked about today are performance standards issues and not the things that benefit us that result from the oxygen requirement and general standards.

Because of the general standards, we have less fine particulate emission from motor vehicles, and fine particulate emission is a substantial contributor to the $PM_{2.5}$ inventory in cities, and we have reduced potency-weighted air toxics, and we have reduced ozone because of carbon monoxide benefits. So I think these things are real and they are not weighted into the debate.

My interest is not necessarily trying to make a larger market for ethanol, which, of course, is the interest of my sponsor. My interest is in maintaining equal public health. And so, as we go down the road, I mean, I really think we seriously need to look at this, and when I addressed the issue of research before that's what I was talking about—trying to figure out what the public health impacts of any of these replacement items are.

I'm also an author of USDA's study that looked at the efficiency of the conversion of ethanol from corn, and the statement in one of these articles that said that this is a less-efficient process than gasoline is totally wrong and it doesn't agree with our findings or the findings of the Department of Energy.

Basically, from an energy point of view, you get about three BTUs of ethanol out from every two BTUs total that you put in, but that really doesn't tell the true story. In today's ethanol business, a majority of the energy that goes into making ethanol really is in a form of coal used in electric-generating and heat-generating facilities to produce the ethanol, and in terms of natural gas which goes into making fertilizer to produce ethanol.

Really, when you look at ethanol, what you're doing is using lesser-grade fossil fuels in solid and gaseous form and you are converting those into a very, very useful liquid fuel, and on that basis, when you look at all of the alternative fuel type process that the Department of Energy and others have looked at over the years, this really turns out to be the most efficient way of converting our fossil resources into liquid fuels.

Finally, we're talking about prices going up, and prices are going up for gasoline primarily because crude prices are going up, and those crude prices are not really within our control. They are within the control of others. But I would point out that removing 100,000 barrels a day of ethanol supply from the gasoline chain, like removing several hundred thousand barrels a day of MTBE supply also from the gasoline chain, is not going to decrease gasoline prices, it is going to increase gasoline prices.

Those would be my comments.

Senator INHOFE. Thank you, Doctor Graboski.

Mr. Early.

Mr. EARLY. Well, Mr. Chairman, the portions of those editorials which confirm my testimony, obviously I agree with, which is using ethanol does not guarantee you an air quality result. Congress may choose to mandate ethanol in gasoline for other reasons, either energy security or other reasons, but we think it is very important that, if Congress chooses to do that, that we ensure that the use of that ethanol—that there are protections so that the use of that ethanol doesn't increase air pollution instead of decreasing air pollution, because that's the result we want when we're cleaning up fuels.

Thanks.

Senator INHOFE. Thank you.

Mr. Greenbaum.

Mr. GREENBAUM. Just briefly, to speak to the comments and the editorials from the perspective of the Blue Ribbon Panel, we called specifically for flexibility, the ability to deal with a reduction in the use of MTBE without dramatic new mandates so that one could see the most cost-effective solution.

We assumed that that would result in an increase in the use of a number of other products, including ethanol, and not in substantial increase in the use of those products. I think we saw that mix of solutions defined by the marketplace dealing with the complex issues of what you needed to blend fuels for clean air in different parts of the country, what you needed for cost effectiveness in terms of infrastructure, etc., in different parts of the country would be the preferred way of addressing this.

We did acknowledge, as well, as has been the case for decades in Congress, that there are sets of interests aside from the fundamental clean air and clean water issues that have called for increased use of ethanol, and that those might need to be considered in this process. We thought that there would be some increase in use, even under any circumstances, if one moved to get rid of the MTBE, kept tight air quality standards, and removed the mandate.

Senator INHOFE. Thank you.

Mr. GRUMET. Mr. Chairman, can I make one point about gasoline prices? I would agree with everybody that there is a feeding frenzy, with consumers at the bottom of the food chain, but, lest we place all of the blame on OPEC, I think it is worth noting that the spot price for ethanol sold by Archer Daniels Midland has gone up $0.15 per gallon in this same time period that we are concerned about.

Senator INHOFE. From what to what?

Mr. GRUMET. I think it was about—this is without the subsidy—I think about $1.45, closer to about $1.60.

Mr. HUGGINS. That's not correct.

Mr. GRUMET. Well, it has been reported in some articles which I can submit for the record.

Mr. HUGGINS. I compete in the marketplace daily. I can tell you the spot price in the Midwest right now is about $1.35. In the start of April it was about $1.20. There's your $0.15.

Mr. GRUMET. OK. Well, the only point I would make, Mr. Chairman, is that we are all in this together, and I think we need to be cautious about creating any policies which would give any one product, and particularly any one company, monopolistic control over the Nation's gasoline.

Senator INHOFE. Mr. Grumet, since you are speaking now, you made the comment during the course of this hearing that maybe the Smith bill would be a good compromise. The question I would ask you, which of your Northeastern States would agree with an ethanol mandate?

Mr. GRUMET. Mr. Chairman, as I would expect, you are probably ahead in this debate than I am. I am only aware that there is a Smith discussion piece. If he has introduced legislation, I would commend that.

With regard to the clean alternative transportation fuel program, I can only refer to the testimony that I submitted, and provide some input on behalf of Governor Jeanne Shaheen, who, when commenting upon the renewable fuel standard in the Daschle bill, which does not provide the Northeast with the flexibility that the Smith discussion piece I think is imagining, indicated that a properly designed renewable fuels requirement ''holds great promise and represents a wise precedent for the Nation to establish.'' That was a comment by Governor Shaheen in a letter that I have submitted into the record.

More recently, Governor Shaheen expanded upon that statement in a letter to Senator Daschle and Senator Lugar in a letter of May 5 commending the introduction of the Renewable Fuels Act of 2000.

Again, this is not a statement that Governor Shaheen, I think, offers lightly. It, again, was in the shadow of what we understand to be the results of Congressional inaction, which would be the worst possible type of mandate—a mandate that, in essence, provided monopolistic control for one company.

So I think we don't feel like we have the luxury of entrenchment, and in that regard we commend Senator Smith for taking what we know to be a courageous and uncomfortable position, to support further requirements for the sale of renewable and clean alternative fuels.

Senator INHOFE. We all thrive on discomfort around here.

[Laughter.]

Senator INHOFE. You've adequately answered the question and I appreciate it. I wanted that clarification.

Mr. Early, I just have one last question to you. You appeared before this committee in 1994, I guess it was, I believe, didn't you? I thought you did. Anyway, I'm reading from some testimony of a previous testimony. I'm quoting now. It says, ''Potentially''——

Mr. EARLY. Senate Natural Resources Committee.

Senator INHOFE. Is that it? OK.

Mr. EARLY. I think so.

Senator INHOFE. I'm going to ask you if your opinion has changed since this time. You said, ''Potentially increasing global warming, increasing smog, increasing air toxics, and increasing water pollution and damages to erodible and sensitive habitat areas.'' I should have read the first part of it. You describe ''increases in ethanol use as potentially increasing global warming, increasing smog, increasing air toxics, increasing water pollution, and damage to erodible and sensitive habitat areas, all of this at the increased cost to the reformulated gasoline consumer and a significant decrease in highway trust fund revenues.''

Is that accurate? And would that still reflect your opinion?

Mr. EARLY. It is clear that some improvements have been made in ethanol production that changed the energy balance in a positive way from 1994. I think it would also reduce the impact on water pollution and erodible land. It's simply a function of the fact that corn production rates have been improving and ethanol production facilities have been reducing their energy use.

But there are still important problems associated with mandating ethanol in the fuel supply, some of which I cover in that testimony, but the proportions have clearly changed and I think that's something that is worth noting.

Senator INHOFE. All right. Thank you very much.

We have our second panel here. With the panel's indulgence, I'd like to give Senator Voinovich his shot at this panel for 5 minutes and then we'll get to you. Is that all right?

Senator Voinovich, questions of the first panel?

Senator VOINOVICH. Yes. I'll try to make them brief.

Dr. Graboski, in your testimony you discussed the effects oxygenates, particularly ethanol, have on particulate emissions. You stated that removing oxygenates from gasoline is likely to lead to an increase in fine particulate matter emissions. Could you elaborate on that point briefly?

Mr. GRABOSKI. Sure. When we talk about fine particulates, we're talking about $PM_{2.5}$ material, which is a subset of the PM_{10}, which is currently regulating—I guess the $PM_{2.5}$ regulation right now has stayed in the courts, but I'm sure EPA will move forward.

$PM_{2.5}$ emissions basically come from combustion sources, whereas a lot of the PM_{10} material comes from grinding up soils. When you look at $PM_{2.5}$, a number of studies tend to indicate that a major contributor to the $PM_{2.5}$ inventory are cars and trucks on the road, light-duty cars and trucks on the road as well as diesel trucks.

The light-duty cars and trucks on the road do respond to oxygenates in the fuel, and a number of studies have shown that between 30 and 60 percent, depending upon whether they are normal-emitter or high-emitter cars, actually have the particulate emissions reduced by 30 to 60 percent by putting 10 percent ethanol in gasoline.

So if you took oxygenates away, the fine particulate inventory is going to go up, and it could go up by a significant amount from the point of view of that fuel effect, and maybe on the order of 5 percent from these combustion sources anyway.

Senator VOINOVICH. If I can interrupt you, if we go to the new standard that is being contested now in the courts, certainly the contribution of oxygenates to that or ethanol would be significant

in terms of a community reaching their attainment of that particular goal.

Mr. GRABOSKI. Sure. But the issue is, in addition to the fact that if you remove oxygen, particulate is going to go up from the point of view of removing oxygen. It is also going to go up from the point of view that the likely replacement for much of the ethanol is going to be aromatics in the fuel, and aromatics in the fuel will increase particulate two ways. One is by increased particulate made from the aromatics directly out of the tailpipe, and second is that in the summertime, in the ozone-forming process, aromatic emissions from vehicles are converted to ozone, but also quite substantial amount are converted to additional fine particulate aerosols.

So going in the direction of removing oxygenates is going to increase, in my mind, and fine particulate inventory is a very, very costly issue in terms of future public health, and that's a concern to me.

Senator VOINOVICH. And States reaching their ambient air thing. And I'd like to make the point that I don't think people are aware of the fact that automobiles do contribute to the particulate matter, the general public.

Mr. GRABOSKI. Yes. We all think they are diesels, and I'm a diesel researcher and I know how bad diesels are, but the fact of the matter is, you know, that 95 percent of the vehicles on the road are cars and 5 percent of the vehicles on the road are diesels, and so even though the amount emitted by cars is a lot smaller, they have a very, very substantial impact on the inventory.

Senator VOINOVICH. The last question I wanted to ask all of the panelists is this: there is some allegation today that one of the reasons why gasoline has gone up so much in the Midwest is that the EPA has mandated the use of reformulated gasoline and ethanol is the way they are achieving that, and that the price has been jacked up very high to create public furor against the use of the oxygenate because it is so expensive, and therefore let's get rid of it so we don't need to deal with the problem.

I'd like Mr. Slaughter, or maybe some others, to comment on that. There are a lot of rumors floating around out there today, and the air needs to be cleared.

Mr. SLAUGHTER. Senator, as you know, across the Nation areas that use RFG are using a new blend of RFG effective June 1. Chicago and Milwaukee are different from the rest of the RFG cities in that they do blend ethanol to reach the oxygenate requirement of reformulated gasoline. That does require a special blend stock—there is a significant reduction in summer RVP—and it is more expensive to handle that type of gasoline within the context of the RFG program.

The refiners that I have talked to say that they are experiencing even slightly more problems than they thought they would in trying to incorporate ethanol into that RFG–II; nevertheless, they are trying to do that.

Now, that being said—and that is a difficulty and it is a source, undoubtedly, of some additional cost—there are other factors involved here, too. RFG–II is, across the board, a more difficult product to make. Also, there have been some logistical problems in the

Midwest involving pipeline outages and the reduction of some pipeline capacities that contribute to that factor.

So I certainly would not say that the fact that ethanol is blended there would account for all of the impacts that people are experiencing, but I think it is one part of it. And, as we have said here today several times, ethanol does require special handling.

Senator VOINOVICH. You would deny that there is an attempt to jack up the price in order to—for example, I think Governor Thompson from Wisconsin has said that he wants to get rid of the oxygenate requirement and go back to the other gasoline because of the high cost of reformulated gasoline.

Mr. SLAUGHTER. Well, I know that a number of people are looking into what is happening in the Midwest in terms of price and supply, and this always happens when there is a disruption, and the industry has generally found that it is due to normal economic forces and the industry has not been guilty of any kind of wrongdoing. I certainly believe this to be the case in this instance, too.

But one thing is true: there are competent organizations like the National Research Council that have questioned the benefit of oxygenation in gasoline, contrary to Dr. Graboski. I take some other issues with how he thinks oxygenates and ethanol might be replaced. But there is some question about that, but we think normal market forces are occurring in the Midwest right now, but we do think that mandates add cost.

Senator VOINOVICH. Any other comments?

Mr. Gatto.

Mr. GATTO. Senator, I appreciate the opportunity to talk about this. I think this is probably one of the most or the largest misconception in the industry.

Let's put this in perspective. Mr. Grumet talked about a 15 percent increase in the price——

Mr. GRUMET. Fifteen cents.

Mr. GATTO.—Fifteen-cent increase in the price of ethanol over the course of the last months. In a 10-percent blend, that is $0.015 per gallon of RFG. When you start looking at it in context of the movement in prices in the Midwest, alone, we don't even compare to the $0.40 or so increase that has resulted. When you talk about the blend stocks impact, for example, this was analyzed very carefully in California where all of the different refiners sat around a room and talked with the California Resources Board and the California EPA with respect to the impact on the refiners to make the blend stock. The outcome of that was roughly $0.01 to $0.03 just in terms of some of the removals that would come as a result.

So what we're talking about here, in perspective, with respect to what we believe would be an inflated price of $0.15 per gallon—we don't agree with that, but necessarily using it would result in about a $0.015 per gallon increase, so I don't believe it contributes in any way, shape, or form.

Senator VOINOVICH. Do you think then that somebody has deliberately jacked up the price of this in order to send a signal to discourage the use of ethanol?

Mr. GATTO. I think absolutely.

Senator VOINOVICH. You are convinced of that?

Mr. GATTO. Absolutely.

Mr. HUGGINS. Senator, if I could?

Senator VOINOVICH. Mr. Huggins?

Mr. HUGGINS. I think you were out when I made earlier comments. I live in Illinois. In fact, I live in Peoria. The price of gasoline in Chicago has gone up 34 percent since April. The price of gasoline in Peoria has gone up 30 percent. We don't use RFG in Peoria.

Senator VOINOVICH. I'm sorry?

Mr. HUGGINS. We don't use reformulated gasoline in Peoria. In fact, a gallon of mid-range gasoline with ethanol blended in it is $1.75 in Peoria. A gallon of conventional 87 octane is $1.79. So it is clearly not just the RFG perception out there. Illinois seems to be having a massive disruption, for some reason, and I'm not sure what that reason is.

Mr. EARLY. Senator, I would just observe that, if you look at the big picture, what has happened is creating a lot of public discontent in the Midwest with the reformulated gasoline program. As Dr. Greenbaum observed, you want to have flexibility as we modify this program to provide air quality benefits at a reasonable cost. This problem in the Midwest, the Lung Association does not have expertise to say what the cause is. But if you reduce the flexibility of the program, in general, you are going to have more of these kinds of problems. In the context of maintaining the oxygen requirement and limiting MTBE so that it is an ethanol mandate, and you are shipping two billion gallons of ethanol to the east and the west coasts, there are going to be disruptions. There are going to be problems. What we fear is that the entire RFG program is at risk under those circumstances.

Senator VOINOVICH [assuming the chair]. I think that I'm going to have to—I've just been informed that we've got a vote at 11:30, and we have three Senators here, very important Senators, and I noticed that they were interested in the answers to your questions.

Senator Grassley, will you start out the statements?

STATEMENT OF HON. CHARLES GRASSLEY, U.S. SENATOR FROM THE STATE OF IOWA

Senator GRASSLEY. Good morning, Senator Voinovich and Senator Inhofe. I appreciate the opportunity to be here to discuss the benefits of using ethanol as an oxygenate in reformulated gasoline.

As a Senator representing the No. 1 corn-producing State, I am a firm believer in ethanol, and with good reason. Ethanol not only helps our farmers by providing $4.5 billion per year value added market for their commodities, but also it improves our air quality and our energy security by reducing our reliance upon OPEC.

With today's high gasoline prices and with economic analysts' predictions of oil company profits exploding by 200 percent over last year's second quarter, it just makes sense that we should be looking seriously at displacing some of our imported oil with homegrown energies. And from reading the press releases that—the Senator from Oklahoma is not here, but we had a chance to read press releases that he posted on his Senate website. I know that he shares my concern about dependence upon foreign energy imports and that he would support establishing a limit on these imports.

But let me share with you what I have learned from my past legislative battles regarding limits on imports. Even though oil companies have sought and obtained market mandates to protect domestic production in the past, now that the majors have moved major investment employees overseas, it doesn't seem that they are any longer keen on limiting imports.

But today we are here to talk about ethanol. What is odd about all the new national scrutiny of ethanol is that it is being driven almost entirely by the fact that oil companies are being told they can no longer use MTBE. MTBE is contaminating our Nation's water supply. Ethanol is not hurting our water, it's the MTBE. In fact, even though I am not a drinker, I know that ethanol is little different than corn whiskey, so if ethanol gets in the water, the worst that can happen is that you might want to add ice, tonic, and soda. MTBE and ethanol are adding to gasoline to meet the Clean Air Act's oxygenate requirements for RFG.

For the most part, refiners have chosen to use MTBE, a petroleum-derived chemical. Frankly, to put it more bluntly, the oil industry did everything in its power, through the regulatory and legal system, after the enactment of the Clean Air Act in 1990 and during the enactment of that, that only MTBE would be used. The oil industry worked for an MTBE mandate, and it was very successful.

Moreover, had it not been for the insistence of officials from the upper Midwest, no RFG-containing ethanol would have been sold anywhere in America, not even in Chicago and Milwaukee.

Now the Petroleum Institute has the gall to blame ethanol for the high gasoline prices in these cities. The truth is that ethanol that is delivered to Chicago and Milwaukee has a net cost of $0.71 per gallon, which is $0.81 less than the price of gasoline. This morning in Des Moines the wholesale price of gasoline was $0.05 higher than the wholesale price of gas plus ethanol.

So today MTBE is showing up in our water supplies across the country, including in Iowa, where we don't even use RFG. MTBE renders water undrinkable.

Now the oil companies would like us to eliminate the oxygenate requirement and trust them to produce a cleaner-burning gasoline without oxygenates. Trust the same folks that brought us MTBE? Trust the folks who manipulated the courts and regulatory process to make certain consumers had no option to buy either MTBE or ethanol in reformulated gasoline? I don't think so.

I am here today to tell you that there is a clean air and clean water substitute for MTBE that is available this very day, and that's ethanol, and it is made by American farmers, not by OPEC, which is driving up our gasoline prices.

The use of RFG with oxygenates has significantly reduced harmful smog-forming vehicle emissions. According to a report of the California Air Resources Board Clean Fuels Development Commission Technical Committee, oxygenates and RFG have reduced air toxics by 28 percent. It has reduced carbon monoxide by 13 percent. Sulfur oxides have been reduced by 11 percent, and particulate matter by 9 percent. Carbon monoxide reductions are even greater—up to 25 percent reduction if you use 10 percent ethanol blends. And the American Lung Association has pointed out that

carbon monoxide reduces the blood's ability to carry oxygen, which is especially harmful to unborn babies, infants, and people with heart disease. So why would we want to eliminate then the oxygenate requirement?

The problem is MTBE in our water, not oxygenates in our gasoline.

So, Mr. Chairman, replacing MTBE with ethanol in RFG would protect our water supply from further damage, maintain air quality gains of the Clean Air Act, reduce our energy imports, and provide much-needed markets for American agriculture.

Replacing MTBE with ethanol means increased farm income. According to the USDA, completely replacing MTBE with ethanol by 2004 would provide a boost to American family farmers to the tune of $1 billion per year, demand for corn would increase by over 500 million bushels per year, and higher crop prices would reduce the need for energy assistance payments and lower loan program spending.

Replacing MTBE with ethanol improves our trade balance. According to the USDA, the average U.S. agriculture net export value would increase by over $200 million per year, while MTBE imports would decrease. The overall impact would be to improve the United States balance of trade by 1^{3}/_{10}$ billion per year.

Replacing MTBE with ethanol means American jobs. It would create 13,000 new jobs across the country.

Mr. Chairman, it is very important that Congress proceed cautiously and with serious deliberation. First, we should demand that the Administration, meaning President Clinton, offer us not merely a press conference articulating a vague outline. We should demand that it present to us a specific detailed legislative draft. There is no consensus among Members of Congress at this point, and the Administration has a responsibility to provide this leadership.

You know that—well, I'm not going to say anything more political.

[Laughter.]

Senator GRASSLEY. So insisting that the Administration place its specific legislative proposals in our hands should be a bare minimum starting point for Congress.

Second, we must not let ourselves be brainwashed into thinking that the RFG oxygenate standard is the cause of the MTBE water contamination. To do so will result in Congress squandering its time and effort in pushing legislation that will do little or nothing to protect Americans from MTBE.

What would eliminating the oxygenate standard do to protect citizens from States like mine? It would do absolutely nothing, because, you see, not a drop of reformulated gasoline is sold in Iowa, not a drop; nevertheless, 29 percent of Iowa's water supply tested were found to have serious MTBE levels.

So, Mr. Chairman, MTBE is not only used in RFG, it is used all over the country as an octane enhancer, and I do not believe for one moment that there is a safe level of MTBE.

Again, Iowa is a perfect example. For several years now, no gasoline containing more than 1 percent MTBE could be sold in Iowa without first posting warning labels. Let me tell you, no warning labels have been posted, so no gasoline sold in Iowa has contained

more than 1 percent MTBE. Yet, you look at the enormous damage even a minuscule amount of MTBE has brought to Iowa's water supplies.

Whatever we do, we must protect States like Iowa from MTBE water contamination. We should be encouraging States to ban MTBE altogether and not encouraging them to gut one of the most successful components of the Clean Air Act.

Third, Mr. Chairman, some argue that ethanol should not replace MTBE as an oxygenate until there is a greater understanding of the benefits and possible adverse impacts. I say this argument is a red herring promoted by petroleum companies who do not want to use a product like ethanol, which they and OPEC don't control. Nevertheless, aside from the fact that I believe ethanol has been thoroughly scrutinized and has passed with flying colors, I would request that the Environment Committee use the same cautious standard in addressing whether or not to eliminate or allow waivers to the oxygenate requirement.

How can we rush to eliminate a program which has been proven so beneficial toward cleaning the air when one and only one oxygenate has proved to contaminate our water?

So, Mr. Chairman, with ethanol we can have clean air and clean water. We can help American agriculture and we can reduce our dependence on OPEC. That is why I co-sponsored S. 2546, legislation introduced by Kit Bond and Dick Durbin. This bill would preserve the oxygen requirement and clean air gains that we have made under the Clean Air Act while banning MTBE, because that is the problem. It must be banned. We can't allow it to continue to use even small amounts. We've seen firsthand in Iowa—ethanol is clean air, clean water alternative to MTBE.

I would ask unanimous consent that a statement by Senator Fitzgerald be placed in the record, as well.

Senator VOINOVICH. Without objection.

Senator GRASSLEY. Thank you.

Senator VOINOVICH. The panel is adjourned. I know you have enjoyed this testimony. We thank you very much for coming here this morning.

Senators we have 12 minutes left for the vote. What would you like to do? Go vote and come back, or would you rather——

Senator HARKIN. No. I'd like to ask unanimous consent, Mr. Chairman, that my full statement be made a part of the record, and I'll just take a couple of minutes here.

STATEMENT OF HON. TOM HARKIN, U.S. SENATOR FROM THE STATE OF IOWA

Senator HARKIN. All I want to say is that you have to look at the history of this. We first—the oil companies first started putting lead into gasoline. Why did they put the lead into gasoline? Octane enhancer. This went on for years and years until finally we found out that lead was poisoning our kids, poisoning the atmosphere, and so we told the oil companies, ''You've got to take the lead out of gasoline.'' Well, they said, ''Well, we've got to have octane enhancers.'' And they came up with what they called the ''VOCs,'' the volatile organic compounds—xylene, toluene and benzene—and they put those in there and kept the octane up.

Well, guess then what we found? After a few years of this, we found out they are highly carcinogenic, so we said to the oil companies, "Hey, you've got to do something about this. You've got to get rid of that."

At about the same time, around 1990, we had the Clean Air Act. Senator Daschle and I offered an amendment on the Clean Air Act in the Senate side for a mandate of oxygen requirement of 3.1 percent, Mr. Chairman, 3.1 percent. It passed the Senate, 3.1 percent. Then it went to Conference Committee. The oil companies then started ganging up. The oil companies realized that they had to replace the VOCs. They knew that they had something to replace it as an octane enhancer that was called "methyltertiarybutylether," MTBE. But guess what? MTBE couldn't reach the 3.1 oxygen requirement. So guess what they did? They got in our Conference Committee and they knocked the 3.1 percent down to 2 percent. That's what we finally came out with was a 2 percent oxygen requirement. MTBE could meet that. It was made out of petroleum. Oil companies were happy. Everybody walked out the door.

Well, now guess what we found out? MTBE is polluting our water supplies. We had lead, we had VOCs, now we've got MTBE polluting our water supplies.

All I'm saying, Mr. Chairman, now the oil companies are saying, "Get rid of the oxygen standard." They were happy with 2 percent when they could use MTBE. Now they're saying, "Get rid of this. Trust us. We'll come up with something else. We've got alkylates. We're going to come up with some other kind of witches' brew here that we're going to put into gasoline that will keep the octane up and will keep our air quality standards high."

Fooled once, fooled twice, fooled three times. Are we going to be fooled another time by the oil companies while we've got something that will both enhance the octane and at the same time clean up the air and won't pollute the water?

Now, if I had my 'druthers, we would have had a 3.1 percent oxygen requirement, but we passed it in the Senate, but they knocked it out in the Conference Committee and we had to pass it 2 percent, and that's why we got MTBE.

So the oil companies have fooled us time and time and time again. We shouldn't be fooled again.

There are benefits to the RFG program. It is cleaning up the air. I have a bunch of charts. I'm just going to show one. I know Dick Durbin wants to speak, too. This is just the first chart I had here, which shows EPA estimates that the RFG program is equivalent to taking 16 million vehicles off the road annually. RFG will bring about an accumulated reduction of over 400,000 tons of pollutants from 1995 to this year, a tremendous benefit.

So why do away with that? I think we ought to keep it. We ought to enhance it. We ought to make sure we keep this RFG program, maintain it. As Senator Grassley said, eliminate MTBE. Just ban it. Maintain the air quality benefits. Don't let the oil companies say, "We can meet the performance standards." That's what they want to do. They want to meet performance standards, but we have to meet the air quality standards and water quality standards at the same time, and to take into account the benefits we get from the oxygen rule that reduces fine particulate matter, carbon mon-

oxide, toxic compounds that we don't have right now, and those are the things that are not being taken into account now and we have to take those into account, aside from all of the other economic benefits that my colleague from Iowa talked about.

Thank you, Mr. Chairman.

Senator VOINOVICH. Thank you.

Senator Durbin.

STATEMENT OF HON. RICHARD DURBIN, U.S. SENATOR FROM THE STATE OF ILLINOIS

Senator DURBIN. Thank you, Mr. Chairman. I will be very brief and make my statement a part of the record, with the permission of the committee.

My two colleagues from Iowa believe, as I do, that ethanol is critically important. I think they've made a strong case, both Senator Grassley from a policy viewpoint and Senator Harkin from a historic viewpoint.

Let me just say that I thank Senator Grassley for his kind words about the bill that I am co-sponsoring with Senator Bond. I think this is the way out. It is a bill that will ban MTBE and establish the oxygenate standard using ethanol. That's the answer, as far as we are concerned, and it is a proven response.

This Administration has been very strong in favor of ethanol from day one. They now find themselves in a predicament because of the deadly aspects of MTBE, and they have to act on requests for waivers because Governors around the country are definitely concerned about the environmental impact of continuing to use this additive.

Let me just close by making one reference to a point that you raised and the panel addressed partially.

When I flew in to O'Hare Sunday night and got on the Kennedy Expressway to go downtown, I took a look at the gas stations as I went by near the airport. Gas prices there are a little higher than usual, because that's right on the expressway—$2.29, $2.39, $2.49. And that is not unusual. Throughout the city of Chicago and the Chicago land area, gasoline is over $2 a gallon.

As we've gone to the oil companies and said, "Explain this to us," they cannot explain it. The oil companies have overplayed their hand in the Midwest with gasoline prices. If they are trying to protest this hearing and the policies in Washington, it isn't going to work. There is no market explanation for the run-up of gas prices in the Midwest. They are using excuses.

The first excuse is ethanol has gone up in cost. Well, as the gentleman here, Mr. Gatto, said earlier, you can't use that as an explanation. That's $0.015 cents. "Oh, no. It is costing more to make the reformulated gas." Well, that's only $0.05 or $0.06. How are you going to explain the $0.30, $0.40, or $0.50 increase in prices? When it comes to increase in oil prices, these companies take the basic philosophy, "Any excuse will do."

When the Persian Gulf war was announced over energy, gasoline prices skyrocketed instantly, and it was an attempt to price gouge and to take advantage of consumers and families and businesses.

We are the last institution that can stand up for consumers, can stand up for the environment, and do the right thing.

As Senator Harkin has gone through the history here, the oil companies have led us down the wrong path time and time and time again, and now they are penalizing businesses and families across America in a fit of pique. I think the U.S. Senate and this committee should show some leadership. Eliminate MTBE and make ethanol the oxygenate standard.

Senator VOINOVICH. Thank you, Senator Durbin.

I just would like to point out to my three colleagues that we have the Director of the Department of Transportation of Ohio here, and we use more ethanol than any other State. I don't know why, but we do. As a result of that, our share of the highway trust fund has gone down. We've got the minimum, but we haven't grown, and it is because $0.031 of the tax on ethanol does not go into the highway trust fund, and I would think that it might be very good, you know, for those of us that feel the way we do, that—I think it is about $400 million, so it's not a whole lot of money, but it would be very good, if we are pushing this, that, in order to take care of that problem, that we ought to direct that that $0.031 ought to go into the trust fund rather than going in the general fund. Just an editorial comment that I think we need to deal with.

If there are no further comments, this hearing is adjourned.

[Whereupon, at 12:46 p.m., the subcommittee was adjourned, to reconvene at the call of the Chair.]

[Additional statements submitted for the record follow:]

STATEMENT OF HON. RICHARD J. DURBIN, U.S. SENATOR FROM THE STATE OF ILLINOIS

Mr. Chairman, I appreciate the opportunity to appear before the Subcommittee and to speak about the positive effects of renewable ethanol fuel and its benefits to our nation's environment.

I'm sure this will come as no surprise to my colleagues, but I'm a strong supporter of ethanol. Illinois is the nation's largest ethanol producer. One in every six rows of Illinois corn—280 million bushels—goes to ethanol production. But, an expanded role for this renewable fuel is more than a boost to industry, it's jobs to rural America, and it's energy security. As we look for solutions to rising oil prices, we must remember that ethanol is a viable alternative fuel—domestically produced and environmentally friendly. In fact, every 23 gallons of ethanol displaces a barrel of foreign oil.

In Illinois, we don't just talk about the importance of ethanol, we practice what we preach. The Chicago reformulated gasoline (RFG) market accounts for 400 million gallons of ethanol demand. It is the foundation of the domestic ethanol industry today. The State enjoys a very successful RFG program. Air quality has improved and refiners support the program. The reason for this success is clear—Chicago's RFG is ethanol-based. Last year, the Chicago chapter of the American Lung Association released a report which lauded the Chicago RFG program and concluded that ethanol RFG has reduced ground level ozone more than any other pollution control strategy. Clearly, Illinois wants the ethanol RFG program to be maintained.

In this 106th Congress, we have several ethanol-related issues before us. Not in many years has the future of the Clean Air program been so clearly on the legislative front-burner on Capitol Hill and at the White House.

First, let me say that this Administration led by President Clinton and Vice President Gore deserves high marks for their continuing commitment to ethanol and to our environment.

This Spring's announcement that U.S. EPA will seek legislative changes to the Clean Air Act to phase out and eventually ban MTBE is good news. We all know the dangers of MTBE to our environment, our water supply, and our communities. Although this additive has only been widely used for about five years, it is now one of the most frequently detected volatile organic chemicals in drinking water supplies across the nation. In fact, MTBE contamination has affected a number of Illinois communities, raising many public health concerns.

Last month, Senator Kit Bond, a Member of the full committee, and I introduced legislation that would ban the gasoline additive MTBE and promote the use of renewable ethanol fuel. The Clean Air and Water Preservation Act of 2000 (S. 2546) addresses MTBE's serious problems by banning it within three years and urging refiners to replace it with ethanol. The bill also improves consumer protection by requiring gasoline stations to label pumps that still sell MTBE. And the Environmental Protection Agency is directed to assist States in getting the chemical out of their groundwater.

Furthermore, the Clean Air and Water Preservation Act of 2000 includes strict anti-backsliding provisions to ensure we do not lose the air quality benefits that we have already achieved. Protection from toxic chemicals and environmentally sound emission levels will not be compromised.

Specifically, this legislation upholds the air quality benefits of the reformulated gasoline (RFG) program by maintaining the oxygenate standard. Adding oxygen to our gasoline has helped clean the air in many cities across the nation. With the use of ethanol, the Chicago RFG program, as I mentioned, has proven highly successful in improving the air quality in Illinois, Indiana and Wisconsin.

I commend the Clinton administration and Senators Tom Daschle (D-SD) and Richard Lugar (R-IN) for their efforts aimed at solving the problems associated with MTBE and opening a dialogue on renewable fuel content standards. However, I strongly feel we need to maintain our commitment to preserving the oxygenate standard, which has proven to be integral to achieving the goals of the Clean Air Act.

The Clean Air and Water Preservation Act of 2000 will preserve what is working in the Clean Air Act, protect our groundwater, and encourage ethanol use. It is good for our environment and public health and a boost for rural economies and I will work for its consideration as we seek to address the MTBE problem.

Mr. Chairman, thank you again for holding this hearing and for giving me the opportunity to speak this morning. I look forward to working with you to continue to promote and expand the use of ethanol in our nation's clean air strategy.

STATEMENT OF HON. ROBERT F. BENNETT, U.S. SENATOR FROM THE STATE OF UTAH

Mr. Chairman, thank you for holding this important hearing. As our Committee has faced the challenge presented by changing the oxygen standard, much has been made of the potential for ethanol to replace MTBE. And yet, it is so important that we know exactly what we are getting into before we run from what we know.

MTBE has served well as an additive producing substantial air quality benefits while extending gasoline supplies at a reasonable cost. In this time of escalating fuel prices, MTBE has played its part in maintaining adequate supply.

Ethanol, by contrast, cannot be counted upon to moderate the price of fuel. Even with its 54 cent per gallon tax credit, it is still too expensive to compete in the marketplace. Furthermore, ethanol is not helpful from an environmental perspective.

First, because ethanol is highly volatile, it cannot be counted upon to be as effective in controlling emissions of ozone and its precursors.

Second, because ethanol has a net negative energy balance, we cannot expect its widespread use to either assist with energy security or control greenhouse gases.

Third, because ethanol is highly soluble, it takes the most toxic parts of gasoline, including cancer-causing benzene, and spreads it in water.

Fourth, because ethanol has been listed as a carcinogen by the World Health Organization, the State of California, and the National Toxics Program, it may be of greater public health concern than MTBE.

Finally, because combustion of ethanol releases harmful aldehydes, it is of little assistance in controlling air toxins.

On the whole, caution is in order. Mr. Chairman, your hearing is a step in the right direction and I thank you for pursuing this issue.

STATEMENT OF HON. BOB SMITH, U.S. SENATOR FROM THE STATE OF NEW HAMPSHIRE

Good Morning. Thank you Senator Inhofe and thanks to all of the witnesses for appearing before us here today.

Ethanol is one factor to be considered while solving the very complicated MTBE problem. I am currently crafting MTBE legislation that will attempt to balance the interests of all stakeholders. A discussion draft is available and I hope to bring a bill before the committee in the very near future.

According to the Department of Energy, the United States uses about 900 million gallons of ethanol in gasoline per year. There is no question that ethanol plays an important role in America's fuel supply.

Ethanol, as a fuel additive, has many positive aspects. It reduces carbon monoxide emissions and provides clean octane. With continuing advancements in biomass ethanol production, it is becoming more cost effective and energy efficient to make. As a renewable fuel source, ethanol is an important part of a sustainable energy approach.

Although there are many positives, we should not treat ethanol as a remedy for the MTBE problem. There is a serious problem with ethanol: it makes gasoline evaporate more quickly which can increase smog in certain areas of the country. While some gasoline suppliers voluntarily use ethanol, it would be unwise for us to force it into America's smoggiest areas, including New England.

Let's not create new air quality problems while trying to solve an existing environmental dilemma. I look forward to the testimony of today's witnesses.

STATEMENT OF A. BLAKEMAN EARLY, ENVIRONMENTAL CONSULTANT TO THE AMERICAN LUNG ASSOCIATION, ON BEHALF OF THE AMERICAN LUNG ASSOCIATION

Good morning Mr. Chairman and members of the committee. My name is Blakeman Early. I am an environmental consultant appearing on behalf of the American Lung Association. I was invited to discuss the benefits and problems associated with the use of ethanol in gasoline under the Clean Air Act. While the American Lung Association has been accused of being anti-ethanol, we consider our position to be neither anti nor pro ethanol. Our view is that ethanol should be used in gasoline when it can help provide useful properties to reduce air pollution and it should be discouraged from being used if the result is increased air pollution.

ETHANOL IN GASOLINE HELPS REDUCE CARBON MONOXIDE (CO)

Ethanol's greatest attribute is its ability to provide oxygen to the fuel which can reduce carbon monoxide. Therefore, the ALA supports the use of ethanol in the wintertime oxy-fuel program to help reduce unhealthy levels of carbon monoxide. The oxy-fuel program is mandatory under the Clean Air Act for areas that are classified "moderate" non-attainment for carbon monoxide. But as you know, the air pollution effort against CO is being won and the number of these areas is diminishing. This is due primarily to improvements in emissions control equipment on new cars. Ethanol helps to reduce CO tailpipe emissions from older vehicles.

ETHANOL PROVIDES CLEAN OCTANE

Ethanol is a good source of octane and contains no aromatics and modest levels of sulfur. These three attributes make it useful as a blending component in gasoline. As a result, refiners use ethanol to help achieve limits on toxic aromatics and sulfur in the RFG program. We anticipate refiners will also use ethanol to help meet sulfur limits in EPA's recently promulgated Tier II sulfur limits for conventional gasoline which begins in 2004.

While ethanol can help achieve limits to aromatics and sulfur, they do not guarantee that result, which is in part why the ALA does not support mandatory use of ethanol in RFG. Looking at Figure B2, taken from the Blue Ribbon panel report, you can see that the RFG sold in Chicago in 1998 achieved among the smallest reduction of air toxics, despite the presence of 10 percent ethanol.[1] Further, looking at the attached Figures 15, 16, and 17 taken from an analysis of 1996–1998 gasoline quality, you can see that sulfur levels in RFG sold in Chicago in 1996 and 1997 were among the highest in the Nation despite the use of ethanol. However, in 1998 sulfur levels in Chicago dropped by 40 percent even though oxygen mandate was still being met with relatively the same amounts of ethanol.[2] Ethanol can help lower sulfur level but does not guarantee it.

The findings above demonstrate why the ALA does not support mandating ethanol to achieve any other outcome besides CO reductions in the wintertime. The ALA and many environmental organizations supported a 2 percent oxygen requirement for RFG in the Clean Air Act Amendments of 1990 based on the assumption at the time such requirement would guarantee reductions of VOCs, and toxics. We now

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[1] Achieving Clean Air and Water, The Report of the Blue Ribbon Panel on Oxygenates in Gasoline, September 1999, p. 43.

[2] An Analysis of 1996–98 Gasoline Quality in the United States, SAE 199–01–3584, October 1999.

know we were wrong. Clearly, the best way to obtain reductions of specific pollutants from gasoline is to mandate them—set performance standards—and let refiners meet such requirements however they choose to.

ETHANOL INCREASES GASOLINE VOLATILITY

Now let me turn to the problems caused by mandating ethanol in gasoline. Quite simply the big problem with ethanol use in gasoline is that it significantly increases volatility when mixed in gasoline at levels above 2 percent by volume. Reducing gasoline volatility during hot summer weather is one of the most important strategies for improving summertime gasoline in order to reduce smog. That is because with the advance of pollution equipment on automobiles, evaporation of gasoline hydrocarbons is now a greater contributor to smog in most areas than the tailpipe hydrocarbon emissions. The volatility increases that ethanol causes in summertime can overwhelm any benefit it provides in reducing CO tailpipe emissions, sulfur dilution or aromatics dilution. That is why the ethanol industry only talks about the tailpipe emissions benefit from ethanol in RFG. The ethanol industry often quotes last year's National Research Council study of reformulated gasoline as finding that CO reduction credit should be included for ethanol in EPA's complex model for RFG because CO tailpipe emissions contribute to ozone formation. But they fail to acknowledge what we believe to be a more important finding. The NRC report stated, " . . . the increase in the evaporative emission from the ethanol-containing fuels was significantly larger than the slight benefit obtained from the lowering of the CO exhaust emissions using the ethanol-containing fuel."[3] The NRC also acknowledged that ethanol increases NO_x tailpipe emissions relative to non-ethanol containing fuel. These NO_x emissions also contribute to greater ozone and particulate formation.[4] The bottom line: the reduction in CO tailpipe emissions obtained by using ethanol in summertime gasoline are not worth the increase in evaporation and the increases in NO_x tailpipe emissions from a smog contribution point of view. Incidentally, the increases in evaporation do not just contribute to ozone formation. Since the gasoline also contains toxic aromatics, such as benzene, these will evaporate more readily along with the ethanol. While ethanol may dilute the amount of benzene in a gallon of gasoline, the amount of benzene that ends up in the ambient air due to increased evaporation from the fuel may be greater than if the ethanol were not added at all.

It is argued that if ethanol is mandated in RFG, air quality is protected because refiners are required to limit the volatility by the RVP limits of EPA's RFG regulations. Thus the impact of ethanol on volatility is not a factor. This is not true. First, while it is clear refiners can off-set the volatility effect of ethanol by blending it with super low volatility blend-stock, we do not know what potential air quality benefits may be lost by changing other parameters of the fuel to meet the RVP limit. For instance, a refiner might actually increase aromatics because they need a sulfur-free component that is low in volatility to help off-set volatility increases from using ethanol. For example, turning back to Table B2, if ethanol were required in RFG sold in Rhode Island where MTBE has been used to provide oxygen, the significant toxics reductions achieved might decline to the same level achieved in Chicago as refiners increase aromatics to help off-set the volatility effect of the ethanol.

LOW VOLATILITY RFG WITH ETHANOL CAN CAUSE INCREASED EVAPORATION OF FUEL

Even RFG with low RVP that contains ethanol may cause increases in evaporation compared to non-ethanol containing RFG in two ways: through increased permeation of "soft parts" in auto engines and also through co-mingling with ethanol free fuel.

EPA in its Tier 2 Final Rule identified permeation as a problem that can increase evaporation of gasoline. Essentially, alcohol in fuels promote the passage of hydrocarbons through the "soft products" in cars, such as plastic fuel tanks, hoses, and "o" ring seals. As a result, all new cars subject to Tier 2 evaporative emissions requirements have to demonstrate that they are using materials that resist the permeability effect by testing them with fuel containing 10 percent ethanol.[5] But of course this does nothing to protect the vehicles on the road today. Only vehicles being made since approximately 1994 have been consistently using alcohol resistant soft materials. How much will an ethanol-containing RFG meeting RVP limits increase evaporation from vehicles on the road today? Probably a great deal. The Toyota Corporation presented test data to the California Air Resources Board that

[3] Ozone-forming Potential of Reformulated Gasoline, May 1999, p. 158.
[4] California Environmental Protection Agency Air Resources Board, Air quality Impacts of the Use of Ethanol in California Reformulated Gasoline, December 1999.
[5] See discussion at 64 Federal Register, 26084, May 13, 1999.

showed a high RVP fuel increased evaporation from gaskets, plastic fuel tubes and plastic gas tank material by 500, 1300, and 800 percent, respectively (See Tabs 1, 2, 3). Even if a fuel meeting RVP limits caused permeation at a half or quarter of the rate of the non-complying fuel tested, this would have a major adverse impact on vehicle evaporative emissions. This concern is of special relevance to a renewable fuel mandate that would apply in areas that are in non-attainment for ozone where conventional gasoline is used. I will discuss this in a moment.

ETHANOL FUEL CAN INCREASE VOLATILITY OF NON-ETHANOL FUELS

Finally, I must note the impact that ethanol volatility can have through a mechanism referred to as "co-mingling". Essentially when two fuels with the same RVP, one ethanol free and one containing ethanol, are mixed together the volatility of the entire mix is substantially raised. In a circumstance where consumers purchase ethanol free fuel, use a portion and then purchase fuel with ethanol in it, even if the ethanol blend is low RVP RFG, volatility can raise as much as $^{8}/_{10}{}^{th}$ of a pound RVP.[6] In essence the adverse volatility effect of ethanol is not limited to the absolute volume sold in a given market area. It can be greatly magnified, depending how much consigners switch back and forth in purchasing the two types of fuels. Whenever the volume of ethanol in the gas tank exceeds 2 percent, the volatility of the entire tank-full of gasoline will be increased. The "co-mingling" might occur between ethanol containing RFG and conventional fuel among drivers who frequent the areas on the border between non-RFG and RFG areas; among purchasers of ethanol-containing and ethanol-free conventional gasoline in non-attainment areas for ozone; or even within an RFG area where there is ethanol-free and ethanol containing RFG. The volatility increases that could be caused by the permeation and co-mingling effects of ethanol in RFG, under some conditions, could potentially offset the entire lower volatility benefit of moving from Phase 1 RFG to Phase 2 RFG.

ETHANOL SHOULD NOT BE MANDATED IN SUMMERTIME GASOLINE USED IN SMOGGY AREAS

All this leads the ALA to the conclusion that ethanol should not be mandated for use in summertime gasoline—RFG or conventional—in areas with smog problems. To the extent that refiners are allowed to use ethanol in summertime on a widespread basis, we must develop ways of calculating and off-setting the adverse effect from increased evaporation that will occur either from permeation, co-mingling, or both. For instance, California has lowered the RVP of its Phase 3 CalRFG by one tenth of a pound in an effort to offset the co-mingling effect. California is studying the need to provide a greater off-set. If ethanol is mandated through a renewable fuel standard such as is in Senator Daschle's S. 2053, which will triple the amount of ethanol in the National fuel supply, appropriate measures need to be taken to protect areas with smog problems. Congress should eliminate the one pound RVP waiver (Section 211 (h)(4)) currently available for conventional gasoline containing 10 percent ethanol sold in the summertime in areas that are non-attainment for ozone. The RVP waiver for 10 percent ethanol fuel also should be eliminated from use in areas designated as non-attainment under the 8-hour National Ambient Air Quality Standard for ozone promulgated in July 1997. The waiver could be retained for ethanol-containing gasoline sold in areas that do not have smog problems. This also happens to be the region of the country where much of the ethanol is currently produced. Given what I have described today, refiners must at a minimum meet the same RVP limits that apply to ethanol-free conventional gasoline so that higher volatility ethanol-containing gasoline does not contribute to increased smog in areas that already have unhealthy levels of smog. This, of course, would not prevent the evaporative effects caused by co-mingling that I described previously. It would encourage refiners to avoid selling ethanol-containing gasoline in areas with smog problems during the designated ozone season because meeting lower volatility limits would increase refining costs. Of course, during the rest of the year refiners would be free to sell ethanol-containing gasoline in these areas, as no RVP limits apply.

Congress should also modernize the anti-dumping provisions for conventional gasoline in Section 211 (k)(8) to prevent increases in aromatics and other air pollution increasing constituents as they modify RFG. The ALA suggests substituting 1999 for the current 1990 baseline as a simple means of up-dating this provision to protect conventional gasoline.

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[6] In-use Volatility Impact of Co-mingling Ethanol and Non-ethanol Fuels, SAE 940765, February 1, 1994.

ETHANOL INCREASES NO_x AND PARTICULATES

Most test data show that ethanol in RFG increases NO_x tailpipe emissions. In California, the Air Resources Board asserts that these NO_x increases are converted in the atmosphere to particulate pollution, thus making it more difficult to achieve the PM–1C National Ambient Air Quality Standard.[7] The ethanol industry asserts that ethanol in RFG actually reduces particulate emissions based on a test conducted by the Colorado Department of Health and Environment. Since this test involved higher RVP wintertime fuel and wintertime temperatures, the ALA sees it as supporting the use of ethanol in wintertime oxyfuel, but not useful in judging the benefits of ethanol in RFG. We believe that the NO_x increases from ethanol in RFG add to the body of evidence indicating mandatory ethanol use in RFG may increase rather than decrease air pollution levels from fuel.

ETHANOL USE IN GASOLINE AND RFG WILL GROW

Much discussion has been generated about mandating the use of ethanol in gasoline for air quality reasons, which the ALA opposes. However, we do believe there will be a large role for ethanol in gasoline without any mandate for one simple reason: octane. Assuming that MTBE is either phased down or eliminated from gasoline, which the ALA supports, refiners face a dramatic shortage in clean octane even if every MTBE plant in the nation is converted to produce iso-octane or alkylates, the most logical substitutes for MTBE. This is because MTBE plants converted to produce iso-octane or alkylates lose about 30 percent volume and produce a product that contains 15 percent less octane per gallon. This octane shortage is magnified by EPA's Tier 2 low-sulfur gasoline standard which will be in full effect in 2006. Refiners will lose modest amounts of octane in conventional gasoline, as they treat it to reduce sulfur in order to meet the new 30 ppm sulfur average requirement. As a result of these two impacts, a rough calculation indicates that demand for ethanol needed to supply octane in gasoline should increase to 3.4 to 3.8 billion gallons per year by 2006, depending upon whether MTBE is totally eliminated from gasoline. (See Tab 4 and Tab 5) This is at least twice the baseline volume of ethanol projected by the Department of Agriculture to be produced in 2006.[8] Should Congress fail to lift the oxygen mandate for RFG so that all the octane currently provided by MTBE be replaced by ethanol in order to simultaneously meet the oxygen requirement, the demand for ethanol would reach 4.6 billion gallons per year in 2006. This would appear to exceed the ability of the ethanol industry to supply ethanol, based on a study conducted for the Governors' Ethanol Coalition.[9] (See Tab 6) Such an outcome would undoubtedly lead to shortages, price spikes, and disruptions which could only lead to reductions in the air quality benefits provided by the RFG program.

Clearly, we will need large increases of ethanol in gasoline, as we phase out MTBE. From an air quality perspective, it is best to set air quality performance requirements for gasoline and allow refiners to use ethanol when and where they need to while meeting performance requirements, taking into account evaporation effects from permeation and co-mingling. Should Congress decide to mandate ethanol in gasoline, we urge that additional air quality protections be put in place that would encourage ethanol use in ways that benefit air quality and not add to the air pollution burden.

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[7] Letter from Michael P. Kenney, Executive Officer, California Air Resources Board to Robert Perciasepe, Assistant Administrator of U.S. Environmental Protection Agency, February 7, 2000.

[8] U.S. Department of Agriculture, Economic Analysis of Replacing MTBE with Ethanol in the United States, March 2000.

[9] John Urbanchuk, Ability of the U.S. Ethanol Industry to Replace MTBE, March 20, 2000.

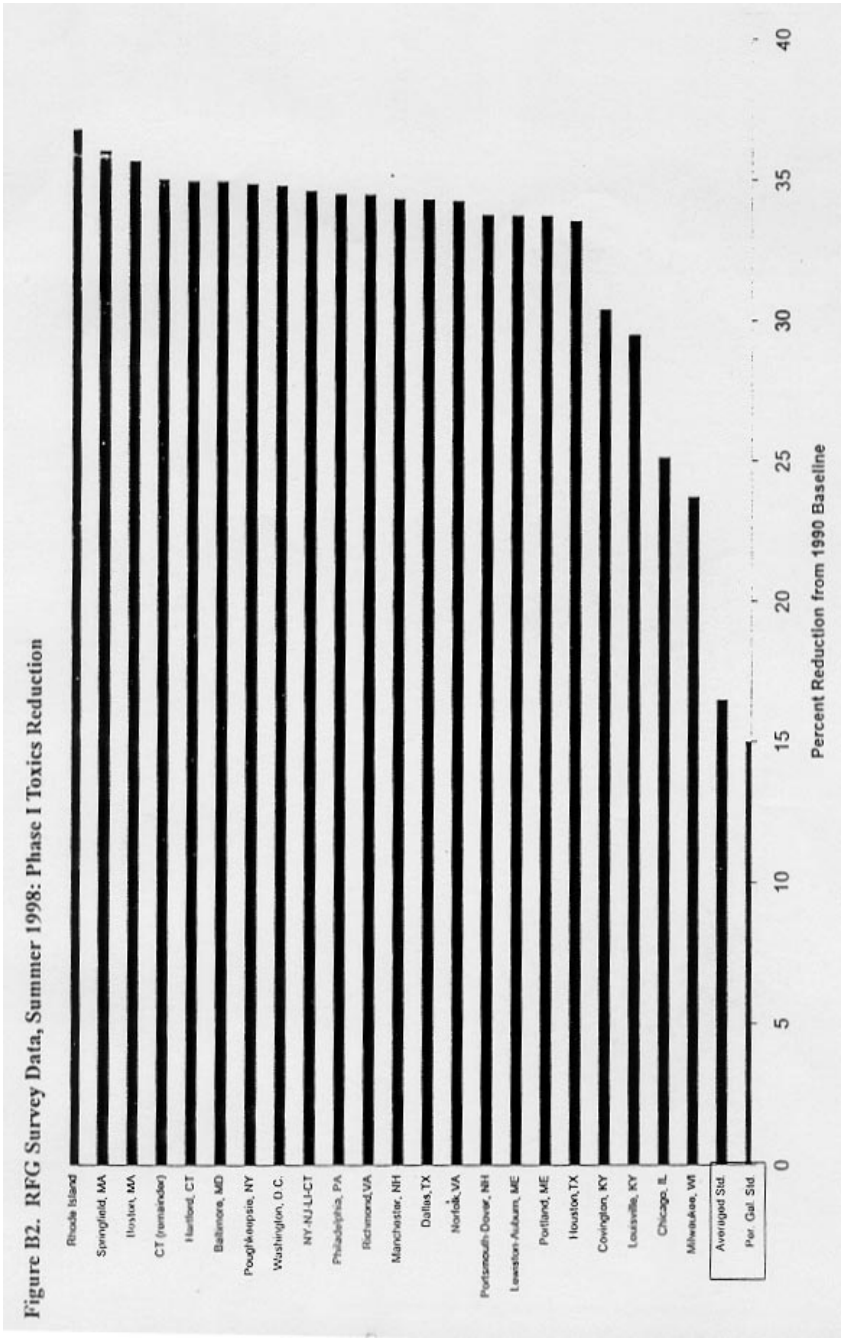


Figure B2. RFG Survey Data, Summer 1998: Phase I Toxics Reduction
Rhode Island
Springfield, MA
Boston, MA
CT (remainder)
Hartford, CT
Baltimore, MD
Poughkeepsie, NY
Washington, D.C.
NY-NJ-LI-CT
Philadelphia, PA
Richmond, VA
Manchester, NH
Dallas, TX
Norfolk, VA
Portsmouth-Dover, NH
Lewiston-Auburn, ME
Portland, ME
Houston, TX
Covington, KY
Louisville, KY
Chicago, IL
Milwaukee, WI
Averaged Std.
Per. Gal. Std.
0
5
10
15
20
25
30
35
40
Percent Reduction from 1990 Baseline

Figure 15
1996 Annual Average Sulfur Results by City

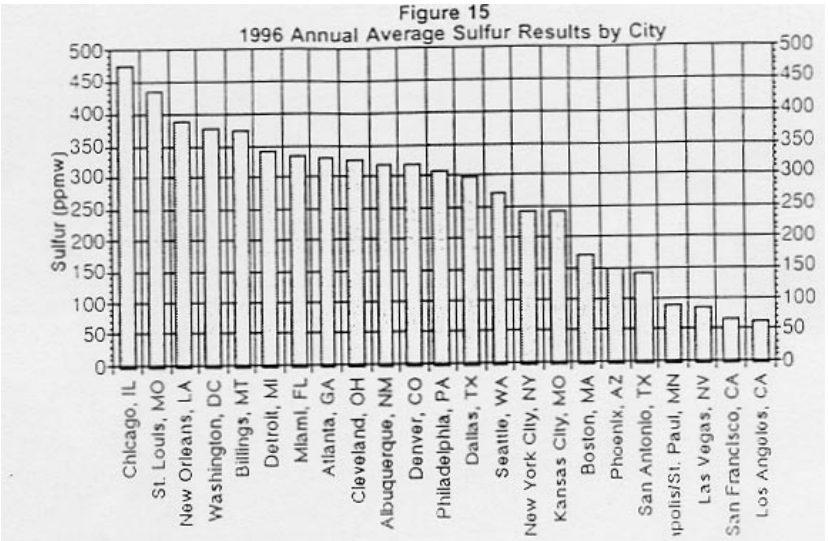


Figure 16
1997 Annual Average Sulfur Results by City

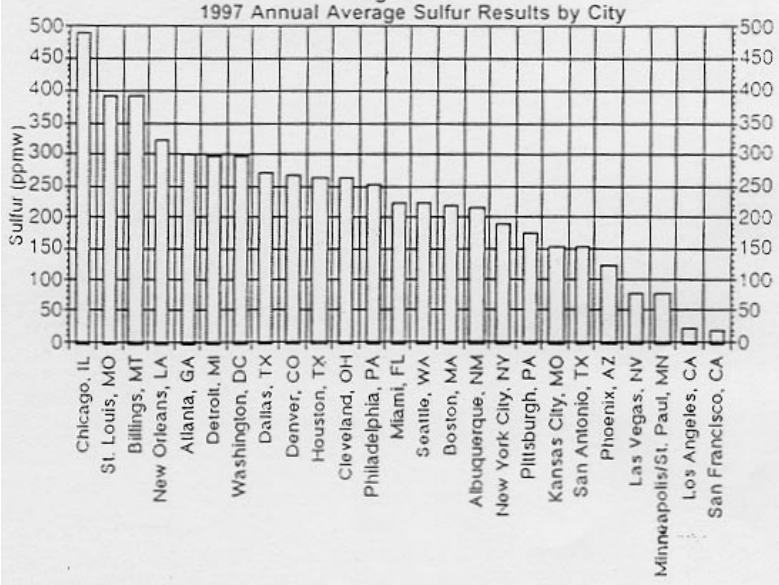
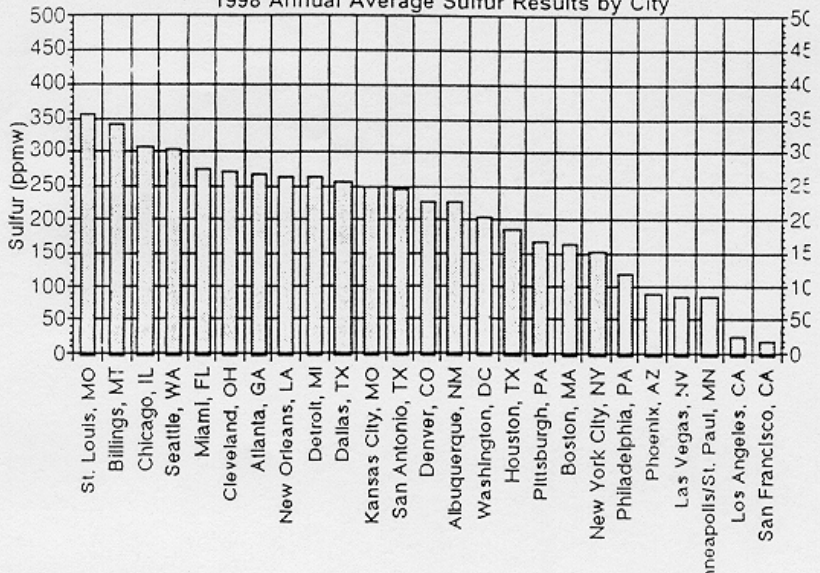
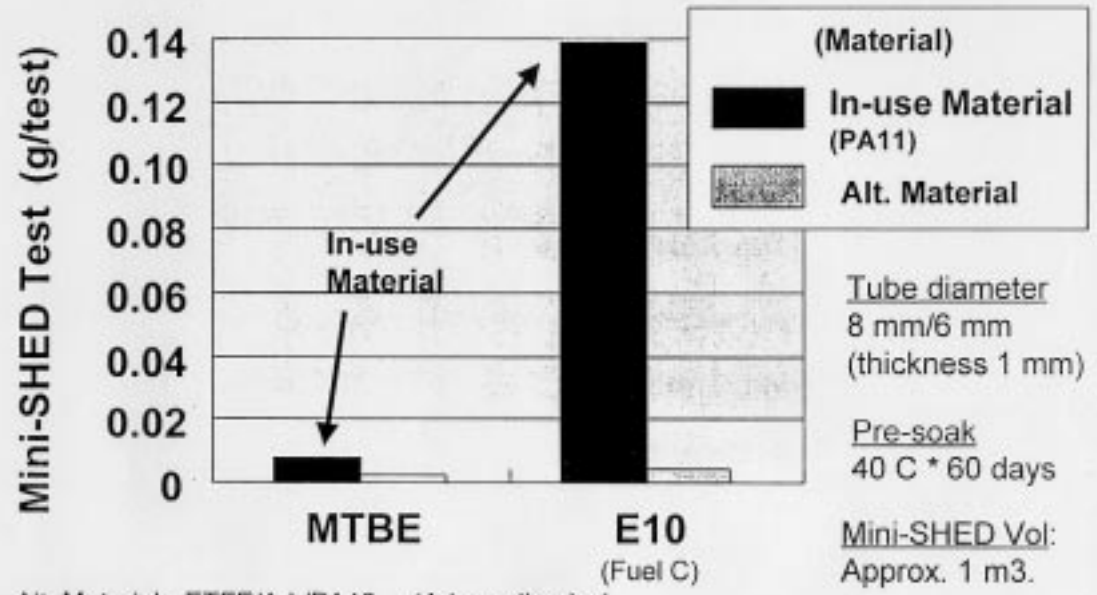


Figure 17
1998 Annual Average Sulfur Results by City



TAB 1

Component Testing
Permeation of Plastic Fuel Tubes

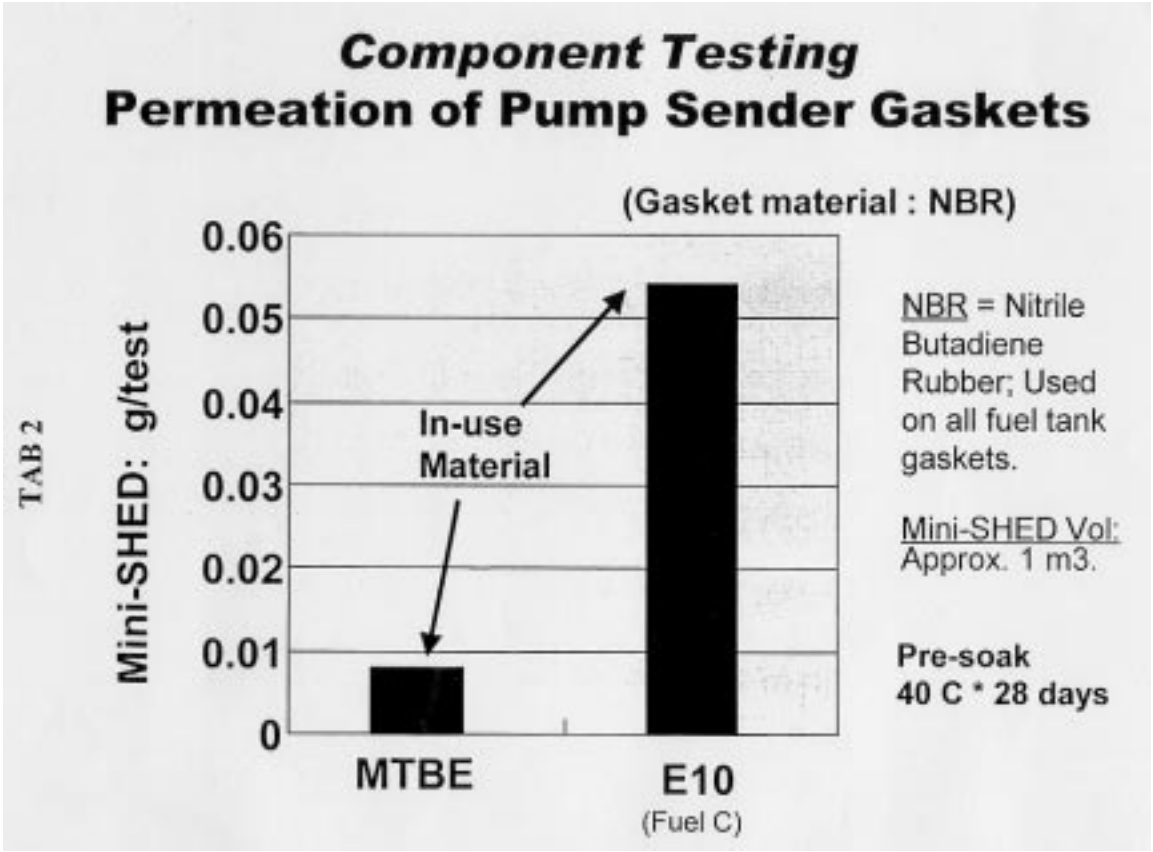


Alt. Material: ETFE/Ad./PA12 *(Ad. = adhesive)*

(PA = Poly Amid; ETFE = Ethylene Tetra Fluoro-Ethylene Copolymer)

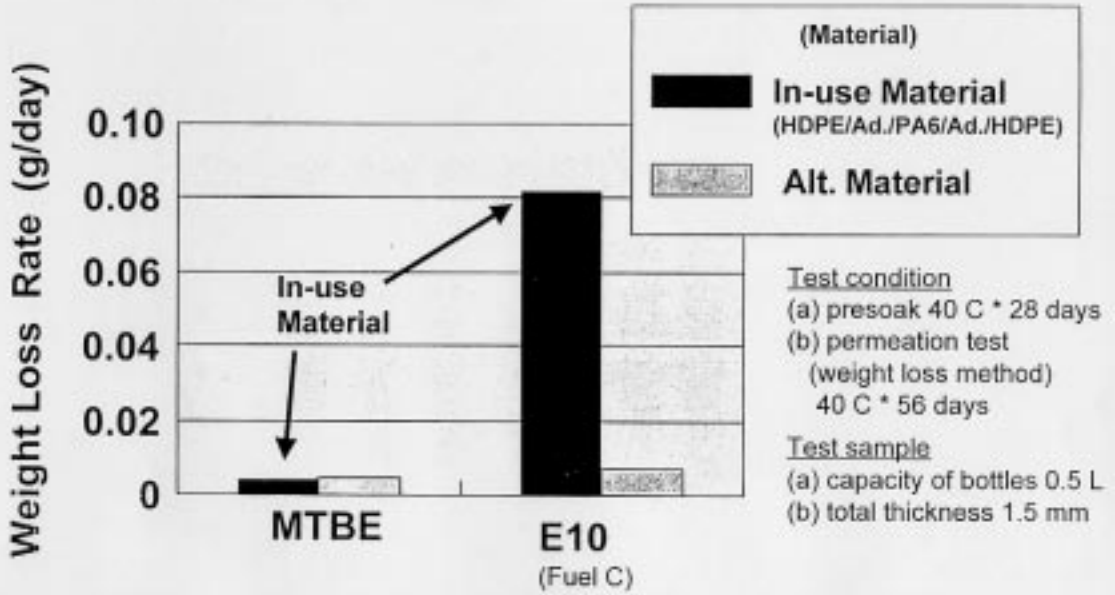
TAB 2

Component Testing
Permeation of Pump Sender Gaskets



TAB 3

Component Testing
Permeation of Plastic Bottles



Alt Material: HDPE/Ad./EVOH/Ad./HDPE *(Ad. = adhesive)*
(HDPE = High Density Poly Ethylene; EV-OH = Ethylene Venyl Alcohol Copolymer)

TAB 4

BILLION-GALLONS/YEAR

		US EX-CAL	CALIFORNIA	TOTAL US	% OF TOTAL US
CURRENT GASOLINE VOLUVE		**100**	**20**	**120**	
CURRENT MTBE VOLUME		**2.26**	**1.54**	**3.8**	
CURRENT ETHANOL		**1.5**	**0**	**1.5**	**1.25%**
MTBE OCTANE	110				
ETHANOL OCTANE	115				
ISO-OCTANE OCTANE	100				
1 % MTBE		1	0.2	1.2	1.00%
TOTAL MTBE VOLUME LOST		1.26	1.34	2.60	2.17%
TOTAL ISO-OCTANE VOLUME-70% OF MTBE VOL IF ALL MTBE UNITS ARE CONVERTED		**0.88**	**0.94**	**1.82**	**1.52%**

VOLUME BALANCE		OCTANE BALANCE	
MTBE VOLUME LOST	2.60	MTBE OCTANE LOST	286.00
ISO-OCTANE	1.82	ISO OCTANE GAIN	182.00
VOLUME LEFT FOR ETHANOL	**0.78**	**ETHANOL VOLUME TO BALANCE OCTANE**	**0.9**

BILLIONS GALLONS PER YEAR REQUIRED TO BALANCE MTBE OCTANE LOSS IF ALL MTBE UNITS ARE CONVERTED TO ISO-OCTANE	0.9	0.75%
EXISTING ETHANOL REQUIREMENTS	1.5	1.25%
TOTAL ETHANOL REQUIRED TO MAINTAIN GASOLINE POOL OCTANE	2.4	2.00%
ADDITIONAL ETHANOL REQUIREMENTS TO GET TO 30 PPM SULFUR INCREASED MTBE USAGE FROM MATHPRO 40 PPM STUDY 1.06 USING OCTGAIN 125		
EQUIVALENT ETHANOL VOLUME ON OCTANE BASIS	1.01	0.84%
TOTAL ETHANOL REQUIRED TO MEET OCTANE REQUIREMENTS BY 2006 WITH ALL MTBE UNITS CONVERTED TO ISO-OCTANE AND 1% CAP ON MTBE	3.4	2.85%

TAB 5

BILLION-GALLONS/YEAR

		US EX-CAL	CALIFORNIA	TOTAL US	% OF TOTAL US
CURRENT GASOLINE VOLUME		100	20	120	
CURRENT MTBE VOLUME		2.26	1.54	3.8	
CURRENT ETHANOL		**1.5**	**0**	**1.5**	**1.25%**
MTBE OCTANE	110				
ETHANOL OCTANE	115				
ISO-OCTANE OCTANE	100				
TOTAL MTBE VOLUME LOST		2.26	1.54	3.80	3.2%
TOTAL ISO-OCTANE VOLUME-70% OF MTBE VOL IF ALL MTBE UNITS ARE CONVERTED		**1.58**	**1.08**	**2.66**	**2.2%**

VOLUME BALANCE		OCTANE BALANCE	
MTBE VOLUME LOST	3.80	MTBE OCTANE LOST	418.00
ISO-OCTANE	2.66	ISO OCTANE GAIN	266.00
VOLUME LEFT FOR ETHANOL	**1.14**	**ETHANOL VOLUME TO BALANCE OCTANE**	**1.3**

BILLIONS GALLONS PER YEAR REQUIRED TO BALANCE MTBE OCTANE LOSS IF ALL MTBE UNITS ARE CONVERTED TO ISO-OCTANE		1.3	1.10%
EXISTING ETHANOL REQUIREMENTS		1.5	1.25%
TOTAL ETHANOL REQUIRED TO MAINTAIN GASOLINE POOL OCTANE		2.8	2.35%
ADDITIONAL ETHANOL REQUIREMENTS TO GET TO 30 PPM SULFUR INCREASED MTBE USAGE FROM MATHPRO 40 PPM STUDY USING OCTGAIN 125	1.06		
EQUIVALENT ETHANOL VOLUME ON OCTANE BASIS		1.01	0.84%
TOTAL ETHANOL REQUIRED TO MEET OCTANE REQUIREMENTS BY 2000 WITH ALL MTBE UNITS CONVERTED TO ISO-OCTANE		**3.8**	**3.20%**

TAB 6

ABILITY OF THE U.S. ETHANOL INDUSTRY TO REPLACE MTBE

John M. Urbanchuk
Executive Vice President
AUS Consultants

March 20, 2000

The U.S. ethanol industry is capable of expanding to meet the demand for oxygenates that would result from a total withdrawal of Methyl Tertiary Butyl Ether (MTBE) from the domestic marketplace. In response to rising national concern about the presence of MTBE in groundwater and potential risk to public health and the environment, the U.S. Environmental Protection Agency (EPA) convened a Blue Ribbon Panel to assess policy options for MTBE. The Blue Ribbon Panel recommended that the use of MTBE be dramatically reduced or eliminated. EPA has subsequently stated that MTBE should be removed from all gasoline.

The replacement of MTBE with ethanol will increase the demand for ethanol to nearly 3.2 billion gallons by 2004 from an estimated 1.3 billion gallons this year. As shown in the following table the U.S. ethanol industry can virtually double capacity within a two-year timeframe and has the ability to exceed the increased demand created by the phase out of MTBE. The increased capacity will come from improvements in production efficiency leading to increased utilization of existing plants; expansion of existing operating facilities; new construction in place, and proposed facilities currently in various stages of development.

Ability of the Ethanol Industry to Replace MTBE
(Million Gallons per Year)

	2000	2001	2002	2003	2004
Ethanol Demand	1,343	1,781	2,231	2,693	3,168
Current Production	1,533	1,533	1,533	1,533	1,533
Increased Utilization	0	180	180	180	180
Expansion of Existing Plants	0	420	839	1,049	1,049
Cap'y Under Construction	0	60	121	121	121
Cap'y Under Development	0	0	0	333	598
Total Supply	1,533	2,193	2,673	3,216	3,481
Surplus	190	412	444	523	313

STATEMENT OF HON. PETER G. FITZGERALD, U.S. SENATOR FROM THE STATE OF ILLINOIS

Good morning, Mr. Chairman. I want to thank you for this opportunity to testify before your hearing to discuss the potential effects of the widespread use of reformulated gasoline blended with ethanol.

As a senator representing the number one ethanol producing state, I have been, and will continue to be, a strong advocate of ethanol use. Ethanol not only encourages our nation's rural economy by bolstering the farm economy by approximately $4.5 billion per year in commodities, but also encourages the reduction of greenhouse gases and particulate emissions produced by automobiles.

Additionally, in my capacity as a member of the Senate Energy and Natural Resources Committee, I have become increasingly aware of the problems that our reliance on foreign oil has caused this country. I believe this is a dependence that can

be substantially alleviated by increasing ethanol and biofuels research, production and use in energy markets across the country.

Despite the many tangential subjects that the reformulated gasoline debate has spawned this year in Congress, the reason we are here today is to talk about ethanol. I find it curious that public scrutiny of ethanol has been sparked almost entirely by congressional and administrative attention to the need to eliminate methyl tertiary butyl ether (MTBE) from commercial use.

The elimination of the use of MTBE in reformulated gasoline should not mean the removal of the oxygenate requirement set forth under the Clean Air Act of 1990 which requires reformulated gasoline to contain two percent oxygen by weight. I believe it to be reasonable for our nation to expect both clean air and clean water, without having to eliminate the reformulated gasoline market or sacrifice our national health.

According to a Department of Agriculture study entitled ''Economic Analysis of Replacing MTBE with Ethanol in the United States,'' replacing MTBE with the corn-based oxygenate additive ethanol would create approximately 13,000 new jobs in rural America and reduce farm program costs and loan deficiency payments through an expanded value-added market for grain. Furthermore, the Department of Agriculture has concluded that within three years, ethanol can be used as a substitute oxygenate for MTBE in nationwide markets without price increases or supply disruptions.

Ethanol has proven to be a viable, environmentally friendlier alternative to MTBE. The use of ethanol in reformulated gasoline significantly reduces exhaust emissions of hydrocarbons and carbon monoxide, reduces particulate emissions, reduces the occurrence of aromatics in gasoline, and also reduces overall greenhouse gas emissions. The Chicago reformulated gas program (RFG) has used ethanol for years, and according to the American Lung Association, Chicago has established one of the most successful RFG programs in the country. Ethanol is vitally important to my home State, since Illinois is the number one producer of ethanol in the Nation. Each year, 274 million bushels of Illinois corn are used to produce about 678 million gallons of ethanol. At a time when agricultural prices are at depression-era lows, this increased demand is sorely needed.

Mr. Chairman, I believe that Congressional action is absolutely necessary in the oil industry. Skyrocketing prices and widespread pollution have taken an enormous toll on our country's well-being and security. I am also very aware of the potential for Congress to act rashly and pass serious mandates without proper deliberations.

As you are aware, I have proposed legislation (S. 2233) to phase out MTBE use across the United States over the next three years, ensure proper labeling of all fuel dispensaries containing MTBE-enriched reformulated gasoline, provide grant awards for MTBE research, and express the sense of the Senate that the Administrator of the Environmental Protection Agency should provide assistance to municipalities to test for MTBE in drinking water sources, as well as provide remediation where appropriate. This bill represents an important first step toward safer and healthier drinking water throughout the nation.

Mr. Chairman, the oxygenate requirement is not the problem with our gasoline, the problem is MTBE. Ethanol is not only in the best interests of my State of Illinois, but also in the best interests of our entire nation's environment, and our nation's energy security. Again, thank you for allowing me time to share with the committee my views on the benefits of ethanol in our nation's gasoline supply.

STATEMENT OF STEPHEN GATTO, PRESIDENT AND CEO, BC INTERNATIONAL CORPORATION

My name is Stephen Gatto. I am the President and CEO of BC International Corporation, a company that is utilizing new technologies to manufacture ethanol from cellulosic biomass wastes, such as wood waste, crop residue, urban waste, and non-energy intensive dedicated crops.

I would like to thank Chairman Inhofe, Ranking Minority Member Senator Graham, and the Subcommittee on Clean Air, Wetlands, Private Property and Nuclear Safety (Subcommittee) for providing me with this opportunity to testify today. I would like to thank Senator Barbara Boxer for the continued leadership she has shown on this issue. I would also like to compliment the Subcommittee for the work that it has been doing to address the use of MTBE in gasoline and explore ethanol as an alternative.

This is a very exciting period for the biomass ethanol industry and BC International. We are currently closing financing for a 23 million-plus gallon commercial biomass ethanol manufacturing facility in Jennings, Louisiana that will use sugar

cane residue as a feedstock. I expect our financing to close any day now, and for the plant to be fully operational in less than 2 years. BC International also has signed a letter of intent with the city of Gridley, California to develop a second facility that will use rice straw and wood chips as its feedstock. In addition, we are planning to develop a facility in Chester, California that will utilize wood waste from a sawmill to produce ethanol. We are also exploring the feasibility of developing plants in the Northeast. The potential capacity of our initial projects is over 150 million gallons of ethanol per year. We expect to double our capacity within 6 months after each plant is constructed. However, the biomass ethanol industry's ability to grow exponentially depends in part on the nation's commitment to providing renewable fuels with sustainable markets, such as the market for ethanol as a gasoline additive.

It is through recent technological advances, developed in 1987 by Dr. Lonnie Ingram, a microbiologist at the University of Florida's Institute of Food and Agriculture Sciences, that today we are able to efficiently and effectively produce ethanol from hemi-cellulose (mostly 5-carbon sugars), as well as cellulose (6-carbon sugars). The process works by replacing the yeast-based fermentation process with a genetically engineered bacterium that was awarded U.S. Patent 5,000,000 in a special Congressional ceremony.

The use of ethanol, particularly biomass ethanol, is a win-win environmental and economic solution to the MTBE problem. Ethanol use contributes to improved air quality and does not pose the same dangers to our water resources as does MTBE, proven by decades of ethanol fuel use in the Midwest. This is why gasoline suppliers in California and the Northeast, such as Tosco and Getty, feel confident enough to displace most of their MTBE with ethanol. For the same reasons, cities such as Chicago and Denver have relied upon ethanol to improve local air quality. Ethanol is also favorable because, unlike petroleum-based alternatives, such as alkylates, ethanol means increased use of renewable resources, and reduced reliance on imported oil and ensuing gasoline price spikes. Equally important, our technology enables us to turn regional waste problems, such as the air pollution caused from the open-field burning of rice straw in California, into economic growth opportunities for rural communities.

I would like to elaborate on some of the benefits of biomass ethanol. But first, I would like to address a misconception about the use of ethanol-blended gasoline—that ethanol use is bad for air quality. This accusation is not supported by scientific community consensus, and has in fact been disproved by many scientists.

Real life examples and research show that ethanol is not bad for air quality, and that it in fact provides air quality benefits that are consistent with and extend beyond the goals of Federal reformulated gasoline. The California Air Resources Board (CARB) report, "Air Quality Impacts of the Use of Ethanol in California Reformulated Gasoline," found that the use of ethanol in gasoline is entirely consistent with the clean air goals of the Clean Air Act. The report showed that the use of ethanol-blended gasoline (2.0 percent wt or 3.5 percent wt oxygen) in 2003 would provide for significant reductions in every emission of concern relative to 1997 baseline levels, when MTBE was the primary gasoline additive. In addition, the use of ethanol-based gasoline (2.0 percent wt oxygen) compared with 2003 MTBE and 2003 non-oxygenated fuel would provide for: (1) similar CO and NO_x emissions; (2) reduced benzene, butadiene, and formaldehyde emissions; and (3) only a slight increase in acetaldehyde emissions, which unlike formaldehyde is non-carcinogenic. Also, ethanol-blended gasoline in 2003 would result in the same average ozone levels as 2003 MTBE and 2003 non-oxygenated fuel. In summary, the report said the substitution of ethanol for MTBE in California's fuel supply "will not have any significant air quality impacts." In addition, compared with conventional fuel, the use of biomass ethanol, such as agricultural waste, can reduce greenhouse gas emissions, specifically CO2, by 68 percent or more.[1]

In addition, several projects demonstrate that the benefits of ethanol extend beyond the air quality improvements that can be achieved through its use in gasoline. In Gridley, California, BC International's planned biomass ethanol plant will use agricultural waste from rice straw farms in the Sacramento Valley as feedstock. The use of rice straw waste will help reduce the need for the annual open-field burning of more than 500,000 tons of rice straw waste, resulting in significantly decreased local air pollution. Past comments by the American Lung Association (ALA) reflect the seriousness of this problem. According to Earl Withycombe, an air pollution engineer and a Director of the Sacramento chapter of the ALA, "We know that many

[1] Argonne National Laboratory, Center for Transportation Research, U.S. Department of Energy. "Effects of Fuel Ethanol Use on Fuel-Cycle Energy and Greenhouse Gas Emissions." Argonne, IL. January 1999.

residents of this area point to rice straw burning as the cause of significant health effects,'' including asthma. Jane Hagedorn, Executive Director of the Sacramento chapter of the ALA, added, ''We take very seriously that we must get alternatives on line so we can use rice straw in commercially productive ways besides burning. The Lung Association is very supportive and appreciative of the people who are making this happen.'' This model can also be applied to other problematic crop residues that are currently burned. Later this summer, BC International plans to begin construction of a similar plant in Jennings, Louisiana that will use sugar cane waste as feedstock, helping to alleviate a waste disposal problem now faced by Gulf of Mexico states.

Waste problems also pervade other parts of the nation. For instance, in the Northeast, as long-term contracts for electricity from biomass energy facilities expire or are bought out, a number of sawmill waste facilities, which currently provide feedstock for biomass energy facilities, face the possibility of closure. Sawmills currently receive $7.1 million in revenue from wood sales to biomass energy plants. If sawmill operators were forced to dispose of their waste in landfills, potential annual costs between $46 million and $59 million per year would result, according to biomass industry consultant Lloyd Irland. In addition, the transport of biomass waste supports a number of jobs, which would also disappear with plant closure. BC International is currently exploring the development of facilities in the Northeast to address this problem.

The disposal of municipal solid waste is another growing problem across the country. Biomass ethanol provides a sustainable alternative to the burning or landfill disposal of municipal solid waste, such as urban yard waste, wood waste, and other paper waste. Arkenol is developing a plant in Southern California to convert municipal solid waste into ethanol. The Masada Resource Group is developing a facility in New York that will both serve as a recycling center and produce about 10 million gallons of ethanol per year.

I would also emphasize that there is more to biomass ethanol than environmental benefits. Both corn starch ethanol and biomass ethanol provide a positive net energy balance. This means that the amount of energy contained in a gallon of ethanol is greater than the amount of fossil fuel energy required to produce that gallon of ethanol. Cellulosic biomass ethanol provides more than four units of energy for every unit of fossil fuel energy used to produce it. Its 4.75 to 1 ratio is significantly higher than the 1.5 to 1 energy balance ratio for starch-based ethanol.[2] The large positive net energy balance for biomass ethanol is due to the fact that relatively little fossil energy is used in the creation of cellulosic biomass and in the biomass to ethanol conversion process itself.

The economic potential of the biomass ethanol industry is also enormous. Without a doubt, the nation's corn ethanol industry will serve as the initial foundation for the further development of a domestic renewable fuels industry. However, starch-based crops, such as corn and barley, represent only a fraction of the total resources that can now be used to make ethanol. In addition, there is only a finite amount of starch from crops available in the U.S. for ethanol production, with estimates of maximum starch crop supply peaking at about double today's ethanol capacity.

With your support, the biomass ethanol industry's potential capacity can extend beyond the limits faced by the starch-based ethanol industry. Realizing this potential would have a huge impact on our nation's transportation fuels industry. According to the U.S. Department of Energy's National Renewable Energy Laboratory, over the long-term, an average of 2.45 billion metric tons of cellulosic biomass could be available annually for ethanol production in the U.S. This translates into enough biomass to produce over 270 billion gallons of ethanol—approximately two times the level of current U.S. gasoline consumption. Two studies have further quantified readily available biomass resources in California and in the Northeast.

The California Energy Commission (CEC) found that California has more than enough biomass resources in the near term both to meet local demand for biomass ethanol as an alternative to MTBE and to become a national leader in the renewable fuels industry. Near term production potential is estimated at 2.5 billion gallons per year.[3]

Conservative estimates by the Coalition of Northeast Governors Policy Research Center (CONEG) find that there is enough readily available biomass in the region

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[2] Argonne National Laboratory, Center for Transportation Research, U.S. Department of Energy. ''Effects of Fuel Ethanol Use on Fuel-Cycle Energy and Greenhouse Gas Emissions.'' Argonne, IL. January 1999.

[3] California Energy Commission. ''Evaluation of Biomass-to-Ethanol Fuel Potential in California.'' December 1999.

to produce over 1.3 billion gallons of ethanol each year.[4] Similar to California, the Northeast region has more than enough biomass ethanol potential to replace MTBE in gasoline.

For the Nation to achieve meaningful fuel independence, it will need to encourage development of a cellulosic biomass ethanol industry. For this reason, I would like to pledge my support for S. 2503, "The Renewable Fuels Act of 2000," introduced on May 4, 2000 by Senators Daschle and Lugar. I firmly believe that the renewable fuels standard (RFS) contained in S. 2503, specifically the provision that credits cellulosic biomass ethanol with 1.5 times as much value as starch-based ethanol for purposes of compliance with the standard, would help this country develop a meaningful domestic renewable fuels industry.

The provision to support cellulosic biomass ethanol would help provide developers and potential investors with the incentives and confidence necessary to develop a domestic biomass ethanol industry. Sound policies combined with continuing biomass ethanol technology improvements, can provide the framework for transforming the Midwest-based corn ethanol industry into a national renewable fuels industry with key production centers where biomass resources are located. These areas happen to be mostly on the periphery of the U.S., as opposed to in the Midwest where ethanol is primarily produced and used today. In turn, the biomass ethanol industry would provide jobs and economic prosperity in rural communities.

In consideration of job creation, operating a single, 15-million gallon per year biomass ethanol plant would create at least 28 permanent operational jobs, and an additional 63 to 100 feedstock-related jobs. These jobs would be augmented by an additional 93 to 122 indirect jobs. The payroll for direct jobs related to plant operations and feedstock supply is estimated to be more than $2.6 million annually. Payroll for combined direct and indirect jobs is estimated to be more than $4.8 million annually. Facility construction itself would create an additional 88 jobs, with an estimated payroll of $2,000,000.[5] Once the biomass ethanol industry capacity grows to just 1 percent of the gasoline market, or about 1.5 billion gallons per year, it would provide 26,000 jobs with an annual payroll of about $480 million in rural regions across the country. Consider the renewable fuels standard to be an investment in our nation's economic and environmental well-being and prosperity.

Having said all this, the question arises: What will these benefits cost gasoline customers? Simply stated, the use of ethanol in gasoline does not and will not significantly impact the price of gasoline. A 1999 study by the California Energy Commission compared the economic costs of replacing MTBE with ethanol to the cost of replacing MTBE with petroleum-based alkylates in California (which, like other states is seeking to phaseout MTBE). The results showed that using ethanol would cost approximately the same, and potentially less over the long-term, as replacing MTBE with alkylates. Using ethanol to replace MTBE would cost approximately 1.9 to 2.5 center per gallon, while the cost of replacing MTBE with alkylates would cost up to 3.7 cents.[6] In addition, we would be using an indigenous renewable fuel versus increasing our dependence of imported petroleum, which historically has led to gasoline price spikes.

In the Northeast, Getty is currently replacing MTBE with ethanol. Getty cites environmental issues and customer satisfaction as reasons for its commitment to use over 40 million gallons of ethanol each year. Vince DeLaurentis, President and COO of Getty, forecasts that the cost of replacing MTBE with ethanol-blended gasoline in the Northeast, and specifically in Maine, would cost no more than 1.5 to 2.0 cents per gallon more than using alkylates to replace MTBE. I should note that Mr. DeLaurentis said that this figure assumes that ethanol-blended gasoline would receive a waiver from the Reid Vapor Pressure requirement that recognizes the reduced carbon monoxide emissions and resulting decrease in ozone forming potential of ethanol-blended gasoline. Consistent with his point, S. 2503 would require the U.S. Environmental Protection Agency to consider the development of a carbon monoxide credit program that would provide appropriate carbon monoxide credits to offset possible emissions increases due to increased volatility.[7]

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[4] Donovan, CT, Lee Rybeck. (1994) . The Potential for Producing Ethanol From Biomass In the Northeast: A Resource Survey. Northeast Regional Biomass Program. CONEG Policy Research Center Washington, D.C.

[5] California Energy Commission, Quincy Library Group, California Institute of Food and Agricultural Research, Plumas Corporation, TSS Consultants & National Renewable Energy Laboratory. "Northeastern California Ethanol Manufacturing Feasibility Study."

[6] California Energy Commission. "Supply and Cost of Alternatives to MTBE in Gasoline." February 1999.

[7] Conversation with Vince DeLaurentis, President and COO, Getty Petroleum Marketing Company, May 2000.

Moving forward, through the development of local renewable fuels production centers across the country, we will see further reductions in the cost of producing and transporting ethanol. BC International recently announced the startup of its New Product and Process Development Laboratory at the University of Florida's Sid Martin—Biotechnology Lab. This Laboratory will serve as a critical component in the continuing drive to improve technology for the wide-scale production of ethanol from biomass. Due to technology advancements, the National Renewable Energy Laboratory projects cost reductions for biomass ethanol of about 50 cents per gallon by 2005, and about 60 cents per gallon by 2010.[8] Biomass ethanol plants also produce a variety of saleable co-products, which in the long term, will help to reduce costs even further.

With the introduction of S. 2503, Senators Daschle and Lugar are seeking to reduce reliance on imported fuel by growing a domestic renewable fuels industry. The bill's provision to support biomass ethanol ensures that the industry will continue to expand beyond the limited capacity of the starch-based ethanol industry. The provision to support cellulosic biomass ethanol would help biomass ethanol companies secure the investments they need to establish local biomass ethanol industries and bring the benefits of renewable fuels to the Nation as a whole. I firmly believe that this vision will make for a better, more sustainable economy and cleaner air and water for our children and our grandchildren.

Thank you for the privilege and opportunity of speaking before the Subcommittee.

STATEMENT OF MICHAEL S. GRABOSKI, DIRECTOR, COLORADO INSTITUTE FOR FUELS AND HIGH ALTITUDE ENGINE RESEARCH, COLORADO SCHOOL OF MINES

I am Dr. Michael S. Graboski, Director of the Colorado Institute for Fuels and High Altitude Engine Research, a part of the Department of Chemical Engineering at the Colorado School of Mines. I am here today on behalf of the National Corn Grower's Association.

Mr. Chairman, I appreciate the honor of providing testimony to you and your distinguished Subcommittee on the environmental benefits of using oxygenates, particularly ethanol, under the Clean Air Act. In addition to my testimony brief, I have provided the committee with Technical Supporting Material that I would like included in the record.

I will use the brief time I have today to summarize the results of my analysis. In my analysis I look at the effects of removing oxygen from reformulated gasoline on emissions of ozone-forming volatile organic compounds, carbon monoxide, toxic air pollutants, and particulate matter. The following environmental and public health benefits result from the use of oxygenates in comparison to gasoline produced without oxygenates.

EFFECT OF OXYGENATES ON TOXIC EMISSIONS

Based upon the 1998 EPA Reformulated Gasoline (RFG) compliance survey, I have estimated how refiners will produce phase 2 reformulated gasolines (RFG2) with ethanol and without oxygen and compared the resulting potency weighted toxic emissions to those from RFG2 containing MTBE. Because the various air toxics pose different cancer risks, potency weighting allows us to compare one toxic compound with another. Using these potency weightings, we can add all the toxic emissions together and compare the relative toxicity of one fuel formulation with another. Potency weighting uses benzene as the reference giving it a value of 1 and weighing other compounds against benzene. For example, if a compound has been shown to be twice as toxic as benzene, its potency weighting is 2.

Figure 1 shows how I expect refiners to produce RFG2 fuels if they were to also satisfy the 28.1 percent reduction in average mass toxic emission from RFG1 surveyed in 1998. Based upon public statements by refiners, I expect new alkylate production to replace most of the lost gasoline volume resulting from the removal of MTBE with aromatics being used to balance octane.

Figure 1 shows that oxygenated fuels with ethanol provide a greater reduction in potency weighted toxic emissions compared to the MTBE fuel where benzene is used as the reference weight. The non-oxygenated fuel in figure 1 has increased aromatic content. Increased aromatics are necessary to meet octane requirements. In this case, the only way for the refiner to also produce the same benzene-equivalent potency weighted toxic emissions is if olefins are reduced but there is no economic in-

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[8] NREL. "Bioethanol Multi-Year Technical Plan, fiscal year 2000 and Beyond." July 6, 1999 draft, 21.

centive for such a reduction. Therefore, we can reasonably expect refiners to increase aromatics when oxygenates are removed from the gasoline pool.

If refiners make non-oxygenated RFG with the same mass toxics reduction as oxygenated gasoline there will be a negative impact on public health because potency weighted toxic emissions will increase. These increases will be due to increases in aromatics that will be used to meet octane and other performance requirements of the fuel when oxygenates are removed.

IMPACT OF REMOVING OXYGEN ON SUMMER OZONE

I recently examined the impact of removing oxygen from RFG in a typical RFG area, Philadelphia-Wilmington-Trenton using EPA inventories and modeling tools. Removing oxygen will increase exhaust emissions of carbon monoxide (CO) from light duty vehicles. In the case of off-road engines, volatile organic compounds (VOC) and CO will both increase as a result of removing oxygen.

Both VOC and CO has been proven to be ozone-forming agents. Figure 2 shows my estimate of how removing 2 percent oxygen from RFG will impact the VOC and CO inventory. Figure 2 shows that ozone-forming emissions may increase by almost 3 percent when oxygenates are removed from RFG. Figure 3 relates the increases to the total combined VOC and CO emissions benefit for the on-road fleet when RFG2 replaced RFG1 on January 1, 2000.

The impact of removing oxygen from RFG2, either as ethanol or as MTBE, is to lose as much as 35 percent of the additional ozone benefits attributable to RFG2 compared to RFG1.

IMPACT OF OXYGEN ON FINE PARTICULATE EMISSIONS

I am also investigating the impact of oxygenates, especially ethanol, on reducing fine particulate emissions, commonly called PM2.5. I would like to share some of my preliminary observations. PM2.5 has been identified as a public health hazard, and EPA is currently attempting to regulate PM2.5. Fine particulate from light duty vehicles is a major contributor to PM2.5 in metropolitan areas and will be so for the foreseeable future. Studies show that ethanol reduces PM2.5 emissions and heavy carcinogenic aromatics emitted from cars and trucks by 30 percent for clean, normal emitting cars, and 60 percent for dirty, high emitting cars.

Scientists have also identified aromatics as significant contributors to the formation of fine mists (aerosols) during the ozone forming process. One recent analysis estimates that aromatics are responsible for 20 percent to 30 percent of the yearly average PM2.5 in the California South Coast Air Basin. Removing oxygenates, MTBE or ethanol from gasoline, as we have already said, is likely to raise the use of aromatics in gasoline and lead to more PM2.5 pollution.

Removing oxygen from RFG is likely to result in an increase in direct emissions of particulate matter from automobile tailpipes, and the subsequent formation PM2.5 in the atmosphere through a complex series of chemical reactions, potentially harming public health.

I believe that the use of oxygen in gasoline has important environmental and public health benefits that must be maintained in any changes in the Clean Air Act. I hope that this discussion will be of value to you in your legislative actions. Thank you for your attention. I will now be happy to answer any questions you may have.

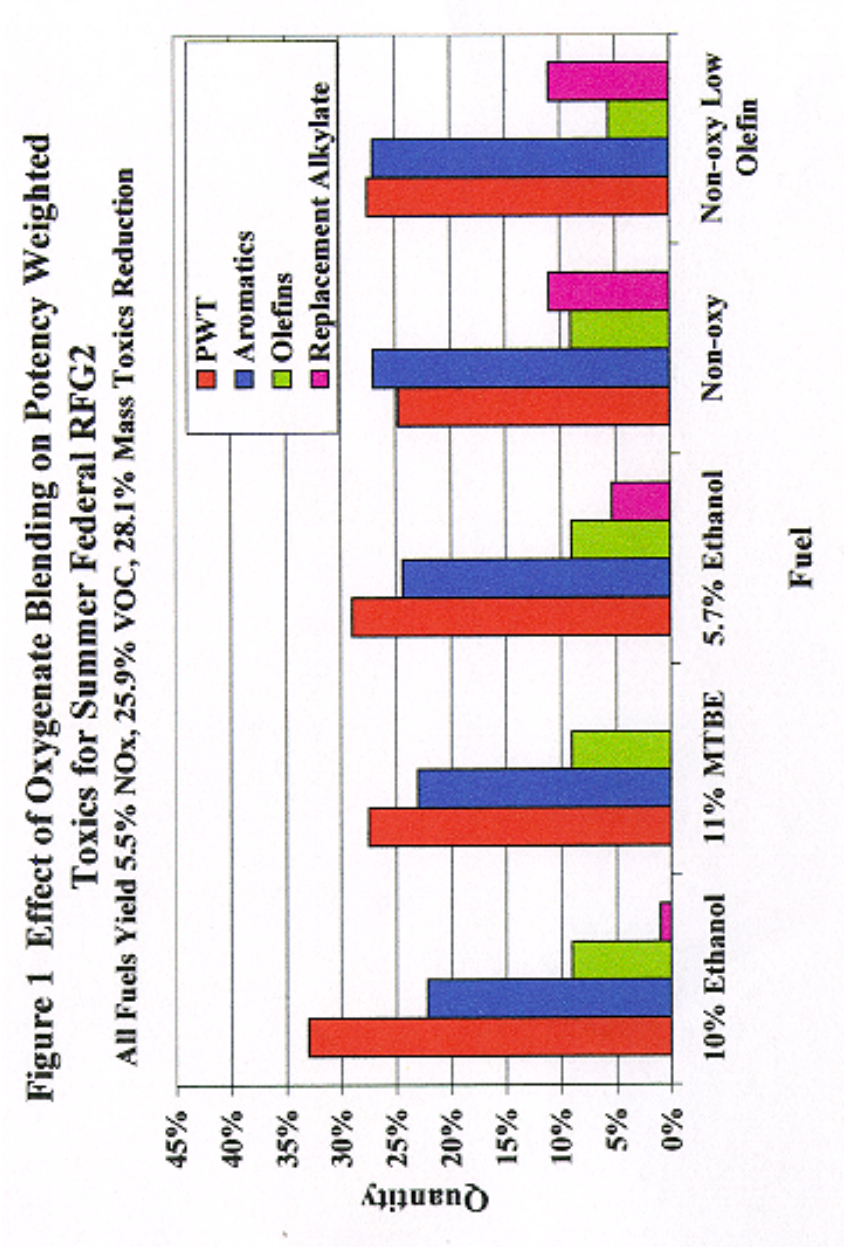
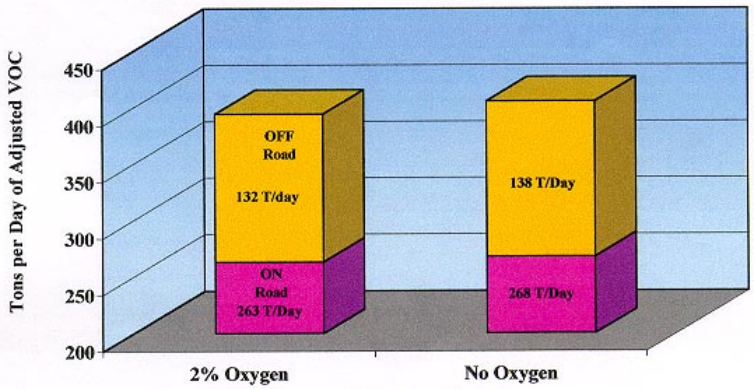


Figure 1 Effect of Oxygenate Blending on Potency Weighted Toxics for Summer Federal RFG2
All Fuels Yield 5.5% NOx, 25.9% VOC, 28.1% Mass Toxics Reduction
PWT
Aromatics
Olefins
Replacement Alkylate
Quantity
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
10% Ethanol
11% MTBE
5.7% Ethanol
Non-oxy
Non-oxy Low Olefin
Fuel

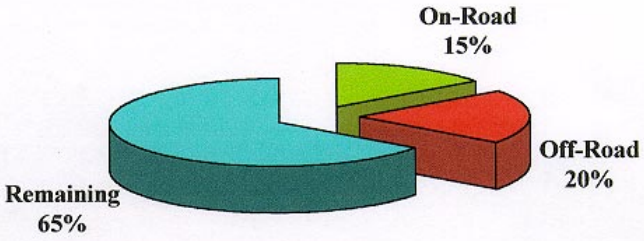
Figure 2 Comparison of Ozone Forming VOC Emissions from On and Off Road Engines for Philadelphia-Wilmington-Trenton During the Ozone Season



Note: Combines VOC and CO Emissions with 42.4 Ton CO valued as 1 Ton VOC

Figure 3 The Effect of Removing the Oxygen Requirement on VOC Reduction

Basis: Phase2 RFG Compared to Phase 1 RFG, VOC Adjusted for CO Impacts



Note 100% equals the full VOC emissions benefit of RFG2 compared to RFG1

STATEMENT OF HON. CHARLES GRASSLEY, U.S. SENATOR FROM THE STATE OF IOWA

Good morning, Mr. Chairman. I want to thank you for this opportunity to testify at your hearing to discuss the benefits of using ethanol as an oxygenate in reformulated gasoline.

As a Senator representing the No. 1 corn producing state, I am a firm believer in ethanol. And with good reason. Ethanol not only helps our farmers by providing a $4.5 billion per year value-added market for their commodities, but also it improves our air quality and our energy security by reducing our reliance on OPEC.

With today's high gasoline prices, and with economic analyst predictions that oil company profits will explode by 200 percent over last year's second quarter, it just makes sense that we should be looking seriously at displacing some of our imported oil with home-grown energy.

And from reading your press releases posted on your Senate web site, I know, Mr. Chairman, that you share my concerns about dependence upon foreign energy imports, and that you support establishing a limit on these imports.

But let me share with you what I have learned from my past legislative battles regarding this subject. Even though oil companies have sought and obtained market mandates to protect domestic production in the past, now that the majors have moved their investments and employees overseas, they are no longer so keen on limiting imports.

But, today, we are here to talk about ethanol. What is odd about all the new national scrutiny of ethanol is that it is being driven almost entirely by the fact that oil companies are being told they no longer can use MTBE.

MTBE is contaminating our Nation's water supply. Ethanol is not hurting our water, it's MTBE. In fact, even though I am not a drinker, I know that ethanol is little different than corn whiskey. So, if ethanol get's in the water, the worse that could happen is you might have to decide whether you want to add some ice, tonic or soda.

MTBE and ethanol are added to gasoline to meet the Clean Air Act's oxygenate requirement for reformulated gasoline (RFG). For the most part, refiners have chosen to use MTBE, a petroleum-derived chemical. Frankly to put it more bluntly, the oil industry did everything in its power through the regulatory and legal system to guarantee that ONLY MTBE would be used. The oil industry worked for an MTBE mandate, and it was successful.

Moreover, had it not been for the insistence of officials from the upper Midwest, no RFG containing ethanol would have been sold anywhere in America—not even in Chicago and Milwaukee.

And now, the American Petroleum Institute has the gall to blame ethanol for the high gasoline prices in these cities. The truth is that ethanol delivered to Chicago/Milwaukee has a net cost of 71 cents per gallon, which is 81 cents less than the price of gasoline!

So, today MTBE is shown in our water supplies across the country, including in Iowa where we don't use RFG. MTBE renders water undrinkable.

Now the oil companies would like us to eliminate the oxygenate requirement and trust them to produce a cleaner-burning gasoline without oxygenates.

Trust the same folks that brought us MTBE?

Trust the folks who manipulated the courts and regulatory process to make certain consumers had no option to buy either MTBE or ethanol in reformulated gasoline?

I say no.

I am here today to tell you there is a clean air and clean water substitute for MTBE that is available this very day—ethanol—and it's made by American farmers, not by OPEC, which is driving up our gasoline prices.

The use of RFG with oxygenates has significantly reduced harmful smog-forming vehicle emissions.

According to a report by the California Air Resources Board's Clean Fuels Development Coalition Technical Committee, oxygenates in RFG have reduced air toxics by 28 percent. It has reduced carbon monoxide by 13 percent. Sulfur oxides have been reduced by 11 percent and particulate matter by 9 percent.

Carbon monoxide reductions are even greater—up to 25 percent reduction—if you use 10 percent ethanol blends. And the American Lung Association has pointed out that carbon monoxide reduces the blood's ability to carry oxygen which is especially harmful to unborn babies, infants and people with heart disease.

So why would we want to eliminate the oxygen requirement?

The problem is MTBE in our water, not oxygenates in our gasoline.

Mr. Chairman, replacing MTBE with ethanol in RFG would protect our water supply from further damage, maintain the air quality gains of the Clean Air Act, reduce our energy imports and provide a much-needed market for American agriculture.

Replacing MTBE with ethanol means increased farm income. According to the U.S. Department of Agriculture (USDA), completely replacing MTBE with ethanol by 2004 would provide a boost to America's family farmers to the tune of $1 billion per year. Demand for corn would increase by over 500 million bushels per year. Higher crop prices would reduce the need for emergency assistance payments and lower loan program spending.

Replacing MTBE with ethanol improves our trade balance. According to USDA, the average U.S. agricultural net export value would increase by over $200 million per year, while MTBE imports would decrease. The overall impact would be to improve the U.S. balance of trade by $1.3 billion per year.

Replacing MTBE with ethanol means American jobs. USDA estimates that 13,000 new jobs across the economy would be created by 2010. While over a third would be in the ethanol industry itself, another 6,400 jobs are created in the trade, transportation and service sectors. Farm sector jobs also increase, as do jobs in the food processing and energy industries.

Mr. Chairman, it is very important that Congress proceed cautiously and with serious deliberation.

First, we should demand that the Clinton administration offer us not merely a press conference articulating a vague outline. We should demand that it present to us a specific, detailed legislative draft. There is no consensus among Members of Congress at this point, and the administration is ducking its responsibility by refusing to provide leadership. You know the games they play: as Congress attempts to resolve this problem, the administration will stick its finger in the wind of public opinion and take pot shots at everything we try to do.

So, insisting that the administration place its specific legislative proposal in our hands should be the bare minimum starting point for Congress.

Second, we must not let ourselves be brainwashed into thinking that the RFG oxygenate standard is the cause of MTBE water contamination. To do so will result in Congress squandering its time and efforts in pushing legislation that will do little or nothing to protect Americans from MTBE.

What would eliminating the oxygenate standard do to protect citizens from states like Iowa? Absolutely nothing!

You see, not a drop of reformulated gasoline is sold in Iowa. Not a drop!

Nevertheless, 29 percent of Iowa's water supplies tested were found to have serious levels of MTBE!

Mr. Chairman, MTBE is not only used in RFG, it is used all over the country as an octane enhancer. And do not believe for one moment that there is a safe level of MTBE.

Again, Iowa is a perfect example. For several years now, no gasoline containing more than 1 percent MTBE could be sold in Iowa without first posting warning labels. Let me tell you, no warning labels have been posted so no gasoline sold in Iowa has contained more than 1 percent MTBE.

Yet look at the enormous damage even a minuscule amount of MTBE has brought to Iowa's water supplies!

Whatever we do, we must protect states like Iowa from MTBE water contamination. We should be encouraging states to ban MTBE altogether, and not encouraging them to gut one of the most successful components of the Clean Air Act.

And third, Mr. Chairman, some argue that ethanol should not replace MTBE as an oxygenate until there is a greater understanding of its benefits and possible adverse impacts. I say this argument is a red herring promoted by petroleum companies who do not want to use a product like ethanol which they and OPEC don't control.

Nevertheless, and aside from the fact that I believe ethanol has been thoroughly scrutinized and has passed with flying colors, I would request that the Environment Committee use this same cautious standard in addressing whether or not to eliminate or allow waivers to the oxygenate requirement.

How can we rush to eliminate a program which has been proven so beneficial toward cleaning the air, when one, and only one, oxygenate has proven to contaminate our water?

Mr. Chairman, with ethanol, we can have clean air and clean water. We can help American agriculture and we can reduce our dependence on OPEC. That is why I am a co-sponsor of S. 2546, legislation introduced by my colleagues Kit Bond and Dick Durbin. This bill would preserve the oxygen requirement and the clean air gains we've made under the Clean Air Act, while banning MTBE. MTBE is the problem. It must be banned. We can't allow it to continue to be used even in small amounts. We've seen that first-hand in Iowa. Ethanol is the clean air, clean water alternative to MTBE.

Thank you.

Mr. Chairman, Senator Fitzgerald has asked me to request that the record be left open so that he may submit testimony later today.

STATEMENT OF DANIEL S. GREENBAUM, PRESIDENT, HEALTH EFFECTS INSTITUTE

Mr. Chairman, and members of the Committee, it is a pleasure to appear before you today to speak on the health consequences of using ethanol in gasoline. I speak today as both the President of the Health Effects Institute—an independent scientific institute funded by both government and industry to provide impartial science on the health effects of air pollution—and as the former Chair of the Blue Ribbon Panel on Oxygenates in Gasoline, which provided its recommendations for the Nation's use of oxygenates late last year.

In 1996, at the request of the White House Office of Science and Technology Policy, the U.S. EPA, and the Centers for Disease Control, HEI published a comprehensive review of the health effects of both ethanol and MTBE. For the record I am submitting here today copies of our report—I will summarize our findings in the brief time allotted.

In assessing the health effects of using ethanol in gasoline, we must look both at the effects of likely increased exposure to ethanol itself, and to the range of other substances which are emitted from motor vehicles and whose emissions will be affected by the use of ethanol, including, the air toxics acetaldehyde and peroxyacetyl nitrate (PAN), the air pollutants carbon monoxide and ozone, and other substances.

We have substantial scientific evidence on the health effects of ingesting ethanol. Pregnant mothers ingesting relatively high volumes can see their infants suffer from Fetal Alcohol Syndrome; lower levels of maternal alcohol consumption result in Fetal Alcohol Effects. Consumption of ethanol in the form of alcoholic beverages has been shown to increase the risks of certain cancers, leading the National Toxicology Program, in its recent Report on Carcinogens, Ninth Edition (May 2000), to designate alcoholic beverage consumption as a "known human carcinogen." For all of these effects, there are not firmly defined thresholds below which effects are not expected, although some investigators have identified an apparent threshold for the fetal effects of about one-half ounce of alcohol per day.

Although we know much about these effects of ethanol at high levels, it is likely that exposure of citizens to ethanol through either inhalation while refilling their fuel tanks, or through ingestion of ethanol-contaminated drinking water, will be substantially below levels at which effects have been seen. In the case of inhalation, HEI's estimate, based on limited exposure testing done to date, is that the dose of ethanol delivered to the body would be below the level of ethanol normally produced internally within the body.

The use of ethanol also results in changes in the exhaust and evaporative emissions from vehicles, in particular an increase in emissions of acetaldehyde and the chemical PAN, a decrease in emissions of carbon monoxide, and the potential for an increase in volatility of the fuel. While we have information on all of these, I will focus today on two key issues—acetaldehyde and volatility.

- Acetaldehyde, which is designated as "reasonably anticipated to be a human carcinogen" by the National Toxicology Program, would, according to a recent analysis by the California Air Resources Board (February 2000), increase in the atmosphere in 2003 when compared to the use of fuel oxygenated with MTBE. However, there would be an overall decrease in acetaldehydes when compared to 1997 levels due to tightening California fuel requirements. While these results are reassuring, similar analyses have not been performed for the rest of the Nation where federal RFG is in effect.
- The addition of ethanol to gasoline can result in an increase in the volatility of the fuel, and in the potential for increased formation of ozone. The base fuel can be reformulated to lower its inherent RVP so as to offset this effect, although there are some continuing questions about the possible impacts of commingling ethanol-blended fuels with non-ethanol fuels.
- PAN, which is an eye irritant, has been declining in the atmosphere, but is likely to continue at levels which could have significant effects with the use of both ethanol and MTBE.
- There have been benefits from the use of ethanol and MTBE for the reduction of carbon monoxide emissions.

Beyond these effects, the use of ethanol as an oxygenate in RFG provides the ability, as do other oxygenates, to replace more toxic octane-providing substances (such as benzene) with cleaner octane. However, the Blue Ribbon Panel identified that it is also possible to achieve these improvements using non-oxygenated reformulated fuels.

One further key question is the potential for ethanol to contaminate groundwater. Both the Blue Ribbon Panel, and more recently the Lawrence Livermore Laboratory, examined this issue. Although there are still many questions about these potential effects, two general conclusions can be drawn:

- First, the high biodegradability of ethanol would suggest that the chances of an ethanol spill or leak finding its way to any significant degree into drinking water is small;
- at the same time, the degradability of ethanol appears to retard the degradation of other components (e.g. benzene) resulting in the likelihood that plumes of these other substances, and the risk of water contamination, would increase somewhat. Precise estimates of the size of this risk do not exist.

In conclusion, we know much about the significant health effects of drinking ethanol, but should recognize that the likely exposure of the public to ethanol either through breathing or ingestion would be low. At the same time, there are continuing questions about the threshold below which we would not see such effects, and about the potential for ethanol in gasoline to increase the risk of water contamination from other components of the fuel. Based on these questions, the Blue Ribbon Panel recommended:

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. (Recommendation 13)

EPA, in conjunction with USGS, the Departments of Agriculture and Energy, industry, and water suppliers, should move quickly to:

- Conduct short-term modeling analyses and other research based on existing data to estimate current and likely future threats of contamination;
- 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;
- Identify and begin to collect additional data necessary to adequately assist the current and potential future state of contamination. (Recommendation 14)

In closing, the decision to greatly increase any one component of the fuel supply is a major one, with potential widespread implications for exposure and public health. Although the current information on ethanol and its effects is somewhat reassuring, it is critical that accelerated efforts be made to fill key information gaps before widespread increases in use of any additive have been accomplished.

Thank you for the opportunity to submit this testimony. I would be pleased to answer any questions.

STATEMENT OF JASON S. GRUMET, EXECUTIVE DIRECTOR OF THE NORTHEAST STATES FOR COORDINATED AIR USE MANAGEMENT (NESCAUM)

Thank you Mr. Chairman. My name is Jason Grumet and I am the Executive Director of the Northeast States for Coordinated Air Use Management (NESCAUM). NESCAUM is an association of State air pollution control agencies representing Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island and Vermont. The Association provides technical assistance and policy guidance to our member states on regional air pollution issues of concern to the Northeast. We appreciate this opportunity to address the Environment & Public Works Committee regarding the use of ethanol as a fuel additive.

Our region has much at stake in the debate over RFG, MTBE and ethanol. Seven of our eight states have or are participating in the Federal RFG program. The use of RFG in the Northeast has provided substantial reductions in smog forming emissions and has dramatically reduced emissions of benzene and other known human carcinogens found in vehicle exhaust. However, substantial evidence has emerged to suggest that the unique characteristics of MTBE pose an unacceptable risk to our region's potable water supply. Groundwater testing conducted throughout the Northeast has detected low levels of MTBE in roughly 15 percent of the drinking water tested. Nearly 1 percent of samples contained MTBE at or near State drinking water standards. MTBE's unpleasant taste and odor at higher concentrations and the frequency of MTBE detections poses a disproportionate and unacceptable threat to our region's drinking water.

The challenge facing us all is to mitigate the environmental and economic harm caused by MTBE contamination without sacrificing the environmental and public health benefits provided by RFG. Adding to this substantive challenge, is the need

to address diverse regional interests in promoting a secure and growing market for ethanol and the opportunity to direct much needed support to a broad array of environmentally beneficial transportation fuels and advanced propulsion technologies. Of course, all this must be accomplished without exacerbating already skyrocketing gasoline prices.

Unfortunately, the law as currently written prevents both the U.S. Environmental Protection Agency (EPA) and the states from effectively addressing this challenge. The good news is that a diverse group of interests have come together to promote a set of legislative principles that will protect our air and water quality, ensure substantial growth in ethanol usage, and provide refiners with the flexibility needed to prevent gasoline price spikes or supply shortages. I would like to submit to the record copies of the legislative framework the Northeast states introduced in January of this year and subsequent statements endorsing this framework submitted by the American Lung Association, the Natural Resources Defense Council and the American Petroleum Institute. Since that time, the unprecedented coalition of interests supporting these legislative principles has grown to include several neighboring Mid-Atlantic states and the independent oil refiners Sun Oil Company and TOSCO.

Allow me to first review the legislative approach supported by our unique alliance. I will then directly address how this approach and other scenarios will affect the demand for renewable and environmentally beneficial transportation fuels.

REVIEW OF LEGISLATIVE FRAMEWORK

I. Repeal or waive the 2 percent oxygen mandate for RFG in the Clean Air Act

It is simply not possible to protect air quality, water quality and ensure gasoline price stability unless the oxygen mandate is lifted or, at a minimum, modified to require EPA to waive this requirement upon State request. Unless the oxygen requirement is lifted or waived, a substantial reduction in MTBE use creates a *de facto* summertime ethanol mandate. Ethanol usage is far preferable to MTBE from a groundwater perspective and promotion of ethanol can further a host of energy, agricultural, and environmental goals. However, we do not believe that an ethanol mandate in the summertime reformulated gasoline program represents sound environmental or economic policy for the Northeast. Due to its high volatility and the resulting increase in evaporative emissions, the use of ethanol during the summer ozone season may actually exacerbate urban and regional smog problems, absent further statutory or regulatory protections.

The growing outcry over skyrocketing gasoline prices demands that any legislative solution to the MTBE problem be mindful of effects on fuel price and supply. The economic impact of mandating the use of ethanol in the Northeast, California and the Gulf Coast is simply unknown. Setting aside the wisdom of coupling mandates with subsidies, serious questions remain about the cost and environmental impacts of transporting and distributing billions gallons of ethanol to regions of the country where it is not produced. There is no question that it is possible to dramatically increase ethanol production. Similarly there is no question that it is possible to ship massive quantities of ethanol to the Northeast by barge, rail and truck. The question is at what cost. While our region embraces the goal of increasing renewable fuels nationally and sees great promise in the development of a biomass ethanol industry in the Northeast, we are convinced that there are policy approaches to achieve these legitimate ends that are far preferable to mandating the use of ethanol in summertime RFG.

We are surprised and disappointed by legislative efforts to maintain the oxygen mandate and ban MTBE. These efforts seek short-term economic enrichment for one region of the country at the economic and environmental expense of all others. Simply stated, this approach holds no promise to build the consensus necessary to craft effective national legislation. We hope that this Committee will reject such shortsighted efforts to perpetuate the oxygen mandate and instead work toward building a national ethanol market that emphasizes product quality over market protection.

II. Severely curtail or eliminate MTBE use as a fuel additive

We propose a three step approach to reduce, and if necessary, eliminate MTBE from the fuel supply. This approach requires a reduction in MTBE use to historic levels and empowers both EPA and the states to further regulate MTBE while minimizing the potential for a patchwork of varying State requirements that could result in increased fuel prices.

(a) *Compel EPA to regulate or eliminate MTBE use as a fuel additive if necessary to protect public health, welfare or the environment from air or water pollution.*— Neither EPA nor the states, with the notable exception of California, have clear authority under Federal law to prevent MTBE from harming drinking water supplies

or the environment. EPA's recent efforts to explore existing authority under the Toxic Substances Control Act (TSCA) as a "safety net" in the absence of Congressional action does little to allay our concern over the inadequacy of existing Agency authority. Even a cursory review of the TSCA provisions suggests that its application to the question at hand will be arduous, inelegant and tangled in years of litigation. The Northeast states share EPA's frustration over the inadequacy of our mutual authority. Our inability to address public concern over MTBE contamination is eroding public confidence in the commitment and competence of all levels of government and exaggerates public anxiety over the risks posed by MTBE. While EPA's strained interpretation of TSCA is understandable against this public backdrop, only Congressional action that both authorizes and obligates EPA to reduce MTBE to whatever levels are necessary to protect public health, welfare or the natural environment will provide the protection the public demands and deserves. While our states and alliance partners do not believe that the currently available data supports a statutory ban of MTBE, we agree that EPA must be required to eliminate MTBE as a fuel additive if the Agency concludes through rulemaking that such action is necessary to protect public health, welfare or the environment.

(b) *Compel EPA to reduce MTBE usage in all gasoline to historic (Pre–1990) levels.*—At minimum, within 1 year from enactment of legislation, EPA must be required to complete a rulemaking that limits MTBE usage in all gasoline to the levels in use prior to the Clean Air Act Amendments of 1990. Data on MTBE contamination prior to the adoption of the oxygen requirements in 1990, suggest that this severe curtailment of MTBE use coupled with the tremendous improvements in underground storage tanks that has occurred since 1990 will effectively mitigate the risks posed by MTBE contamination. However, I must stress that if EPA determines that even this severe curtailment of MTBE usage is not adequate to protect public health, welfare or the environment, the Agency is obligated to further reduce or eliminate MTBE in gasoline all together.

(c) *Authorize states to regulate MTBE beyond EPA requirements.*—If EPA fails to act in a timely manner or fails to effectively mitigate the harms posed by MTBE, states must be empowered to further regulate MTBE sold within their borders. In order to balance the need for measured State authority against the desire for maximum consistency in fuel specifications, we propose to adhere to the State petition process found in the current clean air statute. As in current law, State ability to implement independent fuel requirements would remain predicated upon EPA granting a State petition demonstrating the need for such action. Unlike current law which limits the grounds for State petitions to a demonstration that the action is necessary to attain a National Ambient Air Quality Standard (NAAQS), State MTBE petitions would be required to demonstrate that further regulation of MTBE is necessary to protect public health, welfare or the environment.

III. Enhance the RFG performance standards to reflect the stricter of real world RFG Phase 1 performance or the existing RFG Phase 2 requirements for VOC, NO_x and toxic emissions

The RFG program has produced dramatic air quality improvements. Reductions in airborne tonics have substantially surpassed the performance standards of both Phase 1 RFG and the more stringent Phase 2 requirements that take effect this year. We believe that a substantial portion of these benefits has been provided by the high volume of oxygenates currently mandated in RFG. As we seek to provide refiners with the flexibility to reduce the use of MTBE, it is necessary to ensure that this flexibility does not result in higher polluting gasoline. For toxic emissions, this approach will require EPA to substantially enhance the RFG toxic performance standard over that currently required in the Phase 2 program. To date, the Northeast and Gulf Coast have achieved far greater air toxic reductions than the Midwest under the RFG program. Hence, we believe that setting enhanced air toxic requirements on a regional basis is the most accurate and equitable approach to ensuring that there is no loss of toxic emission benefits once the oxygen mandate is lifted or waived. This approach ensures that the environmental gains achieved across the country will be protected while acknowledging the circumstances that have resulted in the disparate toxic reductions provided by the RFG program to date. This approach is also consistent with the EPA's historic application of different regional RVP requirements in "northern" and "southern" grade gasoline. Our proposed approach would only apply in those states that opt to waive the oxygen requirement. We fully expect that several states will opt to maintain the oxygen requirement as a further incentive for ethanol use. In these states, there is no risk of air quality "backsliding" resulting from a reduction in oxygenate use and hence these enhanced regional toxic standards would not apply.

(a) *Maintaining VOC and NO_x* Benefits.—The Phase 2 standards that take effect this year are more protective than the actual VOC and NO_x reductions achieved under the RFG program to date. Hence, the phase 2 standards would remain in force. By combining the actual toxic emissions performance of Phase 1 RFG with the more protective Phase 2 standards for VOC and NO_x, we believe we can equitably and effectively maintain the full air quality benefits provided by the RFG program.

(b) *Maintaining Carbon Monoxide Benefits.*—While the carbon monoxide (CO) reductions provided by oxygenates have and will continue to diminish as newer technology vehicles enter the national fleet, oxygenates continue to provide important benefits in the few areas of the country that exceed the CO NAAQS. We do not propose any changes to the statutory requirements for oxygenate use affecting CO nonattainment areas. Recent evidence indicates that CO reductions also play a relatively minor but measurable role in ozone reduction. The Northeast states support recognition of these modest and decreasing benefits so long as we count them only once. Since EPA is currently seeking to account for these benefits in a regulation that would provide ethanol blends with a further relaxation of RVP requirements, we do not believe that it is necessary or credible to take account of these same benefits a second time in legislation.

(c) *PM Emissions.*—Advocates of the oxygen mandate have suggested that a comprehensive anti-backsliding approach must also include provisions to maintain reductions in particulate matter attributable to oxygenate use. While an ardent advocate of the need to reduce both direct PM emissions and PM emission precursors, NESCAUM does not believe there is adequate scientific evidence to justify addition of a new PM reduction obligation at this time. We urge EPA and academia to conduct the research necessary to build a general scientific consensus around the impact of oxygenates on PM emissions. However, we cannot delay efforts to enhance the environmental performance requirements for toxic emissions while we await the result of future studies. The inadequacy of our understanding of the relationship between oxygenates and PM is evident by the fact that there is currently no requirement for PM reductions in the RFG program. Unlike in the case of VOC, NO_x and tonics, where there are existing performance requirements and intricate regulatory compliance regimes already in place, we believe it is premature to include PM reductions in the discussion of air quality backsliding.

IV. Promote consistency in fuel specifications through the timely implementation of effective Federal requirements

The Northeast states understand and support the need to provide refiners and fuel suppliers with a consistent and coordinated set of regulatory requirements. The most effective means of achieving this consistency is to authorize and require timely action of the part of EPA. Our states are committed to working with other regions and EPA to develop a Federal regulation that meets our collective needs.

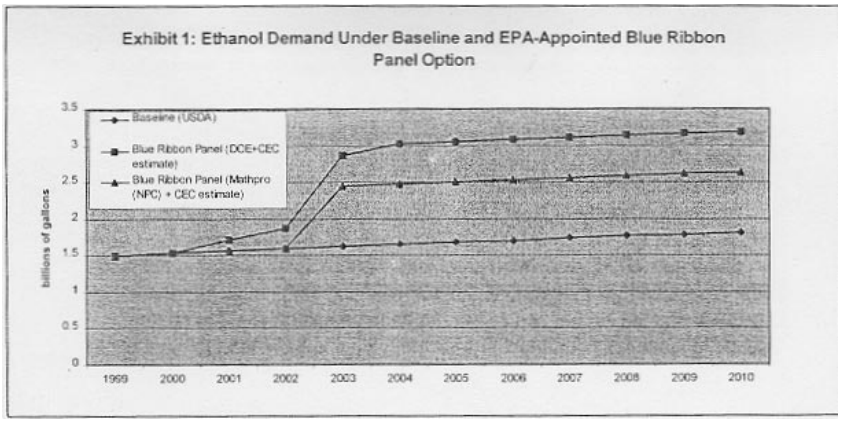
V. Provide adequate lead time for the petroleum infrastructure to adjust in order to ensure adequate fuel supply and price stability

At present, the gasoline system in the Northeast and much of the Nation is dependent upon the presence of high volumes of MTBE. As much as we need immediate action to address MTBE contamination and reinvigorate the RFG program, we recognize that a severe curtailment in MTBE use cannot be completed overnight. Depending on the ultimate extent of required reductions, our states anticipate that 2 to 4 years will be necessary to complete the phase down or elimination of MTBE in the Northeast. We are committed to working with our partners in the Federal Government and the refining industry to ensure that fuel quality, supply and price are protected as we reduce our current dependence on MTBE.

IMPACT ON RENEWABLE FUEL USE

As stated earlier, implementation of legislation based on these principles will result in a substantial increase in ethanol use over the coming decade. The severe curtailment and/or elimination of MTBE as a fuel additive coupled with maintenance of the mass toxic benefits achieved in Phase I RFG will force refiners to substantially increase their current use of ethanol. Key among the market factors leading to this increased demand is the need to replace the loss of octane in the fuel supply without increasing air toxic emissions. While experts vary on the exact magnitude of growth in ethanol demand, every analysis we have seen agrees that the competitive future for ethanol is very bright. The Exhibit 1 illustrates our best assessment of the growth in ethanol as a fuel additive if states are given the authority to lift the oxygen mandate and MTBE is phased down to pre 1990 levels. If MTBE is further reduced or eliminated, the growth of ethanol will be even greater. This projec-

tion reflects analysis conducted by NESCAUM, API and ALA using data generated by the USDOE, the USDA, and two leading consulting firms, MathPro and Downstream Alternatives. The more conservative estimate, assumes that the ethanol needed to satisfy PADD 1 and PADD 3 demand is met by pulling existing ethanol out of the Midwest markets, leaving national ethanol demand outside of California unchanged. It adds to this static 49-state assumption, the growth that would occur in the California market provided by MathPro's analysis conducted for the California Energy Commission.[1] The MathPro study indicates that 40 to 60 percent of California gasoline would be blended with ethanol at 2.7 weight percent resulting in nearly one billion gallons of new ethanol demand annually. The assumption that all ethanol demand outside of California will be satisfied by shifting ethanol out of Midwest markets is an unreasonably conservative projection of the impact of our legislative approach. First, it assumes no additional policies are adopted by Midwest states to promote or require ethanol use and second it assumes that Midwest states opt to waive the oxygen standard. The alternative scenario that projects ethanol use more than doubling over the next decade was derived by combining the same MathPro analysis for California with the DOE estimate for ethanol growth in the Northeast[2]. As you can see, this analysis projects that ethanol use will fully double by 2004 growing from 1.5 to over 3 billion gallons per year.



In order to promote a truly secure future for ETOH, it is time to shift our collective emphasis away from efforts at further market protection and toward to a rejuvenated focus on product quality. While mandates provide a level of absolute security that is never possible in a free market, this security comes at a considerable cost to the ethanol industry. Mandates undermine the public's confidence in the quality of ethanol as a motor fuel. As we have heard from a diverse number of government and private sector experts today, ethanol presents a host of compelling domestic economic and environmental benefits. The imposition of a sales quota, contradicts these expert sentiments by embracing the intuitive contradiction that ethanol is so good for the country that it cannot compete. I firmly believe that the renewable fuels market will never achieve its full market potential so long as that market is understood to depend on political power and not product quality. Moreover, markets that appear contingent upon politics will constantly face the insecurity of political change. Product quality will forever remain the only true security in a democratic Nation with a free market economy.

As an advocate of a set of policies that are projected to more than double ethanol use within 4 years of enactment, I proudly embrace the label of ethanol advocate. At the same time, I recognize that ethanol like all products presents benefits and liabilities. Regardless of whether ethanol use flourishes under a free market or national sales quota, there are a host of economic and environmental considerations that must be accounted for as ethanol use expands.

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[1] Analysis of California Phase 3 RFG Standards, Submitted to the California Energy Commission by MathPro Inc., Subcontract No. LB60 100, December 7, 1999.

[2] Estimating Refining Impacts of Revised Oxygenate Requirements for Gasoline, Oak Ridge National Laboratory, Studies for the U.S. DOE Office of Policy May-August 1999.

Key Environmental Considerations from expanded ethanol use

Air Quality

Without further statutory or regulatory protections, the widespread use of gasoline containing ethanol will increase evaporative emissions of VOCs due to it high volatility characteristics. The obvious first step to address this problem is to remove the 1 lb. RVP waiver for conventional gasoline containing ethanol. Increased evaporative emissions have a deleterious impact on ambient levels of ozone and increase emissions of toxic pollutants such as benzene. Also of concern is the so-called "comingling" effect. When ethanol blends mix with non-ethanol blends they increase the volatility of the entire volume of fuel. Consequently, even if the ethanol fuel itself complies with RVP limits, its presence in a diverse fuels market will have consequences whenever a vehicle that has recently been fueled with an ethanol blend is re-fueled with an ethanol free gasoline.

The combustion of ethanol-blended gasoline results in a 50 to 70 percent increase in acetaldehyde emissions compared to MTBE blends. Ambient levels of this pollutant currently exceed health-based standards by a substantial amount in many areas in the Northeast. Increased ethanol use is also likely to cause some increase in NO_x emissions in the Northeast. There are direct and indirect components to this anticipated NO_x increase. Some engines have been shown to directly emit increased levels of NO_x when burning fuel containing ethanol. In addition, the fact that ethanol blends cannot be shipped through gasoline pipelines will create indirect but potentially substantial increases in NO_x and particulate emissions from the diesel truck, rail and barges used to move hundreds of millions of gallons of product from Midwest production facilities to markets in the Northeast.

Groundwater

There is broad agreement that the potential groundwater impacts of gasoline blended with ethanol are far less significant than those associated with MTBE blends. Nevertheless, the presence of ethanol in gasoline raises some concern with regard to groundwater contamination. In short, there is evidence to suggest that the microbes that biodegrade benzene, toluene and other volatile organic compounds are preferentially attracted to ethanol. The good news is that ethanol is quickly biodegraded when present in groundwater. The bad news is that the bacteria fails to degrade benzene and the other VOCs present in gasoline plumes until the ethanol is consumed. Hence, BTEX compounds are predicted to persist longer in groundwater when gasoline mixtures containing ethanol are leaked or spilled. Evidence presented to the Blue Ribbon Panel suggests that this effect, while not insubstantial, pales in comparison to the groundwater threat posed by MTBE.

Key Economic Considerations from Expanded Ethanol use

Transportation and Distribution

As stated above, gasoline blends with ethanol cannot be transported via existing pipelines due to ethanol's affinity for water. Consequently, unless dedicated ethanol pipeline capacity emerges, the widespread use of ethanol in the Northeast will require transporting hundreds of millions of gallons of ethanol by rail, truck or barge. New storage tank capacity and blending facilities will also be needed in our region to accommodate increased demand. While there are broad differences of opinion about the magnitude of this logistical challenge, it is imprudent to support a market mandate that would require the Northeast to use disproportionate amounts of ethanol compared to the rest of the Nation until these logistical impediments and their associated economic and environmental impacts are better understood.

Gasoline Cost Impacts

Detailed studies by the U.S. Department of Energy and the California Energy Commission suggest that any major shift from MTBE to ethanol should be phased in over 3 to 4 years to avoid dramatic price spikes or fuel shortages.

The Northeast states do not support a waiver of the Reid vapor pressure (RVP) requirements to accommodate the increased volatility of gasoline blended with ethanol. In order to meet the existing volatility requirements, the base gasoline into which both conventional and reformulated gasoline must be more severely refined. While opinions differ on the costs of this additional refining, they will not be insubstantial when incurred across the national fuel market.

Ethanol Subsidies

The fact that ethanol receives a 54 cent per gallon subsidy—in the form of a partial exemption from the Federal fuel excise tax and an income tax credit—has important one implications for the Highway Trust Fund in the Northeast. Currently, this subsidy reduces the nation's Highway Trust Fund by approximately $870 mil-

lion dollars annually. A doubling or tripling of ethanol use in gasoline will have the effect of further reducing highway revenue by a substantial amount. While we are not seeking to address the validity of the ethanol subsidy if market conditions are allowed to determine future ethanol growth, an evaluation of ethanol tax policy is surely warranted if we impose a national ethanol sales mandate.

Renewable Fuels Standard

Many, though not all, of these concerns are mitigated if ethanol is used at the right time and in the right places. Not surprisingly, approaches that enable the market to determine how and where ethanol is used go long way toward encouraging the most economical and environmentally beneficial uses of ethanol. To the contrary, the constraints of a de facto summertime ethanol mandate in RFG legislative efforts to reinforce this outcome provide the worst possible environmental and economic scenario for a growing ethanol industry. Under this nonsensical approach, the national interest in promoting renewable fuels is imposed on regions of the country farthest away for the source of ethanol production at the one time of the year when ethanol's volatility leads to considerable public health concerns.

Compared against this looming disaster in national policy, our region has previously expressed interest in the concept of a Renewable Fuels Standard (RFS) approach. While we maintain a principled apprehension about the imposition of an overarching sales quota for the reasons stated above, the RFS takes a strong step toward free market principles by enabling economic and environmental considerations to influence when and where ethanol is sold. Moreover, an RFS legitimately emphasizes the national security, agricultural, and global environmental benefits that are furthered by an increased use in ethanol. The logic of these interests provides a far more compelling rational than the pretense that ethanol is necessary to protect urban air quality. Efforts to perpetuate the oxygen mandate must justify this position on the basis of ethanol's ability to improve summertime urban air quality which is on one of the weakest rationales for growth in ethanol use.

In July of last year, Senator Daschle wrote to NESCAUM and the region's Governors seeking to explain his support for replacing the oxygen mandate with a 2.1 percent RFS and seeking Northeast State input. I would like to submit to the record copies of my response as well as the responses from Governor Shaheen from New Hampshire and Governor King from Maine. While all three responses expressed apprehension regarding many of the issues outlined above, each letter expressed the belief that the flexibility provided by a properly designed RFS would better respond to our stated concerns about ethanol than Congressional inaction. Key to the proper design of an RFS, is the ability of refiners to avail themselves of market-based approaches to meet their ethanol sales quota. By enabling refiners to average internally and with other fuel suppliers to meet their annual renewable content minimums, we believe that ethanol will be used where it is cost-effective to do so. We simply don't know whether it will be cost effective to transport and distribute ethanol produced in the Midwest throughout the Northeast market. Unlike the oxygen mandate that would force refiners to sell a disproportionate amount of ethanol volume in Northeast regardless of economic considerations, a properly designed RFS enables refiners to sell ethanol where it makes economic sense.

From both an environmental and economic standpoint, a properly designed RFS must also enable refiners to use ethanol if and when it makes sense to do so. The version of the RFS that was provided for our review last year allowed refiners to comply on an annual average basis. This flexibility is critical to ensure that ethanol is only used sparingly in cities that suffer from summertime ozone nonattainment. I am concerned that the more recent incarnations of the RFS seek to impose a quarterly averaging regime. Requiring one-quarter of our national ethanol use to occur during the summer months is unsound environmentally and will lead to increased fuel prices since refiners will be required to reduce to overall volatility of their blendstock to accommodate ethanol within allowable RVP limits. While I recognize that small ethanol producers do not presently maintain the tank capacity to store ethanol produced during the summer season, expanding this tank capacity seems far preferable than forcing the sale of ethanol in the summer months.

Of course the most important feature of a properly designed RFS is the magnitude of sales requirement itself. When Governor Shaheen stated that, "a renewables fuel requirement—accompanied by elimination of the Federal oxygenate mandate—holds great promise and represents a wise precedent for the Nation to establish,[3] she was evaluating a 2.1 percent RFS that was understood to represent a doubling of ethanol production over the next 10 years. We now understand Senator Daschle's approach to contemplate more than tripling ethanol use in this same time period. This con-

[3] Letter for Governor Jeanne Shaheen to Senator Tom Daschle, September 16, 1999

templated increase from a statutory doubling to a tripling of ethanol under an RFS will greatly increase opposition to the RFS in our region.

While it is awkward to offer suggestions on how to design a sales quota that on balance we deem unnecessary, one thing that I have learned from this debate is that those who can't imagine creative compromises are quickly left behind. If we are going consider adoption of policies that encourage ethanol use, these policies should be optimized to encourage entrepreneurial innovation and growth among small businesses and farmers and seek to remedy market barriers and the failure of financial markets effectively internalize the full social costs and benefits of different actions. Toward this end, we wish to applaud Senator Daschle and Senator Lugar's recognition of the additive environmental and potential economic attributes of biomass ethanol in fashioning a differential credit for biomass in their current RFS proposal.

Obviously, the opportunity to cure "market failures" through quotas and mandates can be quite seductive. Hence, before I abandon this creative flourish, I also suggest that RFS supporters consider broadening the universe of fuels that could count toward RFS compliance to include fuels that enable extremely low emission performance. The Northeast states have long advocated for policies that reward advanced transportation technologies like electric and hybrid electric vehicles, compressed natural gas in urban bus fleets and ultimately fuel cell technologies. These technologies promote many of the same national security and fuel diversification goals that we understand form the substantive foundation of the RFS. Moreover, those technologies that rely on electric drive trains achieve far greater reductions in air pollution emissions than internal combustion engines regardless of the volume percentage of renewable fuels. We as a Nation have failed woefully to achieve the laudable Energy Policy Act goal of diminishing our reliance on petroleum transportation fuels by 10 percent this year. If we are truly committed to decreasing our reliance on foreign petroleum, it seems worth contemplating a flexible national approach that will inspire the ingenuity and creativity that our Nation has to offer.

CONCLUSION

In conclusion, let me stress that the preferred approach of the Northeast states is to: (1) lift the oxygen mandate; (2) severely curtail and if necessary eliminate MTBE; (3) maintain the VOC, NO_x, and toxic emission benefits, and (4) allow ethanol to grow on the basis of its legitimate and considerable attributes. I am pleased to learn that many of the strongest traditional advocates of a growing ethanol industry recognize that it is possible to support ethanol while opposing ethanol mandates. I would like to submit a set of six editorials from newspapers in Nebraska and Iowa commenting on State efforts to mandate the use of ethanol over the last year. The headlines demonstrate that our interest in promoting ethanol on the basis of product quality is shared by many of our Midwest neighbors:

- From the *Des Moines Sunday Register,* September 19, 1999—"Let ethanol prove itself: Iowa farmers need help, but coercion at the gas pump is wrong."
- From the *Quad City Times*, September 19, 1999, "Ethanol-only proposal doesn't help consumers."
- From the *Omaha World Herald*, March 9, 2000—"More Alcohol, Less Choice"

Obviously, we are troubled that having failed to impose ethanol mandates in their own states, several prominent Midwest officials now seek Congressional action to impose ethanol mandates on the Northeast. Still, I remain optimistic that by emphasizing market principles in the effort to promote the use of renewable and clean fuels we can fashion a workable solution to the legislative challenges that lie ahead. Thank you for the opportunity to appear before the Committee. I welcome the opportunity to respond to any questions you may have.

NORTHEAST & MID-ATLANTIC STATES, GASOLINE/MTBE TASK FORCE,
Boston, MA.

PRINCIPLES FOR EFFECTIVE FEDERAL LEGISLATION REGARDING REFORMULATED GASOLINE AND MTBE

OBJECTIVES

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

• Ensure that alternatives to MTBE do not pose new threats to public health or environmental quality.

PRINCIPLES FOR EFFECTIVE FEDERAL LEGISLATION

• Repeal or waive the 2 percent oxygen mandate for RFG.
• Clarify State and Federal authority to regulate, and/or eliminate, MTBE or other oxygenates if necessary to protect public health or the environment.
• Phase-down and cap MTBE content in all gasoline.
• Impose the stricter standard of Phase 1 RFG performance or Phase 2 requirements for VOC, NO_x and toxic emissions.
• Promote consistency in fuel specifications through the timely implementation of effective Federal requirements.
• Provide adequate lead time for the petroleum infrastructure to adjust in order to ensure adequate fuel supply and price stability.

NORTHEAST STATES FOR COORDINATED AIR USE MANAGEMENT (NESCAUM),
Boston, MA.

NORTHEAST STATES ANNOUNCE UNIFIED MTBE STRATEGY

(Contact: Cindy Drucker)

CALL FOR IMMEDIATE CONGRESSIONAL ACTION

JANUARY 19, 2000 (BOSTON, MA)—The Northeast States for Coordinated Air Use Management (NESCAUM) representing the eight states of New York, New Jersey, Massachusetts, New Hampshire, Vermont, Rhode Island, Connecticut and Maine today urged Congress to enact effective Federal legislation regarding reformulated gasoline and MTBE. In launching a call for Federal action, the Northeast states set forth six core principles that will protect the region's air and water quality while maintaining an adequate fuel supply and price stability.

The unified principles were developed by the Northeast Regional Fuels Task Force, consisting of State air and water officials. The Northeast Regional Fuels Task Force was formed to implement the recommendations included in a comprehensive RFG/MTBE study conducted by NESCAUM last summer at the request of the Northeast Governors.

Under Federal law passed in 1990, Congress required reformulated gasoline to contain oxygenates such as MTBE or ethanol. Only Congressional action to lift the oxygen mandate can provide an adequate solution to concerns over current levels of MTBE use. Absent changes in Federal law, states are effectively prohibited from addressing this significant public concern.

The Northeast states' principles for changes to the current reformulated gasoline program include:

1. Repeal the 2 percent oxygen mandate for reformulated gasoline (RFG) 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 the toxic emission reduction benefits achieved to date by the Federal RFG program.
5. Promote consistency in fuel specifications through the timely implementation of effective Federal requirements.
6. Provide adequate lead-time for the petroleum infrastructure to adjust in order to ensure adequate fuel supply and price stability.

Jason Grumet, Executive Director of NESCAUM stated, "The Federal oxygenate mandate is outdated and inappropriate national policy. These unified principles call on Congress to grant states and industry the flexibility to preserve clean air benefits while balancing other environmental resource concerns."

Connecticut DEP Commissioner Arthur Rocque, Jr. stated, "The challenge facing the Northeast states and the Nation is to identify a program that effectively mitigates the environmental risks posed by MTBE while maintaining the public health benefits of the current RFG program. We simply can no longer accept Federal mandates that are barriers to that goal."

Under present Federal law, gasoline sold in states must contain a 2 percent oxygenate. Robert Varney, DES Commissioner of New Hampshire remarked, "In calling for a repeal of the current oxygenate mandate, we are seeking the authority to de-

sign consistent regulations that respond to our region's environmental and economic needs."

Steve Majkut, Air Director of Rhode Island, stated, "We need to make sure that we are not throwing the baby out with the bath water. We must maintain the air quality benefits of MTBE while we allow sufficient time for the refining and distribution systems to develop an adequate supply of alternatives. We simply cannot afford a short-term quick fix that sacrifices the clean air benefits in the process."

NESCAUM also commended two recent legislative initiatives that are consistent with the principles announced today. Grumet added, "Legislative measures, such as those proposed by Congressman Greenwood (R–PA) and Senators Feinstein (D–CA), Inhofe (R–OK) and Smith (R–NH) provide a sound foundation for legislation this session. We commend their efforts to date and urge others to join in fashioning a necessary solution." Grumet also credited early initiatives by Congressmen Pallone (D–NJ), Franks (R–NJ) and Bilbray (R–CA) for raising the MTBE issue to the legislative forefront.

Editors' Note: Copies of NESCAUM's RFG/MTBE report may be obtained through the Internet at www.NESCAUM.org or by calling (617) 367–8540.

AMERICAN LUNG ASSOCIATION,
Washington, DC.

(Contact: Diane Maple, ALA)

ALA, NRDC CALL ON CONGRESS TO ENACT CLEAN FUEL FIX TO PROTECT WATER SUPPLIES

WASHINGTON, DC, February 1, 2000.—With Congress back in session and public concern mounting over the water pollution and health threats posed by methyl tertiary butyl ether (MTBE), a widely used fuel additive, the American Lung Association and the Natural Resources Defense Council are calling for action by Congress and the Environmental Protection Agency to "fix" the problem while maintaining the air quality benefits of the nation's reformulated gasoline program.

"Six months ago, an expert panel recommended these changes. It's time for Congress to put clean air and clean water at the top of its agenda," said John R. Garrison, CEO of the American Lung Association (ALA). "Congress should adopt the necessary changes in time for the summer smog season."

The 1990 Clean Air Act Amendments require the "reformulation" of gasoline to reduce vehicle emissions. Reformulated gasoline (RFG) is currently required in nine major U.S. metropolitan areas with the worst ozone pollution problems and many other areas have voluntarily chosen to use RFG. MTBE or other oxygenates are required to be included in the reformulated fuel. Recent health concerns focus on gasoline leaking into public water supplies.

"While there have been huge pollution reductions in smog and cancer-causing air toxics from the switch to reformulated gasoline, Congress can no longer ignore the harm being done by gasoline and MTBE leaking into drinking water supplies," said Janet Hathaway, Senior Attorney with the Natural Resources Defense Council (NRDC). "Oil refiners have the ability to produce gasoline that achieves just as much air pollution reduction without oxygenates such as MTBE. but the law currently mandates their use. Congress should act immediately to repeal the mandate."

Congress would have to amend the Federal Clean Air Act before RFG without oxygen could be sold in states other than California.

It is also critical that Congress prohibit oil companies from producing a fuel that is less effective at reducing smog and toxic air pollutants than the RFG sold today when they remove oxygenates. We do not need to take a step backward in combating air pollution in order to protect groundwater," said the Lung Association's Garrison.

The American Lung Association and NRDC plan to meet with Sen. Bob Smith (R–NH), newly named chairman of the Senate Environment and Public Works Committee, to support his leadership in the push for rapid legislation. Smith has already announced that holding hearings on the oxygen requirement in RFG is a top legislative priority. "Given the MTBE contamination from RFG already found in New Hampshire, Chairman Smith is the logical choice to lead this effort," said the NRDC's Hathaway.

The two groups also are asking the EPA to grant a request from California to exempt RFG sold in the State from the Clean Air Act's mandatory oxygen requirement. "California is the only State where, under the law, EPA could grant a waiver

tomorrow to allow gasoline sold in the State to contain little or no MTBE. For the sake of clean air and water, they should do it,'' said Hathaway.

American Lung Association and NRDC representatives served on an expert panel, called the Blue Ribbon Panel on Oxygenates in Gasoline, appointed by EPA to explore the MTBE problem. Both organizations have endorsed changes in the RFG program that were recently adopted by the Northeast States for Coordinated Air Use Management (NESCAUM), which represents the eight Northeast states that currently participate in the RFG program.

The NESCAUM principles are as follows:

- Repeal the 2 percent oxygen mandate for RFG in the Clean Air Act.
- Phase-down and cap MTBE content in all gasoline.
- Clarify State and Federal authority to regulate, and/or eliminate, MTBE or other oxygenates if necessary to protect public health or the environment.
- Maintain the toxic emissions reductions benefits achieved to date by the RFG program.
- Promote consistency in fuel specifications through the timely implementation of effective Federal requirements.
- Provide adequate lead time for the petroleum infrastructure to insure adequate fuel supply and price stability.

AMERICAN PETROLEUM INSTITUTE

API SUPPORTIVE OF MTBE RECOMMENDATIONS

(Contacts: Susan L. Hahn and Chris Kelly)

WASHINGTON, January 20.—The American Petroleum Institute issued the following statement today in support of the recommendations just released by the Northeast States for Coordinated Air Use Management (NESCAUM) on MTBE (methyl tertiary butyl ether), a gasoline oxygenate additive:

''The U.S. oil and natural gas industry supports clean air and clean water for all Americans. The recommendations released today by NESCAUM on MTBE provide a useful focus for resolving the problems resulting from the requirement to include oxygenates in Federal reformulated gasoline (RFG).

''NESCAUM proposes a multi-component strategy that calls primarily upon the Federal Government to resolve the MTBE issue in a way that addresses air and water quality issues while preventing gasoline supply and market disruptions. This solution would be better than a patchwork of State fuel regulations.

''API supports NESCAUM's call for the repeal of the oxygen content mandate for Federal reformulated gasoline. API also supports NESCAUM's recommendations that any phase down of MTBE use occur on a time schedule that allows refiners and markets to make an orderly transition. Repeal of the Federal oxygenate mandate and adequate time for any phase down of MTBE are critical steps to avoid disruption of the supply and distribution chain of gasoline to consumers.

''API looks forward to continuing to work with NESCAUM, EPA and Congress to resolve these difficult issues.''

U.S. SENATE,
Washington, DC, July 28, 1999.

Jason Grumet,
Executive Director,
Northeast States for Coordinated Air Use Management (NESCAUM),
Boston, MA

DEAR JASON: For more than 20 years, I have believed that a healthy domestic ethanol industry can contribute to a variety of national policy objectives. Most obviously, it enhances farm income and strengthens our rural economy. But it also improves air quality, reduces oil imports and lowers net budget outlays.

The creation of the Reformulated Gasoline (RFG) program as part of the 1990 Clean Air Act Amendments established a minimum oxygen standard that has significantly increased demand for ethanol and other oxygenates. The benefits of this program for the Nation have been impressive. Since taking effect in 1995, the RFG program has exceeded the emissions reduction goals set by Congress, reduced oil imports by over 250,000 barrels per day and increased substantially demand for agricultural and other domestic raw materials.

The presence of MTBE in water supplies in California and elsewhere now poses a serious threat to the RFG program. Questions have been raised about the contin-

ued utility of the oxygen requirement, and the suggestion has been made that refiners be granted additional flexibility in making clean-burning RFG.

In recent months, Senators Feinstein and Boxer have been working with me to explore alternatives to the RFG oxygen requirement that would provide the necessary flexibility for California and other states to address their MTBE water contamination problem, while providing a solid future for ethanol. This process, which is on going, has produced a proposal that addresses the legitimate concerns that have been raised about MTBE without sacrificing the many proven benefits of oxygenates in cleaner burning gasoline.

In return for allowing states to waive the oxygen requirement, this proposal would establish a renewable fuels standard, applicable to all gasoline sold in the United States that would more than double ethanol production over the next 10 years. In addition, it would empower EPA and the states to regulate MTBE and other fuel components.

As you know, the debate over the future of the oxygen standard is approaching a critical juncture. The Blue Ribbon Panel established earlier this year by EPA Administrator Carol Browner has recommended ways to provide additional flexibility to the RFG program. While acknowledging the value of domestic renewable fuels like ethanol in our nation's fuel supply, the panel recommended repeal of the RFG oxygen requirement.

The attached draft proposal is the product of months of consultation with experts in both the public and private sectors and draws upon the deliberations of EPA's Blue Ribbon Panel as well as valuable input from many of my colleagues in the Congress. Again, it was developed in response to concern about MTBE water contamination and is designed to provide states with the flexibility they need to deal with this problem without sacrificing the many benefits ethanol and other oxygenates provide.

I recognize you are extremely busy. However, I value your input, and things are moving very quickly here in Washington on this issue. Consequently, I would appreciate it if you would review these materials and let me know your reaction to the proposal as soon as possible. Should you have any questions about any of this, please feel free to call my Legislative Director, Eric Washburn, at 202/224–2321.

Thank you in advance for your consideration. I look forward to working with you.

Sincerely,

TOM DASCHLE,
U.S. SENATE.

NORTHEAST STATES FOR COORDINATED AIR USE,
Boston, MA, September 3, 1999.

DEAR SENATOR DASCHLE: On behalf of NESCAUM's eight member states, I welcome this opportunity to share our thoughts on your legislative proposal to amend the Federal reformulated gasoline (RFG) requirements found in the Clean Air Act.

As you know, the Northeast region is one of the largest consumers of RFG and MTBE in the nation. Despite achieving substantial pollution reductions over the past decade, many Northeast states remain in nonattainment of the Federal ozone standard. Moreover, all states in our region and most in the Nation exceed public health thresholds for a host of toxic air contaminants emitted by gasoline powered motor vehicles. While the Northeast region clearly needs the air pollution benefits of RFG, growing concerns about the presence of MTBE in groundwater have caused many to question the merits of the RFG program. The lack of flexibility under present law to reduce oxygen content and limit MTBE volumes has left Maine no option but to abandon the RFG program altogether.

The Northeast states strongly desire the flexibility and clear authority to maintain the substantial air quality benefits of the RFG program while limiting the use of MTBE. Toward this end, NESCAUM appreciates your effort to build the consensus necessary enable a narrow amendment to the 1990 Clean Air Act. We believe that it would be counterproductive to initiate a comprehensive revision of the Clean Air Act at this time. Therefore, we welcome the opportunity to bring our region's political diversity to the challenge of developing the bipartisan consensus necessary for legislative success.

Before providing detailed comments on the draft legislation, I would like to share the principal conclusions reached during our recently completed study on RFG and MTBE in the Northeast.

- RFG has provided substantial public health benefits to millions of Northeast State residents. These public health benefits substantially outweigh public health risks from the increased use of MTBE in the Northeast. However, the persistence

and mobility of MTBE in groundwater has convinced us that a reduction in MTBE use is necessary to protect water resources.

In the Northeast, the only *immediately* available replacement for the volume and octane provided by MTBE are highly toxic compounds. Several of these compounds, unlike MTBE, are known human carcinogens. Moreover, present ambient levels of a number of these toxic gasoline constituents (benzene, 1,3 butadiene, acetaldehyde) exceed air quality health based thresholds throughout our region and most of the nation. The unusual tension between MTBE's benefit to public health and risk to environmental quality requires prudence as we seek to diminish MTBE use.

- Over the next several years, ethanol and alkylate provide opportunities to replace MTBE without posing unacceptable increases in air toxics as long as anti-backsliding provisions are enacted. In the Northeast, questions about ethanol supply and distribution networks and concerns about increased fuel volatility need to be better understood before we encourage policies that require the use of ethanol in our region. At present, little is known about the environmental fate and transport of alkylate and its combustion products. Rigorous testing of alkylate, including a thorough public health analysis, is needed before we substantially increase the volume of this compound in Northeast gasoline.

The northeast states are committed to charting a pathway that effectively mitigates the unacceptable risk MTBE poses to our water resources while maintaining the full air quality and public health benefits of the RFG program. We know that you share these goals and look forward to working with you and your staff in the coming months.

The following discussion summarizes our thoughts regarding key legislative provisions. Detailed comments and suggested revisions are attached.

State Flexibility and Authority to Regulate Oxygenates.—We strongly endorse your effort to provide states with the measured authority necessary to fulfill our obligation to protect the environment and our natural resources from MTBE contamination. In order to cost-effectively reduce MTBE use in our region, states must be given relief from the 2 percent oxygen mandate. Our preference is to have the oxygen mandate lifted outright. However, we believe that a streamlined, state-based waiver process designed to avoid bureaucratic delay and limit litigation may provide an acceptable alternative for the Northeast. We recognize the value of consistent national and regional fuel standards. Given the opportunity, the Northeast states will work with the U.S. EPA as a region to provide consistent regulation of gasoline additives.

Anti-backsliding Provisions to Protect Air Quality.—We strongly support your commitment to maintain the air quality benefits presently achieved by the RFG program. At present, RFG in the northeast is providing 75 percent greater air toxic reductions than required under law. Lifting or waiving the oxygen requirement will enable, and in some cases encourage, refiners to increase the volume of high toxicity gasoline blending components in RFG at a considerable cost to public health. At a minimum, future clean-burning gasoline must maintain the actual benefits of the RFG program we are achieving today.

Conventional gasoline in the Northeast produces 13 percent less toxic air pollutants than before the advent of RFG. Changes in the RFG program may significantly affect the quality of the conventional gasoline pool. Maintaining the last decade's improvement in conventional fuel quality must also be a goal of anti-backsliding provisions. A continuing concern about conventional gasoline quality may be exacerbated by a transition from MTBE to ethanol. The statutory one pound Reid vapor pressure waiver for gasoline containing at least 10 percent ethanol will increase hydrocarbon emissions if ethanol use in conventional gasoline increases during the summer months. Preservation of current air quality benefits will require either the elimination of this waiver, or other measures to offset the expected hydrocarbon increases. We offer specific suggestions that address these issues in the attached legislative analysis.

Renewable Fuels Requirement.—We understand from your letter and your history of support for renewable fuels and ethanol that your willingness to play a leadership role in lifting the oxygen standard is linked to "providing a solid future for ethanol." As you are aware, at present there is no ethanol produced and hardly any ethanol used in our region. Understandably, our lack of ethanol production and distribution infrastructure and longstanding concerns about ethanol volatility create apprehension about legislative outcomes that would force the wide-scale use of ethanol in the northeast.

While we have several questions about the proposed renewable fuels requirement, we recognize that the flexibility provided in your legislation may better respond to our stated concerns about ethanol than Congressional inaction. Under the 2 percent oxygen mandate, RFG states' efforts to regulate or ultimately eliminate MTBE will

necessitate the use of ethanol during the height of our ozone season. Moreover, market barriers and cost considerations will have no effect on the volume of ethanol required under the current scenario.

By comparison, the national average renewable standard proposed in your legislation gives us some comfort that ethanol would only enter the northeast market if supply and distribution concerns can be overcome at a reasonable costs. We appreciate that the scaled back renewable standard volumes and 10 year phase-in period are designed to ensure a gradual transition for gasoline refiners and states. These features in combination with the annual averaging provision have the potential to alleviate a majority of the Northeast concerns. If fuel suppliers are able to avail themselves of market-based opportunities to average internally *and with other fuel suppliers* to meet the annual renewable content minimums, then we believe that ethanol will be used where it is cost-effective to do so. If averaging among fuel suppliers is not envisioned in your legislation, then we fear that ethanol could be required to be used in our region during summer months contrary to sound economic and environmental policy.

Our region maintains considerable interest in pursuing the development of biomass ethanol production due to its significant positive climate change, waste management and energy security attributes. If this industry develops during the timeframes contemplated in your legislation, we are certain to overcome many of the supply and distribution hurdles that have hindered the development of a Northeast ethanol market to date.

From an air quality standpoint, we remain principally concerned about ethanol co-mingling and resulting increases in evaporative emissions. While evaporative emissions are a concern throughout the year, we are principally focused on avoiding volatility increases during the 5-month Northeast ozone season. We wish to further explore whether the averaging provisions contained in your proposal enable our states to ensure that any ethanol that enters the region is sold outside of the summer ozone season. Last, we believe that ethanol has significant potential to reduce air pollution, particularly greenhouse gas emissions. The logic of amending the Clean Air Act to contain a renewable fuels requirement would be enhanced if the nexus between the use of ethanol and air quality was made explicit. We would be happy to work with your staff to explore options for setting minimum thresholds for full fuel cycle GHG reductions or other approaches that demonstrate the necessary linkage between ethanol and clean air.

We appreciate your consideration of these initial thoughts and the more detailed comments that are attached.

Sincerely,

JASON GRUMET,
Executive Director.

STATE OF NEW HAMPSHIRE,
OFFICE OF THE GOVERNOR,
Concord, NH, September 16, 1999.

Hon. TOM DASCHLE,
U.S. Senate,
Washington, DC.

Re: Proposed Amendments to the Federal Reformulated Gasoline Program

DEAR SENATOR DASCHLE: Thank you for your letter of August 13, 1999 and its accompanying recommendations for changes to the Federal Reformulated Gasoline (RFG) program. Your letter notes that the air quality benefits of RFG in reducing emissions of ozone precursors and numerous toxic compounds have been substantial, exceeding expectations for the program since its inception in 1995. As you know, however, the gasoline additive methyl tertiary-butyl ether (MTBE), which is used extensively in the Northeast to meet the Federal oxygenate mandate associated with RFG, has been found to present a significant threat to the quality of our groundwater and surface water resources.

Concern about the use of MTBE in the Northeast's regional gasoline supply prompted me, in November 1998, as Chair of the New England Governors' Conference, to ask the Northeast States for Coordinated Air Use Management (NESCAUM) to study the use and effectiveness of MTBE as a component of gasoline and the viability of possible alternatives, including ethanol. Soon after, the U.S. Environmental Protection Agency launched a Blue Ribbon Panel to undertake a similar

assessment. The conclusions of both of these efforts recommend reducing the use of MTBE in RFG dramatically, ensuring that the actual air quality benefits currently provided by RFG are retained, and providing States with clear authority and greater flexibility to regulate oxygenates and other gasoline constituents. I applaud you and Senator Feinstein for crafting a proposal that represents significant progress toward achieving these outcomes. In particular, I think the concept of a renewable fuel requirement—accompanied by elimination of the Federal oxygenate mandate—holds great promise and represents a wise precedent for the Nation to establish.

Your letter thoroughly reviews the advantages of renewable fuels, from both environmental and economic perspectives. While the economic advantages for the agricultural Midwest are clear, I am concerned that a renewable fuels mandate could have a significant financial impact on consumers in the Northeast who may—at least initailly—find themselves subsidizing renewable fuel credits. Implementation of such a requirement over an appropriate time period, as your proposal prudently contemplates, is this essential. I believe that other important implementation issues, such as evaporative emissions, averaging provisions, and shoulder season comingling, can also be successfully addressed. I know that these and other issues have been carefully considered by NESCAUM, so your effort to reach out to NESCAUM to review and revise this proposal should assist materially in developing a solution that is satisfactory to all.

I must also mention two additional personal concerns regarding our joint efforts to find a national solution to the MTBE problem. First, we must have a truly *national* solution. I have recently become aware that some in Congress would like to undertake a single-state solution, leaving other states—including those in the Northeast—to suffer continued contamination of their water supplies. This is simply unacceptable.

Second, we in New Hampshire appear to have a greater sense of urgency of the need to reduce the threat of MTBE contamination than many jurisdictions. Legislation passed this spring, for example, authorized the State to limit MTBE concentrations in gasoline and directed the New Hampshire Department of Environmental Services to seek from EPA an immediate, temporary waiver from the reformulated gasoline program. As you can see, if the oxygenate problem is not solved promptly, the entire RFG program—and its significant air quality belefits—could be jeopardized. As a result, New Hampshire supports moving as expeditiously as possible to determine and implement a national solution, including an aggressive schedule for reducing and/or phasing out MTBE as a gasoline additive.

I congratulate you and Senator Feinstein for your efforts to balance environmental quality, economic well being, and energy supply and sufficiently in shaping a national resolution to these complex fuel issues. We appreciate your interest in helping all States retain the demonstrated public health benefits of cleaner burning gasolines and minimize the environmental threats posed by the continued usage of MTBE. Please let me know of any way that I can help to ensure the prompt passage of this important legislation to preserve clean, healthy air and protect our precious water resources.

Very truly yours,

JEANNE SHAHEEN.

STATE OF MAINE, OFFICE OF THE GOVERNOR,
Augusta, MA, September 28, 1999.

Hon. THOMAS DASCHLE,
U.S. Senate,
Washington, DC.

DEAR SENATOR DASCHLE: Thank you for sharing your legislative proposal to amend the Reformulated Gasoline (RFG) oxygen standard in the 1990 Clean Air Act Amendments. Let me first say that I am very encouraged that a Federal solution may emerge within the next year to help Maine and other states combat the problem of MTBE contamination in groundwater. After reviewing your proposal, I believe it can help establish the proper foundation upon which each State or region can achieve its respective goals.

While the RFG program has provided significant air pollution benefits, there is clear evidence that the use of MTBE in this fuel has contributed to widespread groundwater contamination. I cannot, in good faith, advocate the increased use of MTBE to reduce air pollution, while increasing the contamination of groundwater. Maine, for example, relies on groundwater for the majority of its drinking water, and therefore, widespread contamination of our groundwater with MTBE is simply unacceptable. For these reasons, and the lack of flexibility under Federal law to re-

duce the oxygen content and limit MTBE, Maine has abandoned the RFG program in its entirety. The recent Environmental Protection Agency (EPA)—sponsored Blue Ribbon Panel and the Northeast States for Coordinated Air Use Management (NESCAUM) studies have confirmed Maine's analysis of MTBE and my belief that the Clean Air Act's oxygen standard poses a very real threat to groundwater and public health.

As you know, the path forward is a difficult one, not only for Maine, but also for the rest of the country. Gasoline powered vehicles represent one of the most significant sources of air pollution in terms of ozone forming pollutants and air toxics. Thus reformulation of gasoline is an appropriate means of achieving our environmental goals and protecting public health, as long as this fuel does not have unintended negative environmental consequences.

In light of these considerations, Maine's immediate goals are to:

- (1) eliminate the RFG oxygen level mandate in the Clean Air Act;
- (2) reduce or eliminate the use of MTBE in gasoline; and,
- (3) assist with the development of a regional or seasonal fuel that achieves the original air quality goals of the RFG program without the increased use of MTBE.

It appears that your proposal and our goals are consistent on a number of points. I particularly support the following aspects of your bill:

- the gradual reduction of MTBE to pre-RFG levels;
- the ability of states to further regulate or phase-out MTBE;
- the ability of states to regulate MTBE and to opt-out of the oxygen requirement (I would prefer the oxygen mandate to be removed from the Clean Air Act); and,
- the maintenance of air quality benefits that have been provided by the RFG program.

While I understand your concern that the elimination of the oxygenated requirement has the potential of reducing the amount of ethanol used as a motor vehicle fuel, it will be difficult to increase the use of ethanol in Maine or the Northeast. Inadequate supplies and distribution infrastructure interfere with the use of ethanol in the Northeast, and causes considerable apprehension over the renewable fuels requirement of your proposal. I understand there is recognition of these problems in your bill, since there are provisions of a national average renewable fuel standard and a 10-year phase in period for the renewable fuels requirement. I also have concerns that an ethanol-blended fuel will not be as useful to resolve our particular air quality problems during the summer. Nonetheless, I am sensitive to the needs of farmers everywhere, and I certainly am willing to discuss how our mutual interests can be met.

I appreciate your leadership on this important issue, and I look forward to continuing our dialog as Congress considers this matter. As a first step, I have asked Jim Brooks, Director of Maine's Bureau of Air Quality, to contact your staff to discuss our respective goals.

Sincerely,

ANGUS S. KING, JR.,
Governor.

[From a Lincoln, NE newspaper]

MANDATORY ETHANOL IS GOING TOO FAR

Nebraskans can be proud that their State is one of the Nation's leading ethanol producers.

It's a clean-burning fuel additive made from a renewable resource—primarily corn—that has helped reduce air pollution in smog-ridden cities. It has helped reduce the Nation's dependence on imported oil.

It's clearly superior to the next best alternative, MTBE, a suspected carcinogen that comes in the form of a slippery molecule that quickly contaminates groundwater. By comparison ethanol is no more dangerous than old-fashion corn liquor.

Those are all good reasons to support ethanol and for the Federal subsidy for ethanol to continue.

Gov. Mike Johannna wants to go one step further. He wants to make the use of ethanol mandatory in Nebraska.

Thats going too far. Even though there are powerful arguments and favor of ethanol, the use of government to restrict consumer choice and to favor a particular product in the marketplace should be taken only under special conditions.

For example, the argument is often made that soy products are more healthier than meat. They are low in unsaturated fat. People with high cholesterol are sometime encouraged by doctors to each soy burgers rather than hamburgers.

Do those fact justify legislation restricting Nebraskans to eating only soy burgers? Do those facts justify eliminating steaks and porks chops from the diets of Nebraskans who may not suffer from cholesterol problems?

The power of government to restrict competition should be used lightly, if at all.

A better approach to coping with the danger of MTBE might be to simply ban the unsafe product, an option being considered by the U.S. Environmental Protection Agency.

Already MTBE has fouled water supplies across the Nation. It has even made its way to Nebraska, even though there is no reason for the substance to be in gasoline used here. It has been detected at 18 sites in the State and may be found at more. A probable explanation for the presence of MTBE in Nebraska is that once MTBE is blending into gasoline, it can end up anywhere. It is often mixed at the refinery and shipped by pipeline. Gasoline can be purchased on the open market. Sometimes it may make economic and logistical sense to slip MTBE gasoline to Nebraska. And so some of it ends up in some of the States groundwater.

As the EPA considers a ban on MTBE ethanol supporters should push hard for ethanol at the safest and most—proven additive to help reduce carbon monoxide in cities where levels of lethal gas exceed Federal standards.

No communities in Nebraska, however, have carbon monoxide levels that trigger the requirement that oxygenates such as ethanol or MTBE be added fuel. Until such evidence can be presented, there is insufficient reason to take away the choice that Nebraska motorists now have to pump ethanol, regular or premium.

In the meantime, if the Governor wants to try a mandate, we have a modest proposal: Let him serve only soy products at the Governor's Mansion. The reaction of guests to the delectable, but limited, menu might be instructive.

[From the Des Moines (IA) Sunday Register, September 19, 1999]

THE REGISTER'S EDITORIALS

LET ETHANOL PROVE ITSELF

(IOWA FARMERS NEED HELP, BUT COERCION AT THE GAS PUMP IS WRONG)

The price of corn is low, and Iowa farmers are hard hit.

So here's the deal: Let's prohibit the sale of wheat bread. From now on, only corn bread should be allowed on Iowa grocery shelves. It might help boost the price of corn.

Hog farmers are struggling, too. Why not ban the sale of other meats so that Iowans can eat nothing but pork?

No?

Well, how about requiring that most gasoline sold in Iowa be blended with corn-based ethanol?

That's an idea that has the backing of the governor and State agriculture secretary as well as Iowa's two U.S. Senators.

But that doesn't make it right.

Ethanol is good for Iowa. It creates an additional market for corn. It is an alternative fuel from a renewable resource. Iowa politicians are right to promote ethanol and to provide a tax break until the industry can stand on its own feet. they are right to fight the oil lobby in its efforts to rob ethanol of its market and take away its subsidy.

Promotion is one thing. Coercion is another. An ethanol mandate would deny Iowans a choice of fuels and short circuit the process of ethanol establishing its own worth in the marketplace. Except in places where smog problems dictate the use of an oxygenated fuel, what's the rationale for mandating ethanol?

The justification is to marginally boost the price of corn. Cleaner air is offered as a reason, too, but that's an afterthought. If that were the goal, other measures would be far more effective: outlawing SUVs, for instance, or quadrupling the gasoline tax.

Promotion is one thing, coercion is another.

Ethanol is not recommended for some small engines on lawn mowers, snowblowers, boats, auxiliary generators and the like. Then, too, lots of Iowans drive older vehicles or use older equipment with components that may not have been engineered to use ethanol, as newer vehicles are. Why put these people through a hassle to find the non-ethanol fuel their equipment requires?

One convenience store chain used to advertise free repair for any engine damaged by the use of its gasoline. If the State insists on mandating the use of ethanol, per-

haps it should make the same offer. Better yet, let Iowans make their own choices, and let ethanol prove itself in the marketplace.

[From the Omaha (NE) World Herald, March 9, 2000]

EDITORIAL PAGE

MORE ALCOHOL, LESS CHOICE

(By John Gottschalk, Publisher; Lawrence D. King, Executive Editor; Francis L. Partsch, Editorial pages Editor; and Deanna J. Sands, Managing Editor)

Motorists will have fewer choices at the gas pump if the Nebraska Legislature and Gov. Mike Johanns continue a course down which they have started.

The issue is grain alcohol, or ethanol, which, when mixed with gasoline, produces a fuel that has captured about 25 percent of the Nebraska market. However, this consumer acceptance in Nebraska has been bolstered by State and Federal tax exemptions designed to make alcohol-blended fuel competitive with straight gasoline. Now the Nebraska Legislature is considering eliminating the competition altogether. Support is building for a proposed State law to require most general-purpose automotive fuel sold in the state to contain ethanol.

As a general principle, government should not take sides in such matters unless a strong case can be made that intervention serves a major public purpose. In this instance, the arguments for eliminating competition haven't been persuasive.

One argument is that the financial health of corn growers and ethanol producers in Nebraska would benefit, boosting the economy of the State generally. The statement is indisputably true, but as an argument it breaks down. The power of the Legislature is not appropriately used to eliminate competition for Nebraska-produced products. If Nebraska applies a similar protectionist philosophy to beef, pork and corn, lovers of grilled tuna, among others, might be permanently out of luck. Rice Krispies might disappear from the shelves. Crab legs? Forget it.

Another argument is environmental. Governor Johanns in a conference call with newspaper editors on Tuesday, said he was supporting the legislation because it's time the State set an environmental standards for fuel content.

Perhaps it is time, but that's an argument that could do with a good bit more scientific underpinning than has been evident so far, Johanns said ordinary gasoline contains many chemicals that could when burned, be harmful. Of particular concern, he said is MTBE, an additive used in some parts of the country to enhance octane while reducing carbon monoxide. At seven Nebraska locations, Johanns said, MTBE has been found in underground water.

MTBE has been linked to tumors in laboratory animals and seeps readily into water supplies. In Iowa, MTBE has been found in 29 percent of the State's monitored test wells.

However, petroleum industry spokesmen said they don't know how the additive ended up in the Midlands, where it isn't commonly added to gasoline supplies. One theory is that traces of MTBE exist in some refinery equipment, from where it passes into gasoline supplies that seep into the water from leaky underground tanks.

Ethanol also enhances octane while reducing carbon monoxide. But if no one know precisely how MTBE has been making its way into Midlands water supplies, how can anyone make a credible claim that mandatory ethanol usage will prevent future contamination? What's to say the MTBE contamination won't continue to occur just as it has been occurring?

To say that the proposal could benefit from scientific validation should not be interpreted as hostility to the ethanol industry. There's much to be said for ethanol-blended fuels. The ethanol industry has been good for Nebraska corn growers. It has provided jobs in Nebraska communities. We hope the product has a bright future and continues to own consumer acceptance, as surely it has been doing in recent weeks, with rising petroleum prices making the ethanol blends more price-competitive.

Certainly if scientific analysts showed that a State law governing the content of motor fuel could appreciably prevent the contamination of the water supply, it might constitute justification for the State to do away with consumers' choice. As a general philosophy, however, government should be cautious about eliminating competition. The freer the marketplace to reflect the collective decisions of consum-

ers, the greater the probability that it will provide the jobs and taxable incomes on which the government is so dependent.

[From the Quad City Times, September 19, 1999]

EDITORIALS

A NEW SUBSIDY: MORE FUEL ON THE FIRE

(By John M. Humenik, Editor)

ETHANOL-ONLY PROPOSAL DOESN'T HELP CONSUMERS

Chuck Grassley and Tom Harkin may have the best of intentions, but their proposal to boost ethanol use in Iowa is seriously misguided.

The two U.S. Senators have signed a petition asking Iowa Secretary of Agriculture Petty Judge to require that Iowa service stations sell *only* ethanol-blended gasoline. Ethanol, as most Iowans know, is a fuel derived from a mixture of gasoline and corn-based alcohol.

Harkin and Grassley, of course, are longtime supporters of ethanol. They know that its use is good for Iowa corn farmers and that it reduces the nation's reliance on foreign oil.

But that's only half the story. Federal subsidies of ethanol now cost American taxpayers more than $770 million a year in lost revenue—largely because of ethanol's exemption from Federal fuel taxes. The Congressional Research Service says that figure could reach $1 billion by next year.

And mind you, that subsidy isn't putting more money in the pockets of farmers. The real beneficiaries of the ethanol subsidy are conglomerates like Archer Daniels Midland Corp. that convert the corn into ethanol. The Cato Institute estimates that every dollar of profit now earned by ADM's ethanol operation is costing taxpayers $30 in lost revenue. That's because in addition to the federally subsidized production of ethanol, ADM also has received millions of dollars worth of free corn from American farmers, courtesy of the Department of Agriculture.

Are farmers the co-beneficiaries of the ethanol subsidy? Yes—but not to the extent that some would argue. Subsidized ethanol production *does* guarantee corn farmers a higher price for their product, but that penalizes hog farmers and cattlemen since more than half the Nation's corn crop is used domestically for feed grain.

As for claims that ethanol helps the environment, the National Academy of Science, the Congressional Budget Office, the Department of Energy and even the USDA have each reported that ethanol, which is less efficient than gasoline, provides no significant environmental benefit and may even add to air pollution—which is why ethanol use was restricted in the EPA-proposed rules first issued in conjunction with the Clean Air Act of 1992.

None of this is to suggest that Grassley and Harkins are wrong to support the subsidization of ethanol at a more reasonable level—only that there is an abundance of evidence that indicates ethanol is not all that it's cracked up to be. Not for consumers, not for the environment and not for farmers. With research and continued refinements, it might someday become an economically viable alternative to gasoline—but until that day, it would be ludicrous to argue that Iowa's gas stations be required to sell only ethanol.

Such an agreement would infringe on the rights of thousands of Iowa businessmen and put service stations in border communities such as the Quad Cities at a competitive disadvantage with gas stations in neighboring States. It also would take government subsidization of ethanol to a whole new level, essentially forcing Iowans to buy a product that already is costing them money through lost tax revenues.

The game is rigged as it is. With their million-dollar subsidies, ethanol producers are playing against their competition with loaded dice and marked cards they're *still* losing—to the extent that lawmakers are proposing the outright elimination of the competition—that's a sure sign that ethanol is not a product that consumers are ready to embrace.

Ethanol might be worth some level of government support, but it never will be so valuable as to justify scrapping our system of free enterprise.

[From Gazette newspaper]

GAZETTE EDITORIALS

NOBLE MOTIVES: STILL, ETHANOL IDEA IS BAD

Its almost impossible in Iowa these days of heightened political activity not to run into a politican—already in office or seeking office—who isn't sympathetic to the plight of American agriculture.

Even more than sympathetic, they're typically eager to offer their version of the answers to this economic slump.

Short of the government writing a check to every hog farmer who's lost $20 or $30 on every animal marketed at some point in the last year, or guaranteeing farmers will be paid at least what it costs to produce corn and soybeans, instant relief for what ails agriculture is hardly probable.

That doesn't stop politicians from trying. We would be disappointed if they did give up.

Part of the problem is public policy. Part is global turmoil. Part is the fault of farmers who produce more than the market needs.

Which brings up the situation brought to our attention over the weekend. Sen. Charles Grassley's top aid, Ken Cunningham, has started the ball rolling toward possible implementation of a regulation mandating that all gasoline sold in Iowa be an ethanol blend. Even though lawmakers failed to consider such a mandate earlier this year, Cunningham says the Code of Iowa already empowers the secretary of agriculture to take such action.

Since an ethanol mandate on fuel sold in Iowa would give the price of corn a modest but desirable boost, the motivation for such an effort cannot be challenged.

If it is determined the law actually provides such authority, look for the push to implement its provisions to be intense.

The sense from this corner, as noted recently, is that a policy of government-mandated consumption is bought with difficulty. It is to be avoided under every circumstance. Sure, all of us—at least those of use whose own roots aren't too far removed from the roll—truly can say we feel the pain of Iowa farmers and probably shouldn't object if enhanced ethanol sales jacked up corn prices a notch.

But are we ready for government to tell us which cost food entry to penalized? Or which automobiles we must buy? It's bad enough that the people we elect to public office take the money they collect from us and spend it—something—on projects some may find offensive. But let's not tolerate their being so invasive into our lives as to tell us what has to go into the gas tanks of our cars and pickups. Or on our tables.

And if it's determined that some past legislature managed to pull a fast one on Iowans by giving such discretion to the agriculture secretary, the next legislature should want no time in taking it away.

Public policy decisions should always be open to the full scrutiny of the people, not slipped in through the back door.

[From The Grand Island Independent]

EDITORIAL BOARD

(By Robert L. Krecklow, Editor and Publisher; Bill Brennan, Executive Editor, George Ayonb, Editorial Page Editor; Jeff Funk, Managing Editor; and Jim Paddis, News Editor)

[Volume 130, Number 243]

ETHANOL BACKERS NEED TO GAIN WILLING USERS

Supporters of ethanol need to come to grips with a couple of major hurdles before their fuel will ever become successful.

First, they need to determine that an ethanol-blended fuel is not a problem in cars and then convince the skeptics. Too many mechanics are whispering that some vehicles don't run very well on it.

Second, they need a statewide commitment to use the product if they expect others to use it. However, a state law forcing Nebraskans to use an ethanol blend is not the right way to show commitment.

An ethanol-blended fuel is good for the environment end makes good sense, especially when oil has reached $35 a barrel for U.S. importers and gasoline has reached

$1.50 a gallon for consumers. At these prices, ethanol is cost effective and extends the supply of a non-renewable fossil fuel.

Ethanol also makes perfect sense as a replacement for the MTBE additive, which was mandated in States with pollution problems. MTBE has been successful in reducing air pollution but has become a health hazard in groundwater.

Even so, the makers of ethanol have a major marketing initiative on their hands. They have to win American acceptance of their product. they have to eliminate concerns, real or imaginary, over the use of ethanol in cars.

They need to convince American automobile makers to build cards that offer optimum performance with ethanol blends. They also need to convince major American oil companies that the 10 percent ethanol additive will help manage the supply of crude oil.

Yet it would be a mistake to force Nebraskans to use an ethanol blend. The legislative measure on the floor would force Nebraskans to pay higher prices for gasoline and limit selection. this tactic simply will make motorists resent ethanol.

It is more important for the supporters of ethanol to gain a willing acceptance of their product. It may be harder to market consumption than to legislate it but the long-term.

STATEMENT OF HON. TOM HARKIN, U.S. SENATOR FROM THE STATE OF IOWA

Good morning, Mr. Chairman and other members of the Subcommittee. I very much appreciate this opportunity to appear before you to discuss the environmental benefits of ethanol and its role in the reformulated gasoline program (RFG). As we work to address the crisis caused by use of the toxic additive MTBE in gasoline, it is critically important that everyone knows the facts about the advantages of ethanol the safe and renewable alternative to MTBE.

Before getting into the specifics of ethanol, I want to talk briefly about the Clean Air Act Amendments of 1990 and the reformulated gasoline program. When we adopted the RFG program in 1990 the primary reason was of course air quality, but we also had in mind additional objectives through the use of oxygenates, such as enhanced energy security and environmental and economic benefits from using domestically produced renewable fuels like ethanol.

The air quality improvements from the RFG program, including its oxygen content requirement, are impressive. RFG is currently used in 17 States and the District of Columbia and accounts for about 30 percent of all gasoline sold in the United States. The RFG program has reduced emissions of ozone-forming volatile organic compounds, toxic compounds, carbon monoxide and oxides of nitrogen. EPA estimates that the reduced emissions from the RFG program are equivalent to taking 16 million vehicles off the road annually. And as you can see from this chart, RFG will bring about a cumulative reduction of well over 400,000 tons of pollutants from 1995 through this year.

(Chart #1: Reductions of Pollutants from RFG)

Well, that is the air quality side of the story. Unfortunately, we all know about the water quality side of the story. The oil companies chose overwhelmingly to use MTBE as the oxygen additive in RFG. Currently, about 85 percent of RFG contains MTBE and only about 11 percent of RFG is made with ethanol. And now we have very extensive water quality problems from MTBE contamination. Frankly, I believe we could have avoided a lot of these problems if the we had been able to keep the higher level of oxygen in the RFG amendment that we started with back in 1990. That would have led to much more ethanol use, and less MTBE use. But we ended up with the 2 oxygen level in the law, widespread use of MTBE and consequent water quality problems.

Now we must move to solve the water quality problems caused by MTBE. However, in doing so, I hope that we will not miss the obvious lessons of the MTBE fiasco. We must avoid taking steps to protect water that will take us backwards with respect to air quality and the use of renewable fuels like ethanol.

There is another very important lesson from the MTBE crisis, and that has to do with how much trust we are willing to place in the hands of the oil companies. Remember, it is the same oil companies that brought us the MTBE debacle that are now calling for Congress to do away with the oxygen content requirement in RFG. Leave it up to us, they say. Give us the flexibility, they say, we will produce clean gasoline without the minimum oxygen content requirement.

Well, I am not about to stand by and allow the oil companies to fool us once again, and I hope this Congress will not let them do it.

Despite what the oil companies say, the oxygen content in RFG does have value in improving air quality. The Clean Air Act has both formula requirements and per-

formance requirements for RFG. The oxygen content requirement is in the formula requirements. The performance requirements include reducing volatile organic compound and toxic emissions. The oil companies will say that if they meet the performance standards then they should not have to put oxygen into RFG.

That approach ignores the value of oxygen in RFG that goes beyond what is reflected in the performance standards. Adding oxygen to RFG reduces emissions of ozone-forming carbon monoxide, toxic compounds and fine particulate matter. Oxygen helps to boost octane and replaces aromatic compounds in gasoline that deteriorate air quality. In combination, the performance standards plus the formula requirements—including oxygen content—have led to greater improvements in air quality than would be the case if we just relied on performance standards alone.

In other words, there are inherent benefits to using oxygen in gasoline that are not reflected in the RFG performance standards. We will be giving up these air quality benefits if we eliminate the oxygen requirement and rely on the current performance standards alone. In addition, if we take oxygen out of RFG, we can fully expect the oil companies to start adding back in the aromatic compounds and other junk in order to maintain octane in the gasoline.

As I say, ethanol is the safe oxygen alternative to MTBE. Now, some are saying that ethanol cannot supply the RFG markets at acceptable prices. Analysis done by the Department of Agriculture refutes this claim. USDA concluded that ethanol can replace MTBE by 2004 without price spikes or supply shortages. Work by the Department of Energy also contradicts the suggestion that use of ethanol would substantially increase gasoline prices. The best evidence about gasoline prices is what is happening in the market right now. Ethanol is in fact less expensive in the market than gasoline. And a study looking at prices in California, found that ethanol blends would cost $0.03 per gallon less than MTBE blends if California were to switch to ethanol-blended RFG.

Chart #2 on Gasoline and Ethanol Prices

Another important element of this debate is the need to promote much greater use of renewable fuels in our country. Renewable sources are only 3 percent of U.S. energy supplies. In the gasoline market only about 1.2 percent is renewable ethanol. Our reliance on foreign petroleum is growing dramatically. We are now far more reliant on foreign petroleum than we were back in the 1970s when disruptions in oil supplies caused tremendous shocks to our economy.

(Chart #3: U.S. Dependence on Foreign Oil)

In conclusion, I firmly believe that the oxygen content requirement continues to have real value in improving air quality. I also believe that any legislation regarding the RFG program should incorporate some key principles: (1) eliminating MTBE; (2) fully maintaining and preferably increasing the air quality benefits delivered by the RFG program, including its oxygen content requirement; (3) fully accounting for the environmental benefits of ethanol as an oxygen additive to gasoline, especially with respect to reducing emissions of carbon monoxide, toxic compounds and fine particulate matter and their precursors; and (4) fully maintaining and preferably increasing the opportunities for ethanol and renewable fuels in comparison to the current RFG program.

Mr. Chairman, again I appreciate the opportunity to appear before your Subcommittee.

STATEMENT OF JACK HUGGINS, VICE PRESIDENT, WILLIAMS BIO-ENERGY, THE WILLIAMS COMPANIES

Good morning Mr. Chairman and Members of the Committee. I am very pleased to be here to discuss ethanol's continued participation in the federal reformulated gasoline program (RFG) generally, and the RFG oxygen content requirement specifically. I appreciate the opportunity to provide comments on behalf of the domestic ethanol industry.

First, let me tell you something about my company. Williams is a global energy and communications company headquartered in Tulsa, Oklahoma. We have about 23,000 employees and operate about $25 billion in assets. Through our various energy businesses, we own and operate nearly 60,000 miles of natural gas and liquid pipelines located throughout the United States. Williams is a producer of natural gas, a large processor of natural gas and natural gas liquids, and our energy marketing and trading group is one of the largest in the country. We own two refineries in the United States and operate a refinery in Lithuania. We transport, terminal and retail gasoline and other petroleum products. Our bio-energy group, of which I am part, is the second largest producer of ethanol in the country, with plants in Illinois, Nebraska and most recently, a new project announced in Wisconsin. Given

our extensive involvement in both the petroleum industry and the ethanol industry, I believe we have a unique perspective on the issues being discussed today.

SUMMARY

We believe the RFG program has successfully improved air quality in those regions of the country where it is in place. In the Midwest markets, where ethanol has been used extensively, the air quality record is excellent. On the other hand, many Americans are well aware of MTBE groundwater contamination issues in other RFG areas. Many suggest the solution to this groundwater problem is opening the Clean Air Act to remove the oxygen requirement.

Williams does not believe this type of legislation is necessary. Ethanol production can be expanded to replace MTBE. Ethanol can be transported and distributed efficiently to California and other RFG markets. To the extent refiners need flexibility, EPA could modify the program to require that the oxygen requirement apply on an average basis, rather than a per gallon basis. This would allow refiners to make significant quantities of fuel without oxygen.

If Congress chooses to legislate in this area, then the clean air benefits achieved by including oxygen in gasoline should be preserved. This should be the overriding factor that drives policy. Williams does not advocate using the legislative process to favor one fuel over another, but if ethanol does provide a better overall environmental solution than MTBE, we should not hesitate to use ethanol.

BACKGROUND

Before turning to the RFG program, I would like to provide some perspective as to why ethanol is so critically important to the nation's economic, energy and environmental policies. One need only look at today's headlines to appreciate the need for increased production and use of fuel ethanol. The Energy Department reports oil prices are at the highest levels since the Gulf War, and gasoline prices are expected to top $1.60/gallon this summer. Blending ethanol with gasoline provides an economically competitive source of octane, helping to constrain gasoline prices. As the Congress considers policies to moderate gasoline prices and assure fuel supplies, providing increased market opportunities for domestically produced renewable energy, such as ethanol, should be a top priority. In fact, the farm income and energy security benefits of ethanol were principle factors leading to congressional approval of the RFG program and the oxygen content requirement in the Clean Air Act Amendments of 1990. Today's headlines merely reinforce the efficacy of that decision.

At the same time, overall conditions in the farm economy in 2000 are expected to be similar to last year and the nation facing record oil prices due to OPEC production cutbacks, ethanol production and use will play a pivotal role in providing value-added processing for grain while helping to constrain gasoline prices and promote competition. At a recent USDA Agricultural Outlook Forum, USDA Chief Economist Keith Collins stated that the price for corn this year is "expected to average only $1.90 a bushel, slightly below the 1998 crop." With total supplies predicted to be near 1999 levels and little change in ending stocks, Collins noted that "corn prices are expected to show only modest improvement next season." Collins also predicted that in light of weak markets, substantial government payments will be made under current programs in 2000. The use of corn for ethanol production not only adds to the price of a bushel of corn, it also helps to reduce government payments.

THE REFORMULATED GASOLINE PROGRAM

I think it is important to underscore that the RFG program, with its oxygen content requirement, has worked quite effectively. Air quality has improved. Indeed, about 75 million people are breathing cleaner air because of RFG. EPA reports that RFG is reducing ozone-forming hydrocarbon emissions by 41,000 tons and toxic pollutants such as benzene by 24,000 tons annually. That's the equivalent of taking 16 million vehicles off the road each year. A study by the Northeast States for Coordinated Air Use Management (NESCAUM) shows that today's RFG reduces the cancer risk from gasoline by about 20 percent. It is critically important to recognize that these benefits are significantly greater than required by the Clean Air Act's performance standards for hydrocarbons and toxics, at least in part because of the federal oxygen requirement.

As a consequence of the growing concerns regarding MTBE water contamination, many have advocated amending the Clean Air Act. The domestic ethanol industry has opposed efforts which seek only to eliminate the federal RFG oxygen requirement or address the issue for particular states or regions. However, if Congress chooses to act in this area, the ethanol industry does not want to hinder legislative

efforts to address this serious public health and environmental issue. We want to be part of the solution, not part of the problem. Toward that end, we have developed the following principles, which we believe should guide congressional action on this issue.

- Develop a national solution;
- Address the cause of the problem;
- Protect the environment; and
- Provide the necessary time and "flexibility" to allow refiners to make a rational transition to increased ethanol utilization.

Develop a national solution

State-specific actions will create a patchwork of fuel regulations resulting in increased consumer costs.

State specific programs increase logistics costs and reduce flexiblitity.

Address the cause of the problem

Congress should determine what controls on MTBE are necessary to protect water supplies.

Simply eliminating the RFG oxygen requirement will not assure that MTBE use is reduced and will undermine the "real world" environmental benefits of the current RFG program with oxygen.

Protect the environment

The air quality gains provided by RFG with oxygenates should not be sacrificed as MTBE use is reduced, i.e., the toxic and carbon monoxide emissions benefits of oxygen should be preserved.

The RFG program assures air quality benefits through the combined application of emissions performance standards and an oxygen requirement. As a result, the RFG program has provided toxic reductions in excess of those required by the performance standards alone. The oxygen standard has also provided reductions in carbon monoxide for which there is no performance standard at all.

EPA should conduct a rigorous analysis of the "real world" emissions benefits of oxygen, including the impact on higher emitting vehicles, off-road and off-cycle driving (areas where the impact of oxygen is more critical) to assure there is no backsliding from these effects. EPA should also compare the potency-weighted toxic affects of oxygenated and non-oxygenated RFG. Finally, it is critical that the carbon monoxide (CO) benefits of oxygenates not be ignored. The oxyfuel program worked and CO has been dramatically reduced nationwide. Several CO non-attainment areas have been reclassified into attainment based in part on maintenance plans which include the oxygen content benefits of RFG. If the RFG oxygen requirement is repealed, the CO attainment status of these areas will be jeopardized. In addition, the National Academy of Sciences concluded last year that as much as 20 percent of the ozone coming from automobiles was attributable to carbon monoxide. EPA should assess this beneficial impact and either (1) incorporate a CO performance standard into the program or (2) promulgate a CO offset so that refiners can balance CO reductions with VOC increases.

Provide flexibility to refiners

Refiners and gasoline marketers should be given flexibility in meeting the challenge of removing MTBE.

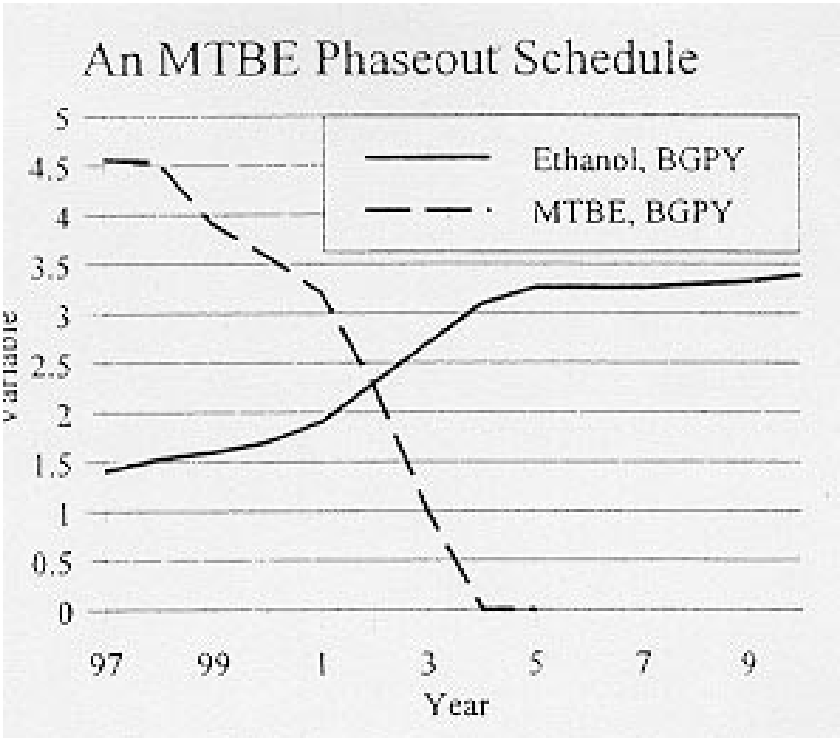
Some claim the only way to eliminate MTBE without increasing consumer gasoline costs is to eliminate the oxygen standard itself. Indeed, some see the two as synonymous. At a time when gasoline prices across the country are soaring, Congress must consider the economic implications of reducing MTBE use. MTBE currently represents about 3 percent of the nation's transportation fuel supply. If it is eliminated without providing for a replacement of that supply, gasoline prices will clearly rise. Indeed, this fact has been established by both the Department of Energy and the California Energy Commission, which concluded a non-oxygenated fuel scenario in California (with no ethanol used) was the most expensive option available to the state in addressing MTBE. If MTBE volume is to be reduced, replacing that volume with safe alternatives, such as ethanol, is both environmentally and economically sound.

The U.S. Department of Agriculture has completed a comprehensive analysis demonstrating that ethanol can effectively replace MTBE by 2004 without price spikes or supply shortages. The Department's analysis shows that total ethanol production capacity will have to increase roughly 50 percent, to approximately 3 billion gallons by 2004, in order to supply the oxygenate demands of RFG while maintaining the existing ethanol octane markets in conventional gasoline.

USDA also analyzed the transportation affects of increased ethanol RFG. The Department concluded that ethanol would be shipped by barge or rail cost-competitively, and that there would be "no transportation impediment to the use of ethanol as a replacement for MTBE." As a company heavily involved in the transportation of liquid fuels, we are planning to ship ethanol to California and have been working with refiners in the state to demonstrate how ethanol could be distributed to the refineries. Based on our experience, the logistics of supplying ethanol to the market should not be a barrier to its use.

The Ethanol Solution

The primary concern with maintaining the oxygen standard appears to be the industry's ability to supply the increased demand for ethanol. But such concerns are unfounded. It is important to understand that because ethanol has twice the oxygen content of MTBE, it will only take half as much ethanol to satisfy the oxygen requirements of RFG. Current MTBE use in RFG is approximately 257 bb/d (thousand barrels per day). That level of oxygen can be met by only 128 bb/d of ethanol. Current ethanol production is 100 bb/d.



A recent report prepared by AUS Consultants, Inc. for the Governors' Ethanol Coalition demonstrates that the ethanol industry can double production within two years, quicker than the proposed three-year MTBE phase out. According to the report, "Ability of the U.S. Ethanol Industry to Replace MTBE":

- Replacing MTBE with ethanol would increase the demand for ethanol to nearly 3.2 billion gallons per year by 2004;
- The ethanol industry can increase production capacity from 1.5 billion gallons to 3.5 billion gallons per year by 2004—more than exceeding the greater demand;
- The increased capacity would come from increased utilization of existing plants, expansion of existing facilities, new plants currently under construction, and proposed facilities currently in various stages of development;
- Using ethanol to replace MTBE will prevent an oxygenate supply shortage that could result in increased gasoline prices;
- Expanding ethanol capacity will result in $1.9 billion in new investment;

• Construction activity and increased commodity demand will add $11.7 billion to real GDP by 2004 and increase household income by $2.5 billion; and
• Switching to ethanol will create more than 47,800 new jobs throughout the country.

Ability of the Ethanol Industry To Replace MTBE (Millions of Gallons per Year)

	2000	2001	2002	2003	2004
Ethanol demand	1,343	1,781	2,231	2,693	3,168
Current production	1,533	1,533	1,533	1,533	1,533
Increased use	0	180	180	180	180
Expanded plants	0	420	839	1,049	1,049
Cap'y under construction	0	60	121	121	121
Cap'y under development	0	0	0	333	598
Total supply	1,533	2,193	2,673	3,216	3,481
Surplus	190	412	444	523	313

It is important to understand that ethanol production facilities are largely modular. Expansions can be done very quickly by simply adding new equipment to existing production streams. New production from green fields is also now done quite efficiently. Since 1990, most new ethanol production has been by farmer-owned cooperatives. These highly efficient dry mill plants typically go from drawing board to production within two years, at an approximate cost of $1.00—$1.50 per gallon of capacity. The next generation of ethanol production facilities will also include production from cellulose and biomass feedstocks. Recently, a new ethanol production plant in Jennings, Louisiana was awarded a $120 billion bond and is expected to begin construction this spring. When completed, this plant will produce ethanol from rice hulls and bagasse. Three other plants are currently planned in California that will produce ethanol from rice straw. Another facility is planned in upstate New York producing ethanol from municipal waste. Already, ethanol is being produced from wood and paper waste by Georgia Pacific in Washington state, and production from forest residue is not far behind. None of this will happen, however, without the assurance of increased market opportunities for ethanol in RFG. If the oxygenate requirement itself is repealed, there will be little increased ethanol production in the coming years. On the other hand, maintaining the oxygen requirement as MTBE use is phased out will stimulate tremendous new economic development across the country.

Ethanol Production Capacity
March 2000

Company	City	State	Primary Feedstock	Capacity (MGY)
A.E. Staley	Louden	TN	Corn	45.0
Ag Power, Inc	Commerce City	CA		2.0
AGP	Hastings	NE	Corn	45.0
Agri-Energy	Luverne	MN	Corn	18.0
Al-Corn	Claremont	MN	Corn	18.0
Alchem	Grafton	ND	Wheat	12.0
Archer, Daniels Midland	Decatur	IL	Corn	750.0
	Cedar Rapids	IA	Corn	
	Peoria	IL	Corn	
	Clinton	IA	Corn	
Broin Assoc	Scotland	SD	Corn	8.0
Cargill	EddyVille	IA	Corn	70.0
	Blair	NE	Corn	35.0
Cent MN Ethanol Coop	Little Falls	MN	Corn	18.0
Chief Ethanol	Hastings	NE	Corn	62.0
Chippawa Valley	Benson	MN	Corn	20.0
Corn Plus	Winnebago	MN	Corn	17.5
DENCO	Morris	MN	Corn	15.0
Eco Products of Plover	Plover	WI		4.0
ESE Alcohol	Leoti	KS	Corn	1.1

Ethanol Production Capacity
March 2000—Continued

Company	City	State	Primary Feedstock	Capacity (MGY)
Ethanol 2000	Bingham Lake	MN	Corn	15.0
Exol Albert	Lea	MN	Corn	18.0
Farm Tech USA	Spring Green	WI	Corn	0.5
Georgia Pacific	Bellingham	WA	Waste	3.5
Golden Cheese of CA	Corona	CA	Cheese/Whey	2.8
Grain Processing Corp	Muscatine	IA	Corn	10.0
Heartland Corn Prods	Winthrop	MN	Corn	17.0
Heartland Grain Fuels	Aberdeen	SD	Corn	8.0
	Huron	SD	Other	12.0
High Plains	Portales	NM	Corn	14.0
	Colwich	KS	Corn	20.0
	York	NE	Corn	40.0
J.R. Simplot	Heyburn	ID	Potato Waste	3.0
	Caldwell	ID	Potato Waste	4.0
Jonton Alcohol	Edinburg	TX	.....	1.2
Kraft	Melrose	MN	Cheese/Whey	3.0
Manildra Energy	Hamburg	IA	Corn	7.0
Midwest Grain	Atchinson	KS	Corn	8.0
	Pekin	IL	Corn	100.0
Minnesota Clean Fuels	Dundas	MN	.....	1.5
MMI/ETOH	Golden	CO	.....	1.5
MN Corn Processors	Marshall	MN	Corn	32.0
	Columbus	NE	Corn	90.0
MN Energy	Buffalo Lake	MN	Corn	12.0
New Energy Co of IN	South Bend	IN	Corn	88.0
Pabst Brewing	Olympia	WA	Bev Waste	0.7
Parallel Products	Rancho Cucamonga	CA	Food Waste	2.0
	Louisville	KY	Corn	10.0
Permeate Prods	Hopkinton	IA	.....	1.5
Pro-Corn	Preston	MN	Corn	19.0
Reeve Agri-Energy	Garden City	KS	Corn	10.5
Stroh's Brewery	Winston-Salem	NC	Bev Waste	1.0
Sunrise Energy	Blairstown	IA	Corn	5.0
Vienna Correctional	Vienna	IL	Corn	0.5
Williams Energy	Aurora	NE	Corn	30.0
	Pekin	IL	Corn	100.0
Wyoming Ethanol	Torrington	WY	Corn	5.0
Total	.....	.....	.....	1,837.8

Source: Bryan and Bryan, Inc.

Ethanol Production Under Construction
March 2000

Company	City	State	Capacity MGY	Feedstock
Golden Triangle	Craig	MO	14.0	Corn
Adkins Energy	Lena	IL	30.0	Corn
BC International	Jennings	LA	20.0	Bagasse/ rice hulls
Nebraska Nutrients	Sutherland	NE	15.0	Corn
Dakota Ethanol	Wentworth	SD	40.0	Corn
NE Missouri Grain Proc	Macon	MO	15.0	Corn
Total	.....	.....	134.0	.....

Source: Bryan and Bryan, Inc.

Ethanol Plants Under Development
March 2000

City	State	Capacity (MGY)	Feedstock
Undisclosed	CO	20.0	Corn
Central Iowa	IA	15.0	Corn
NW Iowa	IA	40.0	Corn
L. Cascade	IL	100.0	Corn
Pratte	KS	15.0	Corn/milo
Undisclosed	KS	40.0	Corn
Undisclosed	KY	20.0	Corn
Central State	MI	40.0	Corn
St. Paul	MN	30.0	Corn
SE Missouri	MO	30.0	Corn
Great Falls	MT	75.0	Wheat/Barley
Neely	NE	15.0	Corn
Central State	NJ	10.0	Corn
Clatskanie, OR	OR	80.0	Corn/wheat
Milbank	SD	40.0	Corn
Platte	SD	15.0	Corn
Rosholt	SD	15.0	Corn
Undisclosed	TX	30.0	Corn
Moses Lake	WA	40.0	Corn/Barley
Lacrosse	WI	20.0	Corn
Subtotal		690.0	
Biomass Conversion			
SE Region	AK	8.0	Wood Waste
NE Region	CA	15.0	Forest Residues
Gridley	CA	20.0	Rice Straw
Mission Viejo	CA	8.0	Rice straw
Chester	CA	20.0	Forest Residues
Onslow County	NC	60.0	Sweet potatoes
Greene County	NC	60.0	Sweet potatoes
Martin County	NC	60.0	Sweet potatoes
Middletown	NY	10.0	MSW
Central Region	OR	30.0	Wood Waste
Philadelphia	PA	15.0	MSW
Black Hills	WY	12.0	Forest Residues
Subtotal		318.0	
Total new capacity		1,008.0	

Ethanol RFG will provide a tremendous economic stimulus to rural America by creating value-added demand for 500 million bushels of grain.

LEGISLATION

As testament to the growing congressional interest in resolving MTBE groundwater issues, numerous bills have been introduced to phase-down or eliminate MTBE, while preserving a role for ethanol in this important program. The Renewable Fuels Association, the industry's trade organization, strongly supports legislation such as S. 2546 and S. 2233, which address MTBE water contamination directly, without undermining the existing air benefits of oxygenated RFG. S. 2546, introduced by Senators Kit Bond (R–MO) and Dick Durbin (D–IL), is particularly effective because it deals comprehensively with a number of issues important to this committee, including anti-backsliding from real-world air quality benefits, the highway trust fund, and MTBE remediation costs.

Another approach to resolving the MTBE issue consistent with the findings of the Blue Ribbon Panel is phasing out the use of MTBE while phasing in a renewable energy requirement. This approach has been incorporated in legislation introduced by Democratic Leader Tom Daschle (D–SD) and cosponsored by Senator Dick Lugar (R–IN). The Renewable Fuels Association supports this bill also, but would encour-

age the committee to craft this bill so that ethanol is used where it will provide the most environmental benefit.

As I indicated at the beginning of my testimony, Williams believes the primary responsibility for government in this area is to make sure that Americans have clean air and that means, among other things, setting emission standards for vehicles and the gasoline that fuels vehicles. These standards should be set on the basis of science. Inevitably, any standards will influence the recipe for gasoline and therefore the mix of additives used to make gasoline. However, so long as compliance with the standards is practical for refiners, then we should not sacrifice clean air. We believe the oxygenate standard is a useful proxy for limits of gasoline components that have negative health effects. If Congress chooses to repeal the oxygenate requirement, then equivalent emission standards will need to be substituted in its place.

CONCLUSION

The domestic ethanol industry understands that the Congress is faced with a daunting challenge, i.e, how to protect water supplies by reducing the use of MTBE without sacrificing air quality or increasing fuel prices. We see ethanol as a solution. Increasing ethanol use in this program will allow MTBE to be phased out cost-effectively while protecting precious water resources and air quality. Stimulating rural economies by increasing the demand for grain used in ethanol production will help farmers left behind by our booming economy. Encouraging new ethanol production from biomass feedstocks will provide additional environmental benefits and take a positive step toward a sustainable energy future and global climate change. The bottom line is that we need to protect both air quality and water quality. With ethanol, we can.

Thank you.

STATEMENT OF GLENN KELLER, ENGINE MANUFACTURERS ASSOCIATION

Good Morning. My name is Glenn Keller and I am the Executive Director of the Engine Manufacturers Association. The Association, headquartered in Chicago, Illinois, represents the worldwide manufacturers of internal combustion engines used in all applications except passenger cars and aircraft. Among EMA's members are the principal manufacturers of truck and bus engines covered by EPA's proposed 2007 rulemaking imposing additional regulatory controls on heavy-duty engines while limiting the sulfur content of diesel fuel used in these engines.

The diesel-fueled engine is the backbone of our nation's transportation system, from delivering produce to our local groceries to powering our mass transit systems in our nation's cities and towns. The diesel engine can be as clean, if not cleaner, than any other power source. It is capable of meeting emission standards significantly below today's levels. And particulate emissions from today's engines have already been reduced by over 90 percent. We recognize that more, much more in fact, can and should be done—and we are poised to meet that challenge by the end of this decade.

The key to achieving these future stringent emissions reductions is to reduce the sulfur content of diesel fuel. As the Environmental Protection Agency acknowledged in its proposed rule, future emissions reductions require a systems approach involving the engine, aftertreatment and fuel. Fuel quality, one leg of this three-legged emissions reduction strategy, enables the technologies necessary to make the other two stand.

Without removing essentially all the sulfur from diesel fuel, advanced NO_x aftertreatment devices will not be feasible; advanced PM aftertreatment will be poisoned; and engines will be exposed to excessive wear, increased maintenance costs, and impaired durability. I cannot emphasize enough the critical importance of ultra-low sulfur fuel: it enables substantial NO_x emission reductions; it provides direct PM emission reductions for every vehicle; and it provides benefits not just from new engines, but from the entire fleet of diesel-fueled vehicles.

Improved diesel fuel also has a role in responding to concerns over potential health effects. Ultra-low sulfur fuel lowers the total mass of particulate from the entire fleet and enables the use of known aftertreatment technologies, such as oxidation catalysts, which can reduce the organic fraction of PM emissions. A rule that calls for ultra-low sulfur fuel also enables the application of catalyst-based technologies to reduce NO_x that, in turn, will reduce the secondary formation of fine particles of concern in our urban air.

We applaud EPA for recognizing the critical role of fuel sulfur. We strongly support the need for a uniform, nationwide low sulfur fuel standard with a hard cap

on maximum sulfur content. Regional differences in sulfur content will not allow the systems approach necessary to meet EPA's very stringent NO_x and PM emission levels. Further, a hard cap on sulfur is critical. Averages simply will not work. They are difficult and impractical to enforce. Moreover, the engine and aftertreatment legs of the stool must be assured of never being exposed to high sulfur fuel.

In our view, a 15 ppm sulfur limit does not go far enough. Our cooperative testing programs have indicated the extreme sensitivity of aftertreatment devices to sulfur poisoning. Therefore, EMA advocates an even lower limit of 5 ppm sulfur in diesel fuel to ensure we are delivering the maximum performance of these devices for the useful life of the truck engine, which is up to 435,000 miles. And, diesel fuel improvements shouldn't only be limited to trucks and buses. Non-road fuels also must be similarly improved.

We are aware of the various arguments raised by the oil industry against improving fuel quality. They don't want to reduce sulfur to even 15 ppm, let alone to lower levels. Nationwide ultra-low sulfur fuel can—no, must—be achieved, and it can be done cost effectively. In a joint project with the American Petroleum Institute and the National Petroleum Refineries Association, the Engine Manufacturers Association contracted with MathPro, a renowned refining consultant, to estimate the cost of producing ultra-low sulfur fuel. MathPro concluded that the typical refining cost to produce a 5 ppm maximum sulfur fuel was from 5½ to 9 cents per gallon for the most severe sulfur scenario which modeled a 2 ppm average across the entire diesel pool. Mr. Chairman, we ask that the entire MathPro Study be included with this statement in the hearing record.

So today we are enthusiastic and hopeful about the bright future for diesel engines and our industry's ability to produce reliable, durable, fuel efficient, high performing diesel engines that also are as clean or cleaner than any other power source. There are issues that will require a great deal of work by manufacturers and the Agency. But it is no longer a question of "if". With nationwide ultra-low sulfur diesel fuel and sufficient development time, tremendous emissions reductions can be achieved.

I would be pleased to respond to any questions the Subcommittee might have.

STATEMENT OF GORDON PROCTOR, DIRECTOR, OHIO DEPARTMENT OF TRANSPORTATION

Chairman Inhofe, members of the committee, I am Gordon Proctor, Director of the Ohio Department of Transportation. Thank you very much for this invitation to testify before the committee. I would especially like to thank Senator Voinovich for helping to provide me this opportunity to address an issue that is of particular importance to Ohio.

The committee today is discussing the role of ethanol as a motor fuel and a fuel additive. Coming from an agricultural state, I understand the importance of ethanol's use to the agricultural industry. I also am aware of ethanol's role as a fuel oxygenate, and as a domestically produced energy source. I am not here to speak against ethanol or the strategy of promoting its use.

As a State director of transportation, I would point out to the committee an unintended consequence that has befallen Ohio as a result of increasing ethanol consumption. Under the funding formula adopted in the Transportation Equity Act for the 21st Century, TEA–21, Ohio's Federal appropriation is determined in large part by our contribution to the Highway Trust Fund. At the time of enactment, this was a welcome move for Ohio, and one that Ohio supported. However, there was a consequence that neither Ohio, nor apparently the appropriators, anticipated.

This consequence was the dramatic increase in the use of ethanol caused by national market forces. I am neither an ethanol nor petroleum expert, but apparently because of continued depressed corn prices and because of the continued Federal tax reduction on ethanol, the use of ethanol-blended gasoline in Ohio has soared from 19 percent to more than 40 percent of all gallons of gasoline sold at the pump. Because ethanol-blended fuel is taxed differently from petroleum fuels, the increase in ethanol use has significantly decreased the amount of revenue credited to Ohio in the Highway Trust Fund. As you know, there is a 5. 4 cent per gallon Federal tax break on each gallon of ethanol-blended gasoline sold. In addition, 3.1 cents of the tax that is collected on ethanol is credited to general revenue funds and not to the Highway Trust Fund. In other words, Ohio's contribution to the Highway Trust Fund is reduced by 8.5 cents for each gallon of ethanol-blended fuel sold in Ohio. I expect ethanol use will continue to increase and will continue to reduce Ohio's trust fund contributions.

The sums involved are substantial. For Ohio, these reduced contributions to the Highway Trust Fund reduce Ohio's Federal highway funding by $185 million annually. To put that number in perspective, it equals 21 percent of Ohio's total Federal obligation ceiling, it equals two-thirds of our state's entire new construction budget and it equals the amount ODOT budgets for routine bridge repair and replacement for an entire year.

The situation appears to be unique to Ohio because we are both a large consumer of ethanol and a donor state. For donee states, other provisions in TEA–21 appear to mitigate the effect of rising ethanol use because those states' appropriations are not tied directly to their Highway Trust Fund contributions.

Please let me emphasize. I am very appreciative of Congress's efforts on behalf of TEA–21 and the unprecedented appropriations the Act has provided. Let me also emphasize, that Ohio has received the minimum appropriations guaranteed by the Act. I do not want to imply otherwise. What Ohio has not realized, however, is a commensurate increase of growing Highway Trust Fund dollars because while fuel consumption in Ohio has risen, our contributions to the Highway Trust Fund have been stunted by the way ethanol is taxed.

This situation exacerbates Ohio's donor State status. We in Ohio have the tenth largest highway network, the fifth highest volume of traffic, the fourth largest interstate highway network and the second largest inventory of bridges in the country. While our traffic and congestion have risen, our Federal receipts have not risen commensurately because of the unintended consequence of the ethanol issue.

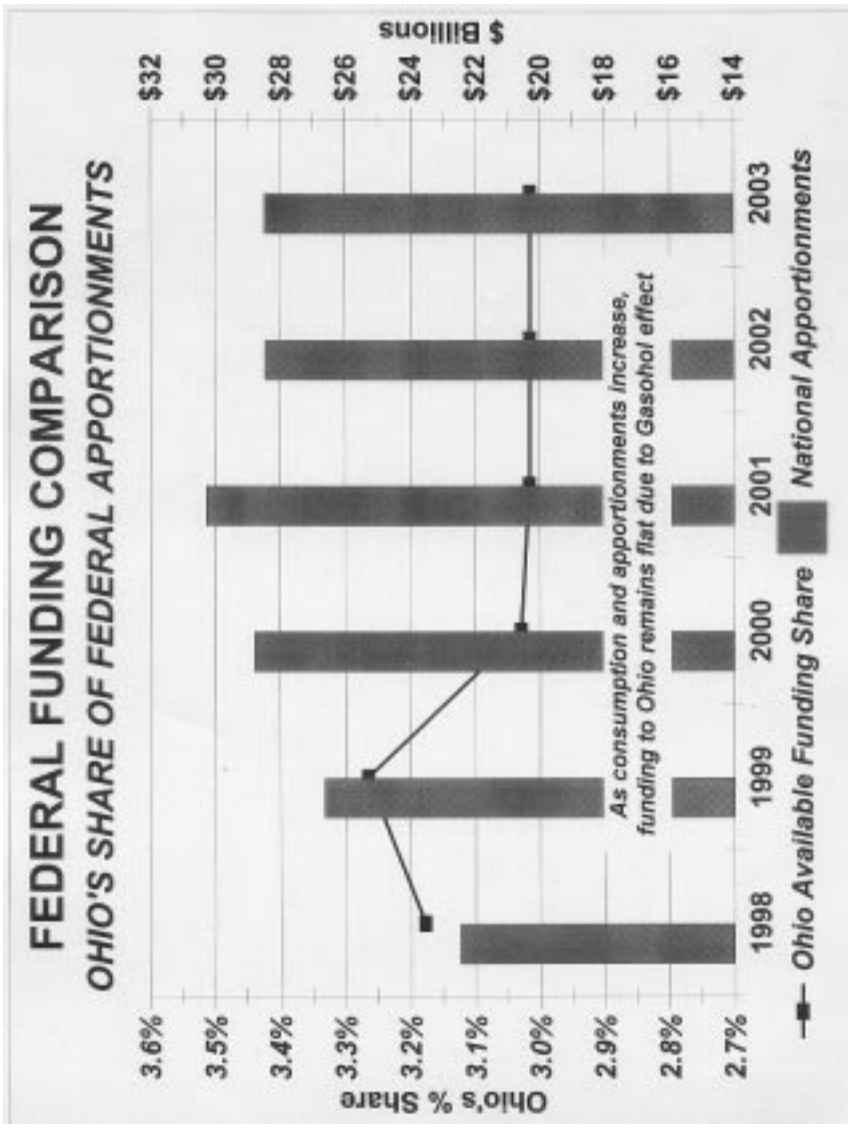
I would ask for your consideration in two ways. First, I would ask, in any future consideration of highway funding formulas, that the use of ethanol be taken into account. Although it is national policy to encourage ethanol use, the cost of this policy is not spread uniformly across the states. Second, I would request, at the appropriate time and in the appropriate legislation, that the 3.1 cents of the ethanol tax that is credited to the general fund be redirected to the Highway Trust Fund. At least, that effort would continue directing transportation tax receipts into the Highway Trust Fund where they would accrue to Ohio.

Mr. Chairman, thank you again for this opportunity. I am grateful for the committee's time and its attention. I would be happy to answer any questions the committee may have.

Gasohol/Tax Subsidy.—Total Cost to Ohio FY 1982 Thru 1999

Fiscal Year	Gasoline Billion Gallon	Gasohol Billion Gallon	Percent of Total	State Gasohol Subsidy	Ohio's Cost Million Dollars	Federal Gasohol Subsidy	Federal General Fund	Federal Cost [In Millions of Dollars]	Total Cost [In Millions of Dollars]
82	4.492	0.016	0.4	$0.035	$0.6	$0.090	.....	$1.4	$2.0
83	4.095	0.375	8.4	0.035	13.1	0.090	.....	33.8	46.9
84	4.077	0.428	9.5	0.035	15.0	0.050	.....	21.4	36.4
85	3.922	0.576	12.8	0.030	17.3	0.060	.....	34.6	51.8
86	3.789	0.776	17.0	0.025	19.4	0.060	.....	46.6	66.0
87	3.869	0.882	18.6	0.025	22.1	0.060	.....	52.9	75.0
88	3.884	0.912	19.0	0.025	22.8	0.060	.....	54.7	77.5
89	3.799	0.924	19.6	0.020	18.5	0.060	.....	55.4	73.9
90	3.750	0.980	20.7	0.020	19.6	0.060	.....	58.8	78.4
91	3.534	1.091	23.6	0.015	16.4	0.054	0.006	65.5	81.8
92	3.482	1.097	24.0	0.015	16.5	0.054	0.006	65.8	82.3
93	3.119	1.497	32.4	0.015	22.5	0.054	0.006	89.8	112.3
94	2.905	1.812	38.4	0.010	18.1	0.054	0.006	109.7	126.0
95	2.930	1.828	38.4	0.010	18.3	0.054	0.006	109.7	128.0
96	3.090	1.741	36.0	0.010	17.4	0.054	0.031	148.0	165.4
97	4.096	0.766	15.8	0.010	7.7	0.054	0.031	65.1	72.8
98	2.981	1.974	39.8	0.000	0.0	0.054	0.031	167.8	167.8
99	2.870	2.177	43.1	0.000	0.0	0.054	0.031	185.0	185.0
Total Accumulated Subsidy	.....	.....	.....	.....	$265.0	.....	.....	$1,365.0	$1,630.0

Gasohol was not taxed by the Federal Government from January 1979 to April 1983 as a result of the Energy Tax Act of 1978. Prior to 1979, gasohol was taxed at the same rate as gasoline.
Federal Subsidy is the difference between the Federal Tax on Gasoline and the Federal Tax on Gasohol.
Federal General Fund is the difference between the Federal Gasoline tax distributed to the general Fund and the Federal Gasohol tax distributed to the General Fund.



STATEMENT OF BOB SLAUGHTER, NATIONAL PETROCHEMICAL AND REFINERS ASSOCIATION

Good morning, Mr. Chairman and members of the Committee. My name is Bob Slaughter. I am General Counsel of the National Petrochemical and Refiners Association. NPRA is a trade association which represents virtually all U.S. refiners and petrochemical companies who have processes similar to refiners. We appreciate this opportunity to appear before the Subcommittee to discuss the environmental effects of ethanol under the Clean Air Act and the general question of whether ethanol should be mandated.

NPRA opposes fuel mandates. Mandates eliminate competition and thus are likely to result in increased costs to consumers. They inevitably foster market protections and monopolies and often result in unanticipated side effects, such as supply curtail-

ments and higher prices. Once in place, they are then difficult to reverse. Mandating a product signals to consumers and industry that a product is uneconomic and "can't make it on its own" without special patronage. This is often harmful to the product's reputation and adversely impacts its long-term commercial acceptability and market performance. Basically, people don't like mandates. Americans value freedom of choice. Our economy reflects that characteristic, and it has served us well. In contrast, it is a foregone conclusion that gasoline subject to an ethanol mandate will be more expensive than it would be in the absence of a mandate.

We have witnessed positive results with public policies which rely on market forces, for example, the acid rain program, but by most accounts our experiment with fuel mandates for RFG oxygenates and alternative fuels has had unsatisfactory results. Given widespread dissatisfaction with the current oxygenate mandate, proponents of continued interference with market forces in fuel policies bear a heavy burden of persuasion. We do not believe that the advocates of a new ethanol mandate under the Clean Air Act have come anywhere close to making their case.

Ethanol has a bright future as a gasoline blendstock. Why risk the negative consequences of a mandate? If MTBE use is constrained, ethanol is one way refiners can provide reliable supplies of gasoline while meeting consumers' demands for fuel performance. Studies by the U.S. Department of Energy and the California Energy Commission predict significant ethanol growth in the Northeast and California, respectively, under an MTBE phase-out without a mandate. Northeast ethanol demand is estimated to exceed 550 million gallons per year if there is withdrawal of MTBE from the market while ethanol demand in California is estimated to reach 828 million gallons. The total annual ethanol demand increase for these two regions would be almost 1.4 billion gallons—or just slightly less than a doubling of today's 1.5 billion gallon usage.

In addition, the ongoing reduction of sulfur in gasoline will lead to a significant increase in ethanol use. Many refiners will give serious consideration to ethanol as a means of replacing octane lost when sulfur is reduced. Absent a mandate, the projected increase in ethanol use will take place where it makes the most economic sense to use it. Much will depend on the price of ethanol in response to such an increase in demand. However, with total U.S. demand for ethanol in 2006 estimated possibly to double today's figure, it is clear that there should be substantial growth in ethanol use even if some demand erodes as prices rise.

The impact of an extensive, national ethanol mandate on the environment is unknown. The EPA Blue Ribbon Panel pointed out "Although ethanol is likely to biodegrade rapidly in groundwater, because ethanol is infinitely soluble in water, much more ethanol will be dissolved into water than MTBE." While the environmental track record—with respect to groundwater contamination—of using ethanol in gasoline has been good, a recent ethanol leak in the Lake Tahoe area has received considerable press and public attention. This is an indication that the environmental consequences of mandated use of this highly soluble chemical are of concern. It seems wise to proceed with a measure of caution in an area in which the public may feel that it has been recently ill-served (i.e. by the oxygenate mandate).

Air quality impacts are possible. A recent study presented by Toyota to CARB has shown that if ethanol blended at 10 percent replaces MTBE blended at 11 percent (by volume), tailpipe NO_x emissions increase significantly. Also, in non-RFG regions, ethanol benefits from an EPA waiver which allows it to be blended at a higher volatility level, thus increasing evaporative emissions. Further, if ethanol blended gasoline is mixed with gasoline not containing ethanol, the ethanol causes an increase in the volatility and the evaporative emissions of the mixture. Thus, an ethanol mandate could have significant adverse impact in areas where increased ozone (smog) producing emissions are of concern.

With regard to effects on water, experience to date with ethanol blends has been relatively benign. We do know that microbes preferentially degrade ethanol present in a spill, which will retard the rate of degradation of other components.

Given the concerns expressed about MTBE, we should be cautious about new programs that would significantly increase usage of ethanol in gasoline beyond traditional volumes. The EPA Blue Ribbon Panel recommended extensive testing of gasoline constituents before widely extending their use, based upon experience with the current oxygenate mandate.

If left to the workings of the free market, ethanol has positive attributes that will promote its use. The Blue Ribbon Panel described ethanol as "An effective fuel-blending component, made from domestic grain and potentially from recycled biomass, that provides high octane, carbon monoxide emission benefits, and which 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 . . . "

Reliance upon a government mandate, however, could focus attention on ethanol's problematic characteristics instead. The Blue Ribbon Panel goes on to say "[ethanol] . . . could raise the possibility of increased ozone precursor emissions as a result of commingling in gas tanks if ethanol is not present in a majority of fuels; [ethanol] is produced currently primarily in the Midwest, requiring enhancement of infrastructure to meet broader demand; because of high biodegradability, [ethanol] may retard biodegradation and increase movement of benzene and other hydrocarbons around leaking tanks."

An ethanol mandate will make it harder for refiners to provide cleaner fuels to consumers at acceptable prices. An ethanol mandate will hinder refiners' ability to optimize the quality and volume of cleaner-burning gasoline. This will increase refining costs, impacting both gasoline supplies and price. According to the California Energy Commission, the costs of substituting ethanol-blended gasoline in that state could increase refining costs by up to 7 cents per gallon. Without a mandate, refining costs are significantly reduced, because refiners have the flexibility to economically blend gasoline in a cost-effective way that meets octane requirements while maintaining emission performance benefits.

Distribution of ethanol blends confronts refiners, other fuel suppliers and, ultimately, consumers with special economic burdens which a national mandate would increase. Adding more ethanol to gasoline is not just a matter of investment in new ethanol production facilities. Ethanol is added to gasoline at terminals, not at the refinery. Therefore, investment is necessary at terminals not currently using ethanol for equipment to receive ethanol by rail or truck (about $300,000 per terminal) to store ethanol in a tank ($450,000 for a new tank) at the terminal and to install blending equipment ($450,000 per terminal). In addition to environmental permitting requirements, these are sizable investment requirements for terminal operators and they should not be forced by a legislative mandate. The National Petroleum Council estimates that if ethanol blends are required at all RFG terminals outside of the Midwest, the terminal capital investment requirements would total $185 million. Total investment expenses would be higher if conventional gasoline terminals in the Southeast, Southwest and West also have to be converted for ethanol blending.

In addition, ethanol presents special logistical problems. Since alcohols like ethanol tend to adhere to water and thus separate out of an oxygenated gasoline blend, it is difficult to transport ethanol blends by pipeline. Instead, a special gasoline blendstock is made for ethanol fuels (both to ease transport and to compensate for the increase in evaporative emissions associated with ethanol's higher volatility.) The ethanol itself is shipped separately by railroad, truck or ship, and the finished gasoline is blended (using special equipment) at storage terminals near the area where it will be sold to consumers. As EIA indicates in discussing ethanol logistics and costs, "Shipments to the West Coast and elsewhere via rail have been estimated to cost an extra 14.6 to 18.7 cents a gallon for transportation."

Ethanol is already heavily subsidized by taxpayers. Ethanol has received a large federal tax subsidy since 1978. Currently, this incentive is $0.54 per gallon of ethanol. The incentive is financed through diversion of moneys that would otherwise go into the Highway Trust Fund. At current ethanol usage rates, the Highway Trust Fund loses about $1 billion per year in revenues because of the reduced tax rate and diversion of some receipts to the General Fund. The only way to avoid this situation is to fund new ethanol incentives out of general revenues, which would have the negative result of assessing every taxpayer to benefit fuel ethanol. As it is, many, if not most, of those who benefit from the ethanol incentives also rely on other agricultural assistance programs for corn. As the Administration states in its most recent policy analysis: "Corn producers currently receive more in direct farm support payments than producers of any other commodity."

Proposals for a national ethanol mandate seek to make energy consumers and highway users pay even more for agriculture subsidies. Consumers already pay for corn and ethanol subsidies that are funded out of the general treasury or Highway Trust Fund. But advocates of a national ethanol mandate are proposing to take an even bigger bite out of their pocketbooks. According to the Administration, ". . . the potential trust fund impacts (of a national mandate), ranging between more than $0.5 billion and a little under $1 billion per year, would be on the order of 1 to 2 percent of the total fund." This means that as much as $2 billion total of revenues that would otherwise go to the Highway Trust Fund would be diverted to ethanol.

According to EIA modeling, "adding a 2 percent renewable fuels standard is projected to increase gasoline prices in the 5 cents per gallon range in 2005." As a rule of thumb, a one cent increase in gasoline prices nationwide amounts to, in the aggregate, a $1 billion additional cost to consumers. Thus, the renewable mandate will

cost gasoline consumers $5 billion more in 2005 than an alternative policy option of phasing-down MTBE usage without a mandate.

The Administration's latest paper on the renewables mandate is clear in assessing the likely beneficiaries: "With 2.5 per cent of the nation's gasoline consisting of ethanol by 2010 . . . The price of corn would be 15 cents per bushel more in 2010 than in the absence of the standard and average 11 cents per bushel more during 2002–2010 . . . U.S. farm income would increase by $1.4 billion in 2010, and would average $750 million more per year during 2002–2010."

Ethanol credit trading pursuant to a national mandate could create regional winners and losers. Many refineries do not produce RFG, do not blend MTBE in conventional gasoline, or do not make blendstock for ethanol blending to produce gasohol. Implementation of a national renewable mandate with averaging, banking and trading could reduce investment requirements at refineries and terminals outside of the Midwest. However, a national renewable fuel mandate would segment the oil industry into winners (those in the Midwest who can offset ethanol expenses by selling excess "credits" and losers (others who would have to purchase "credits"). Consumers who purchase gasoline would benefit or be disadvantaged depending on which category their supplier fits into. Most of the winners would be located in the Midwest, with losers disproportionately located in the Northeast and West.

An ethanol mandate will make it harder for refiners to comply with priority environmental programs. Refiners are concerned with the possibility of supply disruptions as product quality specifications are changed. A renewable mandate is the same as a product specification change for refineries that do not currently use ethanol. Congress should not impose a renewable mandate burden on these facilities that already face significant new investment requirements for reducing sulfur in gasoline and diesel fuel. The industry is committed to current implementation of RFG 2 as it is to reducing sulfur in gasoline and diesel. The imposition of additional, wholly arbitrary requirements such as a nationwide ethanol mandate will further stress refiners and the refining system. This means that some of the programs may not achieve the projected environmental benefits.

"Truth in labeling" is needed to clarify, rather than confuse policy options. The intent and import of the national ethanol mandate policy option would be clearer to consumers/constituents if terms and statements made by its proponents, especially the Administration, were more reflective of the likely result. NPRA makes the following observations:

1. The "renewable fuels standard" is a national ethanol mandate and should be recognized as such. The only renewable transportation fuel likely to be used in the foreseeable future as a gasoline blendstock is ethanol. The "standard" requires its use, and is indistinguishable in intent or effect from a "mandate." Also, there is no such thing as a "flexible mandate" which was EPA's initial euphemism for this program. Like "living death" or "wakeful sleep" the words "flexible mandate" are a contradiction in terms and hence oxymoronic. Policymakers who advocate basing a significant portion of America's gasoline supply on mandatory use of an already heavily subsidized product provided by an extremely concentrated industry should say so.

2. The only likely beneficiary of the national ethanol mandate is corn-based ethanol. Proponents of the national ethanol mandate are claiming that it will provide significant benefits for ethanol from biomass other than corn. The proponents allege that imminent "technological breakthroughs" will enable non-corn-derived biomass ethanol to reap significant benefits from the mandate. It would be imprudent to rely on a significant portion of gasoline supply upon such a speculative source. But the much greater likelihood is that corn ethanol will be positioned to take all of the market for ethanol in the foreseeable future, and that cellulosic biomass will fill only the tiniest increment of any ethanol actually supplied. Once corn ethanol has occupied the additional market created by the national mandate it is hard to imagine that its producers will step aside and surrender any significant portion of that market to competing suppliers of ethanol from cellulose. The Administration's emphasis upon the positive impact of the national mandate on corn prices in its recent paper gives away the real intent behind this national mandate.

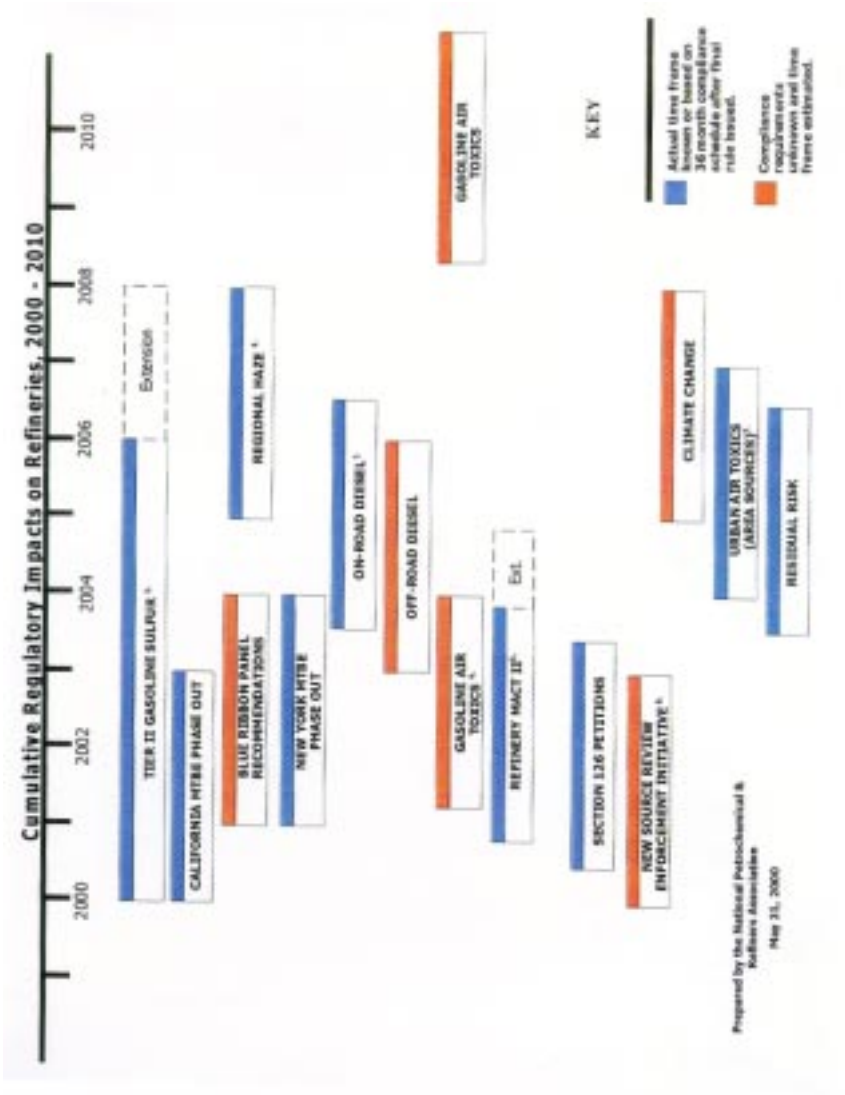
3. The existing ethanol subsidy is unlikely to be repealed. Opponents of the subsidy have been trying for two decades to eliminate it. The result is usually extension of the subsidy far into the future, and often an increase in the subsidy itself. This means that revenues intended for the Highway Trust Fund will continue to be diverted. The only alternative is to take these funds from general revenues, which has other serious drawbacks. Analyses suggesting that reduction or elimination of the subsidy is a real possibility are misleading unless they indicate that the likelihood of this happening is very remote.

CONCLUSIONS

Federal policymakers should reject the call for a national ethanol mandate. Congress and the Administration should learn from, rather than repeat, the mistakes of the past. The ethanol lobby has been trying to mandate ethanol throughout the national gasoline supply for more than ten years. The oxygen mandate that has led to current water quality concerns was supported by large agribusiness in order to guarantee an ethanol market for them. Enacting another mandate to replace the problematic current one could have much greater negative consequences, including higher gasoline costs, tighter and less reliable fuel supplies, the potential for increased smog-creating emissions and a potential to create a consumer backlash. Refineries and ethanol producers can work together better to provide America's future transportation fuels in the absence of a national ethanol mandate. That will really clear the air.

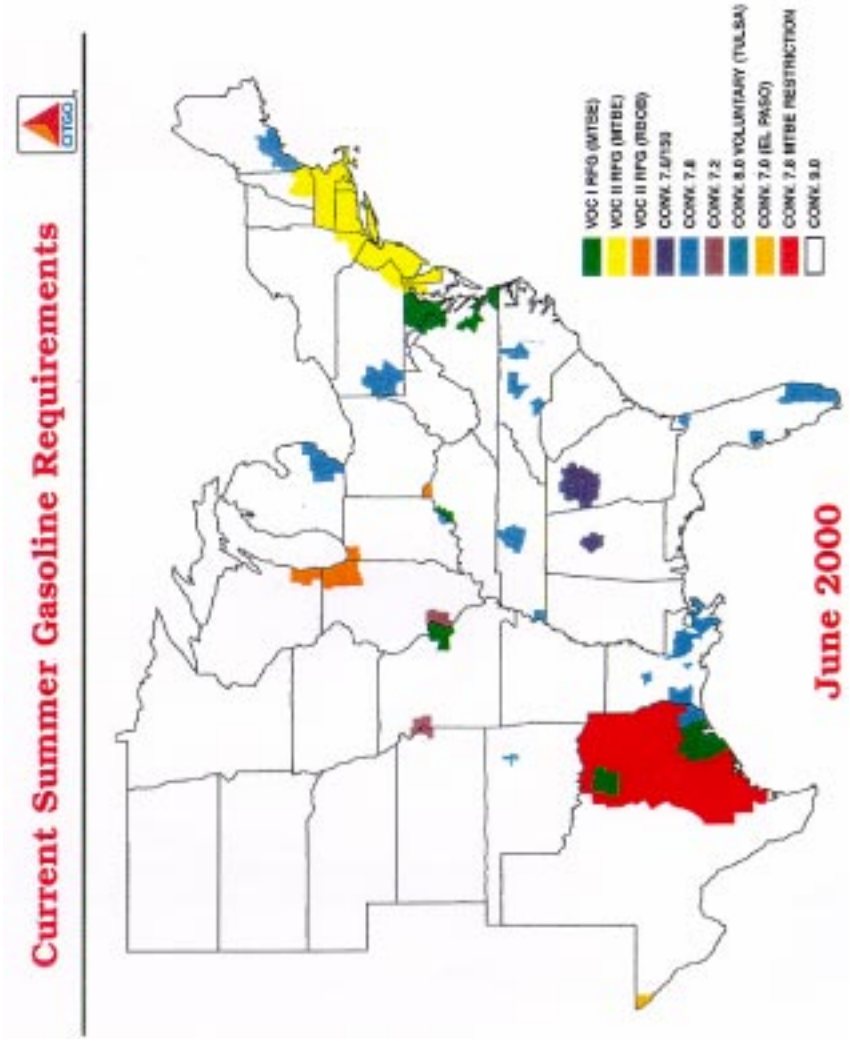
Congress and EPA should follow the recommendations of the EPA's Blue Ribbon Panel. They should help refiners serve the real energy and environmental needs of the nation by repealing the federal oxygen mandate, and by reducing MTBE levels while maintaining air quality benefits. And they should provide enough time for the transition to allow refiners to continue providing adequate supplies of gasoline and other petroleum products to consumers without undue cost increases.

I look forward to responding to your questions.


Cumulative Regulatory Impacts on Refineries, 2000 - 2010
2000
2002
2004
2006
2008
2010
TIER II GASOLINE SULFUR [1]
Extension
CALIFORNIA MTBE PHASE OUT
BLUE RIBBON PANEL RECOMMENDATIONS
NEW YORK MTBE PHASE OUT
REGIONAL HAZE [1]
ON-ROAD DIESEL [1]
OFF-ROAD DIESEL
GASOLINE AIR TOXICS [1]
REFINERY MACT II [2]
Est.
GASOLINE AIR TOXICS
SECTION 126 PETITIONS
NEW SOURCE REVIEW ENFORCEMENT INITIATIVE [1]
CLIMATE CHANGE
URBAN AIR TOXICS (AREA SOURCES) [3]
RESIDUAL RISK
KEY
Actual time frame based on best on 36 month compliance schedule after final rule issued.
Compliance requirements unknown and time frame estimated.
Prepared by the National Petrochemical & Refiners Association
May 31, 2000

FOOTNOTES:

1. Longer compliance time for small refineries in some mid-western and western states and small refineries covered by SBREFA.
2. Regional haze SIPs due 2005-2007. Earliest compliance date. Schedule may be impacted by NAAQS litigation
3. EPA has issued NPRM on May 17, 2000.
4. CAA Section 202 (l) final rule expected December 2000.
5. Compliance date may be harmonized with Tier II schedule.
6. Based on EPA statements to press. Estimated date for implementation
7. Urban Air Toxics Strategy includes controls for gasoline distribution and oil and gas production sources. Estimated compliance schedule.



STATEMENT OF NATSO, INCORPORATION

INTRODUCTION

NATSO Inc., the trade association representing America's travel plaza and truckstop industry, thanks the Clean Air, Wetlands, Private Property and Nuclear Safety Subcommittee for the opportunity to comment on the Environmental Protection Agency's (EPA) Notice of Proposed Rulemaking concerning Heavy Duty Engine Standards and Control Requirements on the Sulfur Content of Highway Diesel Fuel.

As the primary retailer of on-road diesel fuel, the truckstop industry is a vital link in the transportation of goods and services throughout our country. The vast majority of our nation's products are delivered by diesel powered vehicles; everything from the clothes we wear to the food we eat. Our nation's travel plazas and truckstops are a critical link in the movement of these goods, providing the fuel needed to keep these trucks, and our economy, running smoothly.

While the travel plaza and truckstop industry supports efforts to improve our nation's air quality, NATSO has serious concerns with EPA's proposed rule and the ef-

fect it will have on our nation's energy supply and delivery system. These concerns and objections center on two aspects of EPA's proposal: The first being EPA's continued consideration of a "phase-in" approach to the introduction of this reduced sulfur diesel fuel: the second being the extreme level of sulfur reduction being proposed.

EPA'S PROPOSED RULE

In an effort to improve air quality, EPA has proposed sharp reductions in emissions from heavy-duty truck engines in 2007, through the use of advanced catalytic emission control devices which will require a reduced sulfur diesel fuel to operate.

EPA has proposed that the sulfur content of all highway diesel fuel sold to consumers be reduced from its current level of 500 parts per million to 15 parts per million beginning June 1, 2006. This being the case, EPA's proposal continues to consider, and requests additional comment on, various phase-in schemes that would gradually introduce the new ultra-low sulfur diesel fuel into the market over time, temporarily resulting in two separate grades of highway diesel.

NATSO'S CONCERNS/OBJECTIONS

NATSO is strongly opposed to phase-in schemes which would result in the temporary manufacture, delivery, sale, and use of two separate grades of highway diesel, and continues to urge EPA to adopt a "single fuel" approach which would switch to the new ultra-low sulfur fuel at one time. thereby maintaining a single grade of highway diesel, and preserving the integrity of our nation's diesel fueling infrastructure.

The entire diesel fuel delivery system, from refinery to retail, is currently handling a single grade of highway diesel fuel. The presence of two different grades could have a disastrous effect on our energy delivery system; including reductions in the supply of diesel, spot outages, price spikes, tremendous cost increases, and fuel cross-contamination.

Because the travel plaza and truckstop industry is configured to carry a single grade of highway diesel, the introduction of a second separate grade would force the truckstop industry to make tremendous capital investment to carry both products at retail. Significant capital expenditures would need to be made to ensure that these separate grades of diesel are properly segregated to prevent their cross-contamination, and to avert misfueling at the pump. Moreover, the costs associated with upgrading a truckstop to provide both grades of highway diesel would prove to be an unrecoverable expense as the use of these two diesel fuels would be temporary.

The enormous expense required to re-configure a truckstop, over $100,000 per location in many cases, would result from the need to purchase additional storage tanks to segregate the second grade of diesel; the need to tear up concrete for additional tank installation and the requisite re-piping and re-manifolding of tank lines; the purchase of new pumps and monitors, as well as additional compliance expenses which would result from the presence of two highway diesel fuels; not to mention the increased cost to acquire product.

These costs would be extremely prohibitive, unrecoverable due to the temporary use of two fuels in the market, and would need to be borne by an industry which largely consists of small independent owner/operators who are still recovering financially from the 1998 underground storage tank upgrades. The introduction of a second grade of highway diesel could therefore force many truckstop operators out of business, and have the additional effect of further reducing diesel fuel supply.

It is important to note that the entire distribution chain for diesel would face increased costs and expense under a phase-in, further exacerbating the truckstop industry's ability to easily acquire and sell diesel at the retail level. Refineries, pipelines, bulk plants, distributors, and marketers have all stated their concerns with, and opposition to, phase-ins which would result in two grades of highway diesel.

The presence of two grades of highway diesel under these phase-in scenarios would also seriously call into question the viability and success of this entire proposal, thereby resulting in no gain for air quality or the environment.

The distillate market is very tight, with little or no additional supply. Adding an additional grade of highway diesel will further stretch this supply to dangerous levels, and could result in overall supply shortages of diesel fuel. Likewise, the increased costs associated with producing, distributing, and selling two grades of fuel may prompt some to stop distributing or carrying diesel altogether, further reducing supply and availability. Furthermore, two grades of highway diesel will also lead to a much higher price for the new ultra-low sulfur fuel than if that fuel was the only highway diesel in the market, as would be the case if the entire diesel fuel pool was switched at one time with no phase-in.

As a result of these serious market-oriented questions concerning the supply and price of the ultra-low sulfur diesel under a phase-in approach, it is quite likely that many fleets and independent drivers would decline to purchase the more expensive 2007 model year vehicles with the emission control devices. These vehicles would also require a much more expensive fuel under a phase-in. These fleet operators and independent drivers may prefer to make their purchases earlier, such as buying more vehicles in the 2005 or 2006 model year, and/or rebuilding current vehicle engines, in an effort to wait and avoid entering what would be a very uncertain market.

Accordingly, under a phase-in and the market uncertainty which it would produce; even if some ultra-low sulfur diesel supply is somehow guaranteed, there is no guarantee that sufficient demand will exist for either the "cleaner" 2007 model year vehicles, or the ultra-low sulfur fuel needed to power them. This fact calls into serious question the ability of this proposed rule to succeed under a phase-in, and consequently, whether or not any significant environmental benefits would be achieved.

Compounding these serious issues surrounding EPA's consideration of a phase-in for the introduction of the ultra-low sulfur fuel are the extreme cuts EPA has proposed in the level of sulfur in highway diesel. EPA is proposing a 97 percent reduction in the sulfur content of on-road diesel. The travel plaza and truckstop industry has serious concerns that this deep cut will have the effect of reducing the overall supply of diesel, and lead to spot outages and severe price spikes. Furthermore, it does not appear that EPA has provided any compelling technical justification for a cut of this magnitude.

The petroleum industry however, has stated its support for a 90 percent reduction in sulfur levels, which would reduce the sulfur content of highway diesel from 500 parts per million to just 50 parts per million. Such a reduction would apparently allow for virtually the same environmental benefits to be achieved, while at the same time ensuring that our nation's energy supply and delivery system is not put at risk.

CONCLUSION

NATSO would like to reiterate the travel plaza and truckstop industry's support for efforts to improve air quality, without placing our nation's energy supply and delivery system in jeopardy. In order for this proposed rulemaking to achieve those very important goals, it must not damage our nation's diesel fuel supply, distribution, or retail infrastructures.

The phase-in schemes being contemplated in this proposed rule by EPA would place the entire diesel fuel delivery system at risk by placing excessively costly and burdensome requirements on refiners, pipelines, distributors and retailers. This entire system is currently configured to handle a single grade of highway diesel, not two.

The travel plaza and truckstop industry, a critical link in the movement of goods and services throughout our nation, would be hurt tremendously by these phase-in schemes, and urges EPA to reject their further consideration in favor of the single fuel approach which would switch the entire highway diesel fuel pool over to the ultra-low sulfur diesel at one time, thereby maintaining a single grade of on-road diesel, and preserving the integrity of our nation's diesel fueling infrastructure.

NATSO again thanks the Subcommittee for holding this important hearing, and for the opportunity to comment on EPA's Notice of Proposed Rulemaking concerning Heavy Duty Engine Standards and Control Requirements on the Sulfur Content of Highway Diesel Fuel.

April 6, 2000.

Hon. BARBARA BOXER,
U.S. Senate,
Washington, DC.

Dear SENATOR BOXER: As representatives and supporters of the biomass ethanol industry in the United States, we would like to express our gratitude for your support of this important new industry. We appreciate that you have advocated through legislation a solution for the MTBE groundwater contamination problem in California. However, we do not believe that the banning of MTBE will by itself ensure that biomass ethanol will be used in the U.S. We are very pleased that this Administration has recently announced that it will support increased use of renewable fuels to aid in the replacement of MTBE in gasoline. We are writing to underscore our

belief in the need for biomass ethanol incentives and their importance both to California and the nation.

As you know, MTBE has now been detected in groundwater and drinking water nationwide. The seriousness of this problem has provoked widespread debate about the national oxygenate standard and renewable fuels incentives. The outcome of this debate promises to have significant impacts on the nation's domestic ethanol industry, particularly the U.S.'s nascent biomass ethanol industry.

Because of its newness and to ensure that the full benefits of biomass ethanol are realized, specific incentives are needed for biomass ethanol. The incentives will provide prospective ethanol producers and investors with the certainty required to expand production capacity on an expedited timeline.

We would like to assure you that there is ample biomass ethanol capacity now planned to meet the expected future ethanol demand in California. Biomass ethanol will use waste as its feedstock, i.e., agricultural and wood residues, and the non-recyclable cellulose component of municipal solid waste. The world's first two biomass ethanol plants will be located in Louisiana and New York, using sugarcane bagasse and municipal solid waste, respectively. They are expected to begin producing ethanol in early 2002. Two additional biomass ethanol production facilities in California are slated for production in late 2002 and 2003, one located in Gridley/Oroville, using rice straw and wood waste as feedstock, the other in Chester, using wood waste. Another biomass ethanol plant in southern California using municipal solid waste is slated for production in the next several years.

All of these plants are expected to expand their capacity soon after completion of the initial biomass ethanol plant. This capacity, coupled with other bioethanol plants in the planning stages, is more than adequate to sustain the growth needed for future California ethanol demand.

Biomass ethanol plants will be very energy efficient as well as cost-effective due to breakthrough technologies. According to Argonne National Laboratory, they will produce approximately 4 units of energy for every 1 unit used to produce biomass ethanol. In addition, biomass ethanol will expand value-added markets for rural communities.

It is apparent to us that without renewable fuels incentives, oil companies will rely mostly on petroleum-derived alternatives such as alkylates, and even worse, increased aromatics. This would result in increased gasoline prices, reliance on imported oil, and pollution, particularly carcinogenic toxic emissions.

We believe now is the time to develop a truly national renewable fuels industry, acting as an insurance policy against future gasoline price spikes in the U.S. due to our over-dependency on foreign oil, while abating MTBE groundwater contamination. We are grateful for your committed and continued leadership on this issue. Please let us know how we may further assist your efforts.

Sincerely,

Megan S. Smith, Co-Director
American Bioenergy Association
Washington, DC

J.R. Miller, Chief Operating Officer
Arkenol, Inc.
Mission Viejo, CA

Stephen J. Gatto, President and Chief Executive Officer
BCI Gridley, LLC
Gridley, CA

Russell Long, Executive Director
Bluewater Network
San Francisco, CA

California Farm Bureau Federation
Sacramento, CA

Robert Herkert, Manager of Environmental Affairs
California Rice Commission
Sacramento, CA

Thomas Sanford, Mayor Pro-tem
City of Gridley
Gridley, CA

Jack Sivertson, Vice President
Collins Pine Company
Chester, CA

Michael J. Greene
Community Development Services, Inc.
Sacramento, CA

Carol Werner, Executive Director
Environmental and Energy Study Institute
Washington, DC

Jack Huttner, Vice President
Genencor International
Palo Alto, CA

George Craig, President
HFTA
Oakland, CA

Daryl Harms, Chief Executive Officer
MASADA
Birmingham, AL

Paul Wood, Director of Wood Projects
Ogden Power Pacific, Inc.
Redding, CA

Neil Koehler, Founder
Parallel Products
Rancho Cucamonga, CA

Eric Vaughn, CEO/President
Renewable Fuels Association
Washington, DC

Betty Riley, President
Sierra Economic Development District
Auburn, CA

Loyd Forrest
TSS Consultants
Rancho Cordova, CA

COMPANY DESCRIPTIONS OF SENATOR BOXER LETTER

American Bioenergy Association.—ABA is a national trade organization representing the U.S. biomass industry in areas of biomass conversion to ethanol, electricity and chemicals. In helping to carry out the goals of the biomass industry, ABA works closely with environmental groups, and State/local and Federal governments in advancing the environmentally friendly use of biomass in the U.S. and abroad.

Arkenol.—Arkenol is a technology and project development company based in Mission Viejo, CA, whose focus is the construction and operation of biorefineries to produce a variety of biobased chemicals and transportation fuels from their patented technology. Arkenol has a bioethanol pilot plant in S. California, where they are also planning on building a commercial scale bioethanol plant using the cellulose wastestream from municipal solid waste.

BCI Gridley, LLC.—BC International Corporation is a company commercializing its proprietary and patented technologies to produce ethanol and other specialty chemicals from biomass. The company has signed a letter of intent with the city of Gridley, CA, to develop a facility using rice straw and wood chips as its feedstock, providing a creative solution to the region's rice waste disposal problem. Working with Ogden Power Pacific, BCI is planning on co-locating a bioethanol plant at Ogden's Oroville biomass power plant site, increasing the efficiency of both plants.

Bluewater Network.—Based in San Francisco, Bluewater Network is a national environmental organization focused on protecting public waters, lands, and ecosystems. Bluewater has taken the lead on an MTBE/Clean Fuels Campaign aimed at ridding the Nation of MTBE use, while promoting cleaner alternatives such as biomass ethanol.

California Farm Bureau Federation.—The California Farm Bureau is California's largest farm organization. It is a voluntary, non-governmental, non-partisan organization of farm and ranch families seeking solutions to the problems that affect their lives, both socially and economically.

California Rice Commission.—The CRC is a private, non-profit "business league" representing all rice producers in the State of California, including the Rice Straw Cooperative of Butte County. This cooperative, which is an equity partner of the Gridley bioethanol project, organized itself to provide rice straw feedstock to the Gridley project. The CRC's mission is to encourage the profitable production and marketing of California rice, ensuring that the industry is accurately and fairly represented.

Collins Pine Company.—This is a family-owned forest products company with a strong commitment to sustainable forestry, winning President Clinton's 1996 "Sustainable Development" award. Also, Collins' CEO, Jim Quinn, won the Green Cross Millennium for Corporate Environmental Leadership Award from President Gorbachev. They foster strong partnerships with visionary companies, scientists, and environmentalists who are willing to work to achieve a sustainable society. In 1998, BCI and Collins Pine Company agreed to begin development of a biomass ethanol and co-generated electricity project in Chester, CA, using wood residues.

Community Development Services, Inc.—CDS is a for-profit public interest research and advocacy-consulting group located in Sacramento, CA, which works principally on land-use and rural development issues.

Environmental and Energy Study Institute.—The Environmental and Energy Study Institute (EESI) is a non-profit organization dedicated to promoting environmentally sustainable societies. EESI carries out policymaker education and analysis projects in the areas of energy efficiency and renewable energy, transportation, sustainable communities, water quality and conservation, global climate change, fiscal policy and military base cleanup.

Genencor International.—A worldwide industrial biotechnology company, Genencor develops and manufactures a variety of novel enzymes, biochemicals and specialty chemicals, all focused around industry sustainability. Most significant to the bioethanol industry is their work in producing cost affordable cellulase enzymes,

which are needed to bring down the cost of bioethanol in the future. Their technology center is located in Palo Alto, CA.

HFTA.—HFTA, representing their "hydrolysis fermentation technology", is located in Oakland, CA. HFTA has patented a technology, which converts cellulosic biomass into ethanol, and is working closely with DOE's National Renewable Energy Laboratory on analyzing this promising process for future use in a bioethanol industry.

Masada Resource Group.—Masada is a competitive and environmentally responsible provider of waste disposal services to address today's environmental issues. Through the development of its patented process, Masada and its affiliates are in the business of processing and converting municipal solid waste, sewage sludge and waste water into fuel ethanol and industrial by-products. They are about to begin construction on a facility in Middletown, New York which will produce ethanol using components of municipal solid waste as its feedstock.

Ogden Power Pacific, Inc.—Ogden Power is a leading developer, owner, and operator of independent power facilities internationally and provides related infrastructure services. The company is divided into four key business lines including: independent power, waste-to-energy, water treatment, and environmental services. Ogden Waste to Energy, Inc. designs, builds, owns and operates 28 waste-to-energy facilities. Each of its 28 operating projects represents Ogden's commitment to the future to help solve the solid waste and energy challenges faced by communities. Pacific Oroville Power, Inc., is working with DOE on a feasibility study for the biomass ethanol plant in Chester, CA.

Parallel Products.—Parallel Products is currently California's only ethanol producer, owning a 6 million gal/year plant in Southern California. Parallel Products has been producing ethanol from waste products for the last 15 years.

Renewable Fuels Association.—RFA is a national trade association representing the U.S. ethanol industry. Membership includes ethanol producers, marketers and blenders, equipment manufacturers, engineering and design companies, agri-business organizations, and members of consumer and environmental groups.

Sierra Economic Development Committee.—SEDD is a regional non-profit company that facilitates business and economic development in the California counties of El Dorado, Placer, Nevada and Sierra. SEDD's vision is a thriving economy that values the natural environment. They are interested in pursuing the possibility of building a biomass ethanol plant in their area.

TSS Consultants.—Providing consulting services to biomass project developers, owners, operators, investment banks and public agencies, TSS develops new biomass facilities as well as evaluation of existing biomass facilities, including conversion of biomass to power, ethanol and chemicals, specifically on environmental permitting, forestry consulting, biomass market assessments, regulatory agency negotiations and project feasibility studies.

[From the Des Moines (IA) Sunday Register, September 19, 1999]

THE REGISTER'S EDITORIALS

LET ETHANOL PROVE ITSELF

Iowa farmers need help, but coercion at the gas pump is wrong.

The price of corn is low, and Iowa farmers are hard hit.

So here's the deal: Let's prohibit the sale of wheat bread. From now on, only corn bread should be allowed on Iowa grocery shelves. It might help boost the price of corn.

Hog farmers are struggling, too. Why not ban the sale of other meats so that Iowans can eat nothing but pork?

No?

Well, how about requiring that most gasoline sold in Iowa be blended with corn-based ethanol?

That's an idea that has the backing of the governor and state agriculture secretary as well as Iowa's two U.S. senators.

But that doesn't make it right.

Ethanol is good for Iowa. It creates an additional market for corn. It is an alternative fuel from a renewable resource. Iowa politicians are right to promote ethanol and to provide a tax break until the industry can stand on its own feet. They are right to fight the oil lobby in its efforts to rob ethanol of its market and take away its subsidy.

Promotion is one thing. Coercion is another.

An ethanol mandate would deny Iowans a choice of fuels and short-circuit the process of ethanol establishing its own worth in the marketplace. Except in places where smog problems dictate the use of an oxygenated fuel, what's the rationale for mandating ethanol?

The justification is to marginally boost the price of corn. Cleaner air is offered as a reason, too, but that's an afterthought. If that were the goal, other measures would be far more effective: outlawing SUVs, for instance, or quadrupling the gasoline tax.

Ethanol is not recommended for some small engines on lawn mowers, snowblowers. boats, auxiliary generators and the like. Then, too, lots of Iowans drive older vehicles or use older equipment with components that may not have been engineered to use ethanol, as newer vehicles are: Why put these people through a hassle to find the non-ethanol fuel their equipment requires?

One convenience-store chain used to advertise free repair for any engine damaged by the use of its gasoline. If the State insists on mandating the use of ethanol, perhaps it should make the same offer. Better yet, let Iowans make their own choices, and let ethanol prove itself in the marketplace.

[From the Quad City Times, September 19, 1999]

EDITORIALS

A NEW SUBSIDY: MORE FUEL ON THE FIRE

ETHANOL-ONLY PROPOSAL DOESN'T HELP CONSUMERS

Chuck Grassley and Tom Harkin may have the best of intentions, but their proposal to boost ethanol use in Iowa is seriously misguided.

The two U.S. senators have signed a petition asking Iowa Secretary of Agriculture Patty Judge to require that Iowa service stations sell only ethanol-blended gasoline. Ethanol, as most Iowans know, is a fuel derived from a mixture of gasoline and corn-based alcohol.

Harkin and Grassley, of course, are longtime supporters of ethanol. They know that its use is good for Iowa corn farmers and that it reduces the nation's reliance on foreign oil.

But that's only half the story. Federal subsidies of ethanol now cost American taxpayers more than $770 million a year in lost revenue—largely because of ethanol's exemption from federal fuel taxes. The Congressional Research Service says that figure could reach $1 billion by next year.

And mind you, that subsidy isn't putting more money in the pockets of farmers. The real beneficiaries of the ethanol subsidy are conglomerates like Archer Daniels Midland Corp. that convert the corn into ethanol. The Cato Institute estimates that every dollar of profit now earned by ADM's ethanol operation is costing taxpayers $30 in lost revenue. That's because in addition to the federally subsidized production of ethanol, ADM also has received millions of dollars worth of free corn from American farmers, courtesy of the Department of Agriculture.

Are farmers the co-beneficiaries of the ethanol subsidy? Yes—but not to the extent that some would argue. Subsidized ethanol production does guarantee corn farmers a higher price for their product, but that penalizes hog farmers and cattlemen since more than half the nation's corn crop is used domestically for feed grain.

As for claims that ethanol helps the environment, the National Academy of Science, the Congressional Budget Office, the Department of Energy and even the USDA have each reported that ethanol, which is less efficient than gasoline, provides no significant environmental benefit and may even add to air pollution—which is why ethanol use was restricted in the EPA-proposed rules first issued in conjunction with the Clean Air Act of 1992.

None of this is to suggest that Grassley and Harkin are wrong to support the subsidization of ethanol at a more reasonable level—only that there is an abundance of evidence that indicates ethanol is not all that it's cracked up to be. Not for consumers, not for the environment and not for farmers. With research and continued refinements, it might someday become an economically viable alternative to gasoline—but until that day, it would be ludicrous to argue that Iowa's gas stations be required to sell only ethanol.

Such an arrangement would infringe on the rights of thousands of Iowa businessmen and put service stations in border communities such as the Quad Cities at a competitive disadvantage with gas stations in neighboring States. It also would take

government subsidization of ethanol to a whole new level, essentially forcing Iowans to buy a product that already is costing them money through lost tax revenues.

The game is rigged as it is. With their million-dollar subsidies, ethanol producers are playing against their competition with loaded dice and marked cards. If they're still losing—to the extent that lawmakers are proposing the outright elimination of the corpetition—that's a sure sign that ethanol is not a product that consumers are ready to embrace.

Ethanol might be worth some level of government support, but it level will be so valuable as to justify scrapping our system of free enterprise.

STATEMENT OF RUSSELL LONG, PH.D., EXECUTIVE DIRECTOR, BLUEWATER NETWORK

It is an honor for me to present comments to you today as you evaluate the role of ethanol fuels. Bluewater Network believes now is the time to definitively address the problem of water pollution by MTBE and other ether-based fuel oxygenates. It is also a time of opportunity in terms of increasing our use of clean, renewable fuels. Americans can have both clean air and clean water—without promoting one at the expense of the other. We believe the best way to accomplish this is to take immediate action to ban MTBE and other ether-based oxygenates, and to prevent backsliding on air quality and promote use of renewable fuels by simply retaining the oxygen requirement in reformulated gasoline. Alternatively, it's possible air and water quality could be protected through implementation of a good renewable fuels standard and substitution of performance standards for the oxygen requirement—as long as they are crafted in a way that protects the real-world benefits of oxygenated reformulated gasoline. However, I should note that Bluewater Network is extremely skeptical that non-oxygenated fuels will be able to match the real-world environmental benefits of oxygenated fuels.

Over the last 10 years, it has become clear that oxygenated gasoline has afforded significant air quality benefits. However, the program is now in jeopardy because of a nationwide water quality problem from the use of the oxygenate called methyl tertiary butyl ether (MTBE). MTBE's use has led to serious contamination of U.S. water supplies ever since its introduction. In some cases this contamination is severe. For example, all of the water in Glendale, California is contaminated with MTBE at such high levels that it has virtually destroyed a community. The town has become practically deserted, and the State has to truck in clean water every week to the remaining residents. Once MTBE gets into water supplies, it is extremely difficult and expensive to clean up. In Santa Monica, California, alone, cleanup costs for MTBE-contaminated water are projected in the 100 million-dollar range. National cleanup costs are projected to be much higher and may take decades to accomplish.

Other ether-based fuel oxygenates such as ethyl tertiary butyl ether (ETBE), tertiary amyl methyl ether (TAME) and diisopropyl ether (DIPE) are of equal concern. These chemicals have physical characteristics very similar to MTBE, and are essentially unstudied. We do know, however, that they have similar systemic toxicity in animals and may be carcinogenic.

In essence, the use of WTBE and other ether-based oxygenates has traded water quality for air quality. Banning MTBE and other ether-based oxygenates is the logical next step in rectifying this problem. However, such a ban does not necessitate lifting the oxygen content requirement of the Clean Air Act Amendments of 1990. In fact, we believe the most effective strategy to protect the existing real world benefits of reformulated gasoline is to maintain the oxygen requirement. Without the use of oxygen in gasoline, there will be an immediate reduction in gasoline volume from the loss of those oxygenates, resulting in increased demand for petroleum fuels and other octane enhancers to make up the difference. Consequently, refiners will increase aromatic and alkylate levels in gasoline, which will lead to increased hydrocarbon and toxics emissions such as benzene, and potential increases in use of the highly toxic hydrofluoric acid for alkylate production. Loss of oxygen's benefits will also lead to quantified backsliding on carbon monoxide and particulate matter emissions.

In the event that you consider eliminating the Clean Air Act's oxygen requirement, Bluewater Network would support such a change only if a renewable fuels standard is established with specific provisions that maintain the existing, real-world air quality benefits of the oxygen requirement in reformulated gasoline. For example, it would be crucial to enact an aromatic cap, and ensure that there is no increase in emissions of carbon monoxide, particulate matter, hydrocarbons, or toxics. However, as I said before, we believe the positive impact of oxygenates is so significant that it will not be possible to achieve equivalent environmental protec-

tion without their use. Additionally, we would want to see incentives for ethanol produced from biomass and organic crops.

I would now like to give you more detailed background on each of the issues I've raised.

WATER QUALITY IMPACTS OF MTBE

First, I'd like to talk about some of the problems with MTBE, and its impact to our nation's water quality.

As you know, the Clean Air Act of 1990 required the addition of oxygenates to reformulated gasoline to reduce the production of toxic by-products of fuel burning. Unfortunately, the oil industry has chosen to use MTBE over other oxygenates such as ethanol in over 85 percent of reformulated gasoline.

The physical properties of MTBE make it extremely easy for the substance to pass from gasoline to air and from gasoline to water. Additionally, MTBE does not naturally degrade in water. As a result, it travels through and contaminates water faster than all other components of gasoline. Evidence shows that even state-of-the-art underground storage tanks have leaked MTBE.

The EPA has classified MTBE as a "possible" human carcinogen. It is on the EPA's "contaminant candidate list," as well as EPA's Drinking Water Priority List for future regulation. Few studies have been conducted regarding human ingestion of MTBE in drinking water. However, the confirmed major human metabolites of MTBE are tertiary butyl-alcohol (TBA) and formaldehyde, "probable" human carcinogens, and confirmed immune system suppressants.

In 1999, UC-Davis warned that to protect all drinking water consumers from cancer risk, MTBE concentrations should not exceed 5 ppb. However, no technology is currently available to prevent such low levels of MTBE contamination. Stricter control of automobile emissions, underground storage tanks and two-stroke engines cannot prevent this level of contamination.

Over 40 percent of the U.S. population currently live in areas where MTBE is used. At current rates of MTBE market expansion, this figure could grow to 80 percent within a few years. A recent article in the American Chemical Society's Environmental Science and Technology estimated that 35 percent of community supply wells in 31 States could already be contaminated with MTBE (based on their proximity to leaking underground storage tanks).

EPA's Toxics Release Inventory (TRI) for 1996 indicates that the total annual industrial release of MTBE in the United States was 3.4 million pounds (3.1 million pounds into the air; only 100,000 pounds to surface water). However, this does not even account for two-stroke engine emissions. The Bluewater Network estimates that two-strokes account for more than eight million pounds of MTBE annually—this figure exceeds the EPA total for all sources combined, and increases the annual MTBE release into surface (and drinking) water exponentially

A single personal watercraft can dump up to 6 gallons of raw fuel into the water in 2 hours. At this rate, a single jet ski releases one-tenth of a gallon (a soda can) of MTBE into the water in two hours. This amount of MTBE can contaminate 13 million gallons of drinking water, the amount consumed daily by a population of 90,000. Evidence suggests that MTBE is finding its way from marine recreation vehicles into water reservoirs. The Association of California Water Agencies reports that 14 out of 15 reservoirs studied that permit motorized recreation contained significant levels of MTBE. On the other hand, none of the eight reservoirs tested that prohibited motorized recreation contained significant levels of the compound. Further studies in Donner Lake, Lake Tahoe, and San Pablo Reservoir have clearly linked two-stroke marine engine emissions to MTBE levels in excess of primary health standards.

Unfortunately, MTBE appears to be reaching human populations. Various State Centers for Disease Control and Prevention report MTBE levels in human blood where MTBE is used in fuel, ranging from less than 0.05 ppb to 37 ppb in residents tested.

However, what concerns Bluewater Network most is that the contamination appears to be growing exponentially, and the fact that no drinking water plant in the United States is currently designed to treat drinking water for MTBE. Traditional methods used for other hydrocarbon contamination are simply not effective. Even so, many States are only beginning to realize the extent of their MTBE problem. By the time individual States know that they have problem, quantify the impact of MTBE on their water supplies and economy, and push an exemption request through intensive opposition from the oil industry, it will be too late and very costly. This makes a national ban essential.

As I mentioned before, because other ether-based fuel oxygenates such as ethyl tertiary butyl ether (ETBE), tertiary amyl methyl ether (TAME) and diisopropyl ether (DIPE) maybe of just as much concern, any ban of MTBE should include these other ether-based oxygenates as well.

AIR QUALITY IMPACTS OF NON-OXYGENATED GASOLINE

Now I'd like to turn to the air quality impacts of losing the oxygen requirement without substitution of a renewable fuels standard with good anti-backsliding language to ensure maintenance of air quality in reformulated gasoline areas.

Aromatics

First of all, if the oxygen requirement is removed or waived, refiners will need to replace the octane benefits provided by oxygenates. One way is to dramatically increase aromatics—a dangerous component of gasoline. Currently, there is no national cap on aromatics, despite the fact that the dangers of increased aromatics are well documented and far reaching. Their increased use will directly cause higher emission of all of the primary air pollutants emitted by vehicles in the U.S. across the board, including increases in ozone and toxic emissions.

It is natural to assume that refiners might use ethanol to comply with any tougher performance standards that are implemented to replace the oxygen requirement (a legislative option some have promoted). However, history shows that refiners choose instead to increase aromatics, in order to consolidate inherent competitive advantages created through increased oil production.

Alkylates

In addition to aromatics, alkylate use may be increased for octane benefits. For instance, California has a cap on aromatics, so refiners will probably choose alkylale octane enhancers. We have reason to expect that some refiners producing for other States' reformulated gasoline areas will also increase their use of alkylates.

Increased alkylate use could jeopardize public health. Dr. David Rice, who let the 14 member team at Lawrence Livermore Labs that concluded there was NOT a significant water quality problem with ethanol, raised a serious concern about increasing alkylates. Presenting before the California Air Resources Board in January 2000, Dr. Rice indicated that because there are no public health studies on the increased use of alkylates, increasing their use could threaten public health. Bluewater Network contends that a doubling or more of alkylates in gasoline—about which we know almost nothing—is eerily similar to the MTBE mistake made years ago.

In addition to potential increased air pollution risk from the use of alkylates in gasoline, chemicals used to produce alkylates could themselves put public health at risk. At the current time, a significant portion of the nation's refineries use hydrofluoric acid in their alkylation process. Accidental releases of hydrofluoric acid vapor—which is highly toxic and even lethal—could seriously endanger communities near refineries.

If alkylates double in gasoline as predicted, Bluewater Network is concerned about increased transportation and use of this extremely hazardous acid. Bluewater Network believes that hydrofluoric acid alkylation is the most likely and technically feasible process to produce alkylates for gasoline sold in California. The rest of the nation could more easily use alkylates produced with sulfuric acid instead of hydrofluoric acid, but with significant existing capacity set up for hydrofluoric acid, it is likely that increased alkylate demand will lead to increased utilization of this process. Bluewater Network urgently believes further study of potential changes in refinery alkylate production is necessary before committing to legislation or regulatory action that will increase the use of non-oxygenated fuels.

Carbon monoxide

Another air quality concern for us is carbon monoxide. Although oxygenated reformulated gasoline was not specifically designed to reduce carbon monoxide pollution, this is one of its real world benefits. Bluewater Network's analysis demonstrates that without oxygen in reformulated gas, severe carbon monoxide backsliding will occur. The Appendix of the California Air Resource Board's new fuel regulation demonstrates that Phases 3 RFG will cause an increase of 250–590 tons per day of carbon monoxide emissions in California. These are very significant numbers, and will cause serious air quality problems in California in future years. Similar backsliding can be expected elsewhere in the Nation.

In addition, USEPA Federal Ozone Workshops conclude that the current method of estimating ozone seriously underestimates carbon monoxide's role as an ozone precursor. For this reason, EPA sent a Notice of Proposed Rulemaking to OMB in

February 2000, requesting the addition of a carbon monoxide credit to ethanol for reducing ozone—something Bluewater has been requesting of EPA for over a year.

When the effects of high emitters, off-cycle driving, and off-road engines are included—engines that produce the majority of total vehicular emissions—it's clear that oxygenates have tremendous beneficial impacts. However, many regulators, and even the National Research Council acknowledge that their studies have neglected to include an analysis of all of these categories. As a result, we believe that moving to non-oxygenated reformulated gasoline will cause severe increases in carbon monoxide, and therefore, future air modeling, legislation and regulations must take carbon monoxide into account.

Particulate Matter

Particulate matter is also of concern to us. One of the California Air Resources Board's (CARB) major arguments for a waiver from the oxygen standards was based on obtaining particulate matter reductions to meet Federal standards. In other words, CARB argued that oxygenates actually harm their ability to reduce particulate matter. Bluewater Networks takes issue with this assumption.

A study conducted by the Colorado Department of Public Health and Environment showed that gasoline containing a 10 percent ethanol oxygenate significantly reduces emissions of primary particulate matter. In fact, Colorado currently has a 15 percent particulate matter emissions credit for 10 percent ethanol fuel blends, due to evidence of significant reductions in particulate matter emissions for on-road and off-road engines with this fuel.

According to CARB's own data, off-road vehicles account for 80 percent of particulate matter emissions from gasoline engines in California, yet inexplicably, they are not even included in CARB's final analysis. Unlike the State of Colorado which provides significant particulate matter credits for off-road vehicles, GARB conveniently discarded the whole category to arrive at its unusual conclusion that oxygenates increase particulate matter. Bluewater Network contends that if the oxygenate waiver California asked EPA is granted, particulate matter will increase in California, not decrease, as a result of this very serious oversight. We do not want to see elimination or waiver of the oxygenate requirement, which would allow other States to go down this dangerous path.

Hydrocarbons

Hydrocarbons are yet another concern. The proposed regulations for California's Phase 3 reformulated gasoline offer a projected 0.1 percent reduction in hydrocarbon emissions in comparison to Phase 2. Although such a reduction promises to maintain the existing benefits of Phase 2 on paper, Bluewater Network believes that it is extremely unlikely that refiners will produce fuels in the real world which maintain this hydrocarbon emissions reduction. The regulation itself does not ensure that refiners will produce fuels clean enough to maintain this projected emissions reduction.

As I said before, in the event that you consider eliminating or allowing State-by-state waivers of the Clean Air Act's oxygen requirement, Bluewater Network would support such a change only if a renewable fuels standard is established with provisions that maintain the existing, real-world air quality benefits of the oxygen requirement. It would be crucial to enact protections such as an aromatic cap, and ensure that there is no increase in emissions of carbon monoxide, particulate matter, hydrocarbons, or toxics. A ban on additional hydrofluoric acid alkylation capacity is also essential.

Global Warming Benefits of Renewable Fuels

Now I'd like to address the issue of global warming. Most major research labs and universities currently studying ethanol agree that corn ethanol probably reduces global warming impacts. The most recent work done by Argonne National Labs, the Department of Energy, the Department of Agriculture, and the Institute for Local Self-Reliance have shown net reductions in global warming gases from corn ethanol ranging from approximate 15 to 25 percent. Argonne National Labs informed Bluewater Network recently that in their opinion, even obtaining just two or three percent reductions in greenhouse gases from corn ethanol "is significant" and should not be discounted in the climate change debate.

Biomass ethanol represents an even more valuable industry with which to combat global warming. In addition, it actually utilizes waste from other sources, Such as municipal waste, forest thinnings from fire prevention programs, and rice straw which is otherwise burned—causing its own air quality problems.

For these reasons, we believe that substituting MTBE with ethanol, with additional incentives for biomass, could have significant benefits for reducing global warming impacts. We see several ways the environmentally beneficial biomass prod-

uct could be supported. One is ensuring geographical and temporal disbursement of ethanol demand—because these two factors help biomass more successfully compete with corn ethanol in areas where corn is not grown, such as California, Texas, and New York. Another is including a biomass credit, on the order of 1.5 to 1.0, in any renewable fuels standard.

Environmental and Economic Issues Related to Increased Ethanol Use

I'd like now to address some environmental and economic issues related to the increased use of ethanol in reformulated gasoline areas.

Bluewater Network recognizes the need for a thorough study of the environmental and economic issues surrounding increased use of renewable fuels as an oxygenate replacement. This study should examine the pros and cons of renewable fuels production and use, as well as the pros and cons of alternative fuel scenarios, such as the increased use and production of petroleum or other octane and oxygen additives if we move to non-oxygenated fuel. Even so, we believe that the currently available data indicate that ethanol will be an environmentally and economically positive choice.

Fuel Prices

Recent data suggest that ethanol could completely replace MTBE within three years, and that gas prices at the pump would not rise significantly. In California, where very little ethanol is produced, the California Energy Commission predicts virtually no cost increases with ethanol over the long term. Short-term prices may experience mild rises. Fortunately, compared to the oil industry, the ethanol industry is far more diversified; therefore, Bluewater Network believes the renewable fuels industry may be less disposed to price gouging behavior than the oil industry. Coupled with the general increase in the numbers of fuel providers that ethanol will bring, consumers may experience greater price stability than ever before. To the extent that renewable fuels replace gasoline, further insulation from OPEC price shocks will also contribute to greater stability.

In the California Air Resources Board's request for a waiver of the oxygenate requirement, Director Kenny projected a one to two cent per gallon price increase with ethanol. Recent data suggest the opposite: on a per gallon basis, MTBE is more expensive than ethanol by as much as 40 cents per gallon. If this trend continues, replacing MTBE with ethanol or gasoline should lower prices, not raise them over the long term. Even if ethanol use were to raise prices by the one to two cents projected by CARB, this is insignificant in a market where prices can jump 40 cents in a week, which happened recently in California.

On the other end of this price debate, Bluewater Network has significant concern that the oil industry will begin price gouging when they lose ten percent of their production volume by removing MTBE. For example, when California experienced refinery fires in 1999 that reduced production by only five to ten percent, prices rose $0.50 per gallon across northern California. Today's gas prices reflect similar dynamics.

Supply

Another concern about ethanol's use as an oxygenate is supply. I'd like to address this. According to a study prepared for the 24-member Governor's Ethanol Coalition in March 2000, the U.S. ethanol industry is capable of expanding production to meet the demand for oxygenates that would result from a withdrawal of MTBE from the marketplace and continuation of the oxygen requirement. They estimate that if MTBE were phased out by 2004, ethanol demand would reach 3.2 billion gallons. By that time, the ethanol industry could produce 3.5 billion gallons. This increased capacity would come from improvements in production efficiency leading to increased utilization of existing plant; expansion of existing operating facilities; new construction in place, and from proposed facilities currently in various stages of development.

Air Quality Concerns

Some people have raised concerns about increases in acetaldehyde (a carcinogen) and peroxyacetyl nitrate (a mutagen) with use of ethanol in fuel. The California Air Resources Board has looked into this in detail, and their Urban Airshed Modeling results show no increase in emissions of these chemicals in ethanol-blended fuels versus both MTBE and non-oxygenated fuels. The workshops concluded that aromatics and other gasoline components are more responsible for acetaldehyde and peroxyacetyl nitrate emissions than is ethanol. Furthermore, which overall toxics are considered, ethanol-oxygenated fuels come out way ahead of non-oxygenated fuels.

Transportation

I'd like to address one further concern raised regarding the use of ethanol as an oxygenate: transportation, and particularly the alleged difficulty of moving ethanol in pipelines. Bluewater Network believes that this is a non-issue. Before 1992, California used significant amounts of ethanol and the "pipeline issue" was never a concern raised by oil companies using this product. Brazil has been using ethanol for thirty years and has never had a significant problem with transportation, as they pipeline the majority of the substance around the country. Piping ethanol is easily accomplished if the pipes in the line are relatively clear. If ethanol demand and supply increase, it is likely the industry will develop some pipeline capacity. In the meantime, from our data, it appears as though the oil companies will have the option to use a combination of ships, barges and trucks to transport ethanol. In addition, Argonne National Labs has assured Bluewater Network that the energy costs of transporting ethanol by truck or rail will be insignificant.

We support the idea of a life-cycle transportation study of all reasonably expected fuel scenarios. For example, life-cycle transportation impacts of ethanol should be studied and compared to the life-cycle transportation impacts of increased use of oil and other octane enhancers. To determine if environmental impacts will increase, these results should also be compared to the current transportation impacts of MTBE use.

ENVIRONMENTAL AND ECONOMIC COSTS OF OIL DEPENDENCE

Finally, no discussion of eliminating the oxygen requirement without substituting a good renewable fuels package should leave out the environmental and economic costs of oil dependence. In addition to significant backsliding on global warming and fuel cycle emissions, Bluewater Network is concerned that such a scenario would effectively result in increased oil dependence and cause economic and environmental problems.

First, reducing or removing oxygenates from reformulated gasoline will guarantee that the oil industry's control of each tank of reformulated gasoline will increase from 90 to 100 percent. Drilling for oil causes many different types environmental problems, from oil spills to loss of habitat to displacement of local people. Around the world—in the Amazon, Indonesia, Malaysia and other places—pursuit of oil is killing rainforests and the tribal people who live there. In South America, the U'wa, the Huarari, and hundreds of other tribes are being displaced from lands they've owned from time immemorial, their water polluted, their wetlands destroyed, their hunting grounds ruined, their native ways lost. From Nigeria to Columbia, the story is the same. These indigenous people deserve better from America. And now because of America's insatiable demand for oil, the oil industry wants to open the Alaska National Wildlife Refuge for drilling.

Second, the oil shipped from these areas to the U.S. travels in an aging world tanker fleet—a fleet that is responsible for 14 percent of all global nitrogen emissions, and 16 percent of all sulfur emissions from petroleum. Carnegie Mellon University concluded in 1999 that the world shipping fleet is actually changing global climate as a result of its staggering emissions over oceans.

Those same tankers—the vast majority, single hull vessels—also cause incredible damage from oil spills. Coastlines are threatened by major spills such as the *Erika*, a tanker that has shut down the fishing industry in parts of France, and which caused countless millions of dollars in damage to the environment and lost incomes and livelihoods for traditional fishermen and businesses dependent on tourism.

On the other hand, maintaining the oxygen requirement or eventually passing a good renewable fuels standard will: decrease reliance on foreign oil producers and the oil industry as a whole; diversify energy sources; cushion the U.S. against OPEC price shocks; increase national security; and decrease military reliance on protecting foreign oil supplies, the costs related to these activities. Ensuring use of renewable fuels will also help to reduce current subsidies to the farm industry and help independent farmers by increasing demand for their products.

CONCLUSION

In summary, the evidence is dear that MTBE is causing inexcusable damage to our nation's water supplies. This fuel additive is simply too dangerous for continued use. We urge you to protect our water by taking immediate action to ban MTBE and other ether-based oxygenates. At the same time, we urge you to prevent backsliding on air quality and promote use of renewable fuels through retention of the oxygen requirement. Alternatively—but only as a second choice due to our concerns that it is not technically realistic to achieve the same environmental protection with non-oxygenated fuels—we would support an MTBE ban coupled with implementa-

tion of a strong renewable fuels standard and performance standards for reformulated gasoline that preserve the real-world benefits of oxygen.

THE ENERGY JOURNAL

INTERNATIONAL ASSOCIATION FOR ENERGY ECONOMICS

IAEE

Volume 20, Number 4 **1999**

International Association for Energy Economics

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The Economics of Energy Market Transformation Programs

Richard Duke and Daniel M. Kammen***

This paper evaluates three energy-sector market transformation programs: the U.S. Environmental Protection Agency's Green Lights program to promote on-grid efficient lighting; the World Bank Group's new Photovoltaic Market Transformation Initiative; and the federal grain ethanol subsidy. We develop a benefit-cost model that uses experience curves to estimate unit cost reductions as a function of cumulative production. Accounting for dynamic feedback between the demand response and price reductions from production experience raises the benefit-cost ratio (BCR) of the first two programs substantially. The BCR of the ethanol program, however, is approximately zero, illustrating a technology for which subsidization was not justified. Our results support a broader role for market transformation programs to commercialize new environmentally attractive technologies, but the ethanol experience suggests moderately funding a broad portfolio composed of technologies that meet strict selection criteria.

INTRODUCTION

In the classic linear model of innovation, scientific research generates new technologies which industry subsequently commercializes (Bush, 1945, reprinted 1990). The causal flow runs from R&D to innovation, price reductions, and finally an increase in demand. In practice, continuous incremental innovation blurs the distinction between existing and new technologies and much useful innovation derives from the interplay between research and learning-by-doing (Arrow, 1962; Cohen and Noll, 1991; and Stokes, 1997). This complex causality, and the fact that private R&D investment often far exceeds public R&D expenditures, suggests that governments may be able to encourage innovation by "steering" market demand rather than relying exclusively on trickle-down effects from public R&D (Grubb, 1997).

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A significant economics literature addresses the possible welfare-increasing role of market interventions in the presence of learning-by-doing that spills over among firms (Arrow, 1962; Spence, 1981; and Stokey, 1986). When the benefits of learning are not appropriable, learning becomes a positive externality and firms fail to produce enough in each period to maximize efficiency over the entire production period. Moreover, as we illustrate below, output is likely to fall short of the social optimum even if spillover levels are low. This follows because proprietary learning gives incumbent firms widening cost advantages over potential entrants, allowing early entrants to exercise market power.

Specific discussion of the policy implications of these production shortfalls has been limited; nonetheless, a growing number of market transformation programs (MTPs) have emerged.[1] These programs boost demand in order to promote early commercialization of clean energy technologies which exhibit substantial learning-by-doing.[2] As such, they are creative attempts to reduce CO_2 and other emissions without the aid of energy taxes that are often politically difficult to impose.[3] In addition to displacing environmental externalities, MTPs can improve social welfare by correcting the output shortfall associated with learning-by-doing.

Despite the growing significance of MTPs, formal assessments of their impact are scarce. In this paper, we develop a dynamic benefit-cost model and apply it to the World Bank Group's Photovoltaic Market Transformation Initiative (PVMTI), the U.S. Environmental Protection Agency's Green Lights Program (GL) and the federal gasoline excise tax exemption for ethanol. PVMTI is a $30-million program that became operational at the end of 1998, GL is an on-going program that was launched in 1991 and has cost

1. Policy prescriptions have been made in support of infant industry protection against imports. Dasgupta and Stiglitz (1988), for example, identify circumstances that favor this argument. Irwin and Klenow (1994) show that infant industry arguments are not persuasive for the case of semiconductors by demonstrating that spillovers between different generations of memory chips are minimal and that there are significant international learning spillovers in that industry. The former implies that subsidies to promote learning yield only short-term benefits while the latter implies that domestic semiconductor subsidies are, at least in part, an international public good. The short-term benefits critique does not apply to the case studies in this paper and we address the international public goods issue by taking a global welfare maximization perspective.

2. The Clinton administration's Climate Change Action Plan relies heavily on a range of MTPs including the Green Lights program reviewed herein. Note that MTPs can take a wide range of forms. Krause (1996) defines market transformation to describe policies that reduce the environmental externalities associated with energy consumption via any means other than raising prices. We define MTPs narrowly as programs that attempt to commercialize new clean energy technologies by boosting short-term demand.

3. For example, in 1993, the Clinton Administration proposed a broad-based energy tax but retreated in response to a sharp political backlash. In fact, rather than optimal externalities taxes, on a global basis, fossil fuel subsidization is the rule, Gray (1995).

approximately $45 million to date, and the ethanol program has cost approximately $6 billion since it was initiated in 1978.[4] All three programs promote early and more extensive diffusion of technologies by boosting short-term demand; however, efforts to quantify their long-term market transformation impact have thus far been inadequate. Our model integrates theories of industrial learning and economic demand to address this gap, introducing a framework that should prove useful for analyzing other MTPs as well.

Our results indicate that both PVMTI and GL provide net social benefits even without accounting for environmental externalities—though the results are sensitive to parameter choice. We also show that PVMTI and GL induce substantial indirect demand effects which we define as the iterative positive feedback between increased demand and learning-induced decreases in unit costs. Accounting for these effects increases the apparent cost-effectiveness of both programs. We define the benefit-cost ratio (BCR) as the present value of the stream of benefits generated by each program divided by the present value of the stream of costs (using the initial year of each program as the present value reference point). For our base case, including indirect demand effects, the BCR is 1.54 for GL and 1.05 for PVMTI. Including a modest carbon offset benefit ($10/tC), the figures increase to 2.64 for GL and 1.16 for PVMTI.

In contrast, the BCR of the ethanol program is approximately zero. Even after 20 years of massive support, the ethanol market would collapse without the federal subsidy, thus it has yet to produce social benefits; and, if continued at present levels the program will not begin to produce net annual benefits until after 2013.

This analysis raises the possibility of a broader role for MTPs in national and international technology policies designed to promote productivity growth; however, as the ethanol program illustrates, the costs resulting from poor program design, inefficient implementation or simply choosing the "wrong" technologies could easily outweigh cost reduction benefits. It is critical, therefore, to select technologies that are characterized by: 1) excellent prospects for long-term market penetration once subsidies end; 2) the potential for relatively fast cost reductions as indicated by a favorable progress ratio and relatively low cumulative production to date; 3) elastic market demand; and, 4) public access to high-quality data about all of the above.

As underscored by the wide range of BCRs in our sensitivity analysis, the information constraint is severe. We therefore add a fifth criterion: the capacity to displace substantial social externalities (e.g., environmental or military security). This ensures that scarce MTP funds have the best odds of increasing social welfare, even if the government makes an inaccurately high

4. World Bank Group (1996) and authors' estimate based on data from USEPA (1997) and GAO (1997).

estimate of the production shortfall attributable to learning-by-doing. Similarly, this fifth criterion gives insurance against the risk that program costs prove to be higher than expected. Criteria one and five, taken together with the growing consensus that climate change is a major long-term threat, argue for prioritizing clean energy technologies—and this is our focus throughout the paper. This strategy also helps the government to protect and magnify the benefits from its investments in clean energy technology R&D.

These five conditions are restrictive. Computer processor manufacturing, for example, would do well on the second and third criteria; however, there is no clear social externality benefit from subsidizing Intel so it fails the fifth criterion. More importantly, Intel releases faster processors frequently and at varying intervals. Thus, a MTP for Intel also fails to meet the first criterion.[5] It would be difficult for the government to design a sufficiently agile MTP without having enough data to construct a reliable experience curve or knowing precisely how much time was left before the processor it was currently supporting would be displaced.[6]

For its part, ethanol failed most notably on the first count; however, it also under-performed in terms of the third and fourth criteria. All of these problems were to some extent predictable (and some would argue that the ethanol program was simply "pork barrel" politics from the start); however, ex ante information is never perfect. For example, our GL assessment is retrospective. This analysis could have been done prospectively; however, it would have been necessary to assume a value for the experience curve used for electronic ballasts. The government should acknowledge these intractable uncertainties and support a broad portfolio of technologies all of which conform to the five criteria outlined above and each one of which receives modest support. This mitigates the risk that its overall MTP effort will yield a net social welfare loss.

5. For example, the time between new generations of Intel processors has varied from one year to four years since the original 4004 processor was released in 1971.

6. The problem is compounded by the fact that Intel could strategically convince the government that the next generation processor would not be ready until after the actual planned release. Also, for each new processor Intel starts out with strong market power, but it rapidly declines as its competitors catch up. Consequently, the markup of price above marginal cost would change quickly, preventing the government from estimating the progress ratio without access to proprietary production cost data.

LEARNING AND EXPERIENCE CURVES

Learning Curve Theory

Learning curves, most narrowly defined, describe the relationship between cumulative production and the marginal labor cost of a given product manufactured by a specific firm. T.P Wright introduced formal learning curve analysis in a 1936 study of airplane manufacturing (Argote and Epple, 1990). The conceptual foundation for learning curve theory is that production experience facilitates worker skill improvements, and that benefits accrue in proportion to cumulative production. In a conventional formulation:

$$MC(q(t)) = a \cdot (q(t)/q(0))^{-b} \qquad (1)$$

where $MC(q(t))$ = unit cost given cumulative production at time t, the paramcter a = the cost of a unit at $t = 0$, the parameter $q(0)$ = cumulative production by the firm at $t = 0$, and b = the rate of innovation, or the learning parameter.[7] Note that if cumulative production is exactly one unit at $t = 0$ then Equation (1) collapses to the simple $MC = a \cdot q(t)^{-b}$ form. We define unit cost as equivalent to the discrete version of long-run marginal cost, i.e., the marginal unit cost assuming that capital investment levels are allowed to vary. Also, we assume throughout the paper that discrete units are small enough that unit and marginal cost concepts can be used interchangeably.

The underlying intuition for this exponential relationship is that there are diminishing returns to learning. Progress is fast initially, but tapers off as worker productivity becomes optimized. The equation can be linearized to facilitate ordinary least squares regression analysis:

$$\ln(MC(q(t))) = \ln(a) - b \cdot \ln(q(t)/q(0)) \qquad (2)$$

The conventional measure of learning is the progress ratio (Argote and Epple 1990, Dutton and Thomas 1984). For each doubling of cumulative production the cost per unit decreases by (1-PR) percent. The derivation is straightforward:

7. See Hirschman (1964), Argote and Epple (1990), and Badiru (1992) for variants of equation (1). Also, Arrow (1962) summarizes the early learning curve literature and adapts the theory to a model that uses cumulative capital goods investment as the learning proxy.

$$\text{progress ratio} = PR = [a(2 \cdot q(t)/q(0))^{-b}]/[a(q(t)/q(0))^{-b}] = 2^{-b} \quad (3)$$

Experience Curve Theory

During the 1970s, Boston Consulting Group (BCG) introduced the experience curve concept which generalizes the labor productivity learning curve to include all costs necessary to research, develop, produce and market a given product (Boston Consulting Group, 1972). BCG presented evidence that most of its clients benefited from a predictable percentage reduction in overall costs associated with every doubling of cumulative production. That is, BCG argued that learning-by-doing occurs not only in the narrow sense of labor productivity improvements, but also in associated R&D, overhead, advertising and sales expenses. These efficiency gains, in conjunction with the benefits from economies of scale, often yield cost reductions that can be characterized by an experience curve with the same functional form as equation (1), except that *MC(q(t))* incorporates all production costs. Dutton and Thomas (1984), compiled over 100 firm-level studies from a variety of manufacturing sectors that confirm that this is a consistently strong relationship and suggest a mean progress ratio of 80%. The authors caution, however, that there is substantial *PR* variability both within and across industries, products and processes—and they underscore that other variables also drive cost reductions.

A fundamental assumption in the experience curve functional form is that cumulative production levels drive *MC*. This is problematic to the extent that there are also economies of scale (EOS), defined as a decline in *MC* driven by an increase in the level of current production. In reality, however, EOS only explain some fraction of the observed unit cost reductions over time for any given technology, and Lieberman (1987) cites an empirical literature suggesting that learning effects typically dominate EOS in driving cost reductions. Hall and Howell (1985) argue that, in addition to economies of scale, cost reductions are driven by four factors: 1) technological progress; 2) input price changes; 3) internal efficiency improvements; and 4) learning-by-doing. They further contend that except for the last two factors "any correlation [with accumulated output] would be at least partly spurious." We acknowledge these caveats, but emphasize the broader experience curve nonetheless because of the importance of use-inspired process and technological innovations.[8] Moreover, we contend

8. Abell and Hammond (1979) use an analogous broad definition of experience while von Hippel (1988) provides evidence of pervasive user-driven innovation.

that, temporary shortages and exogenous noise aside, higher levels of cumulative production will tend to drive down key input prices (e.g., for specialized machinery) as suppliers gain production experience and reach economies of scale.

We therefore assume that, for a broad range of new technologies, cumulative industry production determines unit costs, i.e., equation (1) applies with unit cost as the dependent variable.[9] This is a critical assertion underlying both the prima facia case for MTPs and our benefit-cost analyses. The BCR estimates for our case studies will be biased to the extent that EOS (and other omitted variables such as firm-specific learning) drive unit costs. Ghemawat and Spence (1984) as well as Irwin and Klenow (1994) discuss empirical strategies for distinguishing proprietary learning from industry-wide learning; however, it is not possible to estimate economies of scale or firm-specific learning without data that are not publicly available for our cases. We can, however, at least test the sensitivity of our *PR* estimates to the inclusion of current industry production as a separate exogenous variable. While a poor proxy for firm-level production, to the extent that the number of producers and their relative shares remain stable, current industry production gives some indication of average production scale. Our data for GL and PV suggest that using cumulative production as the only independent variable is a good parsimonious model specification. For both GL and PV if we add the log of annual production to the regression model the associated coefficients are not significant (p-values of 0.496 and 0.276, respectively), the log cumulative production terms remain significant (p-values of 0.001 and 0.049, respectively), and the residual experience effects are stronger (*PR* = 0.77 vs. 0.82 and *PR* = 0.84 vs. 0.89, respectively).

The corresponding analysis for ethanol suggests that the ethanol experience curve may be spurious since current industry production is a more significant determinant of price than cumulative production. Adding log of current production reverses the sign of the coefficient on the latter (yielding *PR* = 1.32 vs. *PR* = 0.83). This suggests the true ethanol experience curve may be positively-sloped, and conforms with our negative assessment of this program. As explained below, however, we do not need the ethanol experience curve for our principal conclusions in this case.

9. For most industries unit costs approach an asymptote greater than zero, i.e., experience effects do not continue indefinitely. We do not add this complexity since we lack the data to estimate the asymptote and our analysis focuses on the early stages of production (except for ethanol which shows zero social benefits even without accounting for the possible slowing of learning).

Environmental Externalities Rationale for MTPs

Emerging clean technologies generally displace polluting substitute technologies. The true social marginal cost (*SMC*) of a clean technology is therefore:

$$SMC = MC - ME \tag{4}$$

where *ME* refers to the social cost of the fossil fuel externalities displaced by a marginal unit of the clean technology. This creates dead-weight loss (*DWL*) from under-provision of the clean technology where *DWL* is defined as foregone potential trades for which some consumer would have been willing to pay more than the true marginal unit cost. A social planner would attempt to correct this by increasing production of the clean technology to the point where demand intersects *SMC*. When more direct solutions (like Pigouvian taxes on the polluting technologies) are unavailable, this provides an uncontroversial economic case for considering MTPs that target clean technologies.

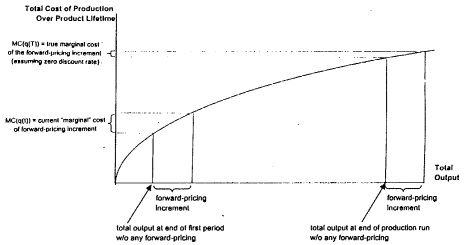
The remainder of this section develops an argument that, under a broad range of conditions, there is a prima facia theoretical case for MTPs that target any industry well-characterized by an experience curve. This rationale is independent of environmental externality considerations. We believe, however, that the uncertain costs involved with any MTP argue strongly for focusing on technologies that both displace environmental externalities and exhibit strong experience curve effects.

Experience Curve Rationale for MTPs

For certain rapidly growing markets, BCG counseled its clients to maximize long-run profits by setting current production higher than the short-run profit-maximizing level. Spence (1981) formalized this, showing that, with a real discount rate of zero and perfect information, firms maximize profit by setting marginal revenue equal to the marginal cost of their last unit of production. He called this the true marginal cost, or *MC(T)*, where *T* refers to the final time period during which the firm will produce the good in question. We denote *MC(T)* as *MC(q(T))* from equation (1) to emphasize that it represents long-run marginal cost as a function of the firm's last expected unit of production, taking

experience effects into account.[10] Figure 1 illustrates this concept using a total cost curve. When deciding how much to produce initially, a firm that has just begun producing a product should not consider its current unit cost *MC(0)*, but rather the lower cost *MC(q(T))* since that is the true cost of producing an extra unit at time 0, taking into account the entire production run from $[0,T]$. Similarly, at each subsequent time $t<T$, the firm should recalculate *MC(q(T))* and set *MR(t) = MC(q(T))* rather than equating marginal revenue with current unit cost, *MC(q(t))*.[11]

Figure 1. Forward Pricing Illustration



Note: Assuming 0% spillover and r=0% then the firm's true marginal cost at time *t* is equal to *MC(q(T))* defined as the marginal cost of final unit to be produced. Derived from Spence (1981).

10. Formally, Spence (1981) applies calculus of variations techniques to the objective function of a firm characterized by learning. He shows that the profit-maximizing output path requires that $S_x(x,t)=MC(q(t))$ for all *t*, where *MC(q(t))* refers to marginal cost as a function of planned cumulative production at the end of the time horizon being analyzed, and $S_x(x,t)$ refers to marginal revenue (net of marginal materials costs) as a function of current output level and time. If the monopolist's real discount rate exceeds zero, the true marginal cost exceeds *MC(q(T))*; however, it remains lower than the present-day marginal cost, labeled *MC(q(t))*, which excludes consideration of future experience effects.

11. We show the standard derivation of the *MR=MC* profit maximization condition for oligopolies and monopolies below. Note also that *MR(t)* allows the marginal revenue schedule to shift over time (i.e., as the demand schedule shifts) but unlike *MC*, marginal revenue is not a function of cumulative production.

The extent to which profit-maximizing firms have an incentive to pursue this strategy (hereafter called forward-pricing) depends on their ability to exclude competitors from experience benefits. A variety of mechanisms allow firms to cut costs based on their rivals' production experience. Among other channels, experience spillovers could result from hiring competitors' employees, reverse engineering rivals' products, informal contacts among employees of rival firms or even industrial espionage. For the extreme case in which spillover is complete, we define $Q = \sum_{i=1}^{N} q_i$ for N firms as cumulative industry output. We then substitute Q for q in equation (1) to obtain an "industry learning curve" or an "industry experience curve" (Figure 2). The former defines $MC(Q(t))$ as unit labor costs and therefore involves labor productivity learning only (e.g., from employee defections). The latter defines $MC(Q(t))$ as overall unit cost and therefore incorporates all forms of industry-wide learning-by-doing and economies of scale.

Figure 2. Experience Curve Terminology

	Labor Costs Only	All Product Development
No spillover	Learning curve	Experience curve
Perfect spillover	Industry learning curve	Industry experience curve

Note: This Figure shows the learning and experience curve terminology matrix.

When the benefits of learning are not appropriable due to spillover, experience becomes a positive externality (analogous to the negative externality caused by environmental pollution) and firms fail to produce enough in each period to maximize industry efficiency over the entire production period. Ghemawat and Spence (1985) refer to this as the disincentive effect. There are, however, also inefficiencies associated with imperfect spillover. Incumbent firms that benefit from proprietary or partially proprietary learning-by-doing are able to gain ever-widening cost advantages over potential entrants. This creates a barrier to entry that allows the incumbent firm or firms to set price above the level at which marginal cost intersects demand. We refer to this as the market power effect. Finally, if spillover is not complete then production costs will be higher to the extent that any given level of industry output is divided among a larger number of firms. All else equal, dividing production by N firms is inefficient if spillover is less than 100% because, for any given progress ratio and fixed total cumulative production, equation (1) yields a higher $MC(Q(t))$ as N increases. We call this the divided experience effect. Ghemawat and Spence (1985) show that for a typical industry characterized by learning or experience effects, industry output is always insufficient to achieve optimum social welfare—but not industry performance generally improves as spillover increases since reductions in inefficiency from the divided experience and market power effects dominate increases in DWL from the disincentive effect.

Our purpose in this section is to show that, divided experience effects aside, some combination of the market power and disincentive effects will generally cause output to fall short of the social optimum in every period (except T). This provides a prima facia case for MTPs to correct the shortfall.

We do not suggest designing any MTPs to address the divided experience effect directly. If a government wanted to increase market concentration to improve the efficiency with which experience accrues, it would have to try to determine ex ante which firms would reduce costs most effectively. Also, to ensure that the benefit from reducing the DWL from divided experience would outweigh the market power costs, a policy that promoted greater market concentration would have to impose expensive price-regulating bureaucracies analogous to public utility commissions.[12] Given the inherent uncertainties and costs in any such effort, it would be inadvisable to consider policies that intentionally affect market concentration in response to divided experience effects.[13]

Figure 3 illustrates the welfare implications of three cases for a hypothetical industry characterized by an experience curve: Panel a) 100% spillover, $N=\infty$; b) no spillover, $N=1$; and c) partial spillover, $1<N<\infty$. Our assumption of a univariate experience curve model implies constant returns to scale. To be consistent with this approach, we employ flat long-run marginal cost curves, denoted MC, and with long-run defined to mean that capital investment levels are allowed to vary. If experience effects were instantaneous, MC might decline slightly due to the effect on cumulative production of incremental increases in current production. We therefore assume a slight lag in experience effects to avoid uninformative complications from this second-order effect. Thus, at any given time $t \in [0,T]$, long-run marginal cost as a function of current output level is flat, but the entire MC schedule shifts down over time as cumulative output increases.

12. Petrakis et al. (1997) show an equilibrium unregulated outcome that maximizes social welfare by generating perfect competition despite learning under 0% spillover conditions. This result requires the assumption of decreasing returns to scale. We therefore ignore this case since decreasing scale economies are unlikely for our chosen technologies.

13. Kahn (1988) analyzes the circumstances under which regulated monopoly may be justified as a response to the natural monopoly conditions in industries exhibiting strong economies of scale. His analysis also highlights many of the pitfalls involved with implementing such regulation.

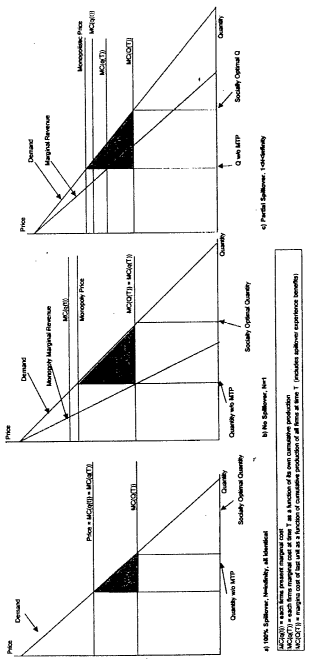


Figure 3. Welfare Illustration for Industry Characterized by an Experience Curve

Note: This Figure illustrates prima facia case for considering MTPs for technologies characterized by an experience curve, regardless of the level of spillover.

We also assume perfect information and we do not formally model strategic interactions and how they would affect market concentration over $[0,T]$.[14] Nonetheless, the cases show a representative snapshot at some time t under a range of spillover rates. In all three cases, output is less than the social optimum, and this implies DWL.[15]

Assuming an industry experience curve (100% spillover) as shown in Figure 3a, experience effects do not give incumbent firms any unit cost advantage over potential entrants despite the incumbents' lead in cumulative production. Thus, this case is consistent with perfect competition. However, with N firms, the marginal experience benefits for each one are only a $1/N$ fraction of the total marginal experience benefits. In the limit as N approaches infinity, experience becomes a pure public good and firms do not forward-price at all.

Formally

$$Q(T) = \sum_{i=1}^{N} q_i(T)$$

$$\lim_{n \to \infty} (q(T)/Q(T)) \to 0$$

Thus in this limit,

$$MC(q(T)) = MC(q(t)) \qquad (5)$$

where $MC(q(t))$ equals current unit cost excluding future experience effects. In Figure 3a, we illustrate this for $N=\infty$ such that $MC(q(T)) = MC(q(t))$ for all firms, but the essential result holds for any sufficiently large N.

A social planner would increase each firm's production to the point where demand intersects $MC(Q(T))$, defined as the MC at the end of the production period calculated by substituting $Q(T)$ into equation (1). In other words, the social planner would "internalize" the spillover externality by accounting for the benefit to all firms from each firm's experience. This policy

14. Majd and Pindyck (1989) argue that uncertainty about the level of future demand reduces the extent to which firms forward-price because producing beyond the point where $MC(q(t)) = MR(t)$ amounts to a sunk investment in future cost reductions. They acknowledge, however, that this result is partly contingent on assuming that firms can costlessly stop and start production in response to demand shocks. This uncertainty effect should not change our qualitative conclusions so we exclude it from our model for parsimony.

15. Note that the figures are not drawn to scale and the relative position of the different cost schedules, and sizes of the respective DWL areas, are not necessarily representative. Also, the figures do not depict divided experience effects.

would thereby eliminate the DWL associated with the disincentive effect.[16] Thus, as with environmental externalities, there is a clear economic rationale for considering a demand-boosting MTP for any technology characterized by an industry experience curve and 100% spillover.

In the other extreme case of 0% spillover, firms completely forward-price to maximize their profits (no DWL from the disincentive effect); however, output falls short of the social optimum because of some combination of the divided experience and market power effects. To illustrate the divided experience effect in terms of figure 3b, adding a second identical firm and splitting the same cumulative production from $[0,1]$ between them would result in higher $MC(q(t))$ and $MC(q(T))$ schedules, and corresponding losses in social welfare.

Spence (1981) formally demonstrates that if spillover is less than 100%, the first-best welfare outcome occurs when one firm produces everything and price is set equal to $MC(q(T))$ in every period. This firm would, however, take a loss in all periods but the last, and would therefore need government subsidies. Without price regulations, if N is small then firms will have market power. For $N=1$ and 0% spillover, in each period, a monopolist produces at the quantity where $MR(t)=MC(q(T))$. The use of $MC(q(T))$ rather than $MC(q(t))$ follows from the fact that experience benefits are fully proprietary, so the firm optimally forward-prices. The equality derives from the standard first order conditions for oligopoly profit maximization (for which monopoly is a special case):

Define firm i's profit as,

$$\pi_i = q_i \cdot P(Q) - TC(q_i) \quad \text{where,}$$

$$Q = \sum_{i=1}^{N} q_i \ ,$$

$P(Q)$ = inverse demand, and,
$TC(q_i)$ = firm i's total cost.

Profit maximization for each firm requires,

$$\partial\pi / \partial\pi_i = P + q_i \cdot \partial P / \partial q_i - MC_i = 0 .$$

Define,

$$P = P\left(q_i + \sum_{i \neq j} q_j\right) \text{ and thus,}$$

$$\partial P / \partial q_i = \partial P / \partial Q \cdot (1 + \alpha_i) \text{ where ,}$$

$$\alpha_i = \sum_{i \neq j} \partial q_j / \partial q_i$$

16. In theory, this intervention would achieve the first-best welfare maximizing outcome because there are also enough firms to ensure perfect competition (no DWL from the market power effect) and there is perfect spillover (no DWL from the divided experience effect).

Substituting,

$$P - MC_i = -q_i \cdot \partial P / \partial Q \cdot (1 + \alpha_i)$$

Defining ϵ_p as in equation (7) while multiplying both sides by $1/P$ and the right-side by Q/Q,

$$(P - MC_i)/P = q_i/Q \cdot -(Q/P \cdot \partial P/\partial Q) \cdot (1 + \alpha_i) = q_i/Q \cdot 1\epsilon_p \cdot (1 + \alpha_i) \quad (6)$$

where ϵ_p is defined conventionally in absolute value terms so that larger negative ϵ_p values are referred to as "higher elasticity" or "more elastic."

Equation (6) is the well-known result for the "structure-conduct-performance" model. The left-hand side measures performance while the market share of the profit-maximizing firm, in conjunction with ϵ_p, represent market structure. The α_i term gives an indication of conduct, defined as the way that firms react to each other's output levels ($\alpha_i > 0$ implies that firms collude, $\alpha_i < 0$ is the standard non-collusive case in which each firm reduces its output if other firms increase theirs, and $\alpha_i = 0$ is the Cournot oligopoly case in which each firm takes all others' output level as fixed).

For the monopoly case, equation (6) collapses to $(P\text{-}MC)/P = 1/\epsilon_p$, the standard Lerner index result showing that both monopoly markup over marginal cost, and the associated DWL, are inversely proportional to the elasticity of demand. For example, as drawn in Figure 3b, price falls between $MC(q(t))$ and $MC(q(T))$, but this depends on the value of ϵ_p in the region where $MR(t)$ intersect $MC(q(T))$. Furthermore, setting $\partial\pi/\partial Q = 0$ yields $MC(Q) = P(Q) + Q \cdot \partial p/\partial Q$, where the right-hand side is defined as marginal revenue. Marginal revenue therefore has a steeper slope than demand since $Q \cdot \partial p/\partial Q$ is negative and decreasing in Q for $Q > 0$. As shown in Figure 3b, price exceeds $MC(q(T))$ at the q for which $MR(t) = MC(q(T))$. Thus, if 0% spillover leads to monopoly or even just oligopoly, then there is a prima facia case for a MTP in order to increase the quantity demanded and thereby reduce the DWL from market power in every period.

Figure 3c, describes the intermediate case of oligopoly under partial spillover. MR still lies below demand but it is not as steep as for monopoly since the absolute value of $q_i \cdot \partial P/\partial q_i$ will generally be smaller than the absolute value of $Q \cdot \partial p/\partial Q$. Firms appropriate some of their experience benefits in this case, so $MC(Q(T)) < MC(q(T)) < MC(q(t))$. Each firm's true marginal cost lies below its current marginal cost creating some incentive to forward-price; however, they do not take into account the benefits from their production that spill over to their competitors, so their true marginal cost exceeds the true social marginal cost. The net effect generates a substantial production shortfall and thus, again, a possible rationale for intervening with a MTP.

Our analysis has thus far assumed exogenous firm entry levels under each of the three cases, and has neglected the strategic interactions among incumbent firms and potential entrants. These interactions determine the level of market concentration over *[0,T]* and the associated DWL from market power and/or divided experience effects. We now briefly consider this topic, emphasizing, however that no definitive analysis is possible without arbitrary assumptions.

Ross (1986) summarizes a substantial literature that uses Cournot assumptions, $\alpha_i = 0$ in equation (6), to demonstrate that largely or completely proprietary learning generates market concentration. These models all show welfare falling below the first-best outcome because of some combination of divided experience and market power effects. Spence (1981) departs from Cournot assumptions, and with exogenous entry (subject to a profitability constraint) he also demonstrates a tradeoff between these two effects as N increases. He also shows that moderate rates of learning yield the worst barriers to entry and associated monopoly DWL. Ross (1986) assumes a Stackelberg leader-follower model, $\alpha_i < 0$ in equation (6), and demonstrates that, with 0% spillover, the first entrant in a new market can establish and hold a strongly dominant market position by maintaining a lead over incumbent and potential competitors in cumulative production experience.

Smiley and Ravid (1983) develop a model that endogenizes the number of firms. They demonstrate that an initial entrant will charge a price lower than that for which $MR(t) = MC(q(T))$ in order to deter entry. Their assumptions include restricting spillover to strictly less than 100% and imposing constant returns to scale. They further show that an initial monopolist can earn profits over *[0,T]* while successfully deterring entry by setting price between its average cost and that of the next most competitive potential entrant. This limit pricing strategy involves a monopolist foregoing some of its monopoly rents by producing where $MC(q(T)) > MR(t)$ in order to scare off entrants. As its cumulative production level rises; however, the incumbent firm gains an ever wider cost advantage over potential entrants and it is able to steadily cut back production towards the point where $MC(q(T)) = MR(t)$ without inducing competitive entry. Absent correction by a MTP or price regulation this creates increasing monopoly DWL.

As illustrated by this brief literature review, the evolution of market concentration is extremely complex when experience effects and strategic interactions are considered. For example, it is conceivable that an industry characterized by 0% spillover could remain competitive. Intervening with a MTP in this case would harm welfare because there would be no production shortfall to correct. Proprietary experience implies there is no disincentive effect and there is no market power if the market remains competitive. The only inefficiency in this case would be from the divided experience effect, but a standard MTP would not address that problem. This case is not significant, however, since it is only likely to arise if experience effects are very weak. Otherwise, incumbent firms should be able to use their proprietary experience to create market barriers. One could envision other scenarios such as an incumbent firm producing up to or even beyond the social optimum for a brief period in order to establish credibility. This is another case in which a MTP would actually hurt social welfare; however, it also seems an unlikely threat given the efficacy of limit pricing of the sort described by Smiley and Ravid.

The preceding discussion emphasizes that nearly any outcome is possible in the realm of oligopoly. Cases of highly unusual strategic behavior aside, however, this section has illustrated that there will be an output shortfall for all technologies characterized by a strong experience effect, regardless of the spillover level, ϵ_p, or the progress ratio. A MTP can address this shortfall and reduce the associated DWL in each period.

In assessing GL and PVMTI we assume perfect competition and 100% spillover (Figure 3a). Data constraints preclude formal statistical tests of these assumptions; however, Lieberman (1987) discusses empirical evidence of spillovers as high as 60-90% in some cases and summarizes a substantial empirical literature suggesting high spillover rates. Nonetheless, it is likely that true spillover rates are somewhat less than 100%. This means that we overstate the extent to which experience is a public good, but we also understate the production shortfall attributable to market power. Moreover, to the extent that experience is proprietary, a MTP that favors a subset of young (mature) companies characterized by fast (slow) proprietary experience would yield cost reductions in excess of (below) those expected under the assumption of perfect spillover.

Clarifying the net effect of relaxing the perfect spillovers assumption is an important goal for future research; however, this uncertainty does not undermine our prima facia case for MTP intervention in any industry characterized by a strong industry experience curve. Evaluating real-world MTPs requires a computational estimate of program benefits and costs. The following section develops a benefit-cost assessment methodology to achieve this.

DESCRIPTION OF THE COST-BENEFIT MODEL

Deriving Experience Curves from Price and Production Data

Where possible, it is preferable to define learning and experience curves using manufacturing cost; however, where these proprietary data are unavailable Lieberman (1984) argues that price provides a legitimate proxy if any of the following conditions hold:

1. Price/cost margins remain constant over time.
2. Price/cost margins change, but in a manner controlled for in the analysis.
3. Changes in margins are small relative to changes in production costs.

The third condition should hold for both PV and electronic ballasts since prices for both are falling briskly (the real price of electronic ballasts has fallen by over 60% since 1986 and the real price of PV modules has dropped by over 95% since 1975). Thus, changes in the price/cost margin should introduce only small deviations relative to the pronounced cost reduction trend. Over a decade of sales and price data are available for both PV and electronic ballasts, ensuring a relatively reliable empirical progress ratio estimate. For ethanol none of the three conditions clearly holds; however, our conclusions for that case do not depend on the accuracy of our ethanol progress ratio estimate.

To make the analysis tractable, for our first two case studies, we assume that the programs take place in competitive markets. This implies that all producers are earning zero economic rents (i.e., they are covering their fixed and marginal production costs and earning the market rate of return for similarly risky investment(s) and the mark up of price above long-run marginal cost should be stable at approximately zero.

EXPERIENCE/DEMAND FEEDBACK EFFECTS

Two of the fundamental factors determining the market diffusion pattern for any new technology are the rate at which manufacturers are able to reduce costs with additional production and the responsiveness of market demand to any such cost reductions. For some industries, the former can be characterized by an experience curve, while the price elasticity of demand (ϵ_p) measures the latter. In discrete terms:

$$\epsilon_p = (\Delta q/q)/(\Delta P/P) \qquad (7)$$

where q refers to annual production and P to price.

Our diffusion model assumes that: 1) the cost reduction due to incremental experience and the associated demand response occur within the one-year time step period; 2) there is no saturation effect; and, 3) a "contagion"

or "free driver" effect also drives sales.[17] Saturation during the time scale of our analysis should be of limited concern for PV since potential markets are orders of magnitude larger than current module sales (World Bank Group, 1996). Moreover, current sales of electronic ballasts represent only about one-third of total ballasts sold in the U.S., and there are immense potential export markets (USDOC, 1997). Similarly, current ethanol consumption amounts to only about 1% of total gasoline sales in the U.S. The "contagion" effect assumes that, in the early stages of new product diffusion, potential users learn about a product by observing early adopters (Bass, 1980; and Vettas, 1998). Our model simulates this effect by using an exogenous percentage growth rate. Thus, the effect of early MTP-induced sales is magnified over time by becoming part of the annual base that determines future compound sales growth.

We underscore that our purpose is not to predict diffusion and price trends but rather to assess the marginal impact of MTPs. For PV, we generate a forecast of future cumulative production levels and the corresponding prices as determined by the empirical PV progress ratio. We define this as the business as usual (BAU) scenario. We then compare this to the "program" scenario where we add sales attributable to PVMTI to the baseline trajectory and use the empirical progress ratio to estimate the associated prices. For GL, we generate a "backcast" of predicted historical prices for electronic ballasts based on actual cumulative production levels, and treat this as the BAU scenario. We then subtract purchases attributable to GL and calculate the associated prices using the empirical industry progress ratio. This is called the "No GL" scenario. For all cases, we assume the empirical progress ratio is constant and completely determines prices.

The unique feature of this model is that it accounts for the indirect effects of MTPs. In particular, the model assumes that MTPs will induce a price reduction via the experience curve, which, in turn will induce a demand response that further reduces price. For each period, the model calculates the indirect effect using the standard discrete midpoint elasticity formula:

$$\epsilon_p = \left[(Q_1 - Q_0)/(Q_1 + Q_0)/2\right]/\left[(P_1 - P_0)/(P_1 + P_0)/2\right]$$

17. Bass (1980) endogenizes experience curve and ϵ_p effects in order to predict diffusion patterns. To analyze the entire product life-cycle, he introduces a probability density function that measures time to purchase given a fixed price. The general pattern that he predicts is for annual production to increase at first and subsequently decline, whereas price decreases monotonically with time. His model accounts for the "social contagion of the adoption process" and it is driven by the assumption that firms will seek to maximize profits. Moreover, it assumes that demand will ultimately saturate.

while,

$$(Q_1 - Q_0) = \epsilon_p \cdot [(P_1 - P_0)/(P_1 + P_0)/2] \cdot (Q_1 + Q_0)/2$$

and we therefore have,

$$\textit{indirect effect} - \epsilon_p \cdot [(P_{MTP} - P_{BAU})/(P_{MTP} + P_{BAU})/2] \cdot (Q_{MTP} + Q_{BAU})/2 \quad (8)$$

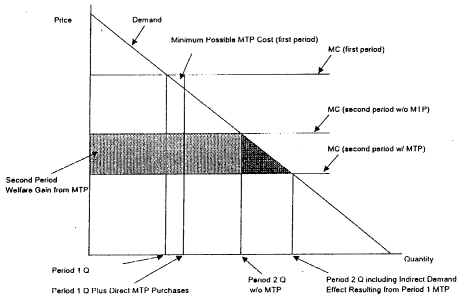
where ϵ_p is exogenous and the subscripts bau and mtp refer to the Business as Usual and program scenarios, respectively. Cumulative production for each period, $Q(t)$, equals the sum of current sales directly attributable to the MTP plus indirect demand effects, plus $Q(t\text{-}1)$. Current price, accounting for indirect effects, is derived by substituting $Q(t)$ into equation (2) and using the appropriate empirical experience parameter b, as defined by equation (3).

ESTIMATION OF BENEFITS AND COSTS

Figure 4 presents a simplified two-period illustration of our benefit estimation methodology. In the first period, a single-period MTP artificially inflates demand with a subsidy at least as large as the triangle marked 'minimum possible MTP cost.' As a result of associated experience benefits, the second period marginal cost is lower than it would have been in the BAU scenario. The primary second period benefit from the MTP is equal to the price reduction times the production level at the unsubsidized second period price that would have prevailed without the first period MTP (the lightly shaded rectangle in Figure 4). To this we must add the benefit from the indirect demand effect (the darkly shaded triangle in Figure 4). The perfect competition assumption facilitates welfare estimation since it implies that producer surplus is fixed at zero. Consequently, to estimate program benefits we simply account for the change in consumer surplus. The flat MC schedules follow from the assumption of constant-returns to scale.[18]

18. As noted above, we define MC as long-run marginal cost, allowing capital investment levels to vary freely. We therefore make the further assumption that the one-year time step is sufficiently long for the industry to re-optimize its capital investment level in response to any demand increase due to a MTP. With upward sloping supply curves the lines currently labeled MC in Figure 6 would represent prices and still produce a trapezoidal increase in consumer surplus; however, the size of the short-run price drop from a given MTP would be smaller, as would the associated increase in consumer surplus. As long as producer surplus is fixed at approximately zero (i.e., profit on infra-marginal units exactly covers fixed costs) then the only other major effect would be that the minimum possible MTP cost for any given demand boost would be larger.

Figure 4. Two-Period Dynamic Welfare Analysis of MTPs



Note: This figure shows a stylized two-period partial equilibrium welfare analysis. The MTP lasts only one period but induces a period-two welfare gain by shifting the marginal production cost schedule downward. In fact, a single period MTP induces an infinite stream of future period benefits; however, later period benefits are generally less significant that near-term MTP benefits both because of discounting and gradual dampening of the positive feedback between demand and experience. The figure also shows the theoretical minimum possible MTP cost represented as the lowest total subsidy that could induce a given increase in the quantity demanded during period 1. This would require optimal allocation of subsidies and zero administrative costs.

In a multi-period analysis, a one-period MTP induces indirect demand effects in all future periods until the market saturates or unit cost approaches some non-zero minimum unit cost. We employ standard methodology to estimate the present value of this benefits stream, dividing the net benefits for each year by $(1+r)^n$, where n refers to the number of years since the last expenditure for the program was disbursed. We select a fixed time horizon (n=20 years) and real social discount rate (r=0.05), consistent with the historical real rate of return from moderately risky long-term investments (e.g., long-term investment-grade corporate bonds), see Ross, Westerfield, and Jaffe (1996). We then estimate the present value of the stream of program costs and then divide the present value of benefits by the present value of costs to yield the benefit-cost ratio (BCR). For both benefit and cost present value calculations we use the initial year of the program as the reference point year.

For GL and PVMTI there is additional social value from reducing fossil fuel consumption and the associated environmental externalities. We therefore include a conservative carbon benefit ($10/tC) for both of these case studies.[19]

Following standard benefit-cost practice, we exclude transfer payments (e.g., utility demand-side management rebates for electronic ballasts) from our program cost estimates except to the extent that they induce purchases for which the social MC of production exceeds the marginal WTP (Folster, 1991). We also consider program administration expenditures to be social costs because they consume resources (e.g., skilled labor) rather than simply transferring wealth from one economic agent to anther.

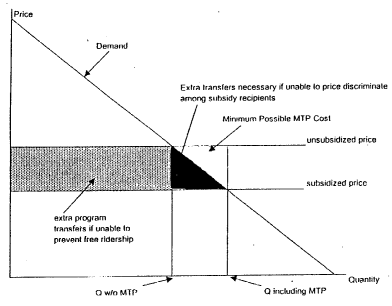
There are a range of possible indirect effects besides the demand effect described above. One example is the DWL associated with any taxation necessary to finance MTPs. It is also possible that R&D induced by a MTP will effectively crowd-out R&D in other sectors. Folster (1991) discusses this sort of indirect effect but he also notes the possibility of positive indirect R&D effects. For example, private R&D induced by a MTP might boost government R&D efficacy. To highlight the principal results of our model without adding undue complexity we do not attempt to estimate the magnitude of possible indirect effects other than the indirect demand effect.

Figure 5 shows a number of allocation inefficiencies that raise the level of program expenditures necessary to boost demand by a given amount. Most MTPs will not be able to "price discriminate" among subsidy recipients. Rather, they will have given all subsidy recipients the minimum per unit subsidy required to induce a purchase by the recipient with the lowest willingness to pay. MTPs may also give subsidies to "free riders" who would have purchased the targeted good without any subsidy. In particular, if a MTP expands to account for an ever-larger share of the overall market, beyond some size, free rider problems become unavoidable. Larger transfers due to these sorts of allocation inefficiencies increase the risk that the DWL of taxation necessary to finance the MTP will be substantial.

Poorly designed MTPs may even subsidize consumers' with relatively low willingness to pay (e.g., if they target the wrong geographic area). This implies a larger minimum possible MTP cost per induced purchase and involves higher transfers as well to the extent that the MTP fails to price discriminate and/or prevent free riders.

19. Bruce et al (1995) reports that published estimates ranged from $5 to $125 per ton of carbon. Moreover, we do not attempt to include any benefits from displacing other externalities associated with fossil fuel consumption.

Figure 5. MTP Subsidy Efficiency



Note: This figure shows the minimum possible cost for a MTP that induces a given amount of incremental demand. It then illustrates the additional cost (in increasing order) if the program is unable to price discriminate, if it fails to prevent free riders, and if it subsidizes some consumers with relatively low willingness to pay.

Finally, it is worth highlighting the links between our prima facia case for considering MTPs and our applied model. The model accounts for dynamic interactions between experience and demand. This effectively credits the MTP for overcoming the DWL associated with any disincentive effect due to spillover. However, the model also assumes perfect competition and spillover, so neither market power effects nor divided experience effects are explicitly modeled. Nonetheless, we would expect programs that involve large theoretical DWL from either experience spillovers or market power to represent better opportunities for strongly positive MTP payoffs.

For example, theory would predict that firms producing a technology characterized by high spillover would insufficiently forward-price. Thus, a MTP for this technology should generate strong benefits. This would show up in the model as a low ratio of direct demand effects to program costs—a detectable phenomenon for ex post analysis of the sort we undertake for the PVMTI and ethanol cases. For such a case, there should also be a strong indirect demand effect because the MTP would be pushing a technology that has not yet been

aggressively promoted by forward-pricing firms. This can never be empirically demonstrated; however, as with the ratio of direct demand effects to program costs, it is partially discernable ex ante through expert judgment (e.g., in estimating program costs, ϵ_p, free rider rates, and exogenous growth rates).[20]

COMPARISON WITH OTHER MTP EVALUATION METHODOLOGIES

USGAO (1997a) reviews the GL program; however, neither they nor the USEPA has published any estimate of the program's net benefits. Rather, the USGAO report focused on the extent to which GL has met its stated quantitative targets. The World Bank Group's projections for PVMTI attempt to estimate the impact of the program on future PV sales and prices; however, they do not model the dynamic impact including indirect demand effects.

In a review of MTP evaluations, Krause (1996) highlights the omission of various feedbacks as one of a number of factors leading to unduly pessimistic bias in assessing these programs. He does not, however, focus on how to quantitatively account for these benefits. Similarly Levine and Sonnenblick (1994) discuss free driver benefits in the context of utility demand-side management rebate programs. They define free driver benefits as adoption of energy efficient technology by non-participants in the rebate programs and develop a simple model that accounts for this contagion effect. They acknowledge, but do not attempt to quantify the dynamic "chain reaction" that this might produce. The indirect demand effect in our model accounts for this dynamic phenomenon.

Colombier and Menanteau (1997) explicitly refer to the possibility that MTPs can initiate a "virtuous circle" driven by the feedback between experience-induced price reductions and demand; however, they do not present a methodology for quantifying such effects. Finally, Geller and McGaraghan (1998) discuss the role of conventional government R&D programs in developing the first prototype electronic ballasts. They also calculate an empirical progress ratio of approximately 0.9 for this industry; however, they make no mention of the effect of GL on this market and do not attempt to characterize dynamic indirect demand effects.

In sum, there is growing recognition of the importance of MTPs and the role that dynamic feedback plays in improving their efficacy; however, we have not identified any other studies that introduce a methodology for quantifying these effects as part of an applied benefit-cost analysis.

20. The same logic would imply the potential for a strong indirect demand effect for MTPs that target technologies for which producers have substantial market power.

THE PHOTOVOLTAIC MARKET TRANSFORMATION INITIATIVE

Photovoltaic (PV) modules convert sunlight into direct current electricity, which can either be used immediately or stored in rechargeable batteries.[21] Individual PV module output is measured in peak watts (Wp) while industry production levels are measured in peak megawatts (MWp). Critical advantages of PV include that it produces very low life-cycle pollution and it can be used anywhere where there is adequate insolation.[22] Consequently, PV has become commercially viable in many "off-grid" niche markets where utility power is unavailable (either because of administrative inefficiencies or the prohibitive cost of connecting dispersed rural customers to the transmission grid). In particular, there is a large market for 10Wp to 100Wp solar home systems (SHSs) in developing countries. A typical 50Wp system provides about 220 watt-hours/day, or enough to power basic lighting, television, radio and other miscellaneous small load appliances (e.g., brief daily use of a blender). About 500,000 SHSs have been installed, but there are an additional 300-400 million unelectrified households in developing countries (World Bank Group 1996). At current prices, the potential SHSs market is only a fraction of the total number of unelectrified households. SHS prices observed during 1993-94 in various developing countries ranged from below $10/Wp to over $25Wp (Cabraal et al. 1996). A number of factors account for this divergence including different levels of local market infrastructure, import tariffs, system quality differences, and subsidy programs.

PVMTI is funded by the International Finance Corporation (IFC) and the Global Environment Facility (GEF):

> ...to significantly accelerate the commercialization, market penetration, and financial viability of PV technology in the developing world...it is believed that PVMTI will provide market signals that spur manufacturing expansion and distribution infrastructure and help achieve accelerated manufacturing cost reductions...[23]

21. See Johansson et al. (1993) for comprehensive background on the technology. With an inverter, PV power can be converted into alternating current for use with conventional appliances or transmission over utility grids.

22. Fabrication emissions are unlikely to be significant except for the pollution associated with providing energy to produce, distribute and install PV systems. At present, manufacturing energy payback times range from 0.5 to ten years depending on the type of PV technology, and the trend is towards faster payback (STAP/GEF Report, 1996).

23. World Bank Group (1996). Note that PVMTI documentation refers to experience curve analysis to underscore the validity of this "demand-pull" approach.

Conspicuously absent from project documents are any quantitative estimates of PVMTI's impact on module prices. In this section, we use the benefit-cost model introduced above to evaluate PVMTI. We conclude that the program is too small to have a major effect on the rapidly expanding global PV market; nonetheless, even using our conservative base case assumptions, PVMTI is cost-effective. This supports expansion of PVMTI or other MTPs which target PV.

The GEF is providing $30 million in PVMTI funding that is expected to cover $5 million in program administration costs and to leverage an additional $60 million in co-financing—yielding a total of $85 million for PV investments.[24] PVMTI became operational in the fall of 1998 and its scheduled duration is five to seven years. The GEF intends to recover $13.5 million of its original investment and we assume that, in conjunction with reinvested capital and profits from co-financing partners, GEF's recovered capital would be sufficient to extend the project through 2018. We assume that GEF recovers nothing at the end of the 20-year period analysis period, and conservatively treat the full $30 million as an up-front social cost (this is consistent with GEF's goal of financing incremental costs only). This allows non-GEF investors to recover their principal plus a market return, so we do not include the co-financing amount in our estimate of social costs. Our model applies all $85 million in available PVMTI funds towards a revolving loan fund for SHS loans with an average term of three years.[25] We also assume an implementation lag: year one loans use one-third of total available funds and by the third year the revolving fund is fully disbursed. Subsequently, PVMTI makes new loans with money released as the original loans are repaid (profits are assumed to be sufficient to cover any loan losses so the fund remains at $85 million).

Estimates for PV industry experience curve progress ratios range from 0.68 to 0.82 (see, for example, Figure 6); however, they cluster around 0.8 and this is the value we employ for the base case.[26] For 1998, we estimate an average PV module manufacturing cost of $3.65/Wp, annual production of 124 MWp, and cumulative end-of-year production of 833 MWp (Jensen, 1996).

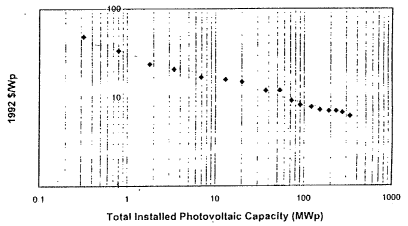
24. The PVMTI figures in this paragraph are based on Kennedy (1998).

25. Kennedy (1998) estimates that roughly 90% of the direct PV sales from PVMTI will be for SHSs though the exact MTP modalities are not yet finalized.

26. Cody and Tiedje (1997) and Williams and Terzian (1993) both report PV progress ratios for all types of modules sold worldwide. For the period from 1976 to 1988, Cody and Tiedje estimate a progress ratio of 0.78 while Williams and Terzian estimate 0.82 for the 1976 to 1992 period. Jensen (1996) confirmed a 0.82 progress ratio for all PV modules. Neij (1997), cites a study showing a 0.79 progress ratio for crystalline modules in Japan during the 1979 to 1988 period. Finally, using his own database, Maycock (1996) calculates a progress ratio for global amorphous and crystalline PV of 0.68. We follow Neij (1997) in relying on the estimates that converge around 0.8.

Cumulative production of thin-film amorphous PV modules is on the order of 10MWp. If amorphous modules follow their own experience curve, this implies that PVMTI's market transformation effect could be much stronger than our results indicate (Williams, 1998). We do not distinguish between crystalline and amorphous panels in our analysis for conservatism and because there is not yet enough production history for amorphous modules to derive a reliable empirical progress ratio.

Figure 6. PV Industry Experience Curve for 1976-1992
PR = 0.82, 95% C.I. = 0.81 to 0.83



Note: Plot of module price against cumulative production in ln-ln space showing a reasonable approximation to an idealized industry experience curve. We confirm William's calculations using ordinary least squares regression in the form of equation (2) to derive *b*, the experience parameter. Substituting this coefficient estimate into equation (3) yields a best estimate progress ratio of 0.82. We also calculate a 95% confidence interval for the progress ratio (0.81 to 0.83) based on the underlying 95% confidence interval for the OLS coefficient estimate for *b*. Source: (Williams, 1993).

While we allow module costs to decline over time, we assume that all other costs are fixed at $350 per 50Wp system. This is a highly conservative approach since it means the model does not allow for any direct or indirect experience effects for the non-module portion of the SHS costs. In fact, as any given local SHS market develops, experience effects should substantially reduce installation and balance of system costs. Data on the installed price of SHSs is not collected in any organized format, however, making it impossible to reliably analyze trends in the non-module cost elements of SHSs price. We further

assume a 100% markup over factory costs for modules sold to final SHSs purchasers in developing countries, yielding a module price of $365 and an initial average system price of about $700.[27]

To account for the possibility that some portion of sales associated with PVMTI would have occurred even if the program were never implemented, we assume a free ridership rate of 10%, (FR=0.1). This is conservative given that the program is specifically designed to provide credit to capital constrained SHS purchasers and to encourage the development of SHS business models that have the potential for widespread replication. Thus, net of free drivers, the free ridership rate could be zero or even negative. Since the BCR varies linearly with free ridership, we do not present the sensitivity analysis in a figure; however, if the indirect demand effect and carbon benefit are included then the BCR for PVMTI remains above 1.0 as long as FR < 0.24.

Under the BAU scenario, we assume that PV sales grow at a 20% annual rate (Jensen, 1996). Based on the 0.8 progress ratio, this exogenous sales growth generates sufficient cumulative production to drive module manufacturing costs down to $1.17/Wp in 2018. PVMTI can accelerate this trend both directly via additional sales induced by the program itself and indirectly due to feedback between the demand response and the experience curve effect. The model uses current PV module costs to determine the number of systems that can be financed in any given year. In accord with PVMTI goals, we estimate that the program directly catalyzes the purchase of 39,000 SHSs in its first year.[28] At an average size of 50Wp each, this increases PV sales by 1.9 MWp (Table 1). Over time, as module costs fall, PVMTI is able to finance more systems, peaking at 58,000 in 2018, or 2.9 MWp. This compares to 1995 SHSs sales of approximately 80,000 and a current total of about 400 million unelectrified homes (World Bank Group, 1996). Note that the indirect demand effect grows to exceed these direct effects by the year 2013. Accounting for indirect effects, PVMTI yields a BCR of 1.05, or 1.16 with a $10/tC carbon benefit.

27. Authors' estimate from data in Cabraal et al. (1996).

28. World Bank Group (1996). Specifically, PVMTI will attempt to expand the demand for PV Kenya, Morocco, and India. In 1996, there were approximately 40,000 SHSs already installed in Kenya; 10,000 in Morocco; and 50,000 in India. Acker and Kammen (1996) and World Bank Group (1996).

Table 1. PVMTI Base Case

ECONOMIC PARAMETERS			
Program Investment (millions)	$30	Real Social Discount Rate	5%
Progress Ratio	0.8	1997$ per metric ton carbon avoided	$10
PV Price Elasticity of Demand	1	annual tC avoided per non-SHS 50Wp module	0.015
Exogenous Sales Growth Rate	20%	annual tC avoided per SHS-year	0.064
		free ridership rate	10%

	BAU SCENARIO			PROGRAM SCENARIO w/ INDIRECT DEMAND EFFECT					PROGRAM SCENARIO w/o INDIRECT DEMAND EFFECT					
	Annual MWp	Cumul. MWp	Cumul. $/Wp	Indirect MWp	MWp	Cumul. Carbon benefit	value of direct tC displaced	value of indirect tC displaced	# of SHSs	Direct MWp	Cumul. MWp	Cumul. $/Wp	net benefits w/o carbon benefit	value of direct tC displaced
1998	124	833	$3.649	0.0	833	($30,000,000)			0	0.0	833	$3.649	($30,000,000)	
1999	149	983	$3.460	0.1	985	$318,469	$24,793	$311	38,803	1.9	985	$3.458	$302,709	$24,793
2000	179	1,162	$3.279	0.2	1166	$639,909	$50,256	$966	39,851	2.0	1,166	$3.275	$592,408	$50,255
2001	215	1,377	$3.104	0.3	1384	$955,517	$76,396	$2,000	40,909	2.0	1,383	$3.100	$861,386	$76,393
2002	258	1,635	$2.937	0.5	1644	$1,265,651	$103,216	$3,449	41,973	2.1	1,643	$2.933	$1,110,829	$103,210
2003	310	1,945	$2.778	0.6	1956	$1,568,870	$130,719	$5,350	43,040	2.2	1,955	$2.773	$1,340,345	$130,710
2004	372	2,316	$2.626	0.8	2331	$1,864,069	$158,905	$7,740	44,108	2.2	2,328	$2.621	$1,549,937	$158,892
2005	446	2,762	$2.481	0.9	2780	$2,150,423	$187,773	$10,659	45,174	2.3	2,777	$2.477	$1,739,914	$187,754
2006	535	3,297	$2.344	1.1	3318	$2,427,345	$217,318	$14,149	46,234	2.3	3,314	$2.340	$1,910,812	$217,294
2007	642	3,939	$2.213	1.3	3964	$2,694,437	$247,537	$18,253	47,287	2.4	3,958	$2.210	$2,063,335	$247,508
2008	770	4,709	$2.090	1.5	4738	$2,951,457	$278,423	$23,016	48,331	2.4	4,731	$2.086	$2,198,299	$278,388
2009	924	5,634	$1.972	1.8	5667	$3,198,288	$309,968	$28,485	49,363	2.5	5,658	$1.970	$2,316,596	$309,927
2010	1,109	6,743	$1.862	2.0	6781	$3,434,909	$342,164	$34,710	50,381	2.5	6,770	$1.859	$2,419,156	$342,117
2011	1,331	8,074	$1.757	2.3	8117	$3,661,377	$375,001	$41,743	51,384	2.6	8,103	$1.755	$2,506,929	$374,948
2012	1,597	9,671	$1.657	2.5	9719	$3,877,811	$408,467	$49,638	52,369	2.6	9,703	$1.656	$2,580,865	$408,408
2013	1,917	11,588	$1.564	2.8	11642	$4,084,371	$442,550	$58,454	53,336	2.7	11,623	$1.562	$2,641,898	$442,486
2014	2,300	13,889	$1.475	3.2	13948	$4,281,257	$477,239	$68,251	54,283	2.7	13,926	$1.474	$2,690,939	$477,170
2015	2,760	16,649	$1.392	3.5	16714	$4,468,692	$512,519	$79,093	55,210	2.8	16,689	$1.390	$2,728,871	$512,445
2016	3,312	19,961	$1.313	3.9	20034	$4,646,919	$548,376	$91,046	56,114	2.8	20,004	$1.3[illegible]	[illegible]756,539	$548,297
2017	3,975	23,936	$1.238	4.2	24015	$4,816,198	$584,796	$104,181	56,995	2.8	23,982	[illegible]	[illegible]774,753	$584,713
2018	4,770	28,706	$1.168	4.6	28793	$4,976,794	$621,763	$118,573	57,852	2.9	28,755	[illegible]	[illegible]784,284	$621,676

Benefit-Cost Ratio (w/o carbon benefit) =	1.05
Benefit-Cost Ratio (w/ carbon benefit) =	1.16

Benefit-Cost Ratio w/o carbon benefit =	0.74
Benefit-Cost Ratio w/ carbon benefit =	0.85

As shown in Figure 7 these results are sensitive to changes in the ϵ_p assumption. Higher ϵ_p induces an exponential increase in the indirect demand effect, which, in turn, increases the BCR. We are not aware of any formal studies of elasticity for PV modules or electronic ballasts; however, both technologies are long-lived capital goods that provide electricity services. Consequently, we use long-run electricity elasticity as the best available proxy.[29] Econometric estimates for the long-term own-price elasticity of demand for electricity vary substantially; however, most estimates exceed unity.[30] Our base case analysis assumes that $\epsilon_p = 1$ for both modules and ballasts. This is conservative in that, unlike electricity for consumers in industrialized countries, neither electronic ballasts nor PV modules are necessity goods (there are close substitutes available such as magnetic ballasts for the former or kerosene lamps for the latter).[31]

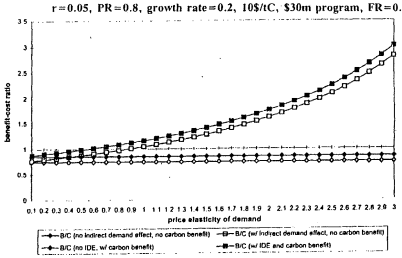
Assuming $\epsilon_p = 1$ is particularly conservative since PVMTI may push PV prices past certain critical thresholds, thereby inducing a strong indirect demand effect. Marnay et al. (1997) show that, at present, residential grid-connected PV systems are not economic even in those states with the most favorable adoption conditions. However if installed rooftop system costs were to fall to half their current level (to $3/Wp), then rooftop systems would be economical in 16% of detached single family households in the U.S. This represents a total market of 27,300 MWp, or over 200 times the current annual global PV market. Similarly, UPVG (1994) estimates that bringing PV module costs below $3/Wp would open up a 9,000 MWp market in U.S. on-grid applications, primarily in transmission and distribution support.

29. Short-run electricity elasticity estimates are lower than long-run estimates in large part because consumers cannot readily change their capital equipment in the short-run. This restriction does not apply for ballasts or SHSs since both represent equipment investments themselves rather than demand for electricity to power equipment.

30. Sweeney (1984) says that ϵ_p "probably exceeds unity" though his results are consistent with ϵ_p as low as 0.7. Beierlein et al. (1981) report $\epsilon_p > 2.0$ for the residential and industrial sectors, but $\epsilon_p = 0.04$ for commercial users. He explains the latter by the fact that commercial users mainly rely on lighting; however, this result may have changed given the availability of new energy efficient lighting technologies such as electronic ballasts. Sav (1984) reports a range of estimates in the literature ranging from $\epsilon_p = 0.2$ to $\epsilon_p = 2.0$, and he assumes a long-run elasticity of demand for energy services of 1.5.

31. Ruffin (1992) summarizes a large literature confirming that, in general, ϵ_p is low for essentials like food and water and high for more discretionary items like movie tickets and leisure travel.

Figure 7. Sensitivity of BCR to Elasticity for PVMTI
r = 0.05, PR = 0.8, growth rate = 0.2, 10$/tC, $30m program, FR = 0.1

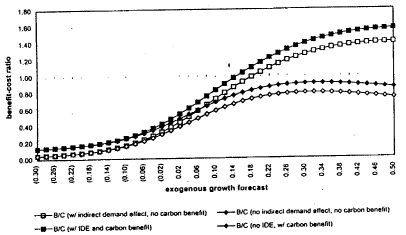


Note: The positive relationship between ϵ_p and the indirect demand effect (shown in Figure 7) drives an analogous positive and exponential relationship between ϵ_p and BCR.

Figure 8 demonstrates the sensitivity of our results to the assumed exogenous growth rate of 20%. As previously noted, using an exogenous growth rate defined as a percentage of current sales is equivalent to crediting PVMTI with a contagion effect resulting from the advertising and product information dissemination value of early product users. Over a range of exogenous growth rates between -30% and 50% the BCR is increasing if we account for the indirect demand effect. This occurs because the value of projected price decreases multiplied over a larger base of annual sales dominates the decreased marginal returns to industry experience associated with a larger cumulative level of sales.[32] Note, however, that if the indirect demand effect is not accounted for, the negative effect of diminishing returns to experience begins to dominate if the growth rate exceeds about 35%. The break-even point for PVMTI occurs when exogenous growth is approximately 18%, excluding carbon benefits, or 15% including a $10/tC benefit. We include a negative growth rate to highlight the risk that PV will not maintain its expected diffusion trajectory (e.g., if a superior substitute emerges, dramatically reducing PV sales in all subsequent years).

32. In terms of equation (7), a faster increase in industry experience due to a higher exogenous growth rate reduces $| (P_{MTP} - P_{BAU})/(P_{BAU} + P_{MTP})/2 |$ by less than the associated increase in $(Q_{BAU} + Q_{MTP})/2$.

Figure 8. Sensitivity of BCR to Exogenous Growth Rate for PVMTI
r=0.05, PR=0.8, 10$/tC, elasticity=1, $30m program, FR=0.1



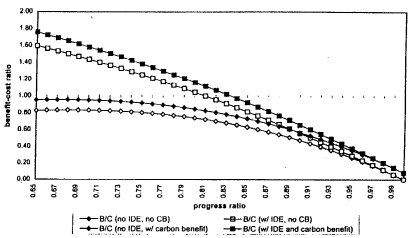
Note: If we account for the indirect demand effect, PVMTI's BCR is increasing (at a diminishing rate) over the range of positive exogenous growth rate estimates. Excluding the indirect demand response, higher growth forecasts yield higher BCR initially, but diminishing returns to experience ultimately override the positive compounding influence of faster growth. We also include negative growth rate estimates to simulate the possibility that PV diffusion will be unexpectedly cut short.

Figure 9 shows the sensitivity of PVMTI to the progress ratio. Assuming base case parameters and an indirect demand effect, reducing the progress ratio (i.e., increasing the strength of the experience effect) unambiguously increases the program's BCR. A lower progress ratio means that demand increases from PVMTI produce a larger percentage reduction in module price and, ceteris paribus, this yields higher program benefits and an improved BCR. Without accounting for indirect effects, however, there are strongly diminishing returns to faster progress. This occurs because faster progress implies a more rapid decline in the module price level in the BAU scenario. This reduces the marginal impact of PVMTI on module price in absolute monetary terms. For progress ratios lower than 0.65, this effect begins to outweigh the benefits of faster progress.

The World Bank Group is considering implementing a program similar to PVMTI that would be approximately five times as large.[33] Assuming base case parameters and excluding carbon benefits, our model suggests that scaling up PVMTI (or an analogous MTP) does not substantially affect the BCR.

33. Kennedy (1998). Among other efforts, the World Bank Group has also initiated a $230 million Renewable Energy and Energy Efficiency Fund (REEF) that will support SHSs dissemination along with other technologies; a $7 million GEF investment in SHSs programs in Zimbabwe; and, a major Indonesian SHSs program ($24.3 million in GEF funds and a $20 World Bank loan).

Figure 9. Sensitivity of BCR to Progress Ratio for PVMTI
r=0.05, growth rate=0.2, 10$/tC, elasticity=1, $30m program, FR=0.1



Note: Faster progress improves the BCR.

A $30-million PVMTI induces year 2005 module prices to fall by only 0.210% while a $300-million program would yield a 2.05% decline for that year. We note, however, that the PR may deteriorate sharply if artificial demand levels become too large. For example, if an expanded PVMTI induced a sufficiently sharp increase in short-run demand this would increase short-run prices as firms struggled to use insufficiently capitalized manufacturing facilities to meet demand. More importantly, it may be hard for large MTPs to maintain allocative efficiency. Nonetheless, it is reasonable to assume an exogenous PR for our analysis since, in its current form, PVMTI expects to catalyze sales accounting for less than 1.4% of current PV sales, or less than 14% of current sales for the $300m version (USDOC, 1997; and World Bank Group, 1996).

To summarize, these results show that a $30-million PVMTI is small relative to the current and projected PV market; however, they also confirm that PVMTI has the potential to be cost-effective. While the results are sensitive to model parameter choice, our base case is conservative:

- We do not attempt to estimate or account for the value of avoided environmental externalities other than carbon dioxide emissions;
- We assume FR=0.1 despite the strong potential for free driver effects;

- We do not model the possibility that amorphous PV modules will gain a large market share and rapidly decline in cost due to their much smaller cumulative production base and amenability to mass production;

- We use a conservative ϵ_p estimate; and, we do not account for quality of life improvements and other non-monetized effects.

The last factor may represent a key omission since SHSs provide key development benefits including pollution-free high quality light that is qualitatively far superior to kerosene lamps and other alternatives that it displaces (Acker and Kammen, 1996).

We now apply the same model to the case of a MTP that encourages the commercialization of energy efficient electronic ballasts for fluorescent lighting. In this case, however, we modify the model slightly to retrospectively assess the performance of a MTP.

ELECTRONIC BALLASTS AND THE ENVIRONMENTAL PROTECTION AGENCY'S GREEN LIGHTS PROGRAM

Fluorescent tube lamps contain ballasts which convert electricity into the appropriate form to sustain fluorescent lamps. Ballasts initially contained magnetic components; however, during the mid-1980s, electronic ballasts entered the marketplace. Although more expensive than conventional ballasts, electronic ballasts are up to 40% more efficient and the energy savings from upgrading typically yield an excellent financial return.[34] Despite high rates of return for a low-risk investment, the majority of firms have still not chosen to invest in electronic ballasts.[35] Possible explanations for failure to adopt electronic ballasts even in new construction include performance concerns, capital constraints, difficulty recovering upgrade costs in higher rents or building values, and inadequately informed customers who fail to factor in future lighting costs when choosing where to buy or lease property. Possible explanations for failure to retrofit existing facilities include inadequate information, limited

34. A single electronic ballast powering four T8 fluorescent tubes (one inch diameter T8s instead of conventional 1.5 inch diameter T12 tubes) saves 82 watts relative to a conventional fixture that uses a pair of two-lamp magnetic T12 ballasts. Assuming ten hours of use/day, this yields 300 kwhs of annual savings, or $30/year at $0.10/kwh. Including installation, upgrades cost $30-60/fixture depending on the exact configuration and volume level, implying a payback period of one to two years on equipment with an expected lifetime that exceeds 20 years.

35. Electronic ballasts still only accounted for 35% of all new ballasts sales in 1997. The trend is clearly towards increasing dominance, however, with corresponding percentages of 4% in 1990, 9% in 1991, 14% in 1992, 23% in 1993-94, and 31% in 1995-96. Source: USDOC (1997).

management time to consider lighting upgrade projects, capital-constraints, and uncertainty about system performance (Jaffe and Stavins, 1994).

Recognizing a "win-win" opportunity to save companies money, improve economic performance and reduce emissions from electricity production, in 1991 the U.S. Environmental Protection Agency, established GL, a voluntary program that offers technical expertise and public relations benefits to encourage companies and organizations to become GL Partners (USEPA 1995). In return, Partners agree to conduct comprehensive audits of all of their facilities and to retrofit any lighting for which the internal rate of return of the upgrade investment exceeds 20% (USEPA, 1995). As noted in the introduction, through 1997, EPA has spent approximately $90 million to administer both GL and Energy Star Buildings (which was launched in 1996 to extend the GL model to non-lighting loads).

Electronic ballasts began to have a significant impact on the U.S. commercial lighting market during the mid-1980s. GL did not contribute to this process until 1991; however, as of 1997 about $220 million worth of electronic ballasts had been purchased as part of GL, accounting for 9% of sales that year.[36] In addition to fluorescent lamps, GL encourages a range of different efficient lighting technologies; however, a large share of the program has been devoted to electronic ballasts because fluorescent lighting is ubiquitous and the upgrade economics are compelling. We estimate that 50% of EPA's GL/Energy Star Buildings budget has been devoted to promoting electronic ballasts under GL, or $45 million through 1997.

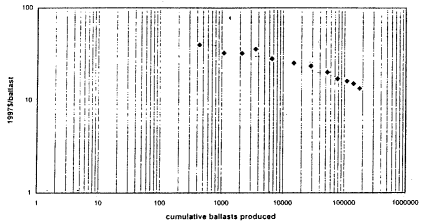
Figure 10 shows the historical relationship between price and cumulative production for electronic ballasts, and the associated progress ratio estimate of 0.89.[37] We then generate a "backcast" (Figure 11) by using actual cumulative production levels from 1986 to 1997 to compute the predicted unit price for each year (assuming the progress ratio was fixed and exactly correct). This "smoothed" price history can then be compared against an estimate made using actual production levels minus all electronic ballasts installed by GL Partners (the "no GL" scenario in Table 2). This estimates how far down the industry experience curve the GL program has pushed electronic ballasts. As of 1997, GL's direct impact had reduced the current price of electronic ballasts by $0.18 per ballast or 1.2%. However, as in the PV case, the direct price reduction caused by GL has induced an increase in the quantity demanded by all potential electronic ballast customers, including both GL Partners and all other

36. Calculated based on self-reported electronic ballast purchases by GL Partners from Lewis (1998).

37. The data for this calculation are from the USDOC (1997) and the methodology is identical to that described for PV.

customers. Accounting for indirect demand effects, GL reduced the 1997 price of ballasts by $0.20, or 1.4%.

Figure 10. Industry Experience Curve for Electric Ballasts (1986-1997) PR=0.89, 95% C.I.=0.87 to 0.91

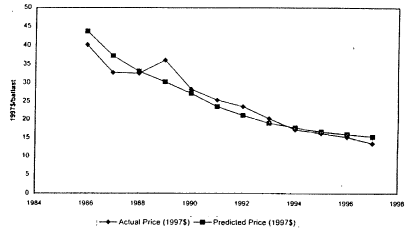


Note: This figure shows a plot of electronic ballast price against cumulative production in ln-ln space (source: U.S. Census Department). It reasonably approximates an idealized industry experience curve. The best estimate for the progress ratio is 0.89 while the 95% confidence interval (0.87 to 0.91) is derived using the same approach described in Figure 9.

Some Partners who purchased electronic ballasts might have purchased upgrades even if GL had never existed, i.e., they were free riders. A comprehensive survey of utility demand-side management programs showed average free ridership rates of 12.2%, with a standard deviation of 11.4%.[38] However, a recent EPA study indicates that GL Partners fail to report about one-third of the total lighting upgrades they undertake (Lewis, 1998). Also, there may be free drivers such as companies that do not become Partners but nonetheless use GL technical information or lighting engineers trained by GL. Thus, on balance, our base case assumption that free ridership is 10% (FR=0.1) is conservative. Since the effect of FR on the BCR is linear, we do not show the sensitivity analysis; however, as long as the indirect demand effect and a carbon benefit are included, the BCR remains above 1.0 for FR=0.65.

38. Eto et al. (1995). Note, however, that most of the surveys are based on voluntary disclosure by program participants and may therefore be substantially biased due to well-known problems such as the tendency of respondents to tell interviewers what they think they want to hear.

Figure 11. Actual vs. Predicted Electronic Ballast Cost



Note: This figure shows actual ballast prices (in constant 1997$) as well as "backcast" predicted prices based on the industry experience curve for electronic ballasts.

As with PVMTI, for our base case, we employ a 20-year time frame (though we also show historical data from five years prior to initiating the program in 1991) and assume $\epsilon_p = 1$. Given that the electronic ballast market is closer to saturation than PV, we assume a more modest exogenous sales growth rate of 5%. Finally, we proceed, contrary to fact, as though the program shut down after 1997. This allows us to estimate the present value of both benefit and cost streams associated with running the program for seven years and then continuing to account for the on-going dynamic benefits for the remaining 13 years in our standard 20 year analytic time frame. We define all present value calculations using 1991, the initial year of the program, as our reference point. Accounting for indirect demand effects yields an estimated BCR of 1.26, or 2.33 including a $10/tC benefit (Table 2). In contrast, the scenario that removes the direct GL sales but does not account for dynamic demand effects shows a substantially reduced BCR of 1.04 or 1.90 with the carbon benefit.

These results are sensitive to the assumed exogenous growth rate, with faster growth generating a higher BCR, particularly when the carbon benefit is included (Figure 12). The ϵ_p assumption also affects the GL analysis in a manner analogous to the PVMTI case, with higher ϵ_p causing an exponentially higher BCR when the indirect demand effect is accounted for (Figure 13). Moreover, beyond a certain level, faster progress means that the absolute price differential between the BAU and program scenarios narrows more quickly and this reduces the BCR of GL unless both indirect demand effects and the carbon benefit are

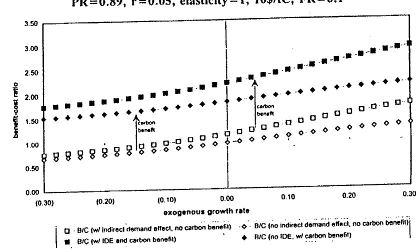
Table 2. Green Lights Base Case

BAU PARAMETERS		ECONOMIC PARAMETERS			
exogenous growth rate	5%	progress ratio	0.89	1997$/tC	$10
		price elasticity of demand	1	free ridership rate	10%
				real social discount rate	5%

	BAU SCENARIO				NO GL SCENARIO w/ INDIRECT DEMAND EFFECT					NO GL SCENARIO w/o INDIRECT DEMAND EFFECT			
	Annual (1000s)	Cumul. EBs (1000s)	Actual Price (1997$)	Predicted Price (1997$)	Indirect EBs (1000s)	Cumul. (1000s)	Price (1997$)	Direct Costs (1997$)	Net.Benefits w/o carbon benefit)	Direct EBs (1000s)	Cumul. Price (1000s)	Price (1997$)	Net Benefits (w/o carbon benefit)
1986	431	431	$40.21	$40.21		431	$40.21				431	$40.21	
1987	652	1,083	$32.76	$34.44		1,083	$34.44				1,083	$34.44	
1988	1,064	2,147	$32.52	$30.70		2,147	$30.70				2,147	$30.70	
1989	1,426	3,573	$36.14	$28.18		3,573	$28.18				3,573	$28.18	
1990	3,001	6,574	$28.35	$25.43		6,574	$25.43				6,574	$25.43	
1991	8,343	14,917	$25.43	$22.16	8	14,827	$22.18	$2,500,000	$128,489	82	14,835	$22.18	$116,397
1992	13,292	28,209	$23.63	$19.91	32	27,809	$19.96	$2,500,000	$517,760	278	27,849	$19.95	$465,568
1993	24,488	52,697	$20.25	$17.92	82	51,640	$17.99	$5,000,000	$1,155,849	575	51,762	$17.98	$1,020,699
1994	24,606	77,303	$17.20	$16.81	155	74,346	$16.92	$7,500,000	$2,713,720	1,744	74,624	$16.91	$2,453,746
1995	32,894	110,197	$16.23	$15.83	342	103,172	$16.01	$7,500,000	$5,068,843	3,726	103,792	$15.99	$4,606,047
1996	30,342	140,539	$15.22	$15.20	373	130,044	$15.40	$10,000,000	$6,311,340	3,097	131,037	$15.38	$5,689,431
1997	36,543	177,082	$13.52	$14.62	483	163,028	$14.82	$10,000,000	$6,844,528	3,076	164,504	$14.80	$6,094,017
1998	38,370	215,452		$14.15	447	200,951	$14.31		$6,243,146		202,874	$14.29	$5,385,642
1999	40,289	255,741		$13.74	405	240,835	$13.88		$5,484,819		243,162	$13.86	$4,602,718
2000	42,303	298,044		$13.39	373	282,766	$13.51		$4,915,273		285,465	$13.49	$4,024,418
2001	44,418	342,462		$13.09	347	326,836	$13.19		$4,472,329		329,884	$13.17	$3,580,794
2002	46,639	389,101		$12.81	327	373,148	$12.90		$4,118,399		376,523	$12.88	$3,230,317
2003	48,971	438,072		$12.55	310	421,809	$12.63		$3,829,422		425,494	$12.62	$2,946,824
2004	51,420	489,492		$12.32	297	472,932	$12.39		$3,589,286		476,914	$12.38	$2,713,044
2005	53,991	543,483		$12.11	285	526,638	$12.17		$3,386,798		530,904	$12.16	$2,517,127
2006	56,690	600,173		$11.91	275	583,053	$11.97		$3,213,936		587,595	$11.95	$2,350,682
2007	59,525	659,698		$11.72	267	642,311	$11.77		$3,064,806		647,119	$11.76	$2,207,609
2008	62,501	722,199		$11.54	259	704,552	$11.59		$2,934,976		709,620	$11.58	$2,083,364
2009	65,626	787,825		$11.37	253	769,925	$11.42		$2,821,051		775,246	$11.41	$1,974,503
2010	68,907	856,732		$11.22	248	838,585	$11.26		$2,720,387		844,153	$11.24	$1,878,362
					Benefit-Cost Ratio (w/o carbon ben.) =				1.26	B/C (w/o carbon ben.) =			1.04
					Benefit-Cost Ratio (w/ carbon benefit) =				2.33	B/C (w/ carbon benefit) =			1.90

included (Figure 14). The progress ratio sensitivity analysis for GL is distinctive; however, in that negative returns to faster progress are more severe. For PVMTI, faster progress unambiguously increased the BCR as long as indirect demand effects were accounted for; however, for GL, even with indirect demand effects, faster progress begins to reduce the BCR for progress ratios lower than 0.87. Nonetheless, if both carbon benefits and indirect demand effects are included, faster progress always increases the BCR.

Figures 12. Sensitivity of GL BCR to Exogenous Growth Rate PR=0.89, r=0.05, elasticity=1, 10$/tC, FR=0.1

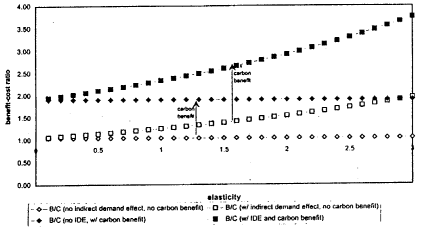


Note: This figure shows that the BCR for GL is increasing (at a slowly diminishing rate) with the exogenous growth rate.

As with PVMTI, the model indicates that the GL program is cost-effective; however, the magnitude of the positive BCR is sensitive to parameter choice. Consequently, we also apply conservative assumptions to this case:

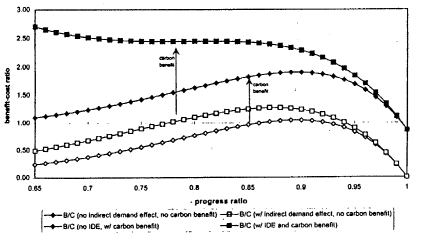
- we employ conservative estimates for ϵ_p, and the exogenous growth rate; and,
- we do not account for energy savings or lighting quality improvements associated with electronic ballasts.

Figure 13. Sensitivity of GL BCR to Exogenous Elasticity PR=0.9, r=0.05, growth rate=0.05, 10$/tC, FR=0.1



Note: As with PVMTI, a sharply positive relationship exists between ϵ_s and BCR due to the effect of ϵ_s on the indirect demand effect (although there is no relationship if we exclude the indirect demand effect).

Figure 14. Sensitivity of GL BCR to Progress Ratio elasticity=1, r=0.05, growth rate=0.05, 10$/tC, FR=0.1



Note: BCR is maximized at a progress ratio of ~0.088 if we account for the indirect demand effect but exclude carbon benefits. With a $10/tC benefit, BCR monotonically increases with faster progress.

The most important conservative assumption in this case is the omission of energy savings. These cost savings are worth over $500 million in net present value terms, or roughly an order of magnitude more than our benefits measure.[39] They accrue to private economic agents (GL Partners); nonetheless, they may legitimately be considered part of total social benefits. We exclude these benefits to ensure that our analysis is congruent with the approach used to assess PVMTI and to highlight the significance of indirect demand effects. The fact that GL yields a strongly positive BCR, even with these extremely conservative assumptions indicates that the program has been highly cost-effective.

FUEL ETHANOL

Starting in 1978, the federal government initiated a MTP to promote the use of corn ethanol as a transportation fuel. The program exempted gasoline containing ethanol from a portion of the federal gasoline excise tax. The exemption initially amounted to a tax subsidy worth $0.40 per gallon of blended ethanol. It peaked at $0.60 per gallon during the late 1980s and has been stable at the equivalent of $0.54 per gallon since 1990. The cumulative federal subsidy for fuel ethanol since the program's inception has been approximately $6 billion in constant 1997 dollars, or $4 billion in net present value terms (using 1980 as our present value reference point and r=0.05).[40]

The fuel ethanol experience curve indicates a progress ratio of 0.83, with a 95% confidence interval ranging from 0.74 to 0.94.[41] Grain prices are volatile and determine nearly half the costs of producing ethanol. Including the price of corn in the model specification, the progress ratio deteriorates marginally to 0.84 with a tighter 95% confidence interval ranging from 0.76 to

39. Lewis (1998) estimates that, through 1997, GL Partners invested over $1.5 billion in energy efficiency upgrades while saving over $500 million in annual electricity costs by 1997. Attributing half of this activity to electronic ballasts, and prorating both the investments and electricity savings over the 1991 to 1997 period (in accordance with reported upgrade activity), yields a net present value of $560 million (with r=0.05 and n=20 years).

40. Taxation rate chronology from GAO (1997:2). Annual fuel ethanol use derived from FHWA (1995), FHWA (1996) and FHWA (1997) assuming 10% average gasohol blend during 1980-1992 period.

41. Price data are cited with permission from "Oxy-Fuel News" published by Hart Publications, Inc. Price data are available only for 1989 to the present; however, it is possible to construct a valid experience curve for this period since cumulative production numbers are available since 1980 and large volume production did not begin until 1982.

0.92.[42] However, as noted above, this may not be significant due to omitted EOS effects.

Unlike the previous two case studies, however, the ethanol MTP has not produced net social benefits. Estimating the exact net social costs of the ethanol MTP is difficult because the precise shape of the ethanol demand curve is unknown; however, we can bound the possible results. First, assume that the long-run marginal cost is essentially flat. This is consistent with Crooks (1997) who argues that cash operating costs for small (less than 30 million gallons per year) plants are only about 5% higher than for large plants. Moreover, he suggests that five of the most recent "state-of-the art" ethanol plants have had average capacities of just over seven million gallons per year. Crooks also discusses a range of possible technological improvements, but makes no mention of any cost-savings potential from building larger ethanol plants. To the extent that input prices are relatively inelastic to marginal changes in ethanol production levels, we can assume constant returns to scale and an essentially flat long-run marginal cost curve.[43]

The real price of wholesale ethanol fell by 23% between 1989 and 1997 (as cumulative production increased by 157%); however, even at the 1997 price, ethanol production would cease if the federal tax subsidy were removed.[44] Assuming a stable ethanol demand schedule, the fact that ethanol production costs were higher in previous years means that in no period between 1980 and the present has any portion of the ethanol demand curve exceeded the unsubsidized marginal cost of ethanol.[45] The upper-bound dead-weight loss estimate for the program is therefore the present value of the stream of annual subsidies. Figure 15 shows this for one year as the rectangle ABCD, with the

42. Goldemberg (1996) shows a bifurcated experience curve for the Brazilian bagasse ethanol market, with PR=0.70 from 1980 to 1990 and PR=0.90 from 1990 to 1995. A massive Brazilian MTP has allowed current ethanol production to exceed three billion gallons per year, though wholesale prices remain high at roughly US$1.30 per gallon. This is more than twice current U.S. production levels and matches prevailing wholesale prices in the U.S. of $1.20 per gallon.

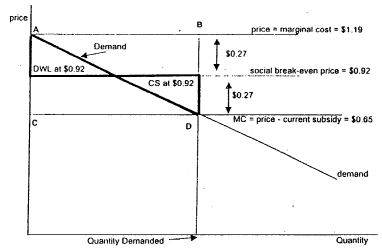
43. USGAO (1997:2) estimates that, prior to the Federal Agriculture Improvement Reform of 1996, completely eliminating the ethanol subsidy would eliminate all production, reducing corn demand by 6% and corn prices by 6 to 9%. Thus, the true LRMC would likely have a slight positive slope due to input cost effects.

44. USGAO (1997:2) estimates that "without the [federal excise tax exemption] incentives, ethanol fuel production would largely discontinue." Similarly, Crooks (1997) estimates that without the federal tax subsidy, ethanol could not compete even if corn were free unless crude oil prices were at least $25/barrel. Finally, Long et al. (1997) also conclude that, based on their model, it would be impossible for Minnesota ethanol producers to make money under any possible set of prices if they lose the federal excise tax exemption.

45. In constant 1997 dollars, oil reached a high of $62 a barrel in 1981, or about three times its 1997 level. However, the experience curve predicts that ethanol prices should have been about three times their 1997 level in 1981 as well. Moreover, corn prices have closely tracked oil prices, with a simple correlation coefficient of 0.88 over the period from 1980-1997.

triangle ACD representing the extent of DWL over-counting under this simplification.

Figure 15. Ethanol Market



Note: Assuming constant returns to scale, linear demand and that no consumers are willing to pay more than the current MC of ethanol, this figure shows the most optimistic case for the ethanol program. Even if the consumers with the highest demand are willing to pay just short of the current cost of $1.19 the program's future is bleak. If the subsidy were gradually scaled back so that the quality demanded remained at current levels as MC fell, then MC would have to fall by half of the current $0.54 per gallon subsidy to first equalize the annual DWL and consumer surplus and then begin generating net benefits. Our analysis indicates this will not occur until after 2013 at current production rates.

Thus, an ex post evaluation of the fuel ethanol program to date yields a BCR of zero. The net present value, using 1980 as the reference year, falls somewhere between zero and negative $4 billion. The true net present value is, however, closer to the pessimistic estimate. This follows because the fuel ethanol demand curve for quantities similar to or lower than current consumption levels is likely to be highly elastic since very close substitutes (e.g., gasoline and other octane enhancers) are readily available. Thus, the triangle ACD in Figure 15 should be small and the producer surplus from

ethanol production is likely to be minimal.[46] It is also worth noting that, while indirect demand effects have helped to drive the observed increase in quantity demanded under the ethanol program, this does not change the fact that none of this production has yielded net social benefits.

As the ethanol MTP continues, there will be additional social losses each year until the MC of the cheapest ethanol produced falls below a large enough share of the demand curve to start generating net social benefits. Without unobtainable detailed knowledge of the fuel ethanol demand schedule, it is impossible to forecast precisely when this might occur. Figure 15 shows an optimistic case in which the highest point on the demand schedule lies just below the LRMC and demand is linear. Under these assumptions, and if the subsidy were steadily reduced such that fuel ethanol production remains constant at 1997 levels as MC fell, then the price would have to fall by exactly half the current $0.54/gallon subsidy for the heavy outlined triangles marked DWL and CS to be of equal size. If the historical experience curve holds and output remains steady then ethanol prices would fall by $0.27 to reach $0.93 per gallon by 2013. This would, however, require billions of dollars in additional social costs until 2013. It is therefore difficult to imagine any scenario under which continuing the ethanol program can yield a positive BCR.

This analysis does not account for any externalities or social considerations associated with greater ethanol use. Regarding environmental effects, USGAO (1997b) concludes that the net impact of ethanol consumption is indeterminate because it may modestly reduce net CO_3 emissions, and it should slightly decrease ozone precursors; however, it will also increase carbon monoxide pollution. Furthermore, there are significant negative environmental externalities associated with corn agriculture including pesticide and fertilizer runoff. On balance, therefore, we assume zero net environmental externalities associated with marginal changes in fuel ethanol use. There are, however, important social implications of the ethanol program. In particular, the program may benefit corn farmers and help to stabilize certain rural communities. We have not attempted to quantify or account for such considerations.

Given an elastic demand curve for fuel ethanol and a progress ratio of about 0.83, one might expect current ethanol sales to approach 10% of gasoline sales, the maximum percentage eligible for the full federal tax subsidy. It is therefore surprising that direct and indirect experience effects have not driven ethanol demand higher than its currently level of just over 1% of total highway

46. Crooks (1997) indicates that the top three ethanol producers controlled 63% of production capacity in 1995, indicating reason for concern about market concentration. USGAO (1997:2) indicates that the data for estimating the size of any potential producer surplus in this industry are simply not available; however, under our plausible assumption of highly elastic demand, market concentration would not translate into large monopoly rents.

gasoline sales. One plausible explanation is that investments in grain ethanol production facilities are extremely risky, a point underscored by Crooks (1997). The federal tax incentive has been modified three times since 1978 and it is constantly under threat of elimination. Moreover, grain and fossil fuel prices are extremely volatile. This is consistent with the observation that recent grain ethanol production facilities have been built by corn growers' cooperatives that have complex political and economic motives. Moreover, ethanol production facilities are concentrated in agricultural states offering substantial state level incentives on top of the generous federal subsidy.

In sum, the corn ethanol MTP has not yielded positive benefits to date, and it appears unlikely that it will do so in the future. One important lesson to draw from this experience is that MTPs cannot be cost-effective if too much time and total investment is necessary before subsidized production lowers costs below market demand. Fuel ethanol lacked substantial niche markets, and the initial cost of production at the start of the MTP was very high relative to consumer willingness to pay. Consequently, very large subsidies were necessary to prompt any ethanol sales and the progress ratio has not been sufficiently favorable to reduce production costs below the unsubsidized market demand schedule even after nearly 20 years of costly government support.

This result also confirms the particular risks involved with initiating MTPs for mature technologies. Morris (1993) reports that total ethanol production in the late 1850s exceeded 90 million gallons; however, production dropped after 1861 when ethanol became subject to a $2.08 liquor tax which was not lifted until 1906. He further explains that ethanol production peaked again at 10 million gallons per year in 1914 and was used widely both as a fuel and especially as a manufacturing input until Prohibition began in 1919. Finally, Crooks (1997) reports that modern fuel ethanol production technology is essentially the same as the equipment and processes used by the beverage and industrial alcohol industries. Consequently, the relevant experience curve for the fuel ethanol that started in the late 1970s may really have been one that reflected the long history and large cumulative production from these closely related industries. Taking this into account should have indicated that rapid cost reduction progress was unlikely (an interpretation bolstered by the extreme sensitivity of the ethanol PR estimate to inclusion of current industry production as an exogenous variable). In conjunction with the large gap between production costs and market demand, the relative maturity of the ethanol industry should have been sufficient grounds for deep skepticism about the fuel ethanol MTP from its inception.

CONCLUSIONS

In this paper, we have introduced a novel analytic framework for assessing the full impact of MTPs on new technology commercialization rates. Our model employs experience curve and demand theory to estimate the BCR of a new MTP (PVMTI) as well as to retrospectively evaluate a MTP that has been operational since 1991 (GL). Our novel benefit-cost methodology improves over existing MTP evaluation strategies by accounting for indirect demand effects.[47] Even under conservative assumptions, we show that the cumulative indirect effect from GL and PVMTI exceed direct program impacts. Thus, failure to account for indirect demand effects will result in MTP impact assessments that are systematically pessimistic. Given the central importance of new technology diffusion rates for both environmental quality and economic productivity, it is important to eliminate this bias against MTPs.

Our preliminary results indicate that MTPs may prove useful; however, this does not diminish the dangers inherent in trying to pick technology "winners." As with any extrapolative exercise, caution is necessary in interpreting our quantitative results. Industry experience curves for many products have been reliable over time but even the tightest historical relationship can break down unexpectedly. For example, dramatic improvements to substitutes can displace any technology. Also, if experience does not drive cost reductions but rather the causality is reversed, then not only do MTPs not work as effectively as indicated by our benefit-cost methodology but they are costly because they encourage premature adoption of technologies for which the price is falling autonomously. These caveats underscore the importance of carefully selecting technologies to support with MTPs.

Among the sectors appropriate for MTPs are emergent clean energy technologies with a steep industry experience curve, elastic demand of approximately unity or greater, and a high probability of major long-term market penetration. The condition that they be clean technologies mitigates poor MTP performance risk by adding the value of displaced environmental externalities, while the other parameter value conditions ensure a strong indirect demand effect. Finally, as with R&D policy, national and international MTP efforts should invest in a portfolio of new clean energy technologies in order to reduce overall MTP program performance risk through diversification.

47. Possible further refinements include: better characterizing the degree of spillover in the electronic ballasts and PV industries; estimating and accounting for the effect of firm-specific economies of scale on our PR estimates; and, analyzing the extent to which industry progress ratios can reliably be treated as exogenous.

ACKNOWLEDGMENTS

The authors would like to thank David Bradford, George Cody, Dan Sperling and Bob Williams for insightful suggestions. We also thank two anonymous referees for particularly useful comments, Kate Lewis for Green Lights data and Ted Kennedy for background on PVMTI. This research was supported by the Class of 1934 Preceptorship (held by Daniel M. Kammen) and a grant from the Princeton University Center for Domestic and Comparative Studies as well as a MacArthur Foundation grant administered by Princeton University's Center of International Studies.

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STATEMENT OF EXXON MOBIL CORPORATION

Chairman Inhofe, Members of the Committee, Exxon Mobil Corporation is pleased to have the opportunity to present a statement on the use of ethanol in gasoline, particularly with regards to the environmental impacts of its expanded use. We are also pleased to offer our thoughts on the uncertainty in the industry caused by the recent Unocal patent rulings.

ETHANOL AND THE ENVIRONMENT

Recently, the EPA announced that it favored legislation that would repeal the Clean Air Act oxygenate requirement for reformulated gasoline and would rapidly phase down MTBE use. However, EPA also wants to permanently mandate use of another oxygenate additive, ethanol. EPA and other ethanol supporters would like the Federal Government to require that the American consumer use their product in all gasoline in order to support their vision of an expanding future market. We are opposed to mandates, which distort energy markets, decrease efficiency and ultimately raise costs to consumers. Substituting one unnecessary and costly government mandate for another is not a policy in the best interests of anyone, especially since the need for such a mandate no longer exists.

The use of ethanol as a gasoline additive is not at issue. Indeed, we have used ethanol to fulfill the oxygenate mandate and as an octane extender for a number of years in the Midwest where the proximity of ethanol production and various subsidies make ethanol the economic oxygenate of choice. While ethanol has long been used as a gasoline additive and will likely enjoy even greater use even without a

mandate, there are a number of questions and concerns that need to be addressed before considering measures that would mandate its broader use.

A Federal oxygenate mandate is not needed to achieve our environmental goals. If the oxygenate mandate were eliminated, clean air progress would continue at the same rate because oxygenates are not needed to produce reformulated gasoline. Therefore, we believe requiring the use of ethanol in gasoline is not necessary. Today's clean-burning fuels and vehicles can meet stringent emission standards without adding oxygenates. Hence, ethanol's role should be determined by whether it is an economic gasoline extender or not.

Beyond the mandate issue, though, the broader use of ethanol raises environmental questions that need to be addressed. There are still unanswered questions about its long-term health effects, which requires more research be conducted. In addition, any proposal to broaden the use of ethanol should first include a thorough evaluation of the environmental consequences of a requirement to use large amounts of ethanol in gasoline.

Air quality impacts are of particular concern. According to a recent California Air Resources Board (CARB) report,[1] tailpipe NO_x emissions increase significantly at higher oxygen concentrations typical of ethanol blends. Also, ethanol's impact on gasoline volatility and its tendency to increase "permeation" (when fuel components move through fuel-system components such as hoses and gaskets into the atmosphere) will create greater evaporative hydrocarbon emissions from the existing car fleet. Hence, if ethanol is mandated, areas where increased ozone (smog) producing emissions are of concern could be significantly impacted.

A 1999 EPA-funded study by the National Research Council (Ozone-Forming Potential of Reformulated Gasoline) supports CARB's findings. The NRC study found that "ethanol blends result in more pollutants evaporating from vehicle gas tanks . . ." and "also increase the overall potential of emissions to form ozone." According to a recent study performed by Toyota Motor Company, this increase occurs because ethanol raises gasoline vapor pressure and because it "permeates" through the rubber/plastic components of vehicle fuel systems. Because of this elevation in the evaporation rate of gasoline, VOC (volatile organic compound) emissions increase, contributing to ozone formation.

The Toyota report, presented at a recent CARB workshop, further highlights the potential impact of ethanol on air quality. After testing nine late-model, low-emission vehicles, it was determined that replacing an 11 percent MTBE blend with a 10 percent ethanol blend results in both increased evaporative losses and *increased* exhaust emissions. This presents a new challenge to areas of the country seeking to reach attainment with ambient air quality standards.

The report further indicates that non-tailpipe emissions from fuel evaporation also increase when fuels contain ethanol vs. MTBE. Two sources are the culprits here—higher fuel volatility and increased permeation.

Although the impact of ethanol on fuel volatility can be reduced by ensuring that ethanol blends have the same Reid Vapor Pressure (RVP) as non-ethanol fuels, the Toyota data indicates that ethanol blends could have higher evaporative emissions even *with* equivalent RVP. This is due to volatility characteristics at the high fuel tank temperatures (120F) that can occur during driving. Additionally, requiring refiners to make a lower RVP "base" gasoline increases the manufacturing cost of gasoline and reduces the energy efficiency of the manufacturing process.

There are water concerns as well. EPA's Blue Ribbon Panel on Oxygenates warns that "(a)lthough ethanol is likely to biodegrade rapidly in groundwater, because ethanol is infinitely soluble in water, much more ethanol will be dissolved into water than MTBE." Gasoline containing no oxygenates is more stable in the case of a spill, whereas ethanol moves faster, dragging gasoline along with it in a spill situation. While the environmental track record—with respect to groundwater contamination—of using ethanol in gasoline appears good, the environmental consequences of large mandated use of this highly water-soluble chemical should be studied further.

Finally, the International Agency for Research in Cancer (IARC) classifies ethanol as a known human carcinogen.

MIDWEST ETHANOL USE

The Midwest is the only major market where ethanol is the primary oxygenate of choice used in RFG. As a result, the area has become isolated in terms of supply, since RFG that does not utilize ethanol cannot be transported to the region or commingled with ethanol-blended RFG. RFG blended with ethanol is more difficult to

[1] California Air Resources Board Staff Report, Initial Statement of Reasons Proposed for California Phase 3 Gasoline Regulations, Chapter I, p.4, October 22, 1999.

produce because the base gasoline must be further refined to offset the increased volatility of ethanol. This further processing of RFG reduces the available supply. Mandating expanded use of ethanol could increase both the difficulty and cost of producing RFG in other parts of the country as well.

THE UNOCAL PATENT

A recent decision by the U.S. Court of Appeals for the Federal Circuit has potentially significant implications for the California and Federal RFG programs because it will likely impose additional costs on the manufacture and importation of fuels. The decision could also impact supplies of RFG as refiners and importers individually evaluate whether to continue to participate in the RFG programs—they must decide whether to pay patent royalties or incur the costs of developing formulations that are outside the scope of the patent.

Because of this uncertainty, concerns have also been expressed that importers and blenders, in particular, may choose to supply less RFG to the market to avoid potentially infringing on the patent. This means that the amount of flexibility the refineries have to make a quality product is diminished. This lack of industry flexibility, particularly when using ethanol, has a negative impact on the local volumes available to the market, again tightening gasoline supplies.

CONCLUSION

Given adequate lead-time, refiners can manufacture blends of cleaner-burning gasoline that achieve the same air quality improvements without the current oxygen mandate. Exxon Mobil agrees with the findings of the recent study conducted by the EPA's Blue Ribbon Panel on Oxygenates. This independent panel of experts recommended that Congress act to remove the current Clean Air Act requirement that 2 percent of RFG, by weight, consist of oxygen. This can be done with no loss of current air quality benefits while allowing a substantial reduction in the use of MTBE.

We strongly encourage Congress to learn from the MTBE experience. Substituting one unnecessary and costly government mandate that had unforeseen environmental consequences for another that could have unforeseen environmental consequences, while also increasing already large subsidy payments, is not a policy in the best interests of the American public. Ethanol is and will continue to be a useful additive in transportation fuels in some areas, but it should compete on price and performance. Congress should eliminate the oxygen mandate altogether and allow refiners to begin reducing MTBE usage while continuing to meet emission requirements using performance-based standards.

[From Environmental Science & Technology, May 1, 2000]

MTBE.—TO WHAT EXTENT WILL PAST RELEASES CONTAMINATE COMMUNITY WATER SUPPLY WELLS?

AN IMPROVED UNDERSTANDING OF THE FACTORS THAT AFFECT THE MAGNITUDE OF THE PROBLEM IS NEEDED

(By Richard Johnson, James Pankow, David Bender, Curtis Price, and John Zogorski)

The increasing frequency of detection of the widely used gasoline additive methyl tert-butyl ether (MTBE) in both ground and surface waters is receiving much attention from the media, environmental scientists, State environmental agencies, and federal agencies. At the national level, the September 15, 1999, *Report of the Blue Ribbon Panel on Oxygenates in Gasoline* (1) states that between 5 and 10 percent of community drinking water supplies in high MTBE use areas show at least detectable concentrations of MTBE, and about 1 percent of those system are characterized by levels of this compound that are above 20 μg/L. In Maine, a desire to determine the extent of MTBE contamination led to a 1998 study (2) that revealed that this compound is found at levels above 0.1 μg/L in 16 percent of 951 randomly selected household wells and in 16 percent of the 793 community water systems tested in that State (37 wells were not tested). The study also suggested that between 1400 and 5200 household wells may have levels above 35 μg/L, although no community water supplies were found to be above that concentration. For comparison, Maryland, New Hampshire, New York, and California have set MTBE remediation "ac-

tion levels'' at or below 20 μg/L, and EPA has set its advisory level for taste and odor at 20–40 μg/L (3).

In California, concern regarding MTBE reached statewide levels in 1996 when seven wells supplying 50 percent of the water for the city of Santa Monica were removed from service because of MTBE at concentrations as high as 600 μg/L. For the city's Charnock well field, an initial review of known and suspected petroleum spill sites identified about 10 potential sources that lay within 1 km of the well field, lay above the hydrologic unit accessed by the well field, and were created after MTBE use began in the State (4). At the time that contamination of the wells was discovered, pumping of the Charnock well field was at 5 million gallons/day (mgd). This aggressive pumping was approximately twice the total natural flow of water moving into the aquifer. Despite the presence of a protective aquitard in the system, the pumping had dewatered a significant portion of the upper aquifer, caused water to flow toward the well field from all directions, and had greatly increased the likelihood that the community water supply (CWS) wells in Santa Monica would in fact become contaminated by one or more persistent organic pollutants such as MTBE.

Besides leaking underground fuel tanks (LUFTs) and leaking pipelines, other sources of MTBE in groundwater include tank overfilling and faculty construction as gas stations, spillage from vehicle accidents, and homeowner releases. In Maine, it is possible that many of the cases of domestic well contamination by MTBE were caused by homeowner releases (2). For the Santa Monica wells, the scale of contamination found there seems consistent only with large releases (e.g., LUFTs).

UNPRECEDENTED GROWTH IN USE

Use of MTBE as a gasoline additive began in the United States in the late 1970s when it was introduced as a means of maintaining adequate octane ratings during the phaseout of alkl lead additives. MTBE use expanded dramatically in the mid-1990s with the implementation of the Clean Air Act Amendments of 1990, which mandated efforts to reduce carbon monoxide emissions, as well as ozone levels in urban air. For carbon monoxide, MTBE was selected by some gasoline producers as a means of producing ''oxygenated fuel'' (oxyfuel) that allowed the more complete combustion of gasoline hydrocarbons. For ozone, MTBE has been used to produce ''reformulated gasoline'' (RFG), which is low in the potent human carcinogen benzene and other aromatic compounds; use of RFG lowers the emissions of unburned aromatic compounds and therefore the formation of ozone in urban air. Alternative oxygen-containing compounds for the formulations of oxyfuel RFG include ethanol, ETBE, TAME, and DIPE (see box above); usage of the last three has been relatively small. Currently, 19 areas in 13 States are involved in the oxyfuel program, with MTBE used in 3 percent of all oxyfuel at levels of 10–15 percent by volume. A total of 29 areas in 18 States are involved in the RFG program, with MTBE used in 85 percent of all RFG at levels of 11–15 percent by volume (5).

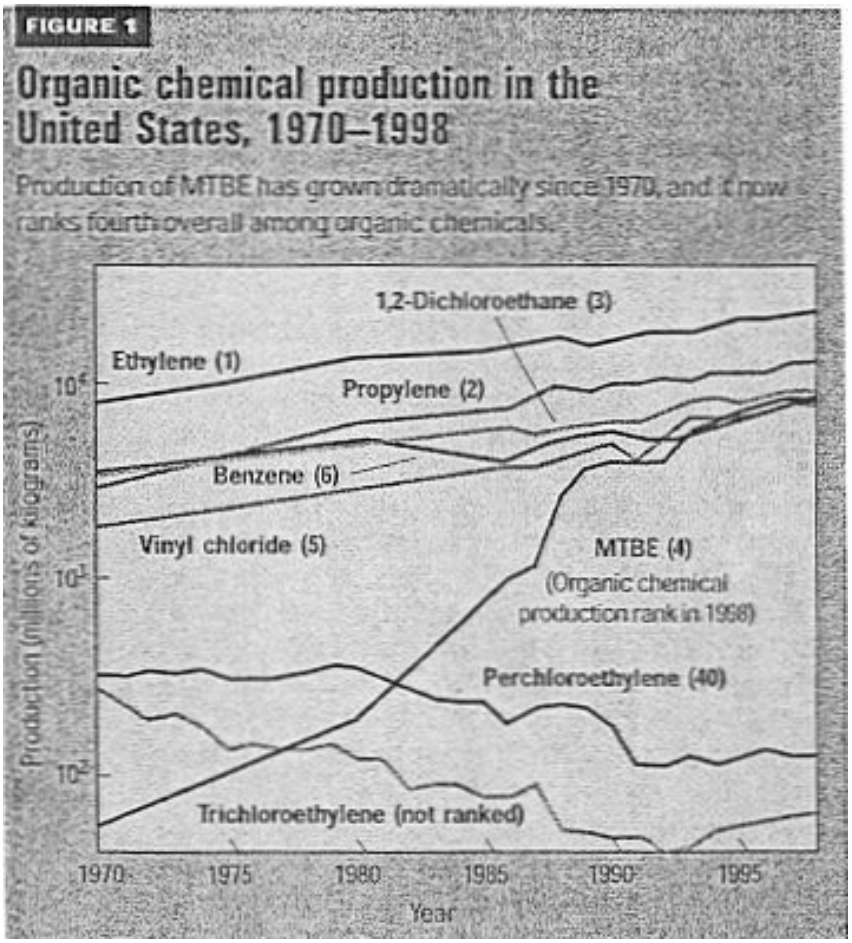
The growth in the use of MTBE has been unprecedented. In 1970, MTBE was the 39th-highest produced organic chemical in the United States. By 1988, it had become fourth-highest (see Figure 1, (6–11)), with an aggregate production of about 60 million metric tons over that period. And, the production of MTBE is exceeded only by that for the monomers used to make polyethylene, polypropylene, and polyvinyl chloride. In 1998, more than 10.5 mgd of MTBE were used in the United States, with 4.2 mgd used in California alone (12). There production numbers are far larger than those of the chlorinated solvent compounds, a group widely recognized as having caused extensive contamination of groundwater in urban and nonurban areas. Thus, regardless of what happens to MTBE use in the future (e.g., both Maine and California have stated that they intend to stop using MTBE, and the Blue Ribbon Panel and Oxygenates in Gasoline (1) has call for a substantial and rapid reduction in MTBE use in RFG areas), it is likely that significant amount of this compound are already present in the subsurface.

Terms

MTBE	methyl ***tert***-butyl ether.
ETBE	ethyl ***tert***-butyl ether.
DIPE	di-isopropyl ether.
TAME	***tert***-amyl methyl ether.
RFG	reformulated gasoline.
oxyfuel	oxygenated fuel.
BTEX	benzene, toluene, ethylbenzene, and xylenes.
CWS ''wells''	community water supply well.
CWS	one or more CWS pumping wells that draw from the same portion of an aquifer.

Terms

LUFT	leaking underground fuel tank.
LUST	leaking underground storage tank.
UST	underground storage tank.
PCE	perchloroethylene (also called tetrachloroethene).
TCE	trichloroethylene (also called trichloroethene).
mgd	millions of gallons per day.
UFT	underground fuel tank.



. . . AND MTBE IS VERY SOLUBLE

Gasoline hydrocarbons are nonpolar compounds composed only of hydrogen and carbon. Of these, the compounds with the lowest drinking-water concentration limits are members of the BTEX group (benzene, toluene, ethylbenzene, and the xylenes). However, the relatively low water solubilities from gasoline mixtures of the BTEX group (see Table 1), combined with their high in situ biodegradabilities, greatly limit their migration from LUFT sites. These limitations have allowed "natural attenuation" processes to mitigate subsurface contamination at many sites where conventional gasoline has been released. The extent of contamination by BTEX compounds at most LUFT sites is typically less than 100 m (12), and benzene has been detected

only rarely in the community water systems of California (1) and across the nation in groundwater samples collected as part of the National Water-Quality Assessment Program of the U.S. Geological Survey (14).

MTBE is a relatively nonpolar either that blends easily with gasoline hydrocarbons. If MTBE behaved like the gasoline hydrocarbons in all respects, the scale of its use would not be itself be a reason for concern. After all, the current numbers for gasoline production in the United States are about 40 times larger than those for MTBE, and 385,000 known releases of gasoline have already occurred at LUFT sites. Unfortunately, MTBE is very soluble in water and is therefore very mobile in groundwater systems. And the absence of any carbon branches more one carbon long on the MTBE molecule make MTBE very resistant to biodegradation. Thus, like the chlorinated solvent compounds TCE and PCE, MTBE has been found to persist in groundwater, and cases of MTBE plumes extending kilometer-scale distances in the subsurface have now been documented (e.g., Port Hueneme, CA; East Patchoque, NY; Spring Creek, WI; and Vandenberg AFB, CA).

Some MTBE plumes have originated from very small spills, as from the gasoline in the tank of a single over-turned auto. Then gallons of a gasoline that is 11 percent by volume MTBE will contain 3 kg of MTBE. If such an amount were to reach the water table (either by direct see page of the gasoline or as assisted by infiltration of precipitation), subsequent dissolution and transport could lead to the contamination of millions of liters of water at the tens of μg/L level. The potential for rapid and extensive transport of MTBE through the subsurface is especially large when spills reach fractured rock where porosities may only be a few percent. For example, a spill resulting from a single automobile accident in Standish, ME, led to MTBE transport through more than 0.7 km of fractured rock and to the contamination of more than 20 domestic wells (15).

TABLE 1—WATER SOLUBILITIES OF HYDROCARBON COMPOUNDS

The relatively low water solubilities from gasoline mixtures of the BTEX group (benzene, toluene, ethylbenzene, and xylenes) combine with their high in situ biodegradabilities, greatly limit their migration from LUFT sites. This situation differs greatly for alkyl ether compounds.

Compound	Solubility	
	Solubility (mg/L) at 20°C	
Aromatic gasoline hydrocarbons	***from conventional gasoline***[a]	
Benzene	18	
Toluene	25	
Ethylbenzene	3	
xylenes (total	20	
Chlorinated solvent compounds	***Solubility (mg/L) at 20***°C	
from the pure compound		
tichloroethylene (TCT)	1440	
perchloroethylene (PCE)	240	
	Solubility (mg/L) at 20°C	
Alkyl ether compounds	***from RFG***[b]	***from Oxyfuel***[c]
methyl ***tert***-butyl ether (MTBE)	4700	6300
ethyl ***tert***-butyl ether (ETBE	1300	1750
tert-amyl methyl ether (TAME)	1400	1850
di-isopropyl ether (DIPE)	1200	1600

[a] Assumes release of a conventional gasoline containing 1 percent benzene, 5 percent toluene, 1.5 percent ethylbenzene, and 10 percent total xylenes.

[b] Assumes release of reformulated (RFG) gasoline containing 2.0 percent by weight oxygen, which would correspond to 11.1 percent MTBE, 12.9 percent ETBE, 12.4 percent TAME, or 12.9 percent DIPE (all by volume).

[c] Assumes release of oxygenated gasoline containing 2.7 percent by weight oxygen, which would correspond to 15.0 percent MTBE, 17.5 percent ETBE, 16.8 percent TAME, or 17.4 percent DIPE (all by volume)

BLUE RIBBON PANEL ON OXYGENATES IN GASOLINE

Appointed by EPA Administrator Carol M. Browner in November 1998, the Blue Ribbon Panel was asked 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 was composed of experts from the Public health and scientific communities, automotive fuels industry, water utilities, and local and state governments.

250,000 LUFT RELEASES OF MTBE

Because MTBE has been used so widely (as an octane enhancer, as a component of RFG, and/or as a component of oxyfuel), most underground gasoline tanks in use after 1979 in the United States probably contained this compound at some point in time. For example, in Kansas, where neither RFG nor oxyfuel use was required, MTBE has been found at 88 percent of 818 leaking underground storage tanks (LUSTs) (16). In California, MTBE was found at 75 percent of 9000 LUFT sites (17). Therefore, of the approximately 385,000 confirmed LUFT releases of gasoline nationwide (18), perhaps some 250,000 of these spills involved MTBE . And, recent evidence from California suggests that spills and leaks continue to occur, even at upgraded UFT facilities (1). Therefore, because approximately 90 million people in the United States obtain a portion of their drinking water from CWS wells, EPA has been advised to work with its State and local water supply partners to

> . . . coordinate the Source Water Assessment program in each State with federal and State Underground Storage Tank Programs using geographic information . . . systems to determine the location of drinking water sources and to identify UST sites within source protection zones.
>
> BLUE RIBBON PANEL ON OXYGENATES IN GASOLINE (1)

Thus, specific information is greatly needed regarding the real density and distribution of UST sites and other significant sources in the areas surrounding CWS wells and also the hydrogeological and pumping information for these wells.

Once this information is in hand, vulnerability assessments based on common sense, as well as detailed hydrogeological modeling can be carried out to determine what steps, if any, are needed to ensure the protection of a given CWS well. While these data are being gathered, it will be very useful to identify the factors that will determine the likelihood that individual CWS wells will be adversely affected by local sources. It will also be important to estimate the number of CWS wells nationwide that ultimately may be affected by MTBE, as well as by other persistent organic compounds. There three scales to this problem: a temporal scale, a site-dependent local scale, and a national scale. Each will be considered here.

TEMPORAL SCALE FOR CWS WELLS

Subsurface contamination has the potential to threaten local CWS wells for tens to hundreds of years. This is because LUST sources can persist for decades and because it can take tens to hundreds of years for groundwater to flow from source areas to a CWS well. The actual time frame that MTBE from a given source has the potential to appear in a CWS well at problematic concentrations will depend on the size of the source, the concentration leaving the source, and how attenuation mechanisms act to reduce the concentration as the contaminant moves from the source toward the well. Experience indicates that most large LUFT–MTBE sources have lifetimes of greater than 10 years, and that the concentrations of MTBE in groundwater leaving such sources are frequently a few hundreds of milligrams per liter. Some States have established maximum allowed concentration values of a few tens of micrograms per liter (or less) for MTBE in drinking water. This suggests that an *overall reduction factor* on the order of 10,000 may be necessary to bring groundwater concentrations coming from CWS wells down to the maximum allowed values.

Three primary mechanisms can reduce the concentration of MTBE as it moves toward and into a CWS well: dilution, dispersion, and degradation plume is drawn into a CWS well. In the example involving a 1-mgd well (see sidebar at right), the *well dilution factor* is 10,000, then an additional *in situ reduction factor of about 40 would be required to reduce the concentration in the CWS to an acceptable level. (Note that in this analysis, the overall reduction factor = in situ reduction factor x well dilution factor.)*

The magnitude of the in situ reduction factor for a nonsorbing contaminant such as MTBE will be determined by the dispersion and degradation that occurs as the contaminant moves in the subsurface. Although dispersion can play an important role in determining the shape of a groundwater plume, when an MTBE source lies within the "capture zone" of a well, dispersion will, in general, not be strong enough to remove much MTBE from the flow paths leading to the well (see sidebar at right). Thus, in most cases, degradation followed by dilution at the well will control the MTBE concentrations found in CWS wells.

If degradation occurs as a first-order process (i.e., the passage of each degradation half-life ($t_{1/2}$) brings a factor of 2 concentration reduction), a 40-fold concentration reduction will require between five and six half-lives. For BTEX compounds released from LUFT sources, degradation in groundwater is relatively fast, with a typical half-life of two to three months. In contrast, based on a limited number of field data (e.g., (19,20)), it has been noted that

> [in] studies to date, in situ biodegradation of MTBE has been minimal or limited at best, which is significantly less (by at least one order of magnitude) when compared to benzene.
>
> Blue Ribbon Panel on Oxygenates in Gasoline (1) Thus, it is appropriate to assume that the degradation half-life for MTBE in plumes from LUFT sources is at least two years. As a required degration time, t_d, of five to six half-lives will probably correspond to at least 10 years (see sidebar on previous page). Significant numbers of MTBE releases may therefore continue to reveal themselves as problematic sources of contamination for the nation until at least 2010.

MECHANISMS THAT CAN REDUCE THE CONCENTRATION OF MTBE ARRIVING AT A CWS WELL

Dilution by mixing in a CWS well

Dilution by mixing the uncontaminated water in a community supply well can be calculated by comparing the groundwater flow rate through the source zone (assumed to be in the capture zone for the well) with the pumping rate for the well. For example, the dimensions for a LUFT source zone might be 30 m wide x 5 m thick. If the groundwater velocity is 0.3 m/day and the porosity is 0.33, the volume of water flowing through the source will be 15 m^3/day. For a community supply well pumping at 4000 m^3/day (1 mgd), this would result in a dilution factor of about 250, *regardless of the distance between the source zone and the well.*

Dispersion

Dispersion can occur both perpendicular ("transverse") to groundwater flow and in the direction of the flow ("longitudinal"). Neither means of dispersion will provide much net reduction in the flux of MTBE as it moves toward a CWS well. Studies of chlorinated solvent plumes in capture zones indicate that transverse dispersion is rarely strong enough to move significant contamination outside the capture zone of a pumping well. This means that transverse dispersion cannot, by itself, help much to reduce the concentration of MTBE in the water produced by a CWS well. For longitudinal dispersion, because MTBE sources are persistent and MTBE is relatively long-lived in groundwater, once such a plume becomes established and longitudinal concentration gradients dissipate, the amount of concentration reduction at the well head that can occur by longitudinal dispersion will be small.

Degradation

Degradation of MTBE by subsurface microorganisms is generally slow. Abiotic degradation is negligible. Field studies of MTBE spills can be used to compute apparent first-order rates of decay and corresponding half-lives, $t_{1/2}$, (in years) for biodegradation. Data obtained from actual spills indicate that MTBE has a half-life in most natural groundwater systems of at least two years, although significant uncertainty exists with these numbers.

Required Degradation Time, t_d

The required degradation time is defined here as the time required for the flux of contaminants from a source to be reduced by degradation to the point at which they no longer pose a threat to the CWS well. It is a function of source size and strength, groundwater flow rate, and pumping rate, as well as the in situ biodegradation rate. As discussed in the text, a value of 10 years has been assumed for the analysis presented here.

FIGURE 2

Modeling well vulnerability to MTBE contamination

By making assumptions about the location of MTBE sources and using numerical models, the vulnerability of wells to contamination by MTBE can be assessed and expressed as the size of an area around a well that is at risk.

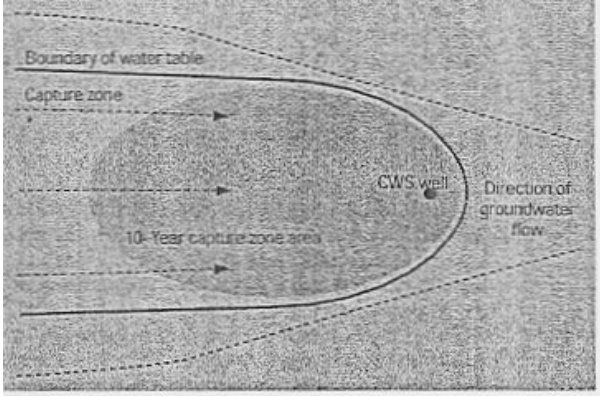
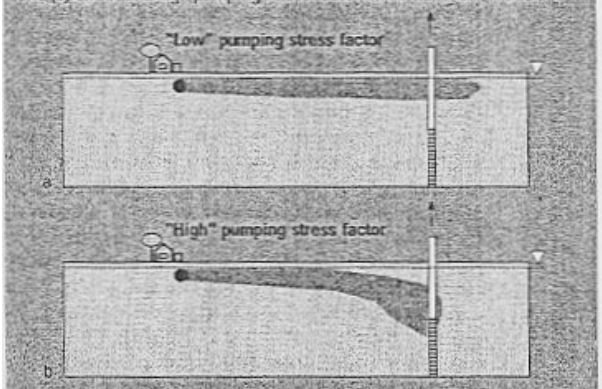


FIGURE 3

The effect of pumping intensity on well contamination

The intensity of the pumping at a well influences the likelihood that MTBE will be drawn up into the well: (a) effect of a low pumping stress factor and (b) effect of a high pumping stress factor on contaminant intrusion.



Local aquifer yield
Local aquifer yield is defined here as the rate that water flows through the 1-km-wide cross section of the aquifer containing the CWS well *in the absence of pumping*.

Pumping stress factor
Pumping stress factor = CWS pumping rate/local aquifer yield

LOCAL SCALE: SOURCES NEAR CWS WELLS

For any specific CWS well, if the hydrogeologic conditions and the locations of contaminant sources near the well are known is sufficient detail, then the movement of contaminants to the well can be assessed using numerical modeling. Although the data exist to do this in certain specific locations, this information is not available for most CWS wells. Therefore, to begin to understand the scale of the threat to CWS wells posed by MTBE sources, an approach is needed that can provide a general measure of the likelihood of contamination at wells when the specific locations of sources relative to the wells are not known.

One approach is to assume that MTBE sources are randomly distributed around CWS wells and use numerical modeling to calculate the likelihood that contaminated water will reach CWS wells under specific sets of conditions. If it is further assumed that MTBE sources occur only near the water table, then the first step in this approach will be to determine the size of the area from which groundwater at the water table is capable of reaching the well before the required degradation time, t_d, needed to achieve the in situ reduction factor can elapse. If, as has been assumed here, t_d is 10 years, then the *10-years capture zone area* (see Figure 2) can be determined through a straightforward application of groundwater flow modeling techniques.

The second step is to determine the real density of significant sources in the vicinity of the well. The third step is to multiply that density by the 10-year capture zone area for that well to obtain the *number of sources*, n_s, that will, on average contaminate the well water at a concentration above tolerable levels. It should be noted that n_s is a probabilistic parameter and is not the number of sources that will impact that specific well. (For example, this analysis cannot determine if a specific well with $n_s = 0.5$ will be impacted by zero, one, two, or more sources. However, a group CWS wells all with $n_s = 0.5$ will, on average, be impacted by 0.5 sources per well.)

Three simple, yet instructive, hydrogeological examples will be examined here: a "*base*" *case*, consisting of a CWS well in a slightly stratified aquifer; an *aquitard case*, in which a continuous low permeability layer lies above the inlet to the well and helps protect the well; and an *infiltration case*, in which the infiltration of precipitation contributes to the downward movement of contaminated groundwater. To better generalize these cases, it is useful to express the magnitude of the pumping rate as a fraction of the rate at which groundwater would flow naturally through some relevant width of the aquifer (e.g., 1 km) in the vicinity of the well. This fraction is a measure of the intensity of the pumping, and as a result, it will be referred to here as the *pumping stress factor* (see Figure 3 for definitions).

When the pumping stress factor is low, even an MTBE plume flowing directly toward a well can pass over it without being drawn down to the well inlet (see Figure 3a). The 10-year capture zone area will therefore remain zero until some minimum pumping rate is reached, at which point water from sources at the water table will begin to be drawn into the well inlet (see Figure 3b).

In the base case, the well begins to capture water table sources when the pumping stress factor reaches 0.4 (see Figure 4). As the pumping stress factor increases to 1.0, the 10-year capture zone area rises to 0.9 km^2.

When an aquitard is present, significant protection of a CWS well can be afforded. For the aquitard case considered here, the pumping stress factor must rise to about 1.3 before contaminated water at the water table begins to be captured by the well. In contrast, when the based case is modified to include infiltration, the 10-year capture some area becomes nonzero when the stress factor is only about 0.2.

As a discussed above, the Santa Monica's Charnock well field, initial modeling by Brown and colleagues (4) indicates that at the time that MTBE contamination was discovered, the pumping rate corresponded to about twice the total natural flow through that 2-km-wide aquifer, and as a result, 100 percent of the water in the aquifer within 1 km of the wells was moving toward the well field. Because for such conditions the pumping street factor would have been about 4, it would be of considerable interest to model the Charnock case to determine how many of the local LUFT–MTBE sources were inside the 10-year capture zone area.

NATIONAL SCALE OF THE PROBLEM FOR CWS WELLS

To understand the issue of MTBE and CWS wells at the national scale, it would be useful to apply an approach such as the one just described to a number of sites to develop a histogram plot that presents the number of CWS wells as a function of the number of sources, n_s, that will, on average, impact those wells. That is, how many of the nation's CWS wells have low $n_s$values, and how many have large n_s, values and are therefore at risk? As has been noted, the data required to prepare

this plot are not currently available. However, two existing geographic information system databases can be useful in a first step toward that goal. This first is the Starview database (21), which has latitude and longitude information for many of the nation's LUST sites (most of which are LUFT sites). It is important to note that this database is known to have significant uncertainties in the locations of individual LUSTs. However, data from Happel and colleagues (17) indicate that the average distances between CWS wells and LUSTs are not biased, so the calculation of LUST densities based on those data is not expected to have significant errors. The second database, the EPS Safe Drinking Water Information System (SDWIS) (22), has CWS well location information for 31 States. (Several large States, including California and Texas, did not have location data available. This sites from the 31 States were filtered to remove multiple wells at the same location, resulting in a total of 26,000 CWS wells.)

Overlaying these two databases allows the determination of a histogram plot of the number of CWS wells versus the number of LUSTs within 1 km of the CWS wells (see Figure 5a). Although it is likely that not every one of the LUSTs in the Starview database has created a significant source at the water table, this type of plot is useful in developing an understanding of how many CWS wells may be at risk of contamination.

When the distribution (see Figure 5a) is integrated to obtain the cumulative frequency distribution (see Figure 5b), we can see that approximately 35 percent of the CWS wells in the database are characterized by one or more LUST sites within a 1-km radius of the well. This corresponds to about 9,000 CWS wells for the existing version of the 31-state SDWIS database.

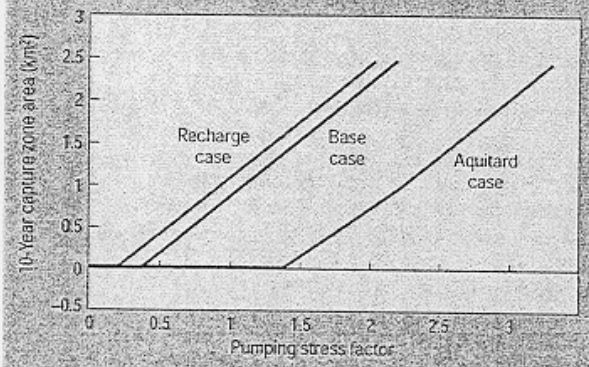
Of course, not all LUSTs are LUFTs, not all LUFT sites will be contaminated with MTBE, and not all LUFT MTBE sites will be significant sources of MTBE. However, more than 90 percent of all LUSTs and LUFTs, perhaps 65 percent of all LUFTs are associated with MTBE contamination, and a large percentage of all LUFT MTBE sources is likely to have caused significant contamination by MTBE. Therefore, although the figure of 9,000 CWS wells in the 31 States is undoubtedly an overtime of the number of wells in those States with at least one significant LUFT-derived MTBE site, the number 9,000 is so large that the actual number may well be worrisome.

As noted previously, information on pumping rates, well characteristics, local aquifer yield, and other important well/aquifer data is not available in a database for all the nation's CWS wells, or even for a random subset of those wells. Thus, the lack of this information currently prevents determination of the 10-year capture zone areas for CWS wells and ultimately production of a figure in which the cumulative frequency of CWS wells versus n_s is plotted. A conceptual version of that plot, with no numerical labels on the *x* axis, is given in Figure 6.

FIGURE 4

Factors affecting the capture zone area

Pumping rate, porosity, aquifer size, groundwater velocity, and other factors, as well as the presence of an aquitard and groundwater recharge, should be assessed in analyzing the relationship between pumping stress factor and capture zone area.



Model assumptions

"Base" case

- 5400 m long × 3000 m wide × 60 m thick aquifer
- No-flow through 5400-m sides
- Groundwater velocity = 0.3 m/day maintained by constant heads at the upper and lower boundaries
- Porosity = 0.33
- Transmissivity = 6000 m²/day (horizontal hydraulic conductivity = 100 m/day)
- Vertical hydraulic conductivity = 10 m/day
- Water table at 0-m depth at the upgradient boundary
- CWS intake depth interval of 30 to 60 m

Aquitard case

- 10-m-thick aquitard located below surface from 10 m to 20 m
- Hydraulic conductivity of aquitard = 0.1 m/day
- Transmissivity = 6000 m²/day (horizontal hydraulic conductivity = 120 m/d above and below the aquitard)
- All other parameters as in base case

Recharge case

- 1/3 of total flow into the model domain occurs by recharge from the surface (6000 m³/day)
- 2/3 of total flow into the model domain occurs as groundwater flow (12,000 m³/day)
- All other parameters as in base case

Note: Hydrogeologic conditions in aquifers are highly variable. The conditions assumed here are typical of those found in many of the relatively shallow, unconsolidated aquifers in some of the systems most highly used to supply drinking water in the United States. Examples include: a) basin-fill aquifers (e.g., those in the California Coastal Basins, the Central Valley of California, and the Puget–Willamette lowland); b) surficial aquifers of the Coastal Plain along the Atlantic and Gulf coasts; c) glacial-deposit aquifers in the Northeast and Midwest; d) large river-valley alluvial aquifers; and e) the shallow parts of large blanket-sand deposits (e.g., the High Plains aquifer).

NEXT STEPS

Although the large number of MTBE–LUSTs in the immediate vicinities of CWS wells may represent a significant threat to drinking water over at least the next decade, the data to determine the magnitude of that threat are simply not available at the present time. To address this issue, information is needed at all three of the scales discussed above. To improve our understanding of the temporal scale of the MTBE problem, a better data set of in situ MTBE biodegradation rates is needed. At the local scale, water providers need to better understand the stress that pumping is putting on their groundwater supplies. Finally, at the national scale, examination of this issue will require two new national databases, one for LUFTs and other sources, and one for CWS wells. As has been suggested by EPS's Blue Ribbon Panel on Oxygenates in Gasoline (1), the LUST database should focus on sites that actually represent threats to CWS wells. In addition to basic site location data, it should include information on the magnitude of each release and the available data on groundwater concentrations (i.e., source strength). The CWS database should contain hydrogeologic and pumping rate data for all CWS wells of interest to the nation. These databases will allow improved estimates of the number of CWS wells that may be affected by significant concentrations of MTBE over the next 10 years. And, quite independent of the MTBE issue, the databases will help identify aquifer and CWS systems that are being pumped at rates that carry unacceptable risks of contamination by persistent chemicals in general.

FIGURE 5

A national-scale view of MTBE threats to wells

Available national databases concerning LUST and well locations information can be used to evaluate the proximity of these wells to LUST sites: (a) Overlaying the databases suggests the number of CWS wells compared to the number of LUSTs within 1 km of the wells; (b) integration of the distribution in Figure 5a provides an estimate of the cumulative frequency distribution.

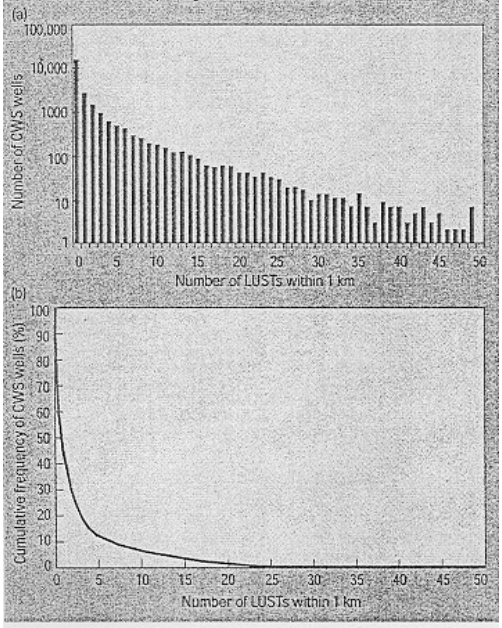
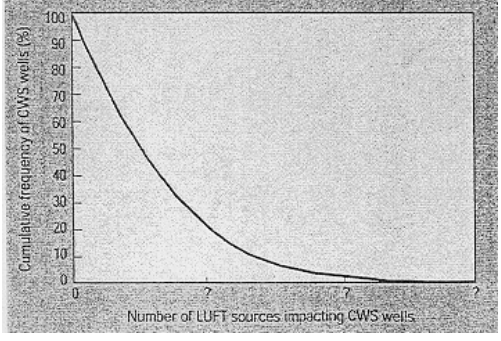


FIGURE 6

LUSTs and well contamination: Data needed

Missing data, such as information concerning pumping rates, well characteristics, local aquifer yield, and other important well–aquifer data currently prevent determination of the 10-year capture zone areas for CWS wells and ultimately production of a figure in which the cumulative frequency of CWS wells versus the number of sources is shown.



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DES MOINES REGISTER,
March 25, 2000.

THE REGISTER'S EDITORIALS

THE MTBE ALTERNATIVE

Banning the additive was a good move. Substituting ethanol is the logical next step.

Once upon a time there were a handful of motor vehicles on America's dirt trails, gradually replacing horses. They stank somewhat, but then so did the horses. By 1950 there were millions and millions of the gas guzzlers, and gas was cheap and nobody much bothered to ask what all the exhaust was doing to the air. Today there are more than 200 millions cars and trucks in use in this country. They get better mileage than most of the 1950's vehicles, but their exhaust is a major contributor to everything from smog to global warming.

Ethanol, made from corn, is also an oxygenator but not a poison. It's also not a finite resource like MTBE.

The Clean Air Act required that in some areas, oxygenators be added to gas to burn it more completely, cutting back on pollutants. Gasoline was mixed with the oxygenator MTBE, which Big Oil supplied along with the gas.

Now we've learned that MTBE, which is a poison, is getting into water supplies—even in Iowa, where it's not used—but particularly in California, whose smog problem means use of lots of MTBE. Iowa's Congressmen Greg Ganske and Jim Leach were among the first to call for outlawing MTBE nationwide, pointing out that ethanol, made from corn, is also an oxygenator but not a poison.

It's also not a finite resource like MTBE, meaning its use doesn't reduce the world's fuel reserves.

Now the Clinton administration wants to ban MTBE, which is laudable, but also wants to drop the oxygenation mandate from the Clean Air Act and require a quota of renewable fuel use nationwide. Ethanol boosters want the oxygenation rule to stay, which with the MTBE ban would virtually assure a huge new market for ethanol.

Leaving one major question: Can the Corn Belt produce enough ethanol to take up the slack if MTBE is banned?

Yes, says Eric Vaughn, President of the Renewable Fuels Association of Washington, D.C.

"I can assure Carol Browner [head of the U.S. Environmental Protection Agency] that the ethanol industry can meet the California demand for a gasoline oxygen additive today, and the entire nation's needs within three years," Vaughn said.

California would need 550 million gallons yearly. There are now 200 million gallons in storage, and ethanol plants have the unused capacity to produce another 300 million gallons. Further, four plants able to produce another 85 million gallons are under construction, and financing is being sought for anther 18 plants with a 440-million-gallon annual capacity, according to RFA.

That's a lot of corn. That's a huge market boost. That's why corn-state politicians are keeping a close watch.

It made sense to have an oxygenate requirement before the hazards of MTBE were recognized, it still makes sense after MTBE is outlawed. Ethanol is the alternative.

STATEMENT OF THE AMERICAN ROAD AND TRANSPORTATION BUILDERS ASSOCIATION

INTRODUCTION

Chairman Inhofe, thank you and the other subcommittee members for offering this opportunity for public comment on the use of ethanol as a motor fuel. The American Road and Transportation Builders Association (ARTBA) appreciates the opportunity to provide our thoughts on this important matter.

ARTBA, founded in 1902, is the only national association that exclusively represents the collective interests of all sectors of the U.S. transportation construction industry before the White House, Congress and federal agencies. The U.S. transportation construction industry ARTBA represents generates more than $175 billion in U.S. economic activity annually and provides employment for more than 2.2 million Americans.

Over the past decade, the association has also become the industry's primary advocate in environmental issues. I am also pleased to tell you that this year ARTBA

has initiated a national awards program to recognize firms in our industry that make outstanding contributions to environmental quality and mitigation efforts.

UNFAIR ETHANOL TAX POLICY

Mr. Chairman, as you are well aware, federal investment in state highway and bridge improvement programs is financed through the collection of user fees levied on motorists—most notably, the federal motor fuels excises. The concept behind the Highway Trust Fund and the imposition of a federal tax on motor fuels is simple: those who drive should contribute to the development and upkeep of the nation's road and bridge system in a manner commensurate with their use of the system. The more motor fuel you use, the more you contribute—through motor fuel excises—to the Highway Trust Fund.

A car operating on gasohol causes as much wear and tear on our roadways and bridges as does a car operating on gasoline. But the gasohol/ethanol user is not now paying his or her fair share to the Highway Trust Fund.

The motorist using gasoline contributes 18.3 cents per gallon to the Highway Trust Fund through the federal gas tax—15.44 cents per gallon to the trust fund's Highway Account and 2.86 cents per gallon to the fund's Mass Transit Account. (An additional 0.1 cents per gallon is contributed to the Leaking Underground Storage Tank Trust Fund.)

The motorist using gasohol (with 10 percent ethanol), however, is only contributing 9.8 cents per gallon to the Highway Trust Fund through federal excises—6.94 cents per gallon to the trust fund's Highway Account and 2.86 cents per gallon to the Mass Transit Account.

WHY IS A FEDERAL MOTOR FUELS USE EXCISE CONTRIBUTING TO THE GENERAL FUND

It is also worth noting that 3.1 cents of the federal per gallon excise on 10 percent gasohol and 2.5 cents of the tax on less than 10 percent gasohol is deposited in the federal General Fund. Consequently, not only are ethanol fuels not paying their fair share to improve the nation's roadways and bridges, but also ethanol' s current tax status returns the favor to the federal government by providing over $400 million per year to the federal General Fund. During these times of projected federal budget surpluses as far as the eye can see, there is no justification for a portion of a federally imposed highway user fee to be dedicated to the federal General Fund.

ETHANOL TAX TREATMENT SHORTCHANGES HIGHWAY PROGRAM BY $1 BILLION ANNUALLY

The computations below in Table 1, based on 1998 ethanol use data reported in the Federal Highway Administration's "1998 Highway Statistics Report," show *federal tax policy toward ethanol supported motor fuels costs the nation's highway and mass transit improvement programs nearly $ 1.1 billion per year!* To put that number in perspective, that is approximately two-and-a-half times Oklahoma's apportioned federal highway funds for FY 2000. It is roughly the equivalent of federal investment in Florida's state highway program this year.

Table 1

10 percent gasohol usage:	10,487,912,000 gallons.	
5.4 cents per gallon subsidy:	$566,347,248.	
3.1 cents per gallon to the general fund:	$325.125.272.	
Highway Trust Fund shortage:		891,472,520
Less than 10 percent gasohol usage:	3,490,851,000 gallons.	
3.1 cents per gallon subsidy:	$108,216,381.	
2.5 cents per gallon to the general fund:	$87,271.275.	
Highway Trust Fund shortage:		$195.487.656
Total Highway Trust Fund shortage:		$1,086,960,176

The federal tax treatment of ethanol use in motor fuels amounts to a huge division of revenue from state highway programs. By reducing the overall income to the Highway Trust Fund, the potential annual highway funding apportionment to all States is cut. TEA–21 protects States that sell a high volume of gasohol from even further cuts in their state highway apportionment through what amounts to a "hold harmless" provision. If that is not retained in the reauthorization of TEA–21, these States could suffer additional large losses of federal highway funds because their total contribution to the Highway Trust Fund will be retarded.

This highway robbery is occurring at the same time the U.S. Department of Transportation reports 58.7 percent of the nation's road miles are in need of repair and 29.6 percent of the nation's bridges are structurally deficient or functionally obsolete. The same report finds available highway and bridge investment from all levels of government falls short of the amount necessary to improve these conditions by $45.3 billion each year.

Given these staggering needs, we suggest federal tax subsidies for ethanol is poor public policy. If promotion of ethanol use in motor vehicles is intended to provide federal support to agricultural interests, it should be financed, like all other discretionary agriculture programs, through the General Fund.

U.S. GAO REPORT ON ETHANOL

A 1997 U.S. General Accounting Office (GAO) report (GAO/GGD–97–41) requested by House Ways and Means Committee Chairman Bill Archer (R–Texas) thoroughly refuted many of the asserted air quality and energy benefits of ethanol use. While we will not summarize the GAO report in these comments, we would like to highlight some of its section headings to provide an idea of the reports conclusions.

- "Tax incentives for ethanol fuel are likely to have had little effect on environmental quality."
- "Little effect likely where gasoline containing oxygenates is not required."
- "No significant effect is likely on global environmental quality."
- "Tax incentives for ethanol fuel are unlikely to have significantly affected U.S. energy independence or energy security."

The GAO report demonstrates some of the commonly alleged benefits of ethanol environmental improvements and reduced reliance on fossil fuels are unclear at best. The report does, however, state the ethanol subsidy does result in positive benefits for some members of the agriculture industry.

As this committee considers the future of ethanol and potential substitutes for methyl tertiary butyl ether (MTBE), we strongly urge you to review the 1997 GAO report or initiate some other neutral review of the alleged benefits of ethanol fuel use.

TRANSPORTATION SECTOR AIR QUALITY IMPROVEMENTS

U.S. Environmental Protection Agency (EPA) data clearly show the nation's air is much cleaner today than it was in 1970 when the original Clean Air Act was adopted. The transportation sector has been at the forefront of this success story.

Despite a 125 percent increase in motor vehicle travel in the U.S. since 1970, there has been a significant reduction in every transportation-related criteria emission. Lead emissions have been eliminated. Motor vehicle emissions of the precursors of ground-level ozone, volatile organic compounds (VOC) and carbon monoxide (CO), have been reduced 58 and 40 percent, respectively. Motor vehicle particulate matter (PM_{10}) emissions are down 38 percent. And oxides of nitrogen (NO_x) emissions have also been reduced.

These improvements will get even better well in the future as ever cleaner vehicles replace older, dirtier ones. The proposed Tier 2 motor vehicle emissions standards and gasoline sulfur control requirements—both of which ARTBA supports—will also have major, positive impacts on air quality without reducing the mobility of the American public.

According to the U.S. Environmental Protection Agency (EPA), these developments alone could reduce NO_x emissions by nearly 800,000 tons per year by 2007 and 1.2 million tons by 2010. By 2020, EPA projects NO_x reductions double that amount-despite increased auto usage.

Mr. Chairman, thank you for the opportunity to present these comments and we would be pleased to respond to any questions from the subcommittee.

STATEMENT OF THE OXYGENATED FUELS ASSOCIATION

INTRODUCTION

There is understandable concern over increases in the price of gasoline. On June 12, 2000, EPA Assistant Administrator for Air, Bob Perciasepe, announced that, "[t]he Clinton administration is very concerned with the price increases of late, and we will continue our discussions with the oil industry until prices at the pump begin to decline to normal levels." Despite this great concern, the Administration and some in Congress and in several States have recently considered proposals to ban or limit the use of MTBE. Unfortunately, little attention has been paid to the effects that removing MTBE from the national gasoline supply would have on gasoline

price and supply as well as on human health and the environment, including the negative consequence of two of the potential substitutes for MTBE, ethanol and aromatics. The Oxygenated Fuels Association applauds the Committee's leadership in convening the hearing on the Environmental Impacts of Expanded Ethanol Use and is pleased to offer the following comments for the record.

We are concerned that, in view of the current legislative impetus to act, action to expand ethanol use in U.S. motor fuels may be undertaken prematurely, i.e., before a thorough assessment of any potential adverse environmental and economic impacts can be completed. The overall evidence clearly suggests that the expanded use of ethanol will create:

1. Overall Increased Health Risk: widespread chronic exposure to ethanol vapors is an unknown health risk which requires further study;
2. Air Quality Risk: air quality improvements will be offset due to increases in air toxic and evaporative emissions;
3. Water Quality Risk: hazardous aromatics are more likely to reach water resources from a tank leaking gasoline containing ethanol than gasoline without ethanol;
4. Economic Impact: gasoline cost and supply due to distribution and blending characteristics particular to ethanol; and
5. Gasoline Supply: switching from MTBE to ethanol will significantly reduce RFG supplies and, ultimately, increase prices for the consumer.

For these reasons, OFA supports the U.S. Environmental Protection Agency (EPA) proposal to launch a study under Section 6 of the Toxic Substances Control Act (TSCA) to address the key questions about MTBE and its replacements, i.e., determining whether the benefits of continued MTBE use outweigh potential risks, considering the benefits and risks of available alternatives such as ethanol, improving gasoline handling practices, and improving the underground tank cleanup and integrity program.

While this hearing provides an excellent forum to frame the issue, OFA believes that the TSCA process is an appropriate mechanism to resolve this complex issue of expanded ethanol use, in contrast to the currently considered legislation. We believe the expanded use of ethanol would be a serious public policy error from both an environmental and an economic perspective. Certainly Congress should be wary of mandating the expansion of a heavily subsidized substance such as ethanol in a field devoid of competition, especially in an industry with a single company so overwhelmingly in control over the market. Perhaps more importantly for the purposes of this Subcommittee, Congress should be wary of the risk of premature action resulting in a net environmental and economic harms versus the hard-earned air quality gains of the current reformulated gasoline program.

The purpose of these comments is to identify the known adverse environmental and economic impacts of expanded ethanol use, and to highlight the areas where additional study is required to ensure that the risk of environmental backsliding is eliminated. While Congress may not be inclined to conduct an exhaustive, full-scale cost-benefit analysis of the risk of expanded ethanol use to health and the environment, at a minimum it is important to engage in a balancing analysis comparing the wide range of risks, benefits, and costs of expanded ethanol use.

Health Risk and Benefit Evaluations

Any decision to expand reliance on ethanol to meet the nation's RFG needs must begin with a thorough examination of its health risks and benefits. The health risks of ethanol, as the primary active ingredient in alcoholic beverages, are well established and recognized, including known human carcinogenic effects, reproductive effects, and fetal effects. In fact, beverage-grade ethanol has been listed repeatedly as a human carcinogen by the National Institute for Environmental Health Sciences, the International Agency for Research on Cancer, the California Proposition 65 Committee, and the National Toxics Program.

Fuel-grade ethanol is currently blended in about 10 percent of the RFG production, primarily in the Midwest region of the country where refinery economics, transportation logistics, and individual State mandates favor its use. Despite this substantial usage and in contrast to MTBE, we simply don't have the inhalation information we need on potential exposures, health risks and public health impacts of vehicle emissions resulting from increased ethanol blending in gasoline. The exposure and impacts of ethanol blending in gasoline, although not very well understood, are casually dismissed by ethanol proponents. Before we can assess the health risk associated with ethanol blending in gasoline, we must obtain and evaluate inhalation toxicological data for ethanol exposures, especially for high risk populations such as recovering alcoholics and sensitive populations such as pregnant women and children.

The analysis must begin with an assessment and quantification of the air quality and other environmental effects of widespread ethanol blending in gasoline. The comprehensive impact of changes to fuel quality parameters and impacts on emissions as a result of increased ethanol blending is unavoidable given ethanol's high vapor-pressure characteristic. Both evaporative and exhaust emissions impacts should be fully evaluated to quantify the risks to public health and then compared to the health benefits of current reformulated gasoline formulations. Ethanol blended gasolines are known to increase the emissions of formaldehyde, acetaldehyde, and peroxyacyl nitrates (PAN), which are hazardous air pollutants. The impacts to respiratory function and other health endpoints of emissions profile changes due to increased ethanol blending should be quantified and compared to current MTBE-blended RFG.

The use of ethanol blends in certain RFG markets affords us the opportunity to evaluate and compare quantitatively the performance of ethanol-based RFG to MTBE-blended RFG and to assess the comparative health benefits for both formulations. Furthermore, common sense should dictate that such a comparison should be performed before the nation commits to widescale expansion of ethanol use. We simply must understand the health consequences of ethanol-blended gasoline exposure to sensitive populations (e.g., young children, recovering alcoholics, pregnant women, etc.) before proceeding with development of legislative and/or regulatory options for ethanol.

EPA's Blue Ribbon Panel on Oxygenates in Gasoline concluded that current "RFG provides considerable air quality improvements and benefits for millions of US citizens." The blending of MTBE to achieve the oxygen requirement for RFG is the single most significant modification taken by refiners to produce cleaner-burning fuel. The use of MTBE to maintain fuel quality and achieve emissions goals resulted in nearly 90 percent of RFG production with MTBE blending. Demonstrated emissions benefits from RFG have achieved as much as a 50 percent reduction in ambient benzene levels (depending on area), as much as a 33 percent reduction in volatile organic compounds (VOCs are precursors to ozone formation), and average air toxics reductions of 32 percent during Phase I of the RFG program. Even greater reductions are anticipated for the Phase II program that began at the start of 2000. In California, where overlapping federal and State fuel quality programs achieve some of the most significant emissions reductions, the State's Air Resources Board estimates that annual reductions in cancer risks due to toxic air emissions are between 40 percent and 50 percent.

These improvements translate to morbidity and mortality improvements for the current RFG program that should serve as the standard for future formulations relying on ethanol.

Furthermore, we should look beyond the narrow definition of benefits attributable to the "oxygen" content provided by ethanol or MTBE in gasoline to evaluate the impacts of blending a specific *oxygenate* in gasoline. The impact on other key gasoline blending quality characteristics (such as low sulfur, T^{50} and T^{90} and lack of olefins and aromatics) must be factored in as we compare and quantify emissions effects on primary air pollutants and air toxics for ethanol blended gasoline. The reductions in morbidity and mortality from both the direct inhalation exposures and the vehicle emissions exhaust for current MTBE-blended RFG should be compared to the risks from exposures and emissions from ethanol-blended formulations. OFA believes that, without appropriate antibacksliding controls, the deterioration in real world air quality associated with expanded ethanol use will be significant.

Another concern related to the increased use of ethanol is increased acetaldehyde emissions. Acetaldehyde, classified by the EPA as a probable carcinogen, is a common byproduct of ethanol combustion (for comparison, EPA has not classified MTBE as a carcinogen). According to EPA's 1990 emissions inventory, on-road vehicles were the second largest source of acetaldehyde emissions, contributing 28,200 tons per year, or 20.48 percent of all acetaldehyde emissions. Small non-road vehicles and equipment, such as lawn mowers and leaf blowers, were the largest single source of acetaldehyde emissions, contributing 35,300 tons per year, or 25.69 percent of all acetaldehyde emissions.

The EPA reference concentration for acetaldehyde inhalation is 0.009 mg/m^3, with an endpoint of olfactory epithelium degeneration. By way of comparison, the RFC for MTBE is 3.0 mg/m^3, based on a concern for potential eye, liver, and kidney damage. These results suggest that acetaldehyde may be 300 times more toxic than MTBE.

The EPA Blue Ribbon Panel reported that "[v]ehicle exhaust emissions data have shown that acetaldehyde . . . emissions can increase by as much as 100 percent with the use of 2.0 wt percent ethanol oxygenated gasoline." Likewise, NESCAUM concluded that replacing MTBE fuel additive with ethanol additives would increase

acetaldehyde emissions by 50 percent to 70 percent. Acetaldehyde and PAN are significant air toxics, and must be controlled as the EPA has recently indicated in its urban air toxics initiative. In areas of high ethanol usage (such as Brazil), ambient levels of acetaldehyde have been detected at many times the reference dose for human health impacts. This is not speculation; it is a real human health question that must be resolved prior to substantial increases in ethanol use.

To date, we are aware of only a single study that compared actual, tailpipe emissions of automobiles burning fuel with ethanol and MTBE. That study reported a 159 percent increase in acetaldehyde emissions for vehicles burning gasoline with ethanol, as compared to a similarly situated MTBE-based fuel; all other air pollutants were comparable.[1] This study has been cited favorably in several other recent studies.[2] The President's National Science & Technology Council reported modeling projections that were consistent with this data in that the modeling projected acetaldehyde increases on the order of 40 percent per weight oxygen.

Water Quality Impacts

The revision of current RFG requirements to enhance the use of ethanol is likely to also result in increased gasoline aromatics content as refiners struggle to meet gasoline volume and octane requirements without MTBE and, at least in the early stages, with limited quantities of available ethanol. When MTBE is used, it replaces aromatics in gasoline to meet octane requirements. Blending 11 volume percent MTBE (2.0 wt. percent oxygen) contributes about 2.6 octane numbers to today's gasoline, which the marketplace shows will generally reduce the aromatic content of the gasoline by 6 to 8 volume percent. This reduction is considerably more than explained by a simple 11 percent dilution, and is equal to about a 25 percent reduction in total aromatics content in gasoline. Without MTBE, aromatic levels in gasoline will increase, because all of the non-aromatic alternatives combined provide little more than half the octane contribution of MTBE. Ethanol at 5.7 volume percent will only provide 1.5 octane numbers to today's gasoline pool. Other non-aromatic hydrocarbons such as alkylates are a very inefficient means of adding octane, and 5 volume-percent alkylate supplies only 0.3 of an octane number, which falls far short of filling the octane gap between blending with ethanol versus blending with MTBE.

As a result, the relative amount of aromatics released to the environment in future gasoline releases (under enhanced ethanol use) would be significantly higher than it is in current gasoline. This includes aromatics with higher health risks associated with them, such as benzene and ethylbenzene. In RFG areas where oxygen is still required, because of their significant cost advantage, aromatics will be used to make up much of the octane and volume gap when using 5.7 volume-percent ethanol to meet the oxygen standard. Although there is a toxics performance standard for RFG, current actual performance using MTBE far exceeds the standard, thus allowing more aromatics to be used. Gasoline aromatic levels can increase by up to 20 percent, adding another 5 percent to the gasoline pool.

The perceived benefit of reduced groundwater risk when using ethanol in lieu of MTBE needs to be carefully reexamined. Certainly ethanol's high biodegradability compared to other gasoline components commonly found in ground water is highly touted. However, this degradability also contributes to the increased spread of aromatics from a gasoline release, because the microorganisms' preference for ethanol delays the degradation of the aromatics. The study presented to the Blue Ribbon Panel suggested that using ethanol can extend BTEX plumes by up to 40 percent. This potentially increases the volumes of water contaminated by BTEX by up to 270 percent. Thus a biodegradability preference for ethanol, combined with up to 20 percent higher mass of aromatics in a gasoline release, will contribute to a wider dispersion of aromatics in groundwater and a potential increase of exposure to aromatics in drinking water. The potential health risk increase for increased exposure to aromatics in drinking water has not been factored in any risk-benefit analysis of substituting/expanding ethanol use to date.

Finally, despite the frequent mention of the need to better assess the possible risk of increased ethanol use in gasoline to humans and water supplies, there is seldom mention of the environmental risks to animals, aquatic life, or other fauna or flora. Given the essentially infinite solubility of ethanol in water, it is surprising that these aspects of the ethanol risk assessment are hardly raised.

In short, the preconceived view seems to be that any groundwater threat associated with ethanol is substantially lower than the perceived "unacceptable" threat posed by MTBE. Despite the urgency to address the perceived MTBE "problem,"

[1] Reuter et al. 1992.

[2] Health Effects Institute 1996, p. 122; Koshland et al. 1998, p. 30; National Science & Tech. Council 1997, p. 1–11.

Committee members should not be willing to forego a complete fate and transport examination of the implications of expanded ethanol use. Any legislative action considered should not only be commensurate to the threat at hand, but also protect against the danger of precipitating market conditions that will ultimately expose the nation to increased, and potentially more potent, environmental risk.

Air Quality Impacts

The statutory purpose behind the use of any oxygenate is to maintain and improve air quality. It is not to enhance markets for any one additive. However, converting from MTBE to ethanol would have an adverse impact on air quality, due to the direct and indirect impacts that fuel changes would have on primary criteria pollutants (ozone (including precursors), particulates,etc.). Unlike aromatics, MTBE has a favorably low distillation temperature that enhances cold engine performance. In addition, MTBE does not have many of the drawbacks of alcohols, such as water solubility and high blending vapor pressure. These favorable blending characteristics of MTBE-blended fuels improve gasoline combustion and reduce emissions from both on-road and off-road vehicle engines. Therefore, using MTBE in gasoline enhances gasoline octane while reducing many of the pollutants that degrade air quality. Widespread replacement of MTBE with ethanol in gasoline would clearly increase the risk of air quality degradation, particularly in the absence of additional, specific fuel quality controls.

RFG regulations use both a recipe and a performance standard to achieve targeted emissions reductions of both toxics and ozone. To quantify performance targets, EPA chose to use Federal Test Procedure (FTP) emissions changes that occur with changes in fuel quality. In addition to the targeted emissions (toxics and ozone precursor VOCs and NO_x), gasoline-burning engines produce other pollutants such as CO, particulate matter (PM), and precursors to secondary organic aerosols (PM), the levels of which are reduced by the use of MTBE in gasoline. An oxygen standard was included in the RFG "recipe," thus requiring the use of oxygenates in RFG. Although some believe it is only the oxygen that provides emission reductions, it is actually the cleaner-burning octane that provides key additional, and substantial, emissions reductions from MTBE use. Furthermore, when that oxygen is provided by MTBE (as it is in the overwhelming majority of today's reformulated fuels), the level of toxics, PM, and cold-start VOC emissions reductions is maximized, even in new-technology vehicles that otherwise minimize the effect of the oxygen on the fuel.

Maximum toxics reduction is achieved when using RFG (at 2 weight percent oxygen content) blended with MTBE, as indicated by EPA's complex model. The oxygenate dilution impact would be reduced when blending ethanol at the same gasoline oxygen content. In addition, smaller toxics reductions would be achieved with ethanol blended gasoline due to the higher expected gasoline aromatics content of the ethanol-blended fuel. Maximum aromatics reduction is realized with current RFG because the 11 volume percent MTBE it typically contains provides more octane than would be obtained when using 5.7 volume percent ethanol. Large aromatics reductions with MTBE have been demonstrated in many clean fuel programs, e.g., in various winter oxygenate programs from 1988 to 1994, as well as in the simple-model years of the RFG program (1995 through 1997) which had no requirement to reduce or cap total aromatics. Without MTBE, gasoline aromatic content will increase and thus increase toxic emissions.

In addition to toxics control, the second primary goal of the current RFG program is control of summer peak ozone levels. When adding 2 wt. percent oxygen, MTBE-blended gasoline provides the maximum reduction in VOCs and CO, because MTBE not only provides oxygen but also maximizes reductions in aromatics and distillation temperatures, which combine to give the greatest reduction in exhaust VOCs and CO emissions. By comparison, ethanol does not offer good blending properties in gasoline; in other words, ethanol tends to generate more volatility in hydrocarbon mixtures than is reflected in its boiling temperature. As a result, mixing ("commingling") an ethanol blend with a non-ethanol blend in vehicle tanks will generate an increase in RVP that is higher than RVP in unmixed gasolines. This RVP increase is known to increase evaporative VOC emissions from the vehicle fleet. For a detailed discussion on the evaporative impacts of ethanol commingling in the marketplace, please reference the recently completed study by Sierra Research entitled "Potential Evaporative Emission Impacts Associated with the Introduction of Ethanol-Gasoline Blends in California." (provided in Appendix A).

Due to ethanol's high water solubility and higher volatility properties, ethanol must be blended at the gasoline truck rack to avoid intermixing and water contact in gasoline distribution pipelines and terminal tanks. Thus, ethanol must be delivered to distribution terminals by trucks, further causing increased traffic and pollu-

tion in neighborhoods with the highest traffic pollution. For a detailed discussion on the impacts of expanded ethanol use on the refined product distribution system, please reference the recently completed study by the Monitor Company entitled "Unstudied Risks . . . Economic Assessment of Conversion from MTBE to Ethanol in California."

Due to ethanol's high RVP, blending ethanol in summer RFG requires that a like amount of volatile hydrocarbon, e.g., pentanes, be removed from the gasoline so the RVP specifications can be met. Unlike MTBE, ethanol use during the summer thus provides little or no expansion of gasoline production for the refiner. This lack of gasoline expansion requires the refiner to process more crude oil and generate even greater stationary source emissions. Most of the refineries that produce RFG are located in the air basins of some badly polluted cities, such as Houston, Los Angeles, San Francisco, and Philadelphia.

Furthermore, MTBE has the lowest atmospheric reactivity of the VOCs and oxygenates found in evaporative emissions. Work by CARB and others show that lowering the atmospheric reactivity of VOC emissions is also important in reducing peak ozone pollution.

CARB has determined that an additional benefit of reformulated gasolines is a reduction in the build-up of combustion chamber deposits (CCDs) in vehicle engines. CARB documented that emission studies show that the decrease in CCD build-up results in even lower NO_x emissions and other emissions beyond the reductions predicted by FTP-based prediction models. These additional NO_x reductions total about 7 percent. The key gasoline property changes that reduce CCD build-up are lower aromatic content and lower distillation temperatures. Both of these fuel parameters would be adversely impacted by converting from MTBE to ethanol.

While the 1990 Clean Air Act Amendments targeted only VOCs and NO_x as ozone precursors, since 1990, summertime CO emissions have been identified as a significant contributor to peak ozone levels. Key gasoline property changes that reduce CO emissions are (1) lowering aromatics and (2) adding oxygen. Using MTBE instead of ethanol in RFG will lead to the greatest CO reduction, because MTBE provides the largest aromatic reduction at 2 wt. percent oxygen.

Although reductions in PM were not specifically targeted in the RFG regulations, a number of studies by EPA and others show that oxygenated gasolines reduce vehicle PM emissions by 30 percent or more. Some studies show that gasoline engines produce a large share of the carbonaceous portion of the PM inventory. Other studies show that unburned aromatics from exhaust emissions are precursors of the secondary organic aerosols that contribute to this carbonaceous PM inventory. To the extent that MTBE's replacement with ethanol results in lower gasoline dilution, PM in tailpipe emissions will increase as gasoline aromatics content rises allowing more unburned aromatics in vehicle and small engine exhaust emissions.

Besides PM reduction from vehicle tailpipes, other studies show that the unburned aromatics in exhaust VOCs are a significant source of precursors of secondary organic aerosols that can make up a large share of the PM inventory. The key to reducing unburned aromatics from vehicle and off-road engine exhaust is minimizing both the aromatic content and the distillation temperatures of gasoline. This is better accomplished by using 11 volume percent MTBE than 5.7 volume percent ethanol as the source of the oxygen in RFG. Thus, carbonaceous PM inventories will likely increase when MTBE is replaced by ethanol in gasoline.

As described above, there are a number of emission increases associated with the use of ethanol that will degrade air quality. This loss in air quality must be factored into any cost-benefit analysis associated with the contemplated expansion of fuel ethanol use.

Economic Impacts

Although the economic aspects of expanded ethanol use are not the primary focus of this Subcommittee's review, it is important that the economic repercussions of mandated increased reliance on fuel ethanol be defined. These include ethanol's energy content, tax subsidy, impact on other sectors of the economy, and socioeconomic distributional effects associated with the income transfer that ethanol growth entails.

For example, use of ethanol over other oxygenates, such as MTBE, reduces RFG supplies by up to 11 percent. This "lost" volume further shortens already tight gasoline supplies and, ultimately, leads to increased prices for consumers. As a result of using ethanol as part of the RFG program, the Chicago and Milwaukee areas are witnessing gasoline prices surge above $2.00 per gallon. Other areas of the country using RFG with MTBE are not seeing the same price spikes.

While ethanol proponents tout the ethanol's energy content as "renewable," it is unclear that expanded ethanol use makes good "energy sense" when comparing the

energy needed to plant, harvest, and process corn (or other ethanol feedstocks) for ethanol production versus the energy released when ethanol is used in automotive applications. Several existing reports suggest that the amount of energy released when ethanol is consumed may actually be less than that required to produce it, depending on the particulars of ethanol feedstock and production. While a gallon of ethanol produces 76,000 BTU, the overall energy-to-produce estimates range from 75,000 to 95,000 BTU. Since fossil energy is typically consumed to produce ethanol, it is imperative that the Subcommittee investigate the sources of the incremental ethanol production and the relative energy balance associated with each.

Clearly the need to reduce the perceived risk that MTBE poses must be balanced against the potential for increased reliance on increased foreign fossil energy and the associated impact on the nation's energy security. The "renewable fuel" concept typically advanced in support of ethanol remains counterintuitive in that, in addition to the petroleum needed to grow corn and distill ethanol, more conventional gasoline is required as a percentage of reformulated gasoline when it is blended with ethanol than when it is produced with MTBE.

The U.S. General Accounting Office (GAO), in a March 6, 1997 report titled "Tax Policy: Effects of the Alcohol Fuels Tax Incentive," suggests that the existing tax incentives for ethanol's use (discussed in more detail later in this section) do not significantly reduce petroleum imports and, consequently, do not appreciably contribute to U.S. energy independence. According to the same report, oil consumption and not oil imports create vulnerability to oil price shocks, and the usefulness of alternatives such as ethanol during times of crisis depends largely on whether their production can be rapidly expanded. Currently, ethanol accounts for approximately 1 percent of the U.S. motor vehicle fuel consumption and is thus of little consequence in dampening oil price shock.

Even at such increased estimated ethanol consumption levels, there would be no significant positive impact on the nation's energy security outlook. More importantly, OFA believes that we should focus on the relative change in the Nation's energy security posture resulting from the replacement of MTBE by ethanol, rather than on the absolute impact of increasing the contribution of domestic ethanol as a percentage of the overall energy usage. It should be recalled that all MTBE reduction and elimination scenarios are projected to yield a more fragile marketplace in terms of overall supply and demand balance, while restricting what has heretofore served as one of the market's most useful pressure relief mechanisms in times of short supply.

Lastly, Congress' selection of an appropriate MTBE risk mitigation strategy should factor in the overall domestic economic impact of enhancing the use of higher priced oil substitutes. The U.S. economy derives substantial benefits from free access to the international oil markets. Low oil prices fuel economic growth, employment, and productivity. High energy prices act as a drag on economic expansion and fuel inflationary pressures. The U.S. cannot now, or in the foreseeable future, meet its petroleum needs except through imports. Federally mandated alternatives to oil imports decrease economic efficiency and hamper free trade without contributing to U.S. energy security.[3]

OFA believes that the economic evaluation of ethanol must extend beyond the narrow confines of motor fuel impacts. While the obvious intent of tax incentives (such as the one enjoyed by ethanol) is to increase farm income, it is reasonable to expect that price increases that benefit farmers may adversely impact consumers of some food products. Roughly 60 percent of all corn produced in the U.S. is used domestically for feed grain. Increased corn prices lead to increases in livestock feed price causing overhead costs to increase for many farmers. "The primary effect of ethanol subsidies on agricultural markets is to allow corn farmers to charge hog farmers and cattlemen higher prices."[4]

Ultimately, these higher costs mean that consumers pay higher beef, pork and poultry prices at the supermarket. If EPA's action raises the price of corn by a mere 5 percent, the price impact on consumers would exceed one billion dollars. Furthermore, to the extent that subsidies are used to produce incremental quantities of industrial or beverage ethanol, the economic impacts are decidedly unintended. That "fits the historical pattern of farm policy: intentionally sacrificing relatively unsubsidized farmers to subsidized farmers and making all farm profits and losses

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[3] Vito Stagliano, Resources for the Future, "The Impact of a Proposed EPA Rule Mandating Renewable Oxygenates for RFG: Questionable Energy Security, Environmental & Economic Benefits" (1994).

[4] James Bovard, Fellow, Cato Institute, "ADM: A Case in Corporate Welfare, Policy Analysis No. 241," September 26, 1995.

increasingly a question of political pull. The higher the price of feed grain, the higher the cost of meet production. Thus consumers get hit from all directions."[5]

A 1986 USDA study concluded that increased production of ethanol would cost consumers and taxpayers roughly $4 for each $1 of extra farm income. The report stated that "increases in consumer food expenditures caused by additional ethanol production far exceed the increases in farm income." The report concluded that consumers would be better off if they exclusively used fossil-derived gasoline for automotive purposes and paid a direct cash subsidy to farmers equal to the net farm income increase expected by expanded ethanol use. At a minimum, the food price impacts of a policy decision to expand fuel ethanol use must be understood and weighed along with the anticipated adverse gasoline price impacts.

The ethanol industry has remained economically uncompetitive long after the typical economic argument of an infant industry requiring subsidies and trade protection in order to survive. In 1986, the U.S. Department of Agriculture estimated the average cost of producing ethanol at $1.60 a gallon, which was more than double the then-wholesale gasoline price of approximately 60 cents. Even after the substantial 54 cent per gallon tax incentive, ethanol remains economically uncompetitive. Thus, MTBE reduction strategies relying upon expanded ethanol use will increase consumer cost simply by virtue of the fact that such strategies will replace a more affordable and more effective pollution-fighting alternative.

Cost-to-produce impacts of gasoline blended with ethanol were outlined earlier as part of the economic impacts of potential strategies to reduce MTBE. Taking into consideration the terms of a legislative mandate for ethanol use (new or existing under the CAA's oxygen requirement), the equivalent environmental performance criteria used, and the location of new ethanol markets vis-a-vis the traditional Midwestern ethanol production base, expanded ethanol use could raise gasoline production costs by more than 7 cents per gallon. This is at equilibrium before the impact of a tighter supply and demand balance is factored in. Short-term price impacts associated with fuel supply shortfall could easily amplify the cost-to-produce impact by a factor of two or three.

In the longer term, the economic impact of having Congress steer the marketplace toward increased reliance on a single alternative may have the exact opposite impact on energy pricing than that desired. In view of the existing track record of government interference in this area yielding less than optimal results, we should carefully examine the longer-term implications of its MTBE risk mitigation action on energy pricing to ensure that it does not yield a clear market "winner" at the cost of controlling consumer choice and preventing competition in the marketplace. In addition to preserving other alternative fuels that may exist as options, Congress should carefully evaluate the impacts on other industries ready to compete for a segment of the motor fuel segment on a level playing field.

Increasing ethanol's share of the nation's gasoline market as part of any MTBE risk mitigation strategy will have the effect of transferring income from Gulf Coast natural gas and MTBE producers to Midwestern corn and ethanol producers. While federal obligations to support farm prices will be reduced, the income transfer is highly inefficient and would not principally benefit farmers of corn. Previous studies have found that 70 percent of ethanol's production cost is associated with post harvest costs. Moreover, public policy aimed at income transfer should aim to keep waste or dead weight losses minimal in relation to total income transferred. Deadweight losses in ethanol-for-MTBE substitution scenarios are defined in terms of the cost difference to produce the two substances. Since MTBE can be produced for roughly 60 percent of ethanol's equivalent cost, it is estimated that every dollar spent on ethanol delivers 30 cents of income to farmers while adding $1.40 in dead weight loss to consumers.[6]

Furthermore, growing ethanol use will transfer income from Northeastern and Californian consumers of reformulated gasoline to Midwestern corn and ethanol producers, given the location of the vast majority of the nation's areas that violate summertime ambient ozone standards. The socioeconomic distributional effects of any proposed ethanol growth strategy would be inequitable as well. The higher, federally mandated cost of RFG would affect low income consumers disproportionately be-

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[5] Id.

[6] David Montgomery, Charles River Associates, as quoted by Vito Stagliano in "The Impact of a Proposed EPA Rule Mandating Renewable Oxygenates for RFG: Questionable Energy Security, Environmental & Economic Benefits," (1994).

cause they devote a higher percentage of their disposal income to energy costs than do higher-income consumers.[7]

In view of ethanol's prohibitive cost to produce, a huge subsidy is required to make its price competitive in the marketplace. The U.S. Department of Agriculture estimates that the cost of corn will rise and the revenue from coproducts will fall as corn ethanol production increases over current levels. In the 1990 Amendments to the Tax Reform Act of 1984, federal excise taxes on gasoline were set at 14.3 cents/gallon, but fuels containing 10 percent alcohol received an exemption of 5.4 cents/gallon. In the Energy Policy Act of 1992, the excise tax exemption was extended to include gasoline containing less than 10 percent ethanol. The statute (and previous laws) were interpreted to include a tax credit for producers of ETBE.

The value of this exemption translates to the current federal $0.54 per gallon tax credit given to the corn ethanol industry. In 1997, the GAO estimated that the ethanol subsidy has cost the federal government more than $7 billion since 1979. The current annual figure is approximately $770 million based on an annual ethanol use of about 1.3 billion gallons. This figure could triple as annual ethanol production grows to over three million gallons in several out-year ethanol growth scenarios as part of replacing MTBE. In addition, seventeen states offer fuel tax exemptions or producer subsidies for fuel ethanol ranging from $0.10 to $0.40 per gallon.

The projected growth in the tax subsidy needed for ethanol in MTBE replacement scenarios is in addition to the $1.9 billion that the Governors Ethanol Coalition recently estimated would be needed to finance the "necessary" expansion in ethanol capacity. In this context, it is noted that the $400 million in loans authorized by Congress in 1978 to finance ethanol plant construction resulted in funding for 18 plants. By 1992, the Federal government had received full repayment for only one of these.

Given the large differential in cost-to-produce between ethanol and gasoline, it is obvious that the fuel ethanol industry wouldn't exist today without the massive subsidy it receives. OFA believes that the risk posed by MTBE does not justify the full economic burden of the corresponding expansion in ethanol use. Once fully developed, these economic impacts should be added to the incremental production costs for the replacement gasoline as part of the overall assessment of curtailing MTBE's use in the Nation's gasoline pool.

The reduction in motor-fuels excise tax revenues due to ethanol-blended gasoline reduces funds that would otherwise have been earmarked for the Highway Trust Fund. These funds are used to maintain and improve the nation's bridges and roads. The potential increase in ethanol subsidies will have a substantial adverse impact on the nation's millions of miles of roads and highways, as well as serious economic ramifications for specific industries involved in road building and maintenance. The International Brotherhood of Boilermakers has estimated that 39,000 jobs are lost as a result of foregone road project work for each $1 billion the Trust Fund loses.[8]

A policy decision to require substantial growth in fuel ethanol use must recognize that, even under conservative assumptions, there is insufficient ethanol supply at present to meet the nation's reformulated gasoline needs. California's minimum supply requirement alone would add 350 million gallons of ethanol to the shortfall, even if it is assumed that ethanol is blended at the minimum 2.0 weight percent oxygen content specified in the CAA. In view of the structure of the federal tax subsidy for ethanol blending, California's demand could easily approach 500 million gallons. Demand projections for MTBE replacement in the Northeast exceed those for California by approximately 15–20 percent. Given that today's overall ethanol production is at 1.3–1.4 billion gallons, and that this volume is currently dedicated to markets near ethanol's Midwestern production base, growth and redistribution of available ethanol production among competing geographic markets remains a major economic uncertainty as steps are considered to mitigate MTBE risk.

Alternative scenarios where California and the Northeast enter the ethanol market must be explored and the associated ethanol price increases must be projected for each demand scenario. The incremental ethanol volume, timetable, and cost for expanded ethanol production from both conventional sources (i.e., corn) and new alternative feedstocks (i.e., biomass) should be clearly defined. Key benefits associated with such scenarios should include potential GDP growth associated with increased demand for corn and other grain, potential positive impact on farm subsidies, and generation of new jobs associated with ethanol industry expansion. In addition to

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[7] Vito Stagliano, Resources for the Future, "The Impact of a Proposed EPA Rule Mandating Renewable Oxygenates for RFG: Questionable Energy Security, Environmental & Economic Benefits," (1994).

[8] Ande Abbott, Director of Legislative Affairs, International Brotherhood of Boilermakers, in Congressional Record August 3, 1994, at S10453.

the incremental refining costs associated with converting to ethanol-blended reformulated gasoline (outlined earlier), key costs to be examined in this analysis should include the impact of potential ethanol supply shortfalls on ethanol and gasoline prices as well as logistical costs associated with transporting ethanol and retrofitting the gasoline distribution system to accommodate ethanol-blended fuels.

Recent analyses by the Monitor Company examining the overall impact of California's anticipated conversion to ethanol following that State's ban on MTBE after 1/1/2003 indicate that significant price increases will be likely in order to facilitate supply demand balancing in the three years following the MTBE phase-out. Although there is potential for redirection of ethanol from other markets/uses, redirection will necessitate price increases. Furthermore, while it is possible that new ethanol plants will be built, it is not clear whether timely capacity additions will be realized. At a minimum, to attract ethanol barrels to California (and the Northeast) where they will likely be required to produce reformulated gasoline, prices will need to rise sufficiently to overcome local State incentives in today's ethanol home markets. Insufficient ethanol supply will ultimately result in pressure on overall reformulated gasoline inventories, reducing them in the case of California from a 6–7 month reserve to a 1–2 month reserve.

Because of its high affinity for water, ethanol cannot be transported by pipeline, except through dedicated systems. As a result, it cannot be blended into gasoline at the refinery and must be blended at the terminals prior to shipment to retail stations. Given the nature of the nation's pipelines through which fungible multiple products are transported, ethanol is projected to move by truck or rail to the distribution terminals. This substantially increases the delivered cost since truck, rail, and marine transport are substantially more expensive than pipeline transport. Price increases associated with additional market demand will be compounded by the cost of transporting ethanol to these areas by truck or rail.

Large scale distribution terminal facility upgrades will also be required for any gasoline market converting to ethanol. These may include upgrades to a terminal's rail facilities to handle the increased traffic or the addition of new rail connection for terminals that were not previously equipped to receive railcars. Additional tank facilities will be needed for ethanol storage at the terminals and modification/expansion of terminal loading and unloading facilities are likely. Finally additional blending controls and instrumentation may be needed at the terminals as well filtration equipment to both the terminals and retail stations to dewater ethanol and ethanol-blended gasoline. The Monitor Company's estimate of total cost associated with such modifications for California was $60 million.

In addition significant costs will be added in distribution and retrofitting terminals to enable widespread ethanol blending. In California's case, the Monitor study identified interstate costs (in marine and rail facilities required to move ethanol from the Midwest) and intrastate costs (inrail and truck distribution facilities from in-state marine terminals and intermodal transfer facilities) amounting to $28 million. These capital facility recovery costs will be incurred in addition to the more than 10 cents a gallon of ethanol in transportation cost to marine and rail operators to deliver ethanol to the State.

We appreciate the opportunity to submit these comments and look forward to working with Members of the Committee on this important issue.

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