Presentation of

Douglas A. Durante

Before the

United Nations
Commission on Sustainable Development

April 23, 1996
New York, New York

CLEAN FUELS DEVELOPMENT COALITION
1925 North Lynn Street, Suite 725
Arlington, Virginia 22209
703-276-CFDC (2332) Fax: 703-276-8447

Good morning Mr. Chairman. My name is Douglas Durante and I am very honored to have the opportunity to address this important Commission of the United Nations as it examines issues related to transportation and the environment.

I was asked to speak here today because of my experience over the last 20 years in the development of alternative motor fuels in the United States. I serve as the Executive Director of the Clean Fuels Development Coalition which is a non-profit organization supporting a number of clean fuels and related technologies. This is a very unique organization in that it is comprised of several divergent interests such as ethanol producers, ether manufacturers, state government agencies, agricultural organizations, automobile manufacturers, design and engineering firms, two domestic refiners, and others with an interest in seeing clean fuel programs move forward. Our organization has been recognized for its successful contribution to many of the clean fuels programs that are currently in place and we continue to promote all fuels that can improve air quality, reduce our dependence on imported energy, and provide other public policy benefits, such as creating jobs and expanding income to individuals as well as governments through the tax base.

To some, our membership might seem like a strange brew but many of today's automakers and refiners are doing all they can to improve air quality and that is proven by their support of our work. Consequently they are working with fuel producers and suppliers as a means of improving their own products. As I have been asked to comment to the Commission regarding the recommendations contained in the Issues Report for transportation, I applaud the work of the panel in its successful identification of a number of specific and tangible measures that can be adopted to reduce pollution in the transport sector. Some of these specifics include seeking technological innovations in the design of vehicles and the use of fuels as well as increased use of alternative fuels, and particularly the use of biomass-derived fuels such as ethanol. Similarly, the use of ethanol and methanol-based oxygenates as a substitute for lead is an important environmental measure.

The alternative fuels movement in the United States has been driven at times by concerns of over-reliance on imported petroleum and at other times by concerns relating to the environment. Both are legitimate reasons to pursue an alternative fuel strategy in my opinion and both are growing in importance every day. The U.S. government's Energy Information Administration (EIA) predicts petroleum use to increase nearly 1 percent per year through the year 2015. At current rates, that would be a 20 million barrel per day increase and many experts from both political parties predict a sharp increase in prices and a likely supply crisis in the near future. That petroleum demand primarily feeds the transportation sector which represents half the total demand and even more in some countries, including the U.S. (see Exhibit 1). With imports providing more than half of that petroleum, there is an obvious relationship to the trade deficit. During the period of 1970-1990 when other imports

increased substantially, the deficit increased accordingly (see Exhibit 2). Gross domestic product (GDP) generally tracks energy use so we are concerned that any modest gains we are making in GDP are going right back out of the country to purchase oil. The reliance on imports will only get worse because U.S. refineries are closing down.

Exhibit 1

Exhibit 2

The other part of the story related to such heavy petroleum use is the environmental impacts which we are just beginning to truly understand. During the increase of 1 percent per year of petroleum consumption estimated by the EIA, carbon emissions are estimated to increase at a slightly higher rate of more than 1 percent per year. The potential for these increased emissions to affect global climate patterns is a serious concern among many countries and the hydrocarbon makeup of most nations' entire fuel supplies makes it a logical place to begin reducing consumption and in turn reducing emissions. The environment is becoming an international political issue in scope and cooperation among countries is critical. In the United States our congress and domestic federal agencies dealing with this problem have recently been joined by the State Department and other bodies with international jurisdiction. Former U.S. Senator Tim Wirth is in a specially created undersecretary role at the State Department to deal with global warming and climate change issues because of his expertise in this area.

The price hikes and shortages the United States experienced in the 1970s served as a harsh reminder of how little planning had gone into developing alternatives and preparing for such a situation. The resulting effort to develop synthetic and other alternative fuels was solely driven by economics and once suppliers of foreign petroleum realized they could eliminate competition by waging economic warfare, they did so. Consequently, the synthetic fuels programs and other efforts to establish alternatives died and with the exception of a limited role for ethanol and an even more limited role for methanol-based oxygenates, the alternative fuels movement stalled. World crude prices simply made it impossible for most alternative fuels to compete with petroleum.

The Clean Air Act Amendments of 1990 marked the first time there had been a major overhaul of the United States' air pollution laws in 17 years. This resulted from growing concern over air pollution and it identified and targeted motor fuels as a prime area for improvement. It also prompted the development of a wide array of alternatives to traditional hydrocarbon transportation fuels and these environmental requirements have advanced these fuels more in the past few years than they had been able to accomplish throughout their entire existence which has been based solely on economics. Parts of the clean air legislation focused on specific types of mobile source pollution and prescribed a number of changes in the content and makeup of motor fuels. The most fundamental of these changes, and one most readily available to many U.N. member countries, is the use of oxygenates such as ethanol and ethers.

Some of the background materials of the Commission's report I reviewed identified the need to control urban air pollution as being a critical component of any control strategy. Obviously this is due to the fact that urban areas represent the highest population and in turn, the highest concentration of automobiles. In the United States, for example, it is no coincidence that the total number of areas with pollution problems is small, yet 100 million people live in areas failing to meet air quality standards (see Exhibit 3). In

many third-world countries the risk to the population is even greater. Furthermore, the Commission has recognized the transportation sector as a key culprit for NOx, VOCs, toxics, and several other specific pollutants (see Exhibit 4). Again, this is something our Congress realized in passing the Clean Air Act and developed some formulas to address these same pollutants. In keeping with the focus on urban air quality, these motor fuels programs began by targeting the most polluted cities in the country.

There is a saying that probably translates well to all of you here today which is that the best way to eat an elephant is one bite at a time. Perhaps no statement so accurately sums up the challenges facing alternative fuel supporters when they attempt to replace a system as huge and entrenched as petroleum is throughout the world. For example, the original motive behind the ethanol program in the United States was to displace 10 percent of our petroleum use by using 10 percent ethanol blends in all the gasoline. Technically this does not present great obstacles yet, that program fell woefully short of reaching that level and after 18 years, it has only captured 1.5 percent of the motor fuel market in the United States. It illustrates once again what a formidable task it is to displace that much petroleum and the oil industry for the most part has fought voluntary cleanup and the introduction of alternatives with considerable force. Clean air programs that target complete replacement of gasoline with alternatives may have an insurmountable challenge. I believe, however, there are indeed ways to take bites out of the elephant and our current environmental programs aimed at cleaning up and extending gasolines do just that. The overall clean fuels program has been phased in with several specific pollutants being targeted through specific formulations of gasoline.

Key in this approach is the use of oxygenates. In my view, the greatest strength of ethanol, other alcohols, and ethers is their ability to mix with gasoline. The use of properly blended volumes (10 to 15 percent) of ethanol, ETBE, and MTBE require no changes to existing automobiles or the refueling infrastructure. They can be quickly implemented and begin producing immediate results. Therefore, oxygenates present an option to eating the entire elephant. Certainly the emissions reductions from other alternatives such as natural gas, electricity, and propane, or even neat ethanol are more dramatic but the limitations of converting automobiles, refueling infrastructure, fuel supply, and the cost of solving all those problems is significant. Furthermore, the emission benefits of these fuels cannot be gauged on the tailpipe alone. Is an electric car producing zero emissions if the electricity was generated from a coal-fired utility? Mandating these alternatives into the fuel system presented a difficult challenge and mandates were opposed by petroleum and auto interests.

The final version of the CAAA stopped short of mandating the complete sale or use of alternative fuels, but included several programs that will require cleaner gasoline-based fuels and will open up the fuel market to non-petroleum gasoline additives. These include provisions that require modifications in gasoline composition and establish more stringent emission standards for vehicles in certain polluted areas. There are several major fuel-related provisions of the CAAA but the two I want to primarily

address are the oxygenated fuel and reformulated gasoline programs (RFG).

Exhibit 3

Exhibit 4

Oxygenated Fuels (Oxy-Fuel Program)

In 1990, 42 urban areas in the United States exceeded the Environmental Protection Agency's (EPA's) National Ambient Air Quality Standard for carbon monoxide. Beginning in November 1992, gasoline sold in those areas contained a minimum of 2.7 percent oxygen (oxy-fuel program) during certain winter months when CO levels are highest. The oxygen portion of the fuels (ethanol, or the methanol portion of MTBE) increases combustion and helps vehicles burn fuel more completely. This program has reduced vehicle CO emissions by 15 percent to 20 percent and has proven to be very successful in allowing areas using the program to achieve CO attainment status (see Exhibit 5). In older automobiles, the reduction is even greater. Plus, oxygen has a linear relationship to CO reduction, meaning the more used, the greater the reduction.

The oxy-fuel program is specifically designed to combat CO which is a colorless, odorless, poisonous gas that directly affects human respiratory and cardiac function. A product of incomplete burning of hydrocarbon-based fuels, CO consists of a carbon atom and an oxygen atom linked together. Through the addition of oxygenates, gasoline burns more completely and less CO is emitted into the atmosphere.

Methyl tertiary butyl ether (MTBE), ethanol, and an ethanol derivative ethyl tertiary butyl ether (ETBE) are the most common oxygen additives for both the oxy-fuel (wintertime) and reformulated gasoline (year-round) programs. Today, these additives are used in just over 25 percent of the nation's gasoline, displacing nearly 300,000 barrels per day of gasoline/crude oil.

The oxy-fuel program is clearly working for the approximately 22 million people who live in these areas. In the first year of the program there was a 95 percent reduction in the number of days exceeding the health standard. Because of the success of the program at reducing levels of winter-time CO, several CO areas with the oxy-fuel program have come into attainment and reached federal air quality standards. At present, 32 areas are still required to implement the oxy-fuel program during specific winter months.

Reformulated Gasoline

The other major type of pollution addressed by alternative fuels and cleaner burning gasolines is ground level ozone formation. Ground level ozone (or Asmog≅) formation is not to be confused with the ozone in the upper atmosphere (the "ozone layer") that occurs naturally, and protects life on earth by filtering out ultraviolet radiation from the sun. Ozone at ground level is a noxious pollutant. It is the major component of smog and presents this country's most intractable urban air quality and health problems.

Unhealthy ozone levels are a problem across the United States, with nearly 100 cities exceeding the EPA National Ambient Air Quality Standard (NAAQS). The standard is

based on the highest ozone exposure sensitive persons can tolerate. Nine cities, home to 57 million people, are considered "severely" polluted, experiencing peak ozone levels that exceed the standard by 50 percent or more. These nine cities are required by the

Exhibit 5

CAAA to use reformulated gasoline. This provision of the Act was the result of a specific amendment by U.S. Senator Tom Daschle of South Dakota. The Senator spent a great deal of time working with the Environmental Protection Agency and other health and fuel experts to determine the fuel formulation that currently is working so well. Senator Daschle was able to give the measure bipartisan appeal and added a number of notable sponsors to his cause including Senator Bob Dole. So now the most important change to gasoline since the removal of lead is a program introduced by both the Majority and Minority Leaders of the U.S. Senate.

The RFG requirement applies to gasoline sold year-round in metropolitan areas within 17 states and the District of Columbia, all with high levels of ozone pollution. RFG specifications include a minimum oxygen content of 2 weight percent and a maximum 1 volume percent benzene content. Heavy metal additives are prohibited. Overall emission performance standards for RFG call for at least 15 percent hydrocarbon and toxic emission reductions by 1995 and at least 20 percent to 25 percent reductions of hydrocarbons and toxic emissions beginning in the year 2000. Preliminary results have shown that RFG has exceeded these requirements in its first full year of use. These reductions are equivalent to taking 8 million cars off the road. In addition to the use of oxygenates, refineries will have to restrict or delete certain high-volatility compounds, aromatics, olefins, and sulfur from gasoline.

Today's RFG baseline displaces about 300,000 barrels per day (b/d) of oil. However, the CAAA permits other polluted cities to voluntarily join, or "opt-in to," the federal RFG program. If these marginal or moderate ozone nonattainment areas -- with more than 100 million people -- decide to opt-in, nearly 60 percent of the nation's gasoline could be reformulated by the year 2000. There has been some discussion about tightening the ozone standard which would result in a dramatic increase in the number of cities in violation of standards.

As I have mentioned, both the CAAA and EPACT address the opportunity for directly substituting petroleum through programs generally referred to as alternative fuels, but the oxygenated fuels and the RFG programs are aimed at cleaning up gasoline rather than completely replacing it. Most importantly, these are extremely cost-effective (see Exhibit 6). Alcohols and their ether derivatives will be the alternative fuels used in these programs.

THE BENEFITS OF OXYGENATES IN GASOLINE

Oxygenate use in RFG is a cost-effective means of accomplishing the CAAA goals of reducing both toxic and ozone-producing compounds from the air. The addition of oxygenates to gasoline serves to lower ozone and toxic air pollutants derived from fuels manufactured at refineries. Oxygenates reduce motor fuel related tailpipe emissions. Oxygenate addition to RFG also expands United States markets for natural gas derivatives and agricultural products, and reduces U.S. reliance on imported crude oil and petroleum products.

Exhibit 6

Benefits at the Refinery:

- Refining reformer severity will be reduced as oxygenates take over a greater-octane role in the U.S. gasoline pool. Total aromatic content in the gasoline pool will drop, and gasoline yield from reforming operations will increase. As a result of oxygenate addition, the naphtha reformer will generate less butane, which also will help volatility control. Federal RFG also serves to reduce stationary source toxic, VOC and NOx emissions as oxygenates provide important downstream octane.

- During the refining process, federal Phase I summer RFG will contain less butane, more straight run naphtha, more natural gas derivatives, and more oxygenates, resulting in a more efficient and cleaner refining process.

Automakers Recommend RFG and Fuel Oxygenates Use:

- Beginning with the 1989 model year, General Motors recommended use of oxygenates in U.S. gasoline to improve fuel quality, and reduce carbon monoxide emissions. The 1995 model year automobile warranty statements reveal that GM, Ford and Chrysler all recommend the use of RFG and fuel oxygenates in U.S. gasoline.

Oxygenate and Fuel Quality Benefits:

- The addition of oxygenates to RFG produces two principle benefits -- the dilution and replacement of aromatics, and the increased efficiency of the engine to burn gasoline attributable to the higher oxygen content. These benefits make oxygenate addition one of the most feasible options for many refiners to achieve the required reductions in air toxics, while also reducing tailpipe sulfur, olefins, and total VOC emissions.

- Oxygenates lower benzene levels in RFG between 6-13 percent. Without the addition of oxygenates, total benzene content in the U.S. gasoline pool would be much greater.

- The high octane characteristics of oxygenates can allow refiners to replace aromatic octane enhancers. Aromatics (benzene, toluene, and xylene) are toxic and contain approximately 10-15 percent more carbon per BTU. The dilution and replacement of aromatics with RFG via lower carbon oxygenates can reduce CO_2/greenhouse gases by 3-6 percent. Oxygenates produced from renewable resources, such as ethanol and ETBE, can reduce these emissions even further.

Tailpipe and Other Emissions Benefits:

- Until recently, a general misperception existed that oxygenates increased NOx in RFG. Federal law prohibits a NOx increase in RFG with or without oxygen. The latest results from extensive industry research show significant increases in emission reductions of NOx, VOCs, toxics, CO and unburned hydrocarbons are achieved using RFG with oxygenates. Substitutes for federal RFG, such as simple low RVP gasolines do not offer corresponding reductions.

- EPA modeling proves that the 2.0 wt percent oxygen requirement in RFG will result in a 6 percent reduction in tailpipe hydrocarbon emissions because the higher oxygen content increases the efficiency of the combustion process.

- Ozone is formed in the lower atmosphere through a series of complex photochemical reactions between VOCs and NOx. The atmospheric reactivity of many higher aromatics, particularly the mixed xylenes, is substantially greater than that of oxygenates. Thus, when oxygenates instead of aromatics are used to increase the octane of gasoline, the ozone-forming potential of the fuel is reduced. Replacing aromatics in general, also reduces emissions of air toxics -- particularly tailpipe benzene (see Exhibit 7).

- The use of oxygenates in RFG reduces CO during the winter, and ozone formation during the summer. RFG with oxygenates also reduces atmospheric concentrations of greenhouse gases.

- Available data suggest that other fuel variables (e.g., aromatic and olefinic hydrocarbon volume percents, and engine variables -- exhaust gas recirculation) can be manipulated to reduce NOx emissions. The octane enhancing characteristics of the oxygenated organics have characteristically lower flame temperatures than aromatic hydrocarbons, thus reducing NOx formation.

- RFG with oxygenates reduces non-winter CO. Because CO is a known ozone precursor, the oxygenate requirement in RFG-- beyond its dilution benefits -- reduces ozone formation as a result of lower CO emissions (see Exhibit 8).

Other Public Policy and Consumer Benefits:

Reduces Imports of Foreign Oil

- The addition of oxygenates to gasoline displaces the amount of gasoline

consumed on a per gallon basis, and reduces the amount of petroleum used and imported by the United States.

Exhibit 7

Exhibit 8

! Producing domestic oxygenates substantially reduces dependence on imported petroleum-based liquid fuels by leveraging domestic crude oil supplies.

Consumer Benefits

! As a result of the addition of 5 -14 volume percent oxygenated fuels, and refinery re-tooling to produce cleaner fuels, RFG will increase the nation's gasoline supply by an estimated 350,000 b/d. Increasing the gasoline supply by that amount could likely result in a decrease in gasoline prices and ultimately lower motor fuel costs for consumers.

New Markets for Natural Gas and American Agriculture

! The production of domestic oxygenated fuels, such as ethanol, ETBE, and MTBE create important new markets for America's abundant supplies of domestic agricultural commodities.

! Natural gas benefits from this clean fuel program by providing process heat for many of the manufacturing facilities and also through increased use of natural gas liquids. A gallon of ether is 30-40 percent alcohol and the remainder is natural gas liquids. Ethers offer some distinct advantages over using the alcohol by itself. They are easily transported in pipelines and generally reduce vapor pressure, the source of evaporative emissions.

Domestic Economic Investment

! Today the U.S. produces over 5 billion gallons of ethanol, ETBE and MTBE. This production has generated over $7 billion in direct investment to the nation's clean fuel energy supply.

The Issues Report specifically identified bioethanol as a positive force for the environment and indeed, ethanol offers a tremendous opportunity to replace petroleum based fuels. Technologies are developing to produce ethanol from feedstocks other than conventional grains which are the primary source for ethanol production in the U.S. and worldwide. These bacteria, enzymes, acid, and other technologies to convert starches to sugars and then to alcohol could ultimately result in the ability to use urban waste like garbage, as well as industrial wastes, and other products that actually cost money to dispose of. We have member companies working on such technologies and our Department of Energy believes it is only a few years away from finalizing a technology to make it economical to use such feedstocks. In addition, these technologies could be applied to specialized crops that would be dedicated solely to ethanol production.

There are many groups in the United States in addition to my Coalition that support the increased use of renewable alcohols. You may note that in the background material made available to you, we produced a general document on ethanol, ETBE, and other alternatives in cooperation with the Governors Ethanol Coalition. This is a 20 state organization that has helped advance ethanol development by supporting industry programs and federal funding for research.

It is also possible to make methanol from renewable resources, but that technology has not been fully developed. In either case, however, the use of renewable resources and a variety of urban, industrial, and agricultural wastes provide significant economic as well as environmental benefits.

In conclusion, other alternative fuels will continue to make more and more of a contribution to reducing pollution in the future, but the immediate availability of cleaner gasolines provides significant benefits (see Exhibit 9). In looking at ways to reduce pollution, costs are a serious consideration and reformulated gasoline continues to be one of the most attractive on a cost-per-ton basis.

I appreciate the opportunity to share this information with you on the status of our clean fuels programs and welcome any questions you might have.

Exhibit 9