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Report to the Chairman, Subcommittee on Health and the Environment, Committee on Energy and Commerce, House of Representatives

August 1991

AIR POLLUTION

Oxygenated Fuels Help Reduce Carbon Monoxide

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United States
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Resources, Community, and
Economic Development Division

B-244152

August 13, 1991

The Honorable Henry A. Waxman
Chairman, Subcommittee on Health
and the Environment
Committee on Energy and Commerce
House of Representatives

Dear Mr. Chairman:

Carbon monoxide (CO) replaces oxygen in the bloodstream and adversely affects one's vision, alertness, and general mental and physical capacities. It is especially harmful to individuals with heart and lung diseases. In an effort to lower excessive levels of CO, the Clean Air Act Amendments of 1990 require the sale of oxygenated fuels, starting in 1992, in the 41 cities identified by the Environmental Protection Agency (EPA) as exceeding national air quality standards. (See app. I.)

In response to your request of September 5, 1990, and as subsequently agreed with your office, this report discusses the extent to which oxygenated fuels have reduced CO levels in six cities—Albuquerque, New Mexico; Denver, Colorado; Las Vegas, Nevada; Phoenix, Arizona; Reno, Nevada; and Tucson, Arizona. These cities already require all gasoline-powered vehicles to use oxygenated fuels during the winter months, when CO levels are the highest and pose the greatest health threat. The report also discusses other measures the cities have taken to meet national CO standards.

Results in Brief

Officials in the six cities reported that the use of oxygenated fuels has reduced CO emissions. Estimated reductions range from 10 percent in Tucson to 20 percent in Albuquerque. Also, some officials credit the use of oxygenated fuels with helping reduce the number of days in which their cities exceeded national CO standards. According to Colorado officials, Denver's use of oxygenated fuels prevented the city from exceeding national CO standards on 5 days during the 1989-90 winter season.

However, officials in all six cities believe that, by itself, the use of oxygenated fuels will not ensure compliance with national CO standards. They told us that other measures are being used, such as the mandatory testing of vehicle emissions and trip-reduction programs. According to the officials, because each year more vehicles are being driven more

miles, it is important that the cities implement strategies specifically designed to prevent future air pollution problems. The experiences of the six cities with oxygenated fuels and other CO reduction measures should be helpful to EPA and the other cities required by the Clean Air Act Amendments of 1990 to use oxygenated fuels and implement other CO reduction programs. Specifically, EPA should be able to use information on the estimated reductions achieved by the six cities to evaluate the reasonableness of estimated improvements in air quality from attainment measures planned by other cities that have not met national CO standards.

Background

CO is a colorless, odorless, poisonous gas produced by the incomplete combustion of carbon-based fuels. Motor vehicles are by far the leading CO producers in the United States, accounting for about 90 percent of all CO emissions. Although more stringent federal standards and improved technologies have reduced new vehicle emissions by 80 percent since 1970, these reductions have been partially offset by the doubling in the number of vehicle miles traveled during this period.

EPA and state and local agencies share responsibility for addressing the CO problem. EPA establishes national air quality standards, sets motor vehicle emissions standards, provides guidance on estimating emissions and implementing CO reduction strategies to state and local agencies, and monitors the success of CO reduction programs. State and local agencies monitor CO conditions and—for those areas under their jurisdiction exceeding CO standards—develop implementation plans for meeting the standards.

The Clean Air Act Amendments of 1990 mandate that cities with excessive CO levels incorporate various CO reduction strategies into their state implementation plans, depending upon the severity of their problem. (See app. I.) Cities failing to achieve national CO standards must periodically update data on the sources and amounts of CO emissions; implement a basic vehicle inspection and maintenance program; and, in some cases, require the wintertime use of oxygenated fuels. Cities with more severe excesses must also prepare annual estimates of vehicle miles traveled, implement more restrictive vehicle inspection and maintenance programs, and use cleaner fuels (e.g., compressed natural gas, methanol, and electricity) in fleets of 10 or more vehicles that are fueled at central locations.

Effectiveness of Oxygenated Fuels in Reducing Carbon Monoxide

The use of oxygenated fuels appears to have been an effective CO reduction strategy in the six cities. According to officials in these cities, using oxygenated fuels during the winter months reduced CO emissions an estimated 10 to 20 percent. For example, Reno officials credit the use of oxygenated fuels with reducing CO emissions by approximately 11 percent, while Phoenix officials estimate an approximate 16-percent reduction from using the fuels. According to Denver officials, had oxygenated fuels not been used during the 1989-90 winter, CO levels would have been 12 percent higher, resulting in excessive CO levels for an additional 5 days.

Widespread acceptance and use of oxygenated fuels has been enhanced by the fuels' economic attractiveness. In general, the cost of oxygenated fuels is comparable to conventional gasoline. An Albuquerque official told us that while methyl tertiary butyl ether (MTBE) blends are selling for the same price as regular unleaded gasoline, ethanol blends are selling for about 1 cent per gallon less.

According to city officials, another attractive feature of oxygenated fuels is that they present little, if any, inconvenience to consumers since the fuels are available at existing gas stations. Further, some cities, like Phoenix, have undertaken extensive public relations campaigns to educate consumers about the benefits of the fuels. According to Phoenix officials, public complaints over mechanical problems allegedly caused by oxygenated fuels have decreased significantly. When the Arizona Department of Environmental Quality examined some of the initial complaints about oxygenated fuels, it did not identify any mechanical problems attributable to the fuels.

Additional Measures Taken to Meet CO Standards

According to state and local officials, no single CO reduction strategy—including oxygenated fuels—will guarantee that cities meet and maintain the national air quality standard for CO. Consequently, each of the six cities is using a variety of CO reduction measures, and some have introduced programs to prevent excessive CO levels in the future.

Vehicle inspection and maintenance programs are being used by all six cities. By identifying and repairing vehicles emitting excessive amounts of CO, cities can significantly reduce their CO levels. Older vehicles are usually the worst offenders: while these vehicles make up less than 20 percent of the fleet in some cities, they produce an estimated 80 percent

of all CO emissions. The most effective inspection and maintenance programs appear to be those, such as the Phoenix program, that test emissions levels while a vehicle is operating under a variety of simulated driving conditions. Arizona Department of Environmental Quality officials estimate a 51-percent reduction in CO emissions after high-polluting vehicles are identified and repaired. Albuquerque officials estimate that CO levels are reduced an average of 68 percent after failed vehicles are repaired.

Reducing the miles traveled by motor vehicles is another significant CO control measure. Although improved technology has significantly reduced CO emissions per vehicle since 1979, a 33-percent increase in vehicle miles since that time has sharply limited reductions in total CO emissions. Moreover, according to a study by the Colorado Department of Health, declines in vehicle emissions should slow after the year 2000, and continued increases in vehicle miles traveled should more than offset emissions reductions from oxygenated fuels and other reduction strategies. Consequently, two cities—Tucson and Phoenix—have recently introduced programs to cut the number of single-occupant trips and reduce vehicle miles traveled. Both programs require employers with 100 or more employees at a single work site to assess employee commuting habits and to encourage employees to use alternate forms of transportation.

In addition to lowering current CO levels, some cities are planning ways to avoid future CO problems as well. For example, Albuquerque has recently enacted an ordinance requiring developers to report any effects their projects may have on the city's air quality and, when necessary, to incorporate pollution reduction measures into those projects. The developers' air quality impact assessments and mitigative actions are subject to review and approval by the City Environmental Health Director and City Planning Commission. Phoenix and Tucson officials told us that they recognize the need for similar ordinances. Also, Tucson officials told us that they plan to reduce vehicle miles traveled by locating essential services and facilities within residential areas and placing commercial centers on public transit lines.

Conclusions and Recommendations

The use of oxygenated fuels by the six cities indicates that the fuels are an effective CO reduction strategy—reducing CO emissions by up to an estimated 20 percent. The experience of the six cities also indicates that

oxygenated fuels alone will not cause the cities to meet national CO standards. Other measures, such as reducing vehicle miles traveled, are required to ensure the most expeditious attainment of the standards.

Information on the experiences of the six cities in reducing CO levels through a combination of oxygenated fuels and other measures should help additional cities required by the Clean Air Act Amendments of 1990 to begin using oxygenated fuels. The information should assist these cities in selecting more effective control strategies and preparing more accurate estimates of CO reductions. Also, the information should be valuable to EPA in its review of state implementation plan revisions required for these cities. Therefore, we recommend that the EPA Administrator make maximum use of the CO reduction experiences of the six cities in providing guidance to additional cities that will be using oxygenated fuels and in evaluating their required revised state implementation plans.

We conducted our review from September 1990 through April 1991 in accordance with generally accepted government auditing standards. Our work focused on the extent to which oxygenated fuels and other CO reduction measures have reduced CO levels in the six cities with oxygenated fuels programs. We interviewed and obtained documents from state, city, and county officials responsible for CO reduction programs in each of the cities. We obtained information on the experiences of the cities in implementing various CO reduction strategies, as well as the results of monitoring efforts and research projects undertaken by government and private organizations.

In addition, to obtain information regarding EPA's role in providing the cities with guidance on CO reduction strategies and in monitoring their progress, we interviewed and obtained documents from EPA officials in the Office of Mobile Sources; the Office of Air Quality, Planning, and Standards; and the Dallas, Denver, and San Francisco regional offices.

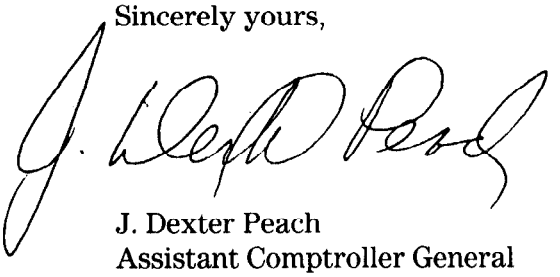
We discussed information contained in this report with EPA, state, city, and county officials, who agreed with its factual content, and we incorporated their comments where appropriate. However, as agreed with your office, we did not obtain official agency comments.

Unless you publicly announce its contents earlier, this report will not be distributed further until 30 days after the date of this letter. At that

time, we will send copies to the EPA Administrator and make copies available to others upon request.

This report was prepared under the direction of Richard L. Hembra, Director, Environmental Protection Issues, (202) 275-6111. Other major contributors are listed in appendix IV.

Sincerely yours,



J. Dexter Peach
Assistant Comptroller General

Contents

Abbreviations

CO	carbon monoxide
EPA	Environmental Protection Agency
GAO	General Accounting Office
HOV	high-occupancy vehicle
MTBE	methyl tertiary butyl ether
OAQPS	Office of Air Quality Planning and Standards
OMS	Office of Mobile Sources
ppm	parts per million

CO Requirements of the Clean Air Act Amendments of 1990

National Ambient Air Quality Standards are set by the Clean Air Act and enforced by the Environmental Protection Agency (EPA). The carbon monoxide (CO) standard is 9 parts per million (ppm) over an 8-hour period. If the standard is exceeded more than one time a year, a violation occurs.

The Clean Air Act Amendments of 1990 designate CO nonattainment areas as moderate or serious on the basis of their design values. The design value is the second highest 8-hour concentration of carbon monoxide. An area is classified as moderate if its design value is between 9.1 and 16.4 ppm and serious if its design value is 16.5 ppm or higher. Moderate areas are required to meet the CO standard by December 31, 1995, and serious areas must meet the standard by December 31, 2000. The 1990 amendments require nonattainment areas to take the following actions corresponding to the areas' levels of nonattainment:

Moderate areas with design values of 9.1 to 12.7 ppm must

- update their emissions inventory every 3 years,
- implement a wintertime oxygenated fuels program with 2.7 percent oxygen content by weight (areas with design values of 9.5 ppm or higher), and
- establish a basic vehicle inspection and maintenance program.

Moderate areas with design values of 12.7 to 16.4 ppm must

- comply with requirements for moderate areas with design values of 9.1 to 12.7 ppm,
- forecast vehicle miles traveled and update the forecast annually,
- adopt contingency measures to be automatically implemented if forecasted vehicle miles traveled are exceeded or if attainment is not reached by the attainment date,
- establish an enhanced vehicle inspection and maintenance program,
- demonstrate emissions reductions by the required dates, and
- implement a clean fuel program for fleets with 10 or more centrally fueled vehicles in areas with design values of 16.0 ppm or greater.

Serious areas with design values of 16.5 or greater must

- comply with requirements for moderate areas and
- adopt transportation control measures to offset vehicle miles traveled.

Classification of CO Nonattainment Areas

Metropolitan area	Design value[a]	Classification
Albuquerque, N. Mex.	11.1	Moderate
Anchorage, Alaska	13.1	Moderate
Baltimore, Md.	9.5	Moderate
Boston-Lawrence-Salem, Mass.- N.H.	9.8	Moderate
Chico, Calif.	10.4	Moderate
Cleveland-Akron-Lorain, Ohio	10.1	Moderate
Colorado Springs, Colo.	11.8	Moderate
Denver-Boulder, Colo.	16.2	Moderate
Duluth, Minn.	9.9	Moderate
El Paso, Tex.	12.6	Moderate
Fairbanks, Alaska	13.2	Moderate
Fort Collins, Colo.	11.3	Moderate
Fresno, Calif.	13.0	Moderate
Greensboro-Winston Salem, N.C.	9.7	Moderate
Hartford, Conn.	10.2	Moderate
Josephine Co., Oreg.	10.3	Moderate
Klamath Co., Oreg.	10.5	Moderate
Las Vegas, Nev.	14.4	Moderate
Los Angeles, Calif.	23.4	Serious
Medford, Oreg.	12.1	Moderate
Memphis, Tenn.-Ark.-Miss.	9.6	Moderate
Minneapolis-St. Paul, Minn.	11.4	Moderate
Missoula, Mont.	9.6	Moderate
Modesto, Calif.	11.8	Moderate
New York-Long Island, N.Y.-N.J.	13.5	Moderate
Philadelphia, Pa.-N.J.-Del.	11.6	Moderate
Phoenix, Ariz.	12.6	Moderate
Portland-Vancouver, Oreg.-Wash.	10.0	Moderate
Provo-Urem, Utah	15.8	Moderate
Raleigh-Durham, N.C.	10.9	Moderate
Reno, Nev.	9.6	Moderate
Sacramento, Calif.	12.6	Moderate
San Francisco, Calif.	11.8	Moderate
San Diego, Calif.	9.9	Moderate
Seattle-Tacoma, Wash.	14.8	Moderate
Spokane, Wash.	13.8	Moderate
Steubenville-Weirton, Ohio-W.Va.	19.6	Serious
Stockton, Calif.	10.4	Moderate
Syracuse, N.Y.	9.7	Moderate

(continued)

Metropolitan area	Design value[a]	Classification
Washington, D.C.-Md.-Va.	11.4	Moderate
Winnebago Co., Wis.	19.9	Serious

[a]Design value = second highest CO concentration achieved over an 8-hour period.

CO Reduction Strategies in Six Cities

Six cities—Albuquerque, Denver, Las Vegas, Phoenix, Reno, and Tucson—already require all gasoline-powered vehicles to use oxygenated fuels during the winter months, when carbon monoxide levels are the highest and pose the greatest health threat. These cities have also taken other measures to meet national carbon monoxide standards.

Albuquerque

Albuquerque, located in Bernalillo County, New Mexico, is the largest metropolitan area in New Mexico, accounting for over one-third (about 500,000 people) of New Mexico's population. Albuquerque has experienced steady growth over the last several decades, and growth in population and vehicle miles traveled is expected to continue at around 2 percent a year.

Mobile sources account for approximately 80 percent of the total annual CO pollution in Bernalillo County. Albuquerque's vehicle fleet, which according to Albuquerque officials is the second oldest in the United States, is the primary contributor.

The Albuquerque metropolitan area is subject to low winds and frequent temperature inversions that cause the air to stagnate and allow concentrations of CO to build up. These conditions worsen in the winter months, when fuel consumption is highest and when additional sources of pollution—primarily wood burning, which accounts for an estimated 33 percent of wintertime CO—are prevalent.

Although Albuquerque has exceeded national CO standards since 1978, the city's CO problem has generally been improving. In the past 3 years, all readings that have exceeded the national standards have occurred at a single monitoring site. Yet, despite recent improvements in CO levels, officials believe that multiple reduction strategies are necessary to meet national CO standards. These strategies include an oxygenated fuels program, a vehicle inspection and maintenance program, restrictions on wood burning, and a public relations campaign aimed at encouraging alternatives to using personal vehicles. In addition, in an effort to prevent future air pollution problems, the city has enacted an ordinance requiring developers to conduct air quality impact assessments and to include preventive measures in their development plans.

Oxygenated Fuels

Albuquerque recently completed its second wintertime oxygenated fuels season. All gasoline sold during this period was required to have a minimum oxygen content of 2 percent by weight. City officials stated that

although the minimum requirement is 2 percent, gasoline supplied to retailers has been averaging about 3 percent. Ethanol blends had about a 66-percent share of the oxygenated fuel market during the first season and an even greater share, 75 to 80 percent, during the 1990-91 season. Methyl tertiary butyl ether (MTBE) blends comprised about 20 to 25 percent of the market during the 1990-91 season.

Several factors have contributed to the widespread acceptance of oxygenated fuels. First, the fuels are competitively priced. Officials estimate that both ethanol and MTBE blends were sold for about 1 cent per gallon more than regular unleaded gasoline during the first oxygenated fuels season. MTBE blends were sold for the same price as regular unleaded gasoline, while ethanol blends were sold for about 1 cent per gallon less during the second season. According to Albuquerque officials, administration costs for the oxygenated fuels program have been minimal—less than $50 per ton of carbon monoxide reduced.

Albuquerque officials have taken an active role in educating the public about the benefits of oxygenated fuels. For example, city officials have conducted radio campaigns, distributed informational brochures, sponsored industry seminars, and hosted public speaking engagements. In addition, an Air Care Hot Line has been established to answer any consumer questions and complaints about oxygenated fuels.

Albuquerque officials estimate an approximately 20-percent reduction in CO emissions because of oxygenated fuels. Because of budgetary constraints, however, the city has not performed tests to determine actual tailpipe emissions reductions or the effects of oxygenated fuels on other air pollutants.

Inspection and Maintenance

In 1989, under a joint powers agreement between the city and the county, Albuquerque/Bernalillo County instituted a decentralized inspection and maintenance program. The program requires engine-idle emissions testing, inspection of emissions equipment for tampering, and lead contamination testing of 1975 and newer vehicles. Testing is required every 2 years, and enforcement is tied to vehicle registration in Bernalillo County. While city officials told us that they favor requiring commuters to participate in the program, their vehicles are not being tested. In addition, the city is considering legislation requiring used cars sold in Bernalillo County to pass inspection and authorizing the city to inspect vehicles on used car lots.

Automobiles, wood-burning stoves and fireplaces, and commercial and industrial sources contribute to the area's CO problems. Motor vehicles, however, continue to be the major source, accounting for approximately 89 percent of CO emissions. The area's cold weather and high altitude combine to cause automobiles to burn fuel less efficiently, resulting in excessive CO emissions. Temperature inversions, which are common in the area, trap the emissions and cause excessive CO concentrations.

While efforts to reduce CO levels have been successful, air quality officials told us that a multifaceted approach is needed to reach and maintain acceptable CO levels. In addition to an oxygenated fuels program, other measures being used include an automobile inspection and maintenance program, a ban on wood burning, and strategies to reduce vehicle miles traveled. Largely as a result of these measures and fleet turnover, days in which CO levels exceeded national standards decreased from 16 in 1987-88 to 3 in 1989-90.

Oxygenated Fuels

In 1987 the Colorado Air Quality Control Commission began the first oxygenated fuels program in the country. Since the inception of the program, the required oxygen content has increased from 1.5 percent to 2.6 percent. In the fourth season (1990-91), 2.6 percent was the minimum oxygen content for all grades of gasoline sold in the nonattainment area except premium, which was required to contain 2.0 percent oxygen. Officials plan to raise the oxygen requirement to 2.7 percent for all grades by November 1992, to comply with the Clean Air Act Amendments of 1990.

Information compiled by Colorado officials indicates that MTBE blends dominate the local gasoline market. During the 1988-89 season, MTBE blends held a 94-percent market share, while ethanol blends held only a 6-percent share. In the 1989-90 season, the market was split 91 percent to 9 percent in favor of MTBE.

According to Colorado officials, the program's widespread public acceptance is due to an active public education campaign including mechanics' training, brochures, and public speaking engagements. The campaign focused on the benefits of oxygenated fuels and on clarifying issues related to vehicle compatibility, fuel economy, and price. During the first oxygenated fuels season, inquiries and complaints were numerous. In the fourth season, however, the inquiries and complaints were significantly fewer. Moreover, program officials stated that most

calls were for information and that the complaints received were largely unfounded.

According to program officials, using oxygenated fuels has reduced the area's CO levels. They estimate that the fuels reduced tailpipe emissions by about 15 percent during the 1989-90 winter season and by about 19 percent during the 1990-91 season. In addition, officials estimate a 12-percent reduction in atmospheric levels of CO in 1989-90 because of oxygenated fuels.

Inspection and Maintenance

Colorado initiated its inspection and maintenance program in 1982. Initially, the program concentrated on identifying poorly maintained vehicles whose emission control equipment had been tampered with. In 1987, computer analysis of tailpipe emissions was initiated, and an opacity test (testing for visible exhaust) for larger diesel fleets was incorporated. In 1990 the program was expanded to include all diesel-powered vehicles.

With the exception of the diesel fleet program, Colorado's inspection and maintenance program is decentralized—inspections are performed at privately owned and operated shops and service stations. Vehicles that fail inspection must be repaired and retested. The program does allow waivers to be granted with proof of repair; there is a $50 repair limit for 1981 or older vehicles and a $200 limit for 1982 or newer vehicles. State analysis of inspection data indicates that CO emissions are reduced an average of 55 percent per vehicle after repairs are completed.

Wood-Burning Restrictions

In 1985 Colorado passed legislation requiring emissions controls on wood stoves and fireplaces. The law requires all wood stoves and fireplace inserts sold in the area to be EPA-certified, low-emission units. The legislation also establishes a voluntary wood-burning ban on high-pollution days.

Strategies to Reduce Vehicle Miles Traveled

The Clean Air Colorado Program is designed to reduce CO and other pollutants by reducing vehicle miles traveled. Citizens are asked to avoid driving 1 day per week and to minimize driving on high-pollution days.

Since the inspection and maintenance program is decentralized, certified Air Care Stations perform the emissions tests, and establish inspection fees. As of March 31, 1990, the average cost of tests was $16. The average cost for repairs to pass a failed test was $200. In lieu of repair cost waivers, the city grants time extensions, up to 12 months for emissions-related repairs costing up to $300 and up to 24 months for repairs over $300. Even though time extensions are granted, repairs must be completed, and vehicles must pass inspection before registration renewal will be granted.

Albuquerque operates its own test facility, which provides free retesting of vehicles that have failed inspections. The city's facility also acts as a referee station for disputes between consumers and inspection stations. The facility maintains records for all inspections, extensions, Air Care Stations, and registration activity. For example, the city records CO emissions levels for vehicles before and after repairs. Data indicate that overall tailpipe CO reductions averaged 68 percent after repairs, while 1981 and newer vehicles experienced average reductions of 93 percent.

Wood-Burning Restrictions

The Albuquerque/Bernalillo County Air Quality Board passed a wood-burning ordinance in January 1988 that restricts wood burning in portions of the county, including Albuquerque, from October 1 through February 28. When a "no burn" period is called, only EPA-certified, low-emissions wood stoves and inserts with no visible smoke are allowed to operate. Exemptions to the wood-burning restrictions may be granted for medical reasons to low-income families when wood burning is their sole heat source and alternate heating systems have not been removed from the home. Albuquerque officials told us that one positive result of the program is that the public is replacing older, high-emissions wood stoves and inserts with newer EPA certified low-emissions units. They also told us that they are attempting to quantify the effect of the restrictions on CO emissions.

Strategies to Reduce Vehicle Miles Traveled

According to city officials, neither Albuquerque nor Bernalillo County has any mandatory transportation restriction measures in place at this time. However, they hold an annual Better Air Campaign to promote the use of public transportation, carpooling, vanpooling, and other alternate modes of transportation. The slogan "Don't Drive One in Five" is used in brochures, posters, radio campaigns, and public service announcements to encourage motorists to refrain from driving their personal vehicles 1 day a week and use alternate modes of transportation.

Air Quality Planning

In July 1990 Albuquerque officials implemented an ordinance requiring that air quality considerations be integrated into zoning and other land use decisions. For example, if a proposed development exceeds specified thresholds (size, trip generation, CO emissions, etc.), the developer is required to submit a written air quality impact assessment. After reviewing the assessment, the city may reject the development, ask for additional information, or approve the development with certain conditions that prevent the project from adversely affecting the city's air quality.

For example, in August of 1990, the city agreed to approve plans for the development of a regional shopping mall in Albuquerque, if four conditions were fulfilled: (1) the developer would provide up to $85,000 for the development of the first phase of a park and ride facility, (2) the site plan would include acceptable transit stops at appropriate entrances to the mall, (3) the developer would provide 100 bus passes per month for 5 years to mall employees, and (4) the developer would actively promote the use of alternate modes of transportation among both mall employees and patrons.

Although city officials expect the air quality planning ordinance to have a significant impact on air pollution, it is difficult to quantify its impact because of its newness and because the greatest benefits will be the prevention of potential problems, not the resolution of existing ones.

For additional information on Albuquerque's oxygenated fuels program and other CO reduction measures, contact:

Mr. Steve Walker, Manager, Air Pollution Control Division
Albuquerque Environmental Health Department
1 Civic Plaza, Suite 3023
Albuquerque, NM 87103
(505) 768-2600

Denver

Denver, located at the foot of the Rocky Mountains, has an estimated population of 490,000. In recent years, the Front Range area, including all or part of nine counties and the cities of Boulder, Colorado Springs, Denver, Fort Collins, Greeley, and Longmont, has experienced CO levels that exceed national standards.

Communities, organizations, and individuals are also encouraged to participate in the program by promoting ride sharing and other air pollution reduction efforts. The program has received wide public exposure through local media coverage.

The Air Pollution Control Division of the Colorado Department of Health has promoted various transportation measures including high occupancy vehicle (HOV) lanes, a rideshare program, park and ride lots, ramp metering, and bicycle lanes. Other measures being considered include a light rail project and a coordinated traffic signal system. Telecommuting and alternative work week programs are also being used to reduce vehicle miles traveled and CO emissions.

For additional information on Denver's oxygenated fuels program and other CO reduction measures contact:

Mr. Bradley Beckham, Director, Air Pollution Control Division
Colorado Department of Health
3773 Cherry Creek Drive, North
Denver, CO 80209
(303) 331-8500

Las Vegas

Las Vegas, located in Clark County, Nevada, has an estimated population of more than 750,000 and is growing by approximately 4,000 people each month. In addition, the city attracts an estimated 20 million tourists annually. The Las Vegas Valley area (approximately 1,650 square miles)—including the cities of Las Vegas, North Las Vegas, Henderson, and Boulder City—has failed to meet national CO standards since 1975.

Automobiles account for an estimated 96 percent of winter CO emissions in the Valley. Since 1980, vehicle miles traveled have more than doubled, reaching over 3 billion miles in 1989. Temperature inversions typical during the winter months trap cold air and high concentrations of CO at ground level. Although this happens throughout the year, CO levels are highest during the winter months.

Although CO concentrations in the Las Vegas area have generally been decreasing, in some cases the number of days in which CO levels exceed national standards have increased. For example, the number of exceedance days dropped from 57 in the 1985-86 winter season to 22 in

the 1987-88 season, but increased to 24 in the 1988-89 season and 32 in the 1989-90 season before dropping to 14 in the 1990-91 season. Las Vegas officials attribute the overall downward trend in CO emissions to fleet turnover, an effective inspection and maintenance program, computerized traffic management systems, roadway improvements, and the use of oxygenated fuels. Periodic increases in emissions are attributed to increases in vehicle miles traveled.

Las Vegas officials believe multiple CO reduction strategies are needed for the area to achieve and maintain CO levels below the national standards. In addition to the oxygenated fuels and inspection and maintenance programs, controls on wood-burning stoves have been implemented, and travel reduction programs are being considered.

Oxygenated Fuels

The Clark County Health District implemented an oxygenated fuels program in November 1989 to decrease excessive wintertime CO levels. The program requires gasoline retailers to sell fuels with a minimum oxygen content of 2.6 percent from October 1 through March 31. Program officials estimate that using oxygenated fuels has helped to reduce CO levels from 15 to 20 percent and has resulted in fewer days in which national CO standards were exceeded.

Consumer opposition to the mandated use of oxygenated fuels has been virtually nonexistent. Program officials believe that consumer acceptance has been enhanced by the dissemination of approximately 400,000 informational brochures to households and gasoline stations. Also, the county has held seminars to train auto mechanics to educate motorists about the benefits of oxygenated fuels.

During the 1989-90 winter season, MTBE blends had a 47- percent share of the oxygenated fuels market, while ethanol blends had a 53-percent market share. During the 1990-91 winter season, MTBE's market share decreased to between 30 and 35 percent while ethanol's share increased to between 65 and 70 percent. Program officials estimate that oxygenated fuels cost about 3 to 5 cents more per gallon than gasoline. However, because of intense competition in the Las Vegas gasoline market, these costs are not always passed on to consumers.

Inspection and Maintenance

Las Vegas' initial inspection and maintenance program required all gasoline-powered vehicles 15 years old or newer to be checked for visible emissions and properly functioning emissions control equipment. As of

February 1991, heavy-duty vehicles were also required to be inspected. Infrared gas analyzers are used to check pollutant levels in the exhaust. Vehicles not meeting prescribed federal emission standards must be adjusted or repaired, and retested.

More stringent regulations were implemented in 1988 in an effort to achieve a 30-percent failure rate for inspections. The regulations required the use of computerized exhaust analyzers, established new CO standards based on vehicle model year, required anti-tampering tests for 1981 and newer vehicles, established a $200 minimum repair cost waiver, and required enhanced training for inspectors. Despite these measures, the failure rate actually decreased from 23 percent in 1988 to 14 percent in 1990. As a result, the state legislature is considering legislation to strengthen the program. In addition, the county hopes to implement inspection and maintenance programs for diesel vehicles as well.

Wood-Burning Restrictions

Although Clark County has not mandated wood-burning bans on high-pollution days, the county requires the installation of cleaner burning wood stoves and fireplaces in all new housing developments.

Strategies to Reduce Vehicle Miles Traveled

Carpooling and public transportation measures are included in the Las Vegas area's air quality implementation plan. Officials believe that an areawide coordinated effort to reduce vehicle miles traveled through public transportation, ride sharing, and employer-sponsored microbuses is needed. County officials estimate that while these measures may cost over $20 million annually, they will reduce CO levels by at least 4 percent a year.

For additional information on Las Vegas' oxygenated fuels program and other CO reduction measures, contact:

Mr. Mike Naylor, Director, Air Pollution Control Division
Clarke County Health District
625 Shadow Lane
Las Vegas, NV 89127
(702) 383-1276

Phoenix

Phoenix, located within Maricopa County, Arizona, has a population of about 1 million. An area covering approximately 2,000 of the county's

9,000 square miles, including the city of Phoenix, does not meet national CO standards.

According to state air quality officials, mobile sources account for approximately 90 percent of Phoenix's CO problem. A relatively high percentage of the city's mobile fleet consists of older vehicles that typically pollute more than other vehicles. Phoenix also has the lowest average wind speeds of any metropolitan area in the United States. This contributes to strong and persistent temperature inversions that trap CO at ground level, often resulting in concentrations of CO exceeding the national standard.

Although CO concentrations and days in which the CO standard has been exceeded in this area have generally decreased (from 60 in 1975 to 6 in 1990), concerted efforts by the county and the city are necessary to maintain these lower levels. According to state, city, and county officials, multiple CO reduction strategies, including oxygenated fuels, a vehicle inspection and maintenance program, a travel reduction program, and a clean air campaign are needed for the city to meet and maintain CO standards. Also, county officials intend to incorporate air quality considerations into its future land-use planning.

Oxygenated Fuels

Phoenix has just completed its second oxygenated fuels season. State legislation requires all gasoline sold in the area from October 1 to March 31 to contain a minimum of 2.3 percent oxygen. According to state officials, this requirement will be increased to 2.7 percent by November 1992 in order to comply with the Clean Air Act Amendments of 1990.

State officials estimate that during the 1989-90 winter season, approximately 18 percent of Phoenix's gasoline market consisted of ethanol blends and 82 percent MTBE blends. As of November 1990, ethanol's share had increased to about 24 percent of the market mainly because of cost advantages over MTBE. No cost estimates have been developed for the current season because of extreme price fluctuations in world oil markets, but officials estimate that last season's oxygenated fuels increased the cost of gasoline approximately 8.5 cents per gallon.

According to state officials, Phoenix has experienced wide public acceptance of oxygenated fuels primarily because of a well-informed public and the fact that there are no major differences in vehicle performance when using oxygenated fuels. The Arizona Department of Environmental Quality has undertaken extensive public relations

efforts, by providing resources such as informational seminars, brochures, and a consumers' hotline to educate people about the program. According to state officials, in the first week of the program, the hotline was overwhelmed with calls concerning potential mechanical problems related to the use of oxygenated fuels. Since then, the number of calls has decreased significantly. In addition, the Arizona Department of Environmental Quality has yet to identify any problems that can be directly attributed to the use of oxygenated fuels.

Arizona officials estimate that using oxygenated fuels in Phoenix has reduced overall CO levels by approximately 16 percent. Actual fleet tests conducted by the Arizona Department of Environmental Quality indicate average reductions of 20 percent per vehicle, with some high-polluting vehicles achieving reductions as high as 50 percent. However, state officials believe the reductions are short-term because improved vehicle emissions technology and fleet turnover will gradually cause CO reductions to level off.

Inspection and Maintenance

Arizona initiated its inspection and maintenance program in 1977, requiring all vehicles registered in Pima and Maricopa counties to meet emissions and other requirements prior to being registered. Since the inception of the program, a number of measures, such as the following, have been taken to make it more stringent:

- Checking emissions control equipment for evidence of tampering (1985).
- Requiring inspections for 1967 and newer vehicles (previous requirements included only 1971 and newer vehicles) (1986).
- Inspecting visible exhaust for diesel vehicles (1987).
- Increasing repair waiver amounts ($50 to $300 depending on model year) (1988).
- Requiring out-of-state college students and commuters from outside the nonattainment area to pass inspection (1989).
- Performing loaded and engine-idle tests on 1981 and newer vehicles (1989).

Analyses by the Arizona Department of Environmental Quality indicate that adoption of the loaded test should reduce CO emissions by about 4 percent. Inspecting and repairing vehicles registered outside the nonattainment area but used by commuters working in the area should reduce CO emissions by approximately 1 percent. Data collected by state officials for the 1989-90 season indicate that CO emissions from cars failing inspection were reduced an average of 51 percent after repairs.

According to an Arizona Department of Environmental Quality official, the use of oxygenated fuels has had a positive impact on inspection and maintenance results. For example, during the first oxygenated fuels season, inspection failure rates decreased from 20 to 16 percent.

Strategies to Reduce Vehicle Miles Traveled

The Maricopa County Travel Reduction Program, implemented in 1988, is a cooperative effort between the county and major city, state, federal, and private employers. Employers with 100 or more employees at a single work site must (1) designate a transportation coordinator, (2) administer an employee survey regarding transportation usage, (3) disseminate information on alternate forms of transportation, and (4) submit a transportation reduction plan to the county. County officials estimate that the program costs employers about $14 a year for each employee. The goal of the program was to reduce single-occupancy vehicle trips and vehicle miles traveled by 5 percent the first year and an additional 5 percent the second year. While the program's results have not been quantified, county officials told us that they believe that it has been successful.

In 1987, Phoenix began a Clean Air Campaign known as "Don't Drive One in Five." Through public service announcements and media campaigns, the county encourages all drivers to reduce vehicle miles traveled by eliminating single-occupancy vehicle trips. The program currently runs from October to March, but the county is considering making it a year-round effort. According to county officials, it is difficult to measure the program's effect because of its objective of changing individual behavior. While no immediate quantifiable results are expected, officials do expect changes in vehicle miles driven and modes of transportation used by the year 2005.

Air Quality Planning

Maricopa County officials recognize the need to manage future growth because of the relationship between land use and air pollution problems. For example, future developments must be planned to minimize their impact on air quality; redistributing traffic patterns by building additional highways will no longer be a viable alternative. At the time of our visit, neither Phoenix nor Maricopa County had a program for specifically incorporating air quality considerations in city development planning. However, county planners have proposed an ordinance requiring all new planning proposals to include an air quality impact assessment.

For additional information on Phoenix's oxygenated fuels program and other CO reduction measures, contact:

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Reno

The Reno metropolitan area has a population of approximately 242,800, with an estimated growth rate of about 2.5 percent a year. A 150-square-mile area known as Truckee Meadows, which includes the city of Reno, Nevada, does not currently meet the national CO standards.

Mobile sources account for approximately 80 percent of the area's CO emissions. Because commuting distances are short and vehicles do not completely warm up, they operate less efficiently and emit more CO. In addition, strong and persistent temperature inversions coupled with the area's location in a basin contribute significantly to excessive CO levels. Wood burning is also a major contributor to the winter CO problems, accounting for 15 percent of total CO emissions.

Concentrations of CO in the Reno area are gradually decreasing. In fact, the number of days exceeding the national CO standards decreased from 55 in 1975 to 1 in 1990. The Washoe County District Health Department attributes the decrease to the use of multiple CO reduction strategies. In addition to an oxygenated fuels program, inspection and maintenance programs, wood-burning controls, and ride-sharing programs are used.

Oxygenated Fuels

The oxygenated fuels program recently completed its second season. All gasoline sold in the area is required to contain a minimum of 2 percent oxygen. MTBE blends account for approximately 96 percent of the oxygenated fuels market, while ethanol blends represent about 4 percent. While officials estimate that gasoline prices increased between 2 and 5 cents per gallon since oxygenated fuels were introduced, they told us that other western cities not using oxygenated fuels have experienced similar price increases.

County officials operate an oxygenated fuels hotline to address consumer questions and complaints. During the first oxygenated fuels season, officials received a number of calls from the public concerning

perceived fuel economy losses resulting from the use of oxygenated fuels. The number of calls decreased significantly, however, in the second season, and county officials told us that they have no information linking reduced fuel economy and engine problems to the use of oxygenated fuels.

While county officials have not conducted vehicle emissions tests to determine precise emissions reductions from using oxygenated fuels, they told us that the fuels have reduced CO. For example, using EPA's Mobile IV model, officials estimate an 11-percent emissions reduction during the first oxygenated fuels season.

Inspection and Maintenance

Reno's initial inspection and maintenance program required that gasoline-powered vehicles, including heavy-duty vehicles built since 1969, be checked for visible emissions and properly operating emissions control equipment. Infrared gas analyzers are used to check pollutant levels in the exhaust. Vehicles not meeting prescribed emissions standards must be adjusted or repaired and then retested.

State legislation was passed in 1988 to strengthen the inspection and maintenance program. The legislation (1) required computerized emissions analyzers, (2) established emissions standards for CO on the basis of the vehicle model year, (3) required anti-tampering inspections for 1981 and newer models, (4) established a $200 minimum repair waiver for parts and labor, and (5) enhanced training for inspectors. Officials told us that the inspection failure rate is still considerably less than the state's goal of 30 percent. For example, during the fourth quarter of 1990, the failure rate was about 18 percent.

Wood-Burning Restrictions

1988 legislation to control CO produced by wood burning required three actions. First, it required the sale and installation of certified low-emissions wood stoves. Second, it required that high-polluting stoves be removed or replaced when a home is sold. Finally, it required that the use of wood stoves be restricted during periods of poor air quality.

On low-pollution days, unrestricted wood burning is allowed, while on moderate pollution days, a slow down in burning is advised. On days when air pollution levels are unhealthy, all residential and commercial burning is stopped; all burning in wood stoves and fireplaces and all commercial burning must be halted for a minimum of 24 hours. Warnings and fines can be levied for violating the ban.

The program's goal is to remove or replace all uncertified wood stoves by 1993. Officials estimate that the replacement of old, high-polluting stoves will result in approximately a 13-percent reduction in CO levels during the winter season. Since the implementation of the program, the percentage of CO from wood burning has declined from 25 percent to 15 percent.

Strategies for Reducing Vehicle Miles Traveled

In 1991 the Regional Transportation Commission began a pilot ride-share/employee trip reduction program. Several strategies are being used to reduce vehicle miles traveled by city, county, private, and public utility employees. The program includes a computerized ride-share matching service, free parking for ride-share commuters, discounted bus fare coupons and flexible working hours for participants. Officials are somewhat discouraged by employee response thus far. Less than 2 percent of the eligible employees have taken advantage of the program. Officials continue to monitor the pilot program and hope to implement a more effective program in the future.

For additional information on Reno's oxygenated fuels program and other CO reduction measures, contact:

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Tucson

Tucson, located within Pima County, Arizona, has a population of approximately 411,000. Mobile sources account for about 90 percent of Tucson's CO emissions. The area is subject to temperature inversions that trap CO at ground level and elevate levels of the pollutant in the atmosphere.

Tucson currently meets national air quality standards for CO. In fact, Tucson has not had any days in which CO levels exceeded the national standard since 1988 and has not exceeded the standard more than once a year since 1984. Although Tucson officials project that CO levels may continue falling until around the year 2000, they also project that vehicle miles traveled will increase during this period. After 2000,

increases in vehicle miles traveled are expected to offset the benefits of CO reduction measures, and CO levels are expected to begin rising.

As a result, Tucson will use a number of reduction strategies to ensure continued compliance with national CO standards. In addition to the continued use of oxygenated fuels, other strategies include a vehicle inspection and maintenance program, a travel reduction program, and an urban form concept for planning future developments.

Oxygenated Fuels

Tucson recently completed its first oxygenated fuels season, October 1, 1990, to March 31, 1991. State law requires gasoline sold in the area to contain a minimum of 1.8 percent oxygen. Because Tucson currently meets national CO standards, it does not have to comply with the Clean Air Act Amendments of 1990's requirement for a 2.7-percent oxygen content. Tucson officials told us that they plan to continue the 1.8-percent oxygen requirement.

The state has undertaken extensive public relations efforts by providing resources such as informational seminars, brochures, and an oxygenated fuels hotline to educate people about the program. According to a state air quality official, in the first week, the hotline was overwhelmed with calls concerning mechanical problems, most of which were not related to the use of oxygenated fuels. Since then, the number of calls has decreased significantly. The Arizona Department of Environmental Quality has yet to identify any problems that can be directly attributed to the use of oxygenated fuels.

State officials estimate that, during the first oxygenated fuels season, MTBE blends had over a 95-percent market share, while ethanol had less than a 5-percent market share. While Arizona officials have not determined the cost of using oxygenated fuels, they estimate that the fuels have reduced CO emissions by 10 to 12 percent.

Inspection and Maintenance

Arizona's inspection and maintenance program applies to both Tucson (Pima county) and Phoenix (Maricopa county). A description of the program is contained in the Phoenix section of this appendix. Pima Association of Governments officials estimate that the inspection and maintenance program reduced emissions by 29 percent in 1990.

Strategies to Reduce Vehicle Miles Traveled

Tucson's Travel Reduction Program, initiated in 1988, is a cooperative effort between major employers within Pima county, including city, county, state, federal, and private employers. Employers with 100 or more employees at a single work site are required to (1) designate a transportation coordinator, (2) administer an employee survey regarding transportation usage, (3) disseminate alternate transportation information, and (4) submit a transportation reduction plan to the county. Each employer is required to resurvey its employees each year. Subsequent survey results are used to measure progress toward the program's goals, which are to increase the use of alternative forms of transportation and reduce vehicle miles traveled by up to 25 percent in the program's first 3 years.

Another effort to reduce vehicle miles traveled is Tucson's Ride Share program. The program, started in 1983, was designed to provide a central information point for individuals interested in car/van pools. People with similar ride-sharing needs are matched through the use of a computer data base. In addition, the program encourages the use of parent pools to transport school children.

Air Quality Planning

Tucson uses an Urban Form and function program in planning new residential and commercial developments. The objective of the program is to plan future developments to minimize distances traveled by single-occupancy vehicles, thereby reducing CO emissions. The program focuses on locating shopping centers, commercial centers, and other essential services near residential areas and within close proximity to mass transportation routes.

For additional information on Tucson's oxygenated fuels program and other CO reduction measures, contact:

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