Transportation Air Quality

Selected Facts and Figures

U.S. Department
of Transportation
Federal Highway Administration

January 2002

Purpose and Terms

Purpose

This brochure provides an overview of facts and figures regarding the linkages between transportation and air quality. The focus of this brochure is primarily on transportation-related emission trends, policies, technologies, and standards that affect on-road mobile sources including automobiles, light-duty trucks, and heavy-duty trucks.

Terms

CAAA	The Clean Air Act Amendments of 1990.
CO	Carbon-monoxide—a criteria pollutant—a product of incomplete fuel combustion.
Fugitive dust	Largely windblown dust from paved and unpaved roads.
HC	Hydrocarbons—gaseous compounds made of carbon and hydrogen (used interchangeably with VOC).
NAAQS	National Ambient Air Quality Standards—federally established standards for pollutant concentrations that States, cities, and towns must meet by specified deadlines.
NO_X	Oxides of nitrogen—a collective term for all compounds of nitrogen and oxygen (includes nitrogen monoxide, nitrogen dioxide, etc.).
Nonattainment areas	Areas that have failed to meet the NAAQS.
Non-road engines	Aircraft, trains, boats, off-road recreational vehicles, farm and construction equipment, and yard tools.
On-road vehicles	Cars, vans, buses, light-duty and heavy-duty trucks, and motorcycles.
Ozone	A criteria pollutant—an oxygen compound that can develop when NO_X, VOC, and sunlight interact in the lower atmosphere; the primary constituent of smog.
PM_{10}	Particulate matter with a diameter less than 10 micrometers.
$PM_{2.5}$	Particulate matter with a diameter less than 2.5 micrometers.
Point and area sources	Stationary sources of emissions, including electric utilities, factories, petroleum refineries, dry cleaners, and so forth.
Precursors	Pollutants that contribute to the formation of other pollutants; HC and NO_X are precursors of ozone.
VMT	Vehicle miles traveled.
VOC	Volatile organic compounds—gaseous compounds made of carbon and hydrogen (used interchangeably with HC).

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Transportation and Air Quality

In response to the Clean Air Act of 1970, the U.S. Environmental Protection Agency (EPA) established National Ambient Air Quality Standards (NAAQS) for various pollutants—known as "criteria" pollutants—that adversely affect human health and welfare. This brochure focuses on the three major transportation-related criteria pollutants:

- Ozone (O_3) and its precursors, volatile organic compounds (VOC) and oxides of nitrogen (NO_X)
- Particulate Matter (PM)
- Carbon Monoxide (CO)

Other criteria pollutants include sulfur dioxide (SO_2), nitrogen dioxide (NO_2), and lead (Pb). In the past, motor vehicles were a major source of lead emissions but are no longer a major contributor because leaded gasoline is no longer generally available.

Fuel combustion by motor vehicles and other sources releases carbon dioxide (CO_2), which is a "greenhouse gas" that traps heat within the earth's atmosphere. CO_2 is not directly harmful to human health and is not regulated under the Clean Air Act.

Significant progress has been made in reducing criteria pollutant emissions from motor vehicles and improving air quality since the 1970s, even as vehicle travel has increased rapidly. The air is noticeably cleaner than in 1970, and total criteria pollutant emissions from motor vehicles are less than they were in 1970 despite a more than doubling of vehicle miles of travel.

Challenges still remain. In 1997, EPA issued revised standards for ozone and particulate matter that reflect improved understanding of the health effects of these pollutants. Based on monitored data, approximately 121 million people in the United States reside in counties that did not meet the air quality standards for at least one NAAQS pollutant in 2000.

For more detailed data on the subjects covered, refer to the sources and Web sites listed on pages 47–49 of this publication.

Source: U.S. Environmental Protection Agency. *Latest Findings on National Air Quality: 2000 Status and Trends*. September 2001.

Pollutant Effects

Above certain concentrations, ozone (O_3), particulate matter (PM), and carbon monoxide (CO) can cause or exacerbate health problems and/or increase mortality rates, making their control an important goal under the Clean Air Act.

Ozone (O_3)

Ground-level ozone is the major component of smog. While ozone in the upper atmosphere (the "ozone layer") occurs naturally and protects life on earth from harmful ultraviolet radiation, ozone at ground level is a noxious pollutant. Ground-level ozone is not directly emitted, but is formed by the reaction of oxides of nitrogen (NO_X) and volatile organic compounds (VOC) in the presence of sunlight.

Ozone is a severe irritant, responsible for choking, coughing and stinging eyes associated with smog. Ozone damages lung tissue, aggravates respiratory disease, and makes people more susceptible to respiratory infections. Children are especially vulnerable to ozone's harmful effects, as are adults with existing respiratory disease. Even healthy individuals may experience impaired lung function from breathing ozone-polluted air. In addition to health problems, ozone harms vegetation, resulting in reduced agricultural and commercial forest yields, increased tree and plant susceptibility to disease and other environmental stresses, and potential long-term effects on forests and ecosystems. Peak concentrations typically occur in summer.

In July 1997, EPA announced a new ozone standard. The new 8-hour standard is more stringent than the old standard requiring ozone levels to be lowered to .08 parts per million (ppm) rather than the old one-hour .12 ppm standard. The new standard is expected to be implemented during 2002–03.

Particulate Matter (PM_{10} and $PM_{2.5}$)

Particulate matter is the term used for a mixture of solid particles and liquid droplets found in the air. These particles come in a wide range of sizes and can remain suspended in the air for extended periods. PM can be emitted directly by a source or formed in the atmosphere by the transformation of gaseous emissions such as sulfur dioxide (SO_2), oxides of nitrogen (NO_X), and volatile organic compounds (VOC).

Fine particles, under 2.5 microns in diameter ($PM_{2.5}$), result from fuel combustion from motor vehicles and other sources, as well as transformation of gaseous emissions. Coarse particles under 10 microns in diameter (PM_{10}) generally consist of windblown dust, and are released from agriculture, and crushing and grinding operations.

In July 1997, EPA announced revisions to the particulate matter standards. Two new $PM_{2.5}$ standards (annual and 24-hour standards) were added to the existing standards for PM_{10}. The new standards focus on fine particles under 2.5 microns in diameter, which are believed to be the most closely associated with acute health effects. The new standards are expected to be implemented by 2005.

Particulate matter irritates the membranes of the respiratory system, causing increased respiratory symptoms and disease, decreased lung function, alterations of the body's defense systems, and premature morality. Sensitive groups at risk include the elderly, individuals with cardiopulmonary disease such as asthma, and children. In addition to health problems, airborne particles cause soiling and damage to materials and reduce visibility in many parts of the U.S. There are daily (24-hour) and annual PM NAAQS.

Carbon Monoxide (CO)

Carbon monoxide is an odorless, colorless gas that interferes with the delivery of oxygen to the body's organs and tissues. The health effects of CO vary depending on the length and intensity of exposure and the health of the individual. CO has both a one-hour and eight-hour standard. The health threat is most serious for those who suffer from cardiovascular disease. Effects of CO include dizziness, headaches, fatigue, visual impairment, reduced work capacity, reduced manual dexterity, and poor learning ability.

CO is produced by the incomplete burning of carbon in fuels, including gasoline. High concentrations of CO occur along roadsides in heavy traffic, particularly at major intersections, and in enclosed areas, such as garages and poorly ventilated tunnels. Peak concentrations typically occur during the colder months of the year when CO vehicular emissions are greater and night-time inversion conditions are more frequent.

Air Quality Standards

National Ambient Air Quality Standards (NAAQS) are set by EPA to protect public health and welfare. Primary standards are designed to protect against adverse health effects, while secondary standards protect against welfare effects such as damage to crops, vegetation, buildings, and decreased visibility.

An area is in violation of the standard if it exceeds the concentration level for the specified form of the standard and evaluation time frame. For example, four exceedances of the one-hour ozone standard must occur over a three-year period for a violation to occur.

Primary Air Quality Standards for Transportation-related Pollutants

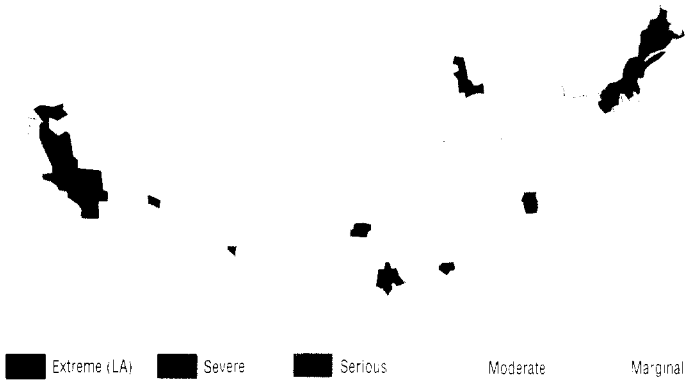
Pollutant	Type of Average	Concentration
CO	8-hour	9 ppm (10mg/m^3)
	1-hour	35 ppm (40 mg/m^3)
O_3	8-hour	0.08 ppm (157 μg/m^3)
	1-hour	0.12 ppm (235 μg/m^3)
$PM_{2.5}$	Annual	15 μg/m^3
	24-hour	65 μg/m^3
PM_{10}	Annual	50 μg/m^3
	24-hour	150 μg/m^3

ppm = parts per million.
mg/m^3 = milligrams per meter cubed.
μg/m^3 = micrograms per meter cubed.

Nonattainment Areas

Classified 1-Hour Ozone Nonattainment Areas

(August 2001)



Areas that do not meet the NAAQS are designated as nonattainment areas. These areas must submit air quality plans, known as State Implementation Plans (SIPs), showing how they will attain the standards. If they do not meet these and other requirements, they face Clean Air Act required sanctions and other penalties, including possible loss of highway funds. Metropolitan Planning Organizations and the U.S. Department of Transportation must ensure that transportation plans, programs, and projects conform to these SIPs.

Ozone nonattainment areas were classified under the Clean Air Act Amendments of 1990 based on the severity of the air quality problem—from marginal to extreme—with expected attainment dates corresponding to the severity of the problem. Although most geographic areas of the country now meet the one-hour standard, many of our largest cities do not. This map shows current ozone nonattainment areas under the one-hour standard in August 2001.

Source: U.S. Environmental Protection Agency. *Green Book: Nonattainment Areas for Criteria Pollutants,* 1 August 2001, Web site: Welcome to the Green Book Nonattainment Areas for Criteria Pollutants. O_3 <http://www.epa.gov/oar/oaqps/greenbk/onmapc.html>(3 October 2001)

Note: Alaska and Hawaii have no 1-Hour Ozone Nonattainment Areas.

Nonattainment Areas

Classified PM_{10} Nonattainment Areas

(as of August 2001)

This map shows that a majority of the PM_{10} nonattainment areas are located in the western half of the United States where a dryer climate contributes to the formation of PM_{10} pollution.

Source: U.S. Environmental Protection Agency. *Green Book: Nonattainment Areas for Criteria Pollutants* 1 August 01; Web site: Welcome to the Green Book Nonattainment Areas for Criteria Pollutants, PM_{10}, http://www.epa.gov/airs/rvnonpm1.gif (3 October 2001).

Note: Hawaii has no PM_{10} Nonattainment Areas.

Classified CO Nonattainment Areas

(as of August 2001)

The number of exceedances for CO continues to decline, and fewer than 10 million people are living in nonattainment areas for CO.

Source: U.S. Environmental Protection Agency. *Green Book: Nonattainment Areas for Criteria Pollutants* 1 August 01; Web site: Welcome to the Green Book Nonattainment Areas for Criteria Pollutants, CO http://www.epa.gov/airs/rvnonco.gif (3 October 2001).

Note: Hawaii has no CO Nonattainment Areas.

New Standards

Potential 8-Hour Ozone Nonattainment Areas

(based on 1998–2000 data)*

EPA regulations require three consecutive years of data before an area can be designated as attainment or nonattainment. After development of an implementation plan, EPA is expected to formally determine which areas of the country do not meet the 8-hour ozone standard and designate them as nonattainment. In doing so, EPA will use the three most recent years of data, (for example, 1998–2000). This map shows the areas of the country that do not meet the 8-hour ozone standard based on 1998–2000 monitored data.*

Source: A.S.L. & Associates, Helena, Montana, USA. July 2001. <http://www.asl-associates.com/cb49800.htm> (4 October 2001)

*Since designations are not yet made, these may change.

Note: Based on 1998–2000 data, neither Alaska nor Hawaii have monitored exceedances of 8-hour Standard.

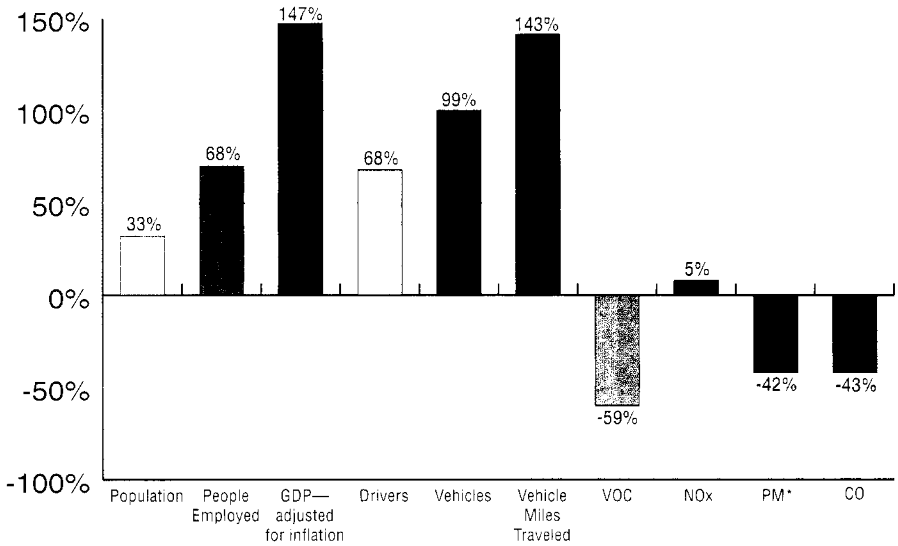
$PM_{2.5}$

The composition of PM is complex and transportation's contribution is being researched. There were 180 counties with monitors in 1999 that showed exceedances of the $PM_{2.5}$ standards. However, because there are not three consecutive years of monitoring data, no designations can be made at this time. EPA expects to have the data by the end of 2001. It is anticipated that designations will not be made until 2002–05, and that many new areas will be in nonattainment for particulate matter.

Progress in Reducing Motor Vehicle Emissions

Percentage of Change in Motor Vehicle Emissions Related to Demographics and Transportation

(1970–99)



Air pollution emissions from motor vehicles have dropped considerably since 1970—VOC emissions are down 59 percent, and CO emissions are down 43 percent. These reductions in emissions have occurred along with increasing populations, 147 percent growth in gross domestic product (GDP), and 143 percent growth in vehicle miles traveled. Although similar progress from an emissions point of view has not been realized with NO_X, current regulatory emission and fuel programs should help reduce the rate of growth in NO_X emissions in the future (see Tier II and Heavy-Duty Diesel discussions on pages 28 and 29, respectively).

Sources: Bureau of Economic Analysis. *Survey of Business.* August 2000. Table 2A.

U.S. Census Bureau. *Statistical Abstract of the United States, 2000.* December 2000. Table 1.

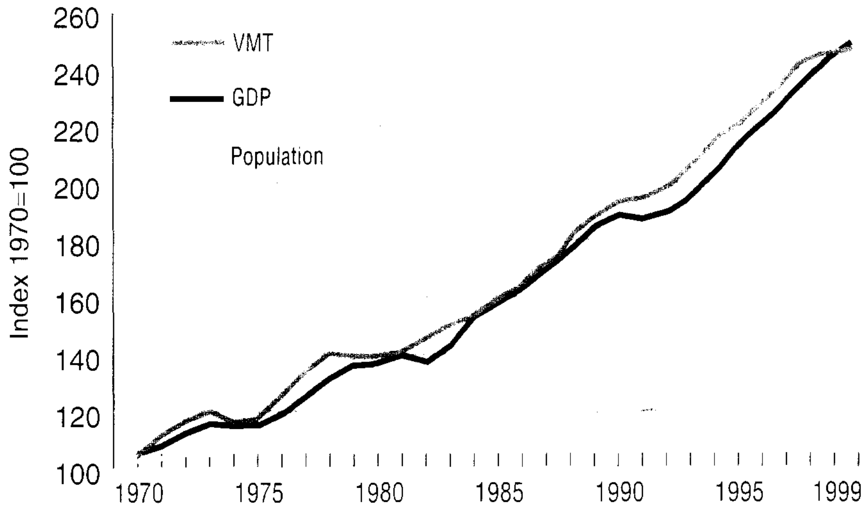
Federal Highway Administration. *Highway Statistics Summary to 1995.* July 1997. Tables VM-201, DL-201, MV-200; *Highway Statistics 1999.* October 2000. Tables VM-3, DL-22, MV-1.

U.S. Environmental Protection Agency. *National Air Pollutant Emissions Trends.* June 2001.

**Note:* Consistent data not available through 1970.

Travel, Economic Growth and Population

(1970–99)



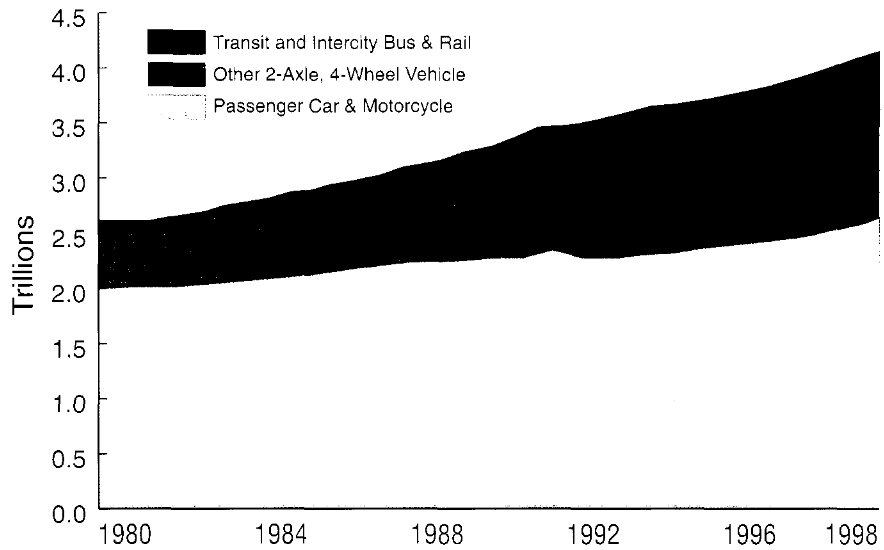
Vehicle travel growth has far outpaced population growth since 1970. This tracks closely with economic trends as seen with GDP.

Sources: Federal Highway Administration. *Highway Statistics Summary to 1995*. July 1997. Table VM-20; *Highway Statistics 1997*. October 1998. Table VM-3; *Highway Statistics 1999*. October 2000. Table VM-3.

Bureau of Economic Analysis. *Survey of Current Business*. August 2000. Table 2A.

Surface Passenger Miles by Mode

(1980–98)

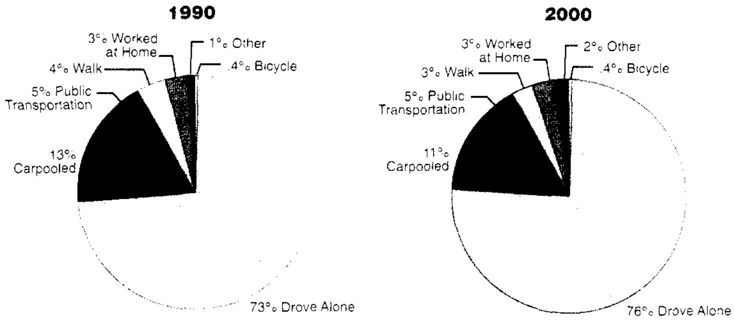


Americans are traveling more than ever. Between 1980 and 1998, the number of surface passenger miles traveled increased by 1.4 trillion. Americans use cars more than any other form of ground transportation—96 percent of all passenger miles took place in personal vehicles (automobiles, motorcycles, and light-duty trucks) in 1998. Light-duty trucks, such as minivans, pickup trucks, and sport utility vehicles, make up an increasing portion of miles traveled. Passenger travel on 2-axle, 4-tire trucks increased 903 billion miles or 173 percent between 1980 and 1998, while travel by automobiles and motorcycles increased by only 22 percent, or 452 billion miles. From 1985 to 1998, transit and intercity bus and rail use increased by 59.5 billion passenger miles or 50 percent.

Source: Bureau of Transportation Statistics. *National Transportation Statistics 2000*. April 2001. Table 1-3.

Note: Intercity bus figures were not included in transit prior to 1985.

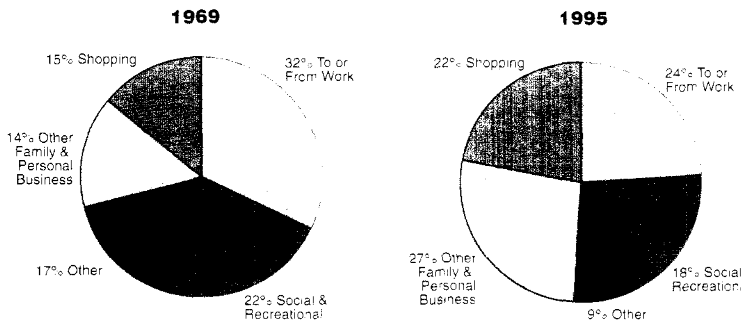
Commuter Modes Split



Americans commute to work in single-occupant vehicles more than by any other method. In 1990, 73 percent of the workforce drove to work alone. That percentage increased to 76 percent in 2000. The share of people commuting by walking, and carpooling declined, while the share of people taking transit or working at home remained constant.

Sources: U.S. Census Bureau, *1990 Census of Population* Table P049: Labor Force Status and Employment Characteristics: 1990, June 1992; *2000 Census Supplemental Survey Summary,* August 2001, Table P047: Means of Transportation to Work for Workers 16 years and Over.

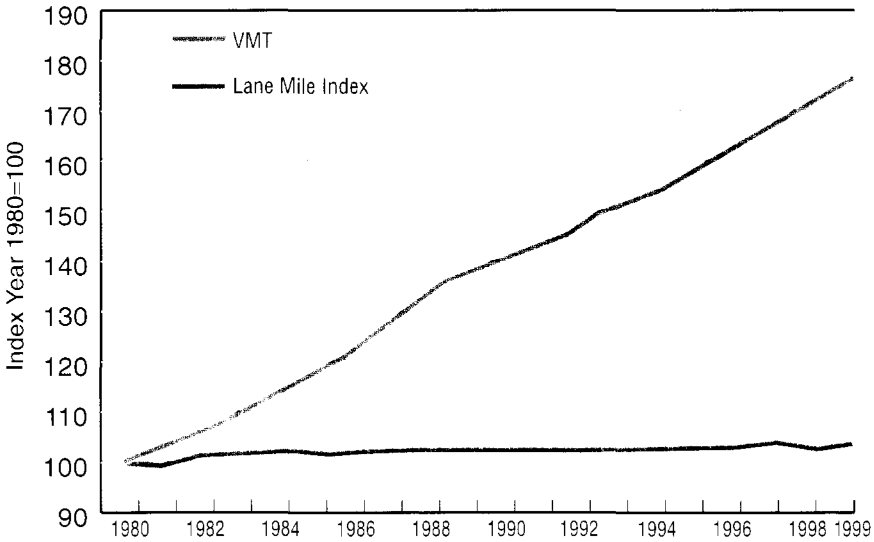
Vehicle Trips by Purpose



Commuting has declined as a share of all vehicle trips. In 1969, nearly one-third of all vehicle trips were made traveling to or from work. By 1995, less than one-quarter of all vehicle trips were made traveling to or from work.

Source: Federal Highway Administration, *1995 NPTS Summary of Travel Trends,* December 1999, Table 5.

Vehicle Miles Traveled and Lane Mileage



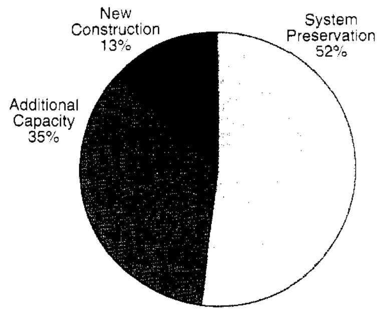
Despite rapid growth in Vehicle Miles Traveled, lane miles have remained relatively constant since 1980. Over the past twenty years, VMT have almost doubled, while lane miles have increased only 3 percent. This is mitigated somewhat by targeted traffic flow improvements in some communities that enhance capacity without additional lane mileage.

Sources: Federal Highway Administration. *Highway Statistics Summary to 1995*. July 1997. Table VM-20; *Highway Statistics 1997*. October 1998. Table VM-3; *Highway Statistics 1999*. October 2000. Table VM-3.

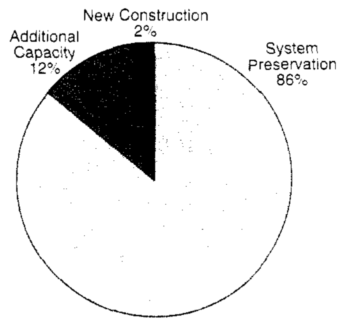
Federal Highway Administration. Office of Highway Policy Information, Highway Systems Performance (HPPI-10) "Rural and Urban Lane-Miles" *Highway Statistics, Summary to 1995* (electronic version, unpublished).

Capital Outlays

Obligation of Federal Funds for Roads



Miles of Federal-Aid Roadway Projects



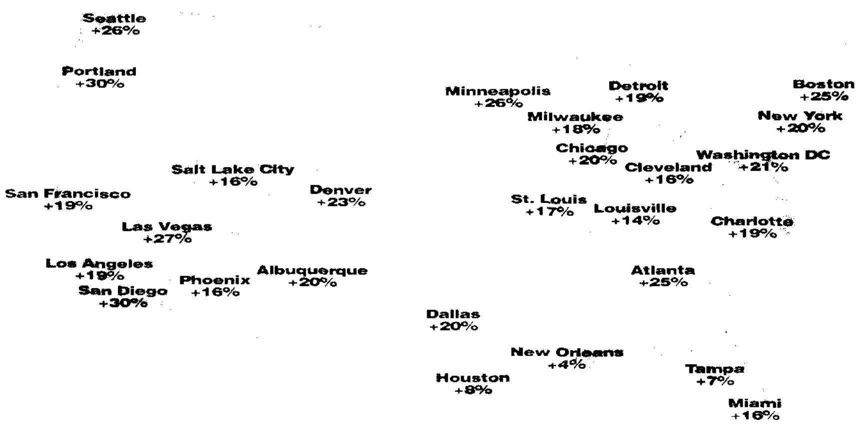
In 1999, $11.3 billion in Federal funds were obligated and 20,942 miles of Federal-aid roadway projects were underway. Although 52 percent of the funds went toward system preservation, 86 percent of the project miles underway involved system preservation. Only 12 percent of the miles involved capacity additions and 2 percent involved new construction.

Source: Federal Highway Administration. *Highway Statistics 1999*. October 2000. Table FA-10.

Note: Bridge, Safety, Environmentally related and other projects not included.

Percentage of Change in Urban Congestion

(1982–99)

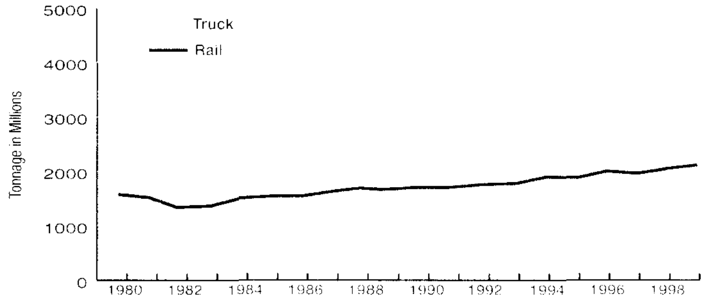


Many urban areas have experienced increases in traffic congestion in recent years. This map shows the percentage increase in roadway congestion from 1982 to 1999 for selected areas. Urban roadway congestion levels are estimated using a formula that measures the density of traffic.

Source: Texas Transportation Institute. *2001 Urban Mobility Report.* May 2001. Appendix A-3.

Growth in Freight Movement

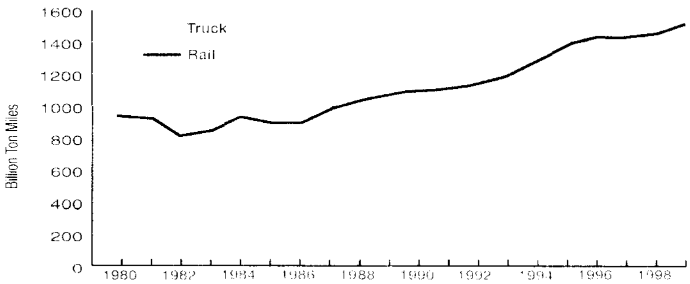
(1980–99)



The amount of freight moved grew by 50 percent between 1980 to 1999. Trucks hauled 49 percent of the freight in 1999, more than doubling the tonnage they carried in 1980. Rail carriers hauled 25 percent of the freight in 1999, down from 29 percent carried in 1980.

Domestic Intercity Ton Miles

(1980–99)



The overall growth in domestic intercity ton-miles for all modes increased by 49 percent between 1980 and 1999. Over this period of time, rail ton-miles increased 61 percent and truck ton-miles increased 97 percent.

With this growth in the movement of freight, comes the potential for increased emissions and the increased importance of emission controls and fuel technologies to garner emissions benefits.

Source: Eno Transportation Foundation, Inc. *Transportation in America. Statistical Analysis of Transportation in the United States Eighteenth Edition with Historical Compendium 1939–99.* Rosalyn A. Wilson, 2001.

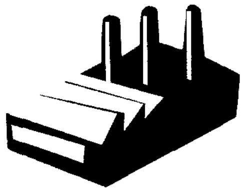
Emission Sources

Emission Source Categories

Point and Area Sources

Electric utilities and other fuel combustion Industrial processes such as:

- Manufacturing
- Painting and surface coating
- Metals and chemical processing
- Dry cleaners and others



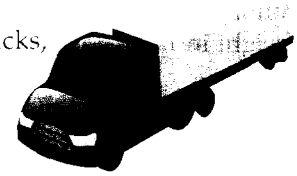
On-Road Vehicles

Automobiles and motorcycles

Light duty trucks (minivans, pickup trucks, sport utility vehicles)

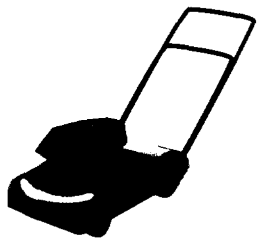
Heavy duty trucks

Buses



Non-road Engines

- Lawn and garden equipment
- Construction equipment
- Farm equipment
- Aircraft
- Boats and other marine vessels
- Railroads and other



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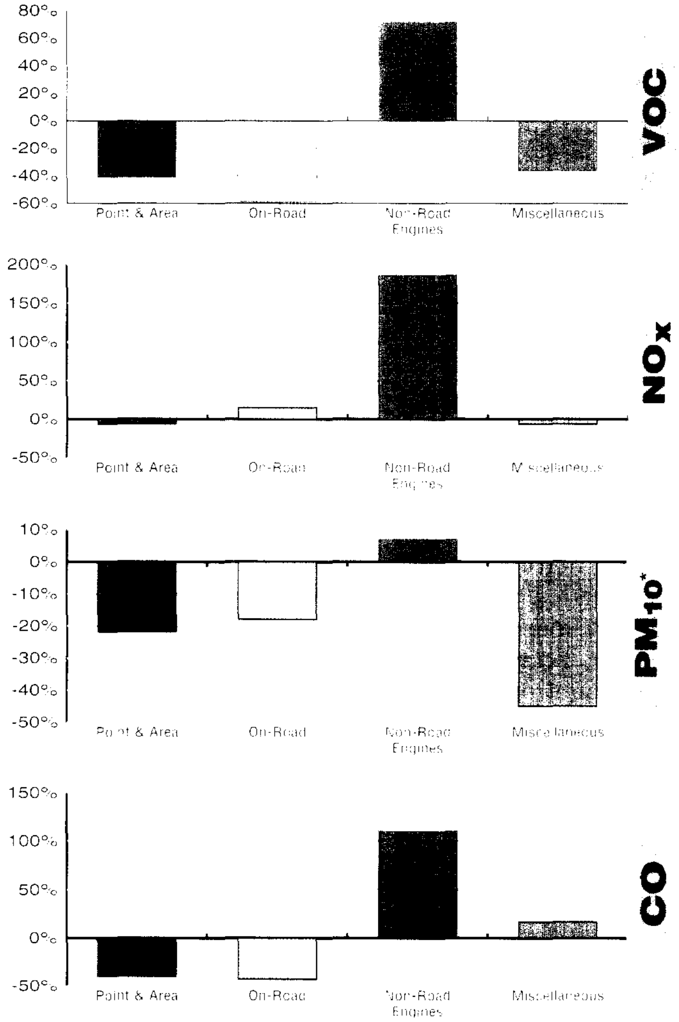
Forest wildfires and agricultural fires

Health services

Cooling towers

Windblown dust

Percent of Change in Emissions
(1970–99)



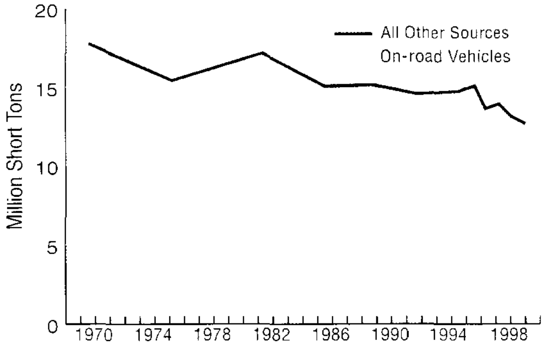
Americans have made great progress in cleaning the air. For nearly three decades, national emission trends have been declining. A great deal of credit for the improvements goes to cleaner cars and trucks and reformulated fuels.

*Note: 1985–99.

Source: U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, *National Air Quality Emissions Trends, 1900–1999*, March 2001, Tables A-2, A-4, A-5 and A-6.

Emission Trends

VOC Emissions
(1970–99)

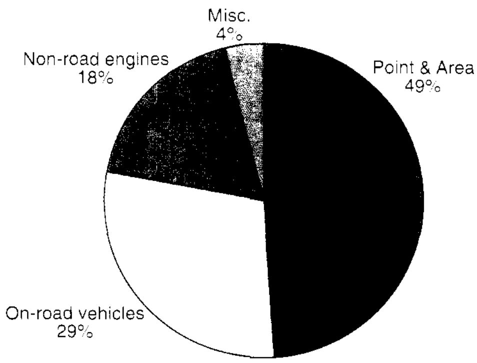


Change in Total VOC Emissions: -41%

Change in On-road vehicle VOC Emissions: -59%

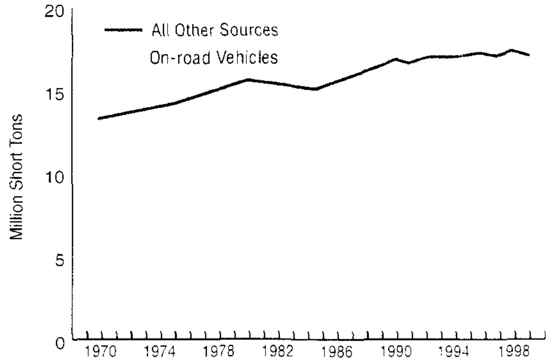
Volatile organic compounds (VOC) are precursors of ground-level ozone. Since all organic compounds contain carbon, volatile organic compounds are often called hydrocarbons (HC). In 1999, on-road vehicles produced 29 percent of all VOC emissions, down from 42 percent in 1970. Point and area sources made up 49 percent of VOC emissions, while non-road engines made up 18 percent and miscellaneous sources made up 4 percent. On-road vehicle emissions of VOC are down 59 percent since 1970. Meanwhile, point and area sources are down 41 percent and miscellaneous sources are down 35 percent. VOC emissions from non-road engines and vehicles rose by 72 percent during this time period.

VOC Emissions
(1999)



Source: U.S. Environmental Protection Agency: Office of Air Quality Planning and Standards. *National Air Pollution Emission Trends, 1900–1999*. March 2001.

NO_x Emissions
(1970–99)

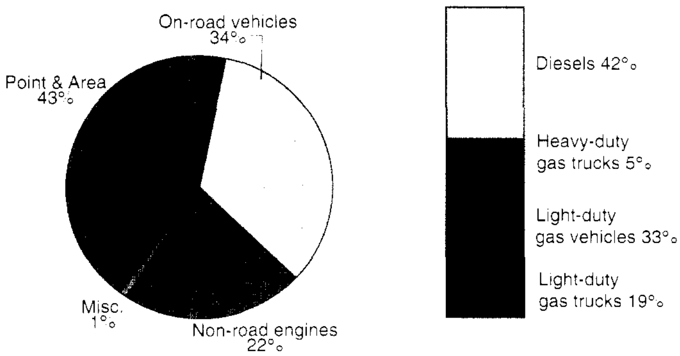


Change in Total NO_x Emissions: 21%

Change in On-Road Vehicle NO_x Emissions: 16%

In addition to VOC, oxides of nitrogen (NO_x) contribute to the formation of ozone. In 1999, on-road vehicles produced 34 percent of all NO_x emissions, down slightly from 35 percent in 1970. Point and area sources made up 43 percent of NO_x emissions, while non-road engines made up 22 percent and miscellaneous sources made up 1 percent. On-road vehicle emissions of NO_x are up 16 percent since 1970, due primarily to the growth in heavy duty diesel engines, where VMT increases have outpaced emissions control technology to effect a net increase in emissions from these vehicles. Meanwhile, point and area sources are down 4 percent since 1970 and non-road engines are up 186 percent.

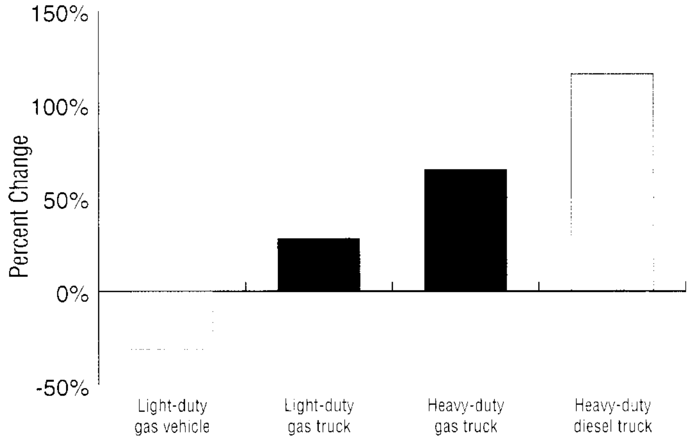
NO_x Emissions
(1999)



Source: U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards. *National Air Quality Emissions Trends, 1990-1999*. March 2001.

Emission Trends

Change in NO_X Emissions by Vehicle Class,
(1970–99)

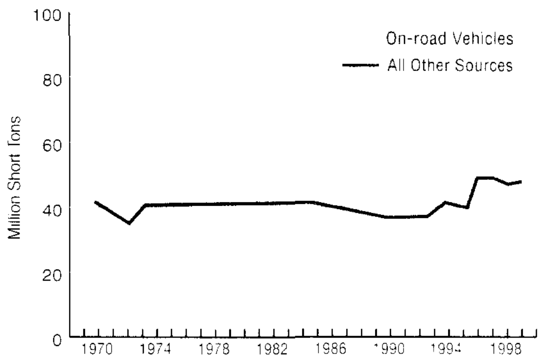


Between 1970 and 1999, NO_X emissions from passenger vehicles decreased 31 percent. By contrast, NO_X emissions from light- and heavy-duty gasoline and diesel vehicles increased 28 percent, 65 percent and 116 percent, respectively. As reported above, total on-road NO_X emissions have increased 16 percent.

Source: U.S. Environmental Protection Agency. *Current Emissions Trends Summaries: Annual Average Emissions, All Criteria Pollutants, years including 1970, 1975, 1980, 1985, 1989, 1990-1999*. 13 June 2001. <http://www.epa.gov/ttn/chief/trends/trends99/tier3_yrsemis.pdf> (3 October 2001).

CO Emissions

(1970–99)



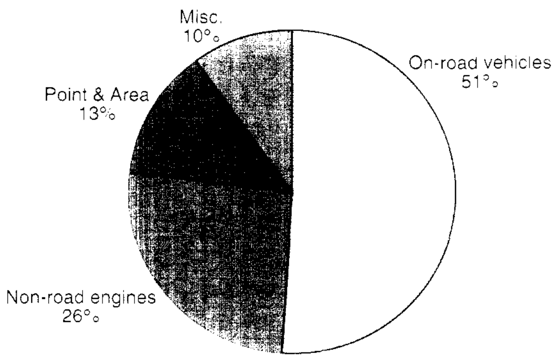
Change in Total CO Emissions: -25%

Change in On-road Vehicle CO Emissions: -43%

On-road vehicles are the largest source of carbon monoxide (CO) emissions. In 1999, on-road vehicles produced 51 percent of all CO emissions, down from 68 percent in 1970. Point and area sources made up 13 percent of CO emissions while non-road engines made up 26 percent and miscellaneous sources made up 10 percent. On-road vehicles emissions are down 43 percent since 1970. Meanwhile, point and area sources are down 40 percent. CO emissions from miscellaneous sources increased by 19 percent and non-road engines rose by 110 percent during this time period.

CO Emissions

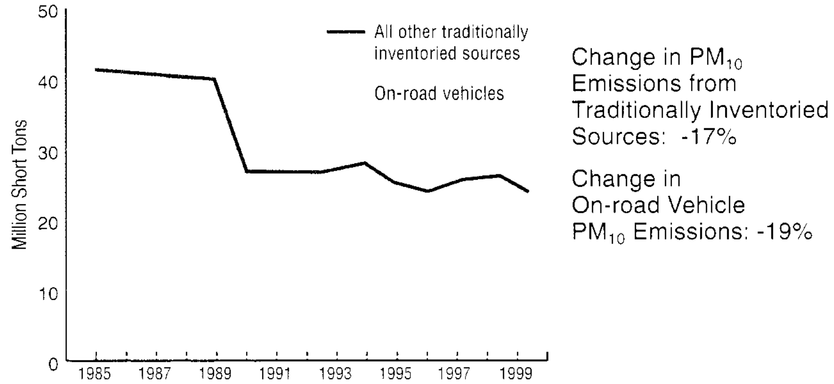
(1999)



Source: U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, *National Air Quality Emissions Trends, 1900-1999*, March 2001, Table A-2.

Particulate Matter (PM_{10}) Emissions

(1985–99)

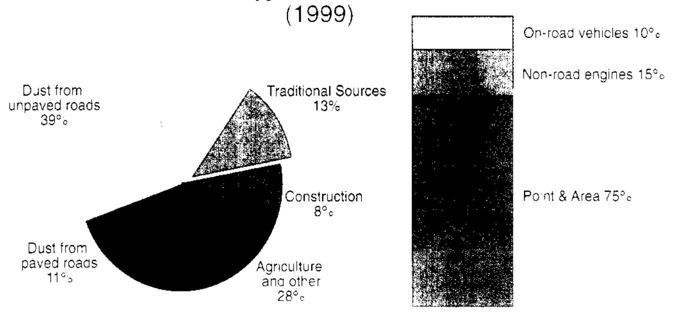


Particulate matter consists of dust, direct smoke, and liquid droplets. Traditionally inventoried sources, such as fuel combustion, industrial sources, and transportation, together make up only about 13 percent of total PM_{10} emissions. PM_{10} from traditionally inventoried sources (on-road and non-road engines, point area sources) has dropped 17 percent between 1985 and 1999, and on-road vehicle emissions have dropped 19 percent during this time period.

A majority of PM_{10} emissions come from sources that are not traditionally inventoried, such as fugitive dust from paved and unpaved roads, construction and agriculture. Fugitive dust from unpaved and paved roads contributed 50 percent of PM_{10} emissions nationwide in 1999. In addition, secondary PM formed from SO_X, NO_X, and other gases contribute to PM concentrations in the air.

PM_{10} Emissions

(1999)

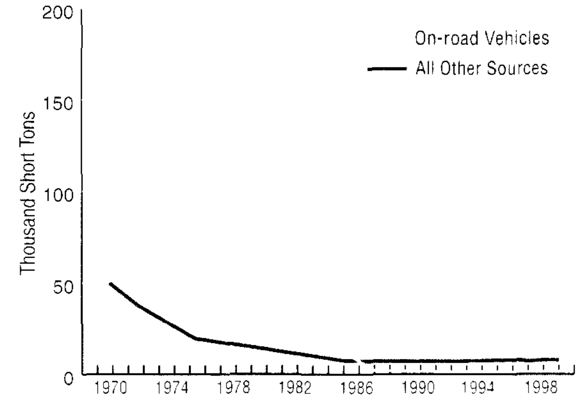


Source: U.S. Environmental Protection Agency. Office of Air Quality Planning and Standards. *National Air Quality Emissions Trends, 1990-1999*. March 2001. Table A-6.

Emission Trends

Lead Emissions

(1970-99)



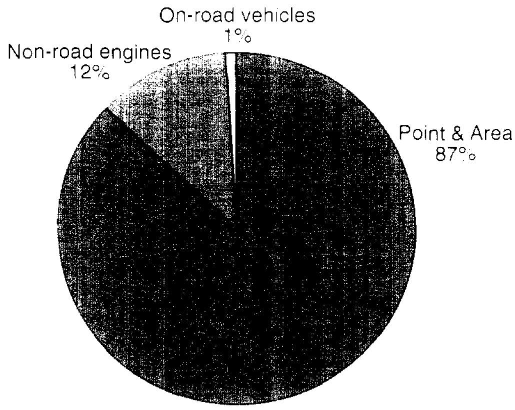
Change in Total Pb Emissions: -98%

Change in On-road vehicle Pb Emissions: -100%

The dramatic reduction in lead emissions in the United States is a success story attributable in large part to the removal of lead from motor vehicle gasoline. In 1999, on-road vehicles produced less than 1 percent of all lead emissions, down from 78 percent in 1970. On-road vehicle emissions of Pb were virtually eliminated by the late 1980s.

Pb Emissions

(1999)



Source: U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, *National Air Quality Emissions Trends, 1900-1999*, March 2001, Table A-6.

Air Quality Trends

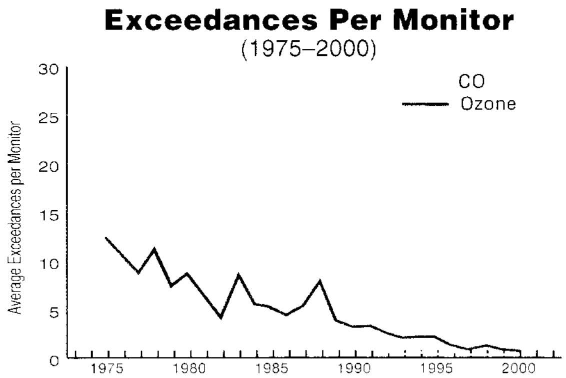
Air Pollutant Concentrations

Pollutant	Total Emissions % Change, 1981–2000	Air Quality Pollutant Concentration % Change, 1981–2000
Ozone 1-Hour	-32% (VOC) +4% (NO_X)	-21%
PM_{10}*	-19%	-19%
Carbon Monoxide	-18%	-61%
Lead	-94%	-93%

As air pollutant emissions have dropped over time, air quality has improved. Reductions in air quality concentrations are impressive, with concentrations of carbon monoxide in the air decreasing by more than half and lead concentrations virtually eliminated. All the years throughout the 1990s have had better air quality than any of the years in the 1980s, showing a steady trend of improvement.

Source: U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards. *Latest Findings on National Air Quality: 1999 Status and Trends.* August 2000, p. 4.

*Note: PM_{10} figures are for 1985 to 1999; emissions include only directly emitted particles.



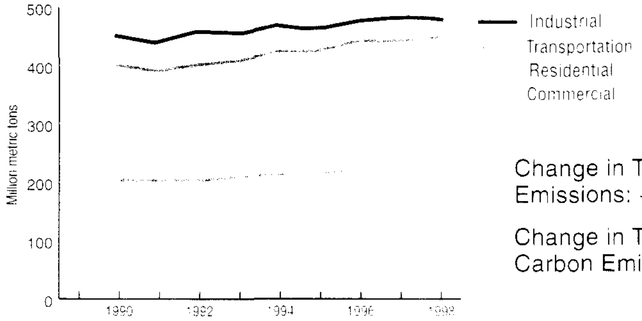
As air pollution concentration has fallen, the number of exceedances of air quality standards has fallen dramatically across the United States.

Source: U.S. Environmental Protection Agency. Tabulated from EPA's Aerometic Information Retrieval system database. 13 August 2001 <http:www.epa.gov/airs/data/> (3 October 2001).

Greenhouse Gas Emissions

Carbon Emissions

(1990–98)



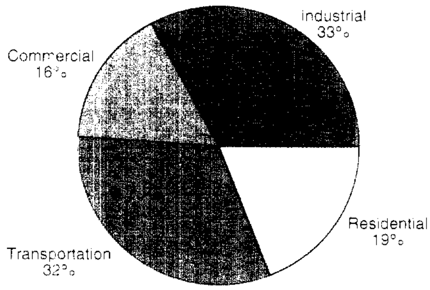
Change in Total Carbon Emissions: +11%

Change in Transportation Carbon Emissions: +13%

Greenhouse gases trap heat within the earth's atmosphere. Although most greenhouse gases occur naturally and help to keep the earth hospitable to life, they are also generated by human activities. Carbon dioxide (CO_2) is a greenhouse gas, accounting for more than 80 percent of U.S. greenhouse gas emissions. Greenhouse gas emissions are contributing to changes in the planet's temperature that could lead to harmful effects, such as sea level rise and changes in global hydrological patterns. Although the United States only makes up 4 percent of the world's population, it emits 23 percent of carbon emissions from fossil fuel combustion.

In contrast to most criteria pollutants, emissions of greenhouse gases have been rising from all sectors. Transportation, including all modes of travel, has been the fastest growing sector. From 1990 to 1998, carbon emissions from transportation grew by 13 percent, and overall, it contributes approximate one third of national carbon emissions.

Carbon Emissions,
1998 (MMTCE)*



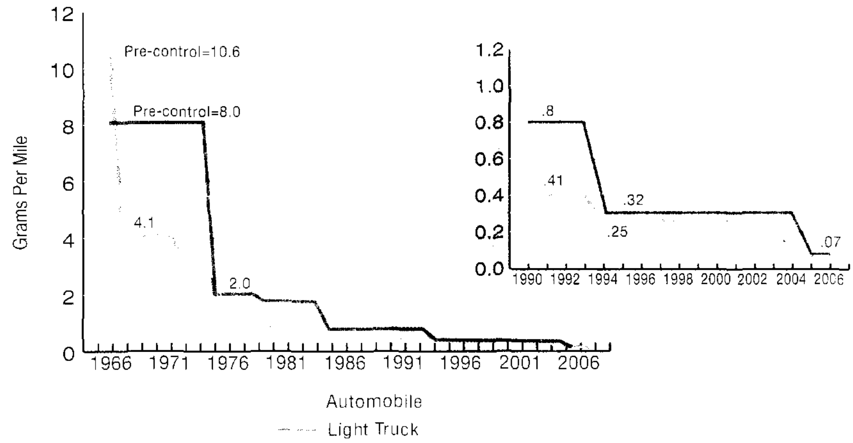
*Million Metric Ton Carbon Equivalent.

Source: U.S. Environmental Protection Agency, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-1999*, April 2001, Table ES-8.

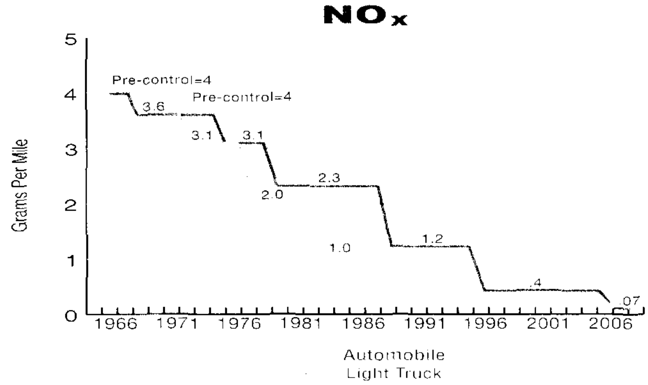
Federal Emissions Standards

The Clean Air Act of 1963 and its subsequent amendments set federal emissions control standards for all new cars and light trucks sold in the United States. The most recent Clean Air Act Amendments in 1990 established more restrictive "Tier 1" emissions standards, which became effective in 1994. The CAAA also required EPA to study whether more stringent—Tier 2—standards were needed to meet the NAAQS. In 1999, EPA determined that new standards were needed and cost-effective. Starting in 2004, all classes of passenger vehicles, including sport utility vehicles and light trucks, will have to comply with new average tailpipe standards of 0.07 grams per mile for nitrogen oxides.

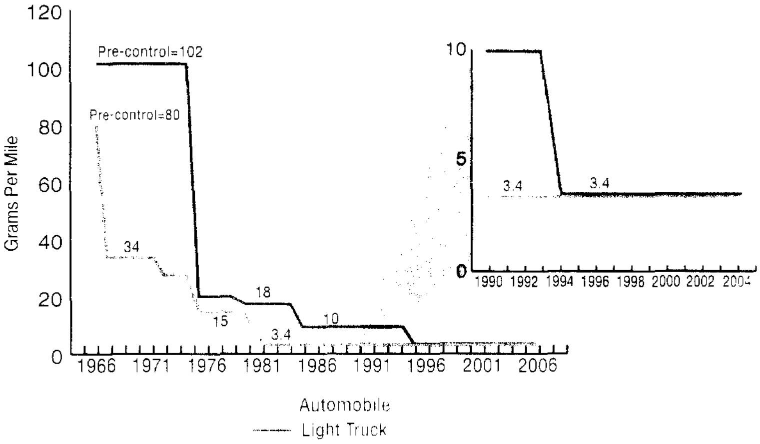
VOC (Non-methane hydrocarbons)



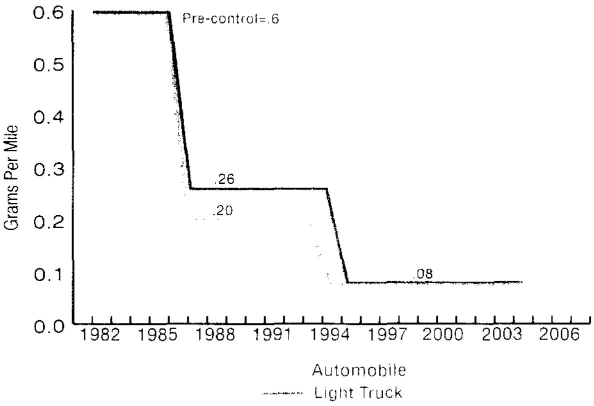
NOx



CO



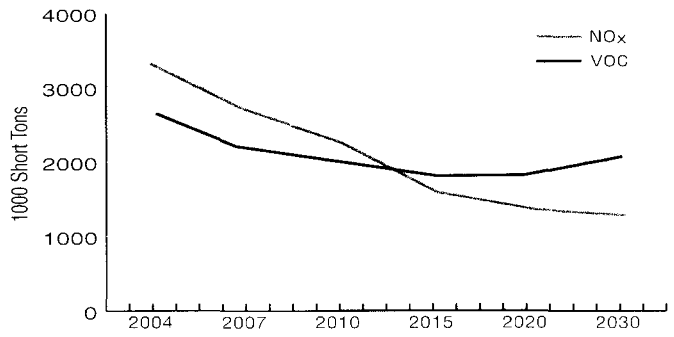
PM_{10}



Source: Davis, Stacy C. 1998. *Transportation Energy Data Book: Edition 18*. September 1998.
U.S. Environmental Protection Agency, *Transportation Energy Data Book: Edition 20*. October 2000.

Tier II Emission Standards

Light-Duty Vehicle Emissions Under Tier II and Low Sulfur Gasoline Rule



Assumes VMT growth rate 1.7% per year from 2007 to 2030.

Source: Cleaner Vehicles and Cleaner Gasoline Tier 2/Gasoline Sulfur Rule, 22 December 1999. Regulatory Impact Analysis, <http://www.epa.gov/otaq/regs/ld-hwy/tier-2/frm/ria/chiii.pdf> Table III.A.-1, III.A-3, III.A-5, III.A-7, III.A-11, III.A-12, III.A-14, III.A-15

In December, 1999 EPA announced new engine and gasoline standards commonly known as Tier II. The standards were designed to reduce the emissions from new passenger cars and light trucks, including pickup trucks, minivans, and sport-utility vehicles. Beginning in 2004, the nation's refiners and importers of gasoline will have to manufacture gasoline with sulfur levels capped at 300 parts per million (ppm), approximately a 15 percent reduction from the current industry average of 347 ppm. By 2006, refiners will meet a 30 ppm average sulfur level with a maximum cap of 80 ppm. The Tier II regulations are predicted to decrease NO_X emissions by 61 percent, and VOC emissions by 24 percent between 2004 and 2030.

Sources: National Archives and Records Administration, *Code of Federal Regulations. Title 40 Volume 11 Part 80.* 1 July 1999. <http://www.access.gpo.gov/cgi-bin/cfrassemble.cgi?title=199940> (4 January 2002)

National Archives and Records Administration, *Code of Federal Regulations. Title 40 Volume 2 Part 86.* 1 July 1999. <http://www.access.gpo.gov/cgi-bin/cfrassemble.cgi?title=199940> (4 January 2002)

American Petroleum Institute, *News Releases*, "Low Sulfur Gasoline, Petroleum industry purposes regulations for cleaner fuels." 25 April 1998. <http://www.api.org/news/announcements/lowsulfgas.htm> (3 October 2001)

Heavy Duty Diesel Emission Standards

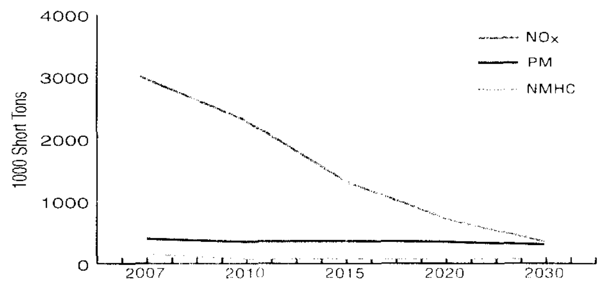
Due to the growth in movement of freight, regulation of vehicles used to transport freight is becoming increasingly important. U.S. Environmental Protection Agency (EPA) has moved to address this situation with the following:

In December 2000, the EPA issued the final rule for the two-part strategy to reduce diesel emissions from heavy-duty trucks and buses. The EPA issued new diesel engine standards beginning in model year 2004 for all diesel vehicles over 8,500 pounds. Additional diesel standards and test procedures will begin in 2007. These standards are based on the use of high-efficiency advanced emissions controls.

Because the control devices are damaged by sulfur, EPA is also initiating a program requiring cleaner diesel fuels. Refiners will be required to start producing diesel fuel for use in highway vehicles with a sulfur content of no more than 15 parts per million (ppm), beginning June, 2006. This is down from the current level of 500 ppm, a 97 percent reduction. These two rules will be phased in between 2006–10 in order to ensure a smooth transition.

Source: U.S. Environmental Protection Agency. *Heavy Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements*. December 2000.

Heavy-Duty Vehicle Emissions Under Heavy-Duty Engine/Fuel Rule



These rules are predicted to reduce NO_X and PM_{10} emissions from Heavy-Duty Diesel engines by 88 percent and 64 percent, respectively, between 2007 and 2030.

Note: Assumes a variable growth rate for VMT by Heavy-Duty Diesel Engines that averages 2.5 percent per year.

Source: Control of Air Pollution from New Motor Vehicles: *Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements, Regulatory Impact Analysis*. December 2000. <http://www.epa.gov/otaq/regs/hd2007/frm/ria-ii.pdf> (3 October 2001) Tables II.B-19, II.B-20, II.B-21.

Emissions Standards

National Low Emission Vehicle (NLEV) Emission Standards

The National Low Emission Vehicle (NLEV) program is a voluntary program between auto manufacturers, EPA and states. Under the NLEV program, auto manufacturers agreed to comply with tailpipe standards that are more stringent than the EPA mandate prior to model year 2004. In return, EPA and the states agreed to provide manufacturers with regulatory stability and not to impose the stricter California motor vehicle emissions standards. Through this voluntary program, cars significantly cleaner than the law requires were available in various states in the 1999 model year (fleet average NMHC emissions of 0.148 g/mile in 1999 and lower thereafter) and elsewhere across the county in 2001.

Source: National Archives and Records Administration. *Code of Federal Regulations. Title 40 Part 86. 1706-99.* 1 July 1999 <http://www.access.gpo.gov/nara/cfr/waisidx_99/40cfr86_99.html> (14 January 2002).

California Emissions Standards

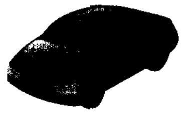
California has amended its Low-Emission Vehicle regulations. The new amendments, known as LEV II, will advance the state's clean air goals through improved emission reduction standards for automobiles. The LEV II regulations will apply from 2004 through 2010 and represent continued progress in emission reductions. Some highlights of the LEV II amendments include the extension of passenger car emission standards to sport utility vehicles and pick-up trucks, the creation of a new group of super-ultra low emission vehicle (SULEV) for light-duty trucks, and expansion of in-use compliance testing.

Source: California Air Resources Board Fact Sheet. February 1999.

Sources of Vehicle Emissions

The power to move a motor vehicle comes from burning fuel in an engine. Emissions from vehicles come from the by-products of this combustion process. In addition, volatile organic compounds (VOC) escape through fuel evaporation. As vehicle exhaust systems have improved, evaporative emissions have become a larger component of total vehicle VOC emissions.

Exhaust Emissions

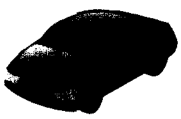


The combustion process results in emissions of volatile organic compounds (VOC), oxides of nitrogen (NO_x), particulate matter (PM), and carbon monoxide (CO), which are released from the tailpipe while a vehicle is operating. Exhaust emissions occur during two modes:

Cold Start Emissions—Starting and driving a vehicle the first few minutes results in higher emissions because the emissions control equipment has not yet reached its optimal operating temperature.

Running Emissions—Pollutants are emitted from the vehicle's tailpipe during driving and idling after the vehicle is warmed up.

Evaporative Emissions



Volatile organic compounds (VOC) also escape into the air through fuel evaporation. Despite evaporative emission controls, evaporative losses can still account, on hot days, for a majority of the total VOC pollution from current model cars. Evaporative emissions occur in several ways:

Running Losses—The hot engine and exhaust system can vaporize gasoline while the vehicle is running.

Hot soak (cooling down)—The engine remains hot for a period of time after the vehicle is turned off, and gasoline evaporation continues when the car is parked while cooling down.

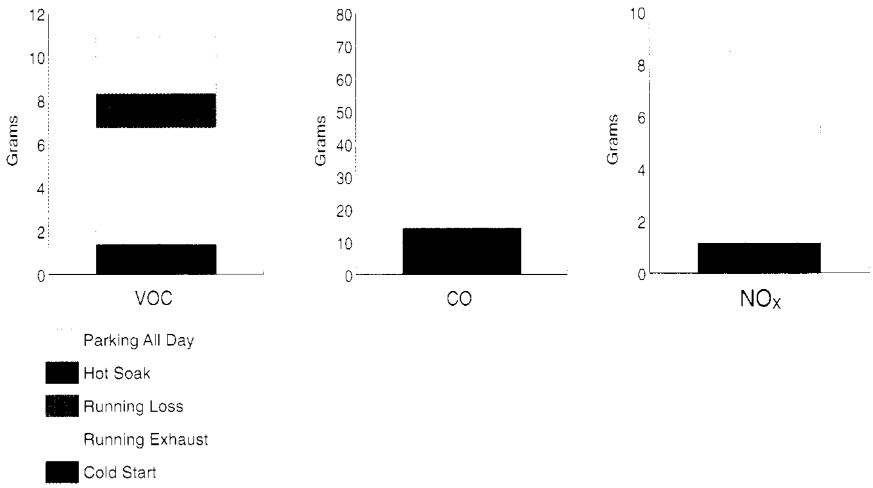
Diurnal (while parked and engine is cool)—Even when the vehicle is parked for long periods of time, gasoline evaporation occurs as the temperature rises during the day.

Refueling—Gasoline vapors escape from the vehicle's fuel tank while the tank is being filled.

Source: U.S. Environmental Protection Agency. *Automobile Emissions: An Overview.* Fact Sheet OMS-5. August 1994.

Trip Emissions

Emissions of a Typical Car on the Road in 2000 for a 7.5 Mile Trip



Starting a car cold increases trip emissions compared to starting the car warm. For a 7.5 mile trip by a typical car in 2000, the vehicle emits about 8.7 grams of NO_x and 95.1 grams of CO if the engine is already warm. If, however, the engine is cold, an additional 1.4 grams of NO_x and 37.8 grams of CO are generated. As a result, for a 7.5 mile trip, starting the car cold generates about 16 percent more NO_x and 40 percent more CO than starting the car when it is warm.

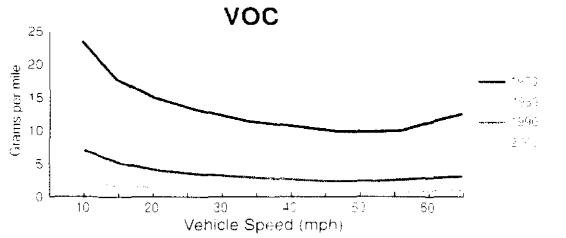
Volatile organic compounds (VOC) are emitted both from the tailpipe and through fuel evaporation. About 6.3 grams of VOC are emitted from the tailpipe if the engine is warm, and evaporative emissions (during travel and while cooling down) result in 2.3 grams of VOC. Starting the car cold generates another 4.3 grams of VOC.

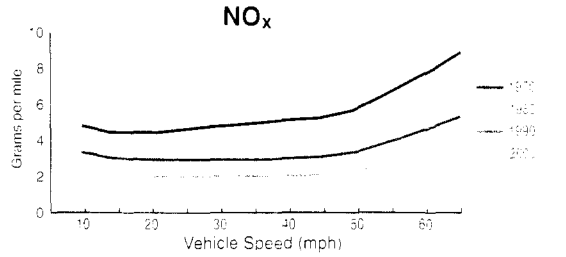
Linking multiple trips — called trip chaining — helps reduce emissions by eliminating the cold start. However, on hot summer days, even when a car is parked all day, VOC evaporates from the vehicle's fuel tank and control systems. Approximately 2.6 grams of VOC per day are emitted simply from having the car parked all day.

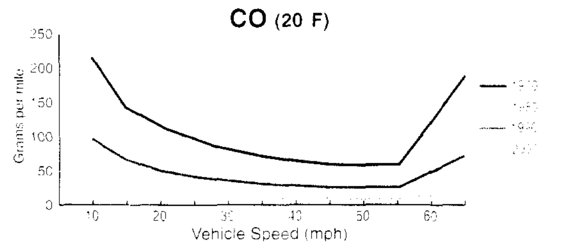
Source: U.S. Environmental Protection Agency. MOBILE5b assumes basic I&M (annual inspections), *National Low Emission Vehicle Standards and 2004 Heavy Duty Vehicle Standards*. Summer temperature 69–94 degrees, 19.6 mph average speed (Federal Test Procedure Speed). 14 September 1996.

Emission Rates at Different Operating Speeds

Emission rates vary based on the speed a vehicle is traveling. The EPA's model for highway vehicle emissions—MOBILE 5b—shows how speed affects emission rates. VOC and CO emission rates typically drop as speed increases, but increase at high speeds. NO_X emission rates turn up at lower speeds. Emission rates at all speeds have been falling over time as newer, more controlled vehicles enter the fleet.





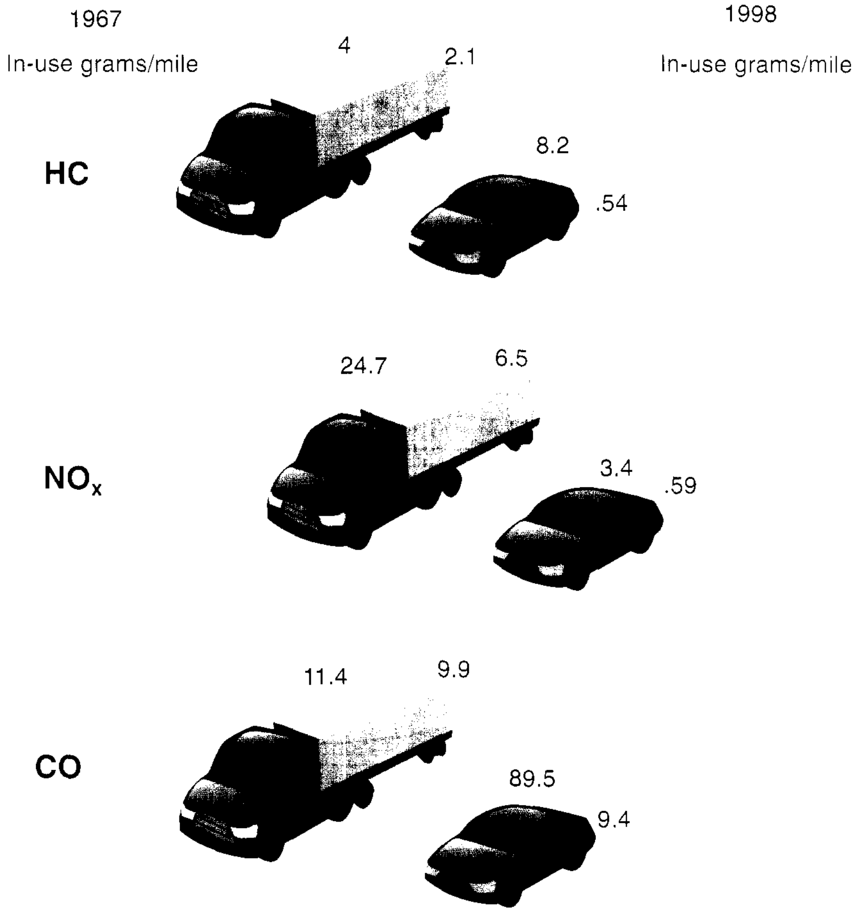


These curves do not represent the full range of effects associated with travel at different speeds. Emission rates are higher during stop-and-go, congested traffic conditions than free flow conditions operating at the same average speed. Modeling improvements are underway to capture these effects.

Source: U.S. Environmental Protection Agency. Mobile5b, fleet average, low altitude, including NLEV and Heavy Duty Vehicle (2004) Standards, 14 September 1996.

Car and Truck Emissions

These comparisons show in-use emission rates, in grams/mile, for cars and heavy-duty diesel trucks with 1998 control technology versus 1967 vehicles (before significant control). Car emission rates have declined by 80–95 percent depending on pollutant, while heavy-duty diesel truck emission rates have declined by 47 percent for HC, 74 percent for NO_X, and 13 percent for CO.



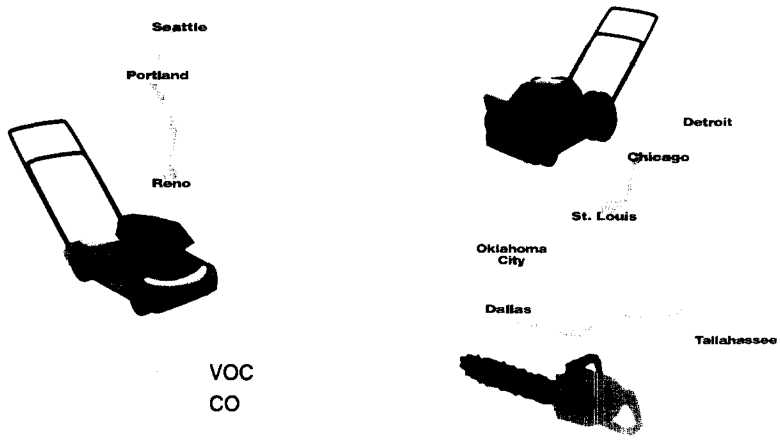
Source: U.S. Environmental Protection Agency. AP-42: *Compilation of Air Pollutant Emission Factors*. November 24, 2000. Tables 7.1.1, and 1.1A.1.

Car and Yard Tool Emissions

The map below shows the number of miles a typical 1998 car would have to drive to generate the same amount of emissions as one hour of tool use (pre-control lawnmower, snowblower, and chainsaw). For example, using a chainsaw for one hour emits the same amount of VOC as driving 660 miles. To emit the same amount of CO as using a snowblower for one hour, you would have to drive 305 miles.

Because non-road engines are a significant source of pollution, in 1997 EPA promulgated new regulations aimed at these engines. These engines have had to meet emission standards for HC, CO, and NO_X since 1997 and have resulted in a 32 percent reduction in HC levels.

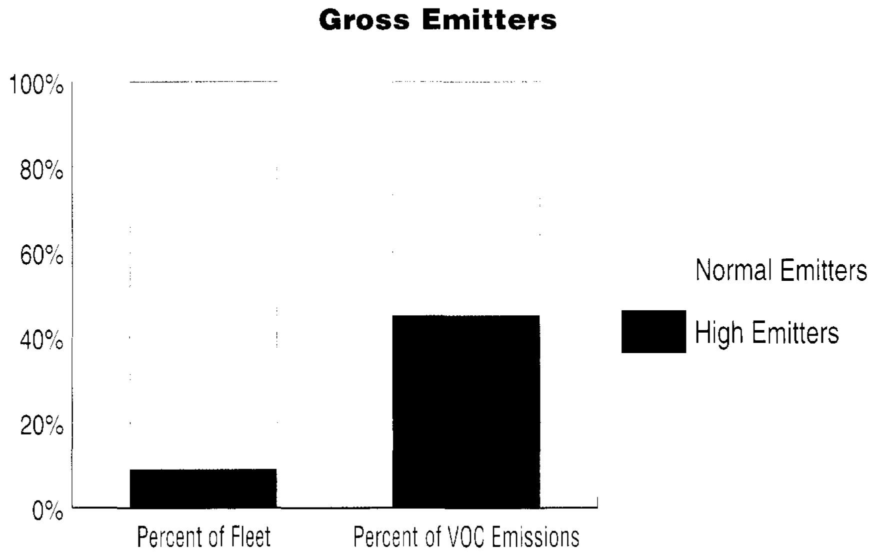
EPA has also adopted an additional set of standards for small engines. For nonhandheld applications (such as lawn and garden tractors and lawnmowers), these standards will be phased in between 2001 and 2007 and are predicted to result in an additional 60 percent reduction in HC and NO_X emissions beyond 1997 levels. For handheld applications (such as leaf blowers and chainsaws), these standards will be phased in between 2002 and 2007 and are predicted to result in an additional 70 percent reduction in HC and NO_X emissions beyond the 1997 levels.



Sources: U.S. Environmental Protection Agency. *Nonroad Engine and Vehicle Emission Study-Report.* November 1991. Table 2-07 (yard tools).

U.S. Environmental Protection Agency. "Emission Facts." Fact Sheet OMS. 1998 (car). November 2000. <http://www.epa.gov/otaq/regs/nonroad/f00048.htm> (30 October 2001)

Vehicle Emissions



A small percentage of vehicles emit a large percentage of the pollution from on-road vehicles. These "gross emitters" include not only older model vehicles but also some newer cars with poorly maintained or malfunctioning emissions control equipment. As shown in the diagram, it is estimated that less than 10 percent of the vehicle fleet emits approximately 50 percent of the VOC emissions. The same vehicles, however, are not always gross emitters for all criteria pollutants—a different 10 percent may be gross emitters for CO, NO_X, and others. Additionally, 10–27 percent of the vehicles failing inspection never end up passing the State Inspection and Maintenance tests.

Source: National Academy Press. *Evaluating Vehicle Emissions Inspection and Maintenance Programs.* July 2001. Pages 27–29, 33 (Copyright 2001).

Policy Responses

Despite continued improvements, the air quality issues facing States and regions require that policymakers consider strategies to reduce emissions from all sources—point and area, on-road vehicles, and non-road engines. The array of strategies available to transportation and air quality officials range from regulatory to voluntary and from technology- and fuel- based strategies to market-based measures aimed at changing driver behavior. A few of the more common policy responses are described below.

Conformity

Transportation conformity is a process to ensure that federal funding and approval are given to those transportation activities that are consistent with air quality goals. The conformity regulation requires that all transportation plans and programs in nonattainment or maintenance areas conform to the State's air quality plan, known as the State Implementation Plan or SIP. It ensures that transportation activities do not worsen air quality or interfere with the purpose of the SIP, which is to attain the NAAQS. Meeting the NAAQS often requires emission reduction from mobile sources. Several transportation emissions reduction strategies are available and, in some regions, required to help regions attain the standards.

EPA is developing its implementation strategy, including new conformity rules for the eight-hour ozone standard.

Inspection and Maintenance (I&M) Programs

An I&M program identifies and corrects excessive vehicle emissions.

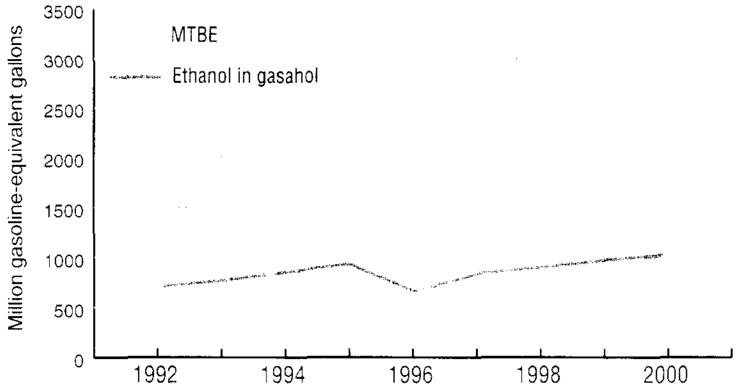
- **Basic I&M** includes annual or biennial inspections by the State or municipal authority at central or local inspection facilities. Basic I&M is required in certain ozone and CO nonattainment areas.
- **Enhanced I&M** includes inspection for tampering with emissions controls or misfueling, use of computerized emission analyzers, and inspection of on-board diagnostic systems. States supervise testing annually or biannually at testing stations.

Policy Responses

Technology Improvements

Emissions reductions can be achieved by improving engine technology or using alternative fuels or reformulated gasoline. Among engine improvements, the catalytic converter, which extracts pollution from exhaust, has made the largest contribution to reduce vehicles emissions in recent years. A catalytic converter does not operate effectively, however, until it reaches its operating temperature after a car has been running for a few minutes. During the first few minutes of running time, the car emits a higher amount of pollutants—cold-start emissions. Additionally, high sulfur content in fuel has been shown to reduce the effectiveness of the catalytic converter. To reduce these emissions, EPA has promulgated a low sulfur fuel rule in conjunction with Tier II and researchers are exploring ways to reduce the time needed to heat the catalytic converter.

Use of Reformulated Fuels



Oxygenates such as methyl tertiary butyl ether (MTBE) or ethyl tertiary butyl ether (ETBE) are blended with gasoline (in other words, reformulated fuel) to increase the oxygen content for more complete combustion in engines, resulting in decreased tailpipe emissions.

The U.S. EPA has implemented two "cleaner burning" fuel programs. One is the Winter Oxyfuel Program that requires oxygenated fuel during the cold months in cities that have elevated levels of carbon monoxide. Ethanol is the primary oxygenate used in this program, and once an area is redesignated to CO attainment, the use of oxygenated fuels becomes optional.

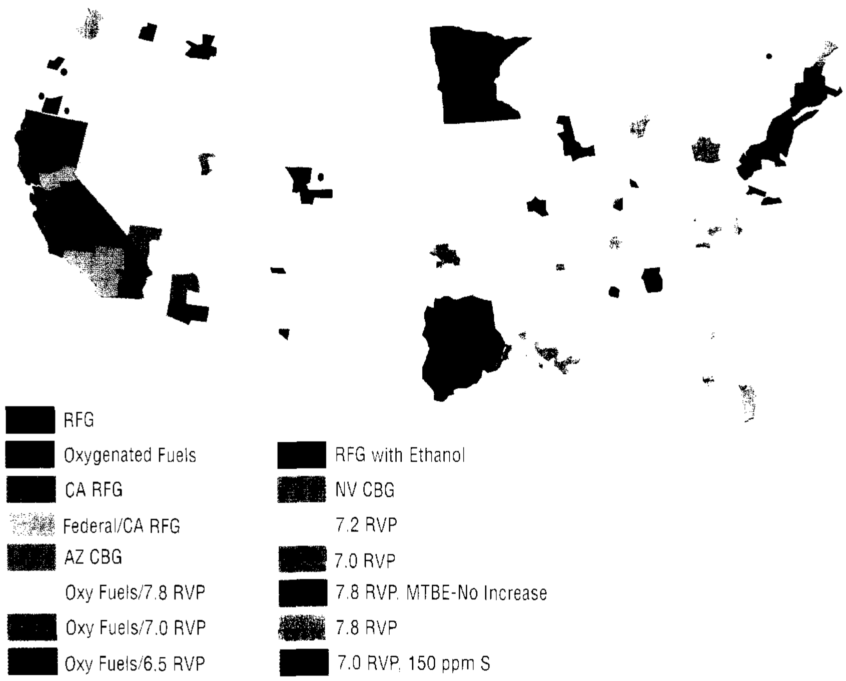
The Year-Round Reformulated Gasoline Program requires reformulated gasoline (RFG) year-round in cities with the worst ground-level ozone (smog). RFG is oxygenated fuel that is specially blended to have fewer polluting compounds than conventional gasoline.

The use of MTBE in the nation's fuel supply has gotten into the groundwater and created a risk to drinking water and ground water resources. Due to these concerns, Congress is considering a limit or ban on the use of MTBE as a fuel additive.

Source: U.S. Department of Energy, Energy Information Administration. *Alternatives to Traditional Transportation Fuels 1999*. Table 10.

Source: U.S. Environmental Protection Agency, *Legislative Principals for Protecting Drinking Water Supplies, Preserving Clean Air Benefits, and Promoting Renewable Fuels*. March 2000.

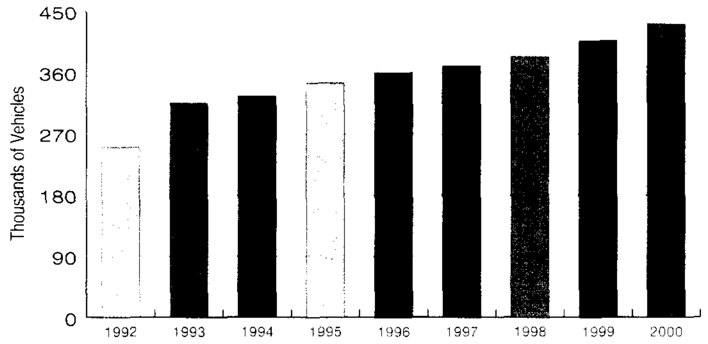
U.S. Gasoline Requirements



U.S. Gasoline requirements vary across the county. The map above depicts the 15 different fuel requirements currently used in the United States.

Source: ExxonMobil. *U.S. Gasoline Requirements*. K.W. Gardner, June 2001 <http://www.exxon.com/exxon_gas/us_fuels_map/.pdf> (7 November 2001).

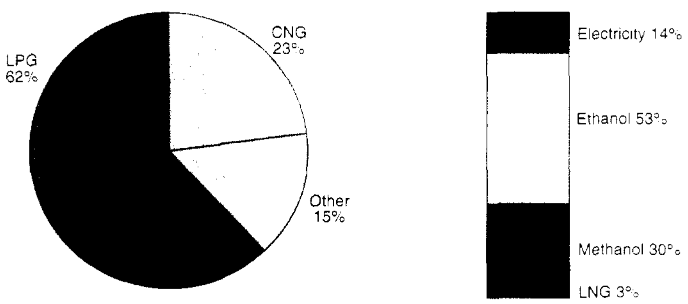
Alternative Fueled Vehicles in Use



Use of alternative fuels for motor vehicles has increased in recent years. More than 432,000 Alternative Fueled Vehicles (AFVs) were projected to be on the road in 2000, a 72 percent increase since 1992. These increases are due to a number of policies including the availability of federal funding under the Congestion Mitigation and Air Quality Improvement (CMAQ) program, the Energy Policy Act of 1992, and Presidential Executive Order 12844, which require minimum AFVs purchases for federal government vehicle fleets. Mandates requiring state and fuel provider fleets to acquire AFVs also took effect in model year 1997.

Share of Alternative Fueled Vehicles by Fuel Type

(1999)



Most AFVs used in 1999 were designed to operate on Liquified Petroleum Gas (LPG). The second most popular fuel was Compressed Natural Gas (CNG).

Source: U.S. Department of Energy, Energy Information Administration. *Alternatives to Traditional Transportation Fuels*. December 2000. Table 1.

Alternative Fuels

A variety of alternative fuels are available and can be used to combat different air pollution problems:

Liquefied petroleum gas (LPG)—A fossil-fuel derivative composed of 95 percent propane and 5 percent butanes. It produces lower CO emissions, but NOx emissions may be higher.

Natural Gas—A fuel that can be in compressed (CNG) or liquified (LNG) form. The CNG form, more common in the transportation sector, is stored in high-pressure cylinders. CNG generates lower CO and VOC emissions than conventional gasoline, and lower NO_x and PM than diesel fuels.

Methanol—Wood alcohol made from natural gas, coal, or biomass.

Ethanol—Grain alcohol made from corn, sugarcane or woody biomass. Ethanol blends may reduce CO emissions, but their effect on ozone is negligible.

Electricity—Electric vehicles may be powered by batteries charged at home or at charging stations with electricity from power plants. They have no tailpipe emissions; overall emissions depend on power plant energy sources.

Hydrogen—A clean-burning fuel that can be produced from coal, natural gas, oil, solar, or wind energy. A vehicle operating on a fuel cell, which generates electricity by harnessing the reaction of hydrogen and oxygen to make water, produces no CO or VOC emissions and extremely low NO_x emissions.

Vehicle/engine design is a critical factor affecting emissions from alternative fueled vehicles.

Hybrid vehicles switch from one power source to the other continuously, depending on the engine load. A hybrid electric vehicle uses a high-energy-density battery and small internal combustion engine. The in-use emissions of the hybrid electric vehicle depend on fuel used in the internal combustion engine—most typically diesel, gasoline, or CNG.

Transportation Control Measures

States and localities can help reduce motor vehicle emissions by implementing measures to manage travel demand or improve traffic flow. "Transportation control measure" (TCM) is the term used to refer to these efforts when they are included within a State Implementation Plan. Examples of these measures include:

Alternatives to Single Occupant Vehicle Travel

Measures that focus on providing alternatives to single-occupant vehicle travel, such as carpooling, transit, and bicycling:

Bicycle/pedestrian facilities—Provisions of paths, special lanes, lockers, showers, or other facilities.

Area-wide ridesharing—A program that provides carpool matching and information services.

Park & ride facilities—Parking lots or facilities located to provide access to transit stations, HOV lanes, bus services, or to encourage carpooling.

Improved Public Transit—Infrastructure improvements, including system expansion, provision for new expanded services, and financial incentives to use existing transit services, such as special fare programs to entice riders.

Traffic Flow Measures

Measures that focus on improving the smoothness of traffic flow to reduce stop-and-go traffic conditions:

Intelligent Transportation Systems (ITS)—A system of information technologies and advances in electronics that are applied to our transportation network. These technologies include the latest in computers, electronics, communications and safety systems. Some of the more common applications include:

- Freeway management
- Transit management
- Incident management and emergency response
- Electronic toll collection and electronic fare payment
- Railroad crossings
- Regional multi-modal traveler information

HOV lanes—Highway lanes reserved for high-occupancy vehicles (HOVs), for example, buses, vanpools, and carpools.

Signal timing improvements—Intersection signal light changes to enhance the flow of vehicles on arterial streets.

Policy Responses

Market Measures

Measures that rely on pricing as an incentive to reduce travel congestion:

Parking pricing—Increases in parking fees or reduced fees for carpools.

Parking cash-out/transit subsidies—A program in which employees are given the option of taking the cash value of a parking space or a transit subsidy instead of free parking at the job site.

Buy-backs of old cars—Programs that pay owners of older cars to scrap their vehicles.

Congestion/value pricing—Assessment of road charges during hours of peak demand.

Emissions/VMT taxes—Use of vehicle registration fees charged on the basis of emissions rates and/or miles driven.

Fuel taxes—Taxes paid at the pump on motor vehicle fuels.

Employer-Based Measures

Measures that involve implementation by employers:

Compressed workweeks—Extension of the typical workday in order to reduce the number of days worked, thereby reducing the number of work trips.

Telecommuting—Arrangements allowing employees to work at home or at satellite offices close to home.

Commuter Choice—Benefits that employers can offer employees to commute to work by methods other than driving alone. These may include "qualified transportation fringes" under IRS rules (transit and vanpool vouchers and passes and qualified parking), biking, walking, teleworking, roller blading, and others.

Non-Traditional Measures

Episodic measures—Measures that are put in place during days when air quality is expected to be poor to reduce exceedances of air quality standards.

Land use planning—Incentives and planning to encourage development patterns that place jobs, housing, and services closer together and that encourage pedestrian—and transit friendly environments.

Parking restrictions—Parking policies that discourage vehicle use, such as time restrictions and eliminating on-street parking.

Funding

Numerous funding mechanisms are available to implement these strategies. Traditional transportation funding sources, state and local sources, user fees, and private sector involvement may be used. The Congestion Mitigation and Air Quality Improvement (CMAQ) Program was developed under the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 and reauthorized under the Transportation Equity Act for the 21st Century (TEA-21). The CMAQ Program is a potential funding source for measures to reduce air pollution emissions from motor vehicles.

CMAQ Program

The CMAQ Program allocates funds to States to implement transportation control measures and other strategies to help areas meet the NAAQS for ozone, CO and PM. State and local governments select the projects to fund and coordinate them through Metropolitan Planning Organizations. The projects vary by region but typically include the following measures:

- Transit improvements
- Alternative fuels programs
- Shared-ride services
- Traffic flow improvements
- Demand management strategies
- Pedestrian and bicycle programs
- Inspection and maintenance programs

Other activities, such as education and outreach programs, may also be eligible for CMAQ funds if they contribute to reductions in mobile source emissions. In addition, TEA-21 included extreme low-temperature cold start programs, magnetic levitation transportation technology deployment programs and public-private partnerships.

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Resources

Web sites

U.S. Department of Transportation (DOT)

http://www.dot.gov

U.S. DOT, Federal Highway Administration (FHWA), Planning and Environment Core Business Unit
http://www.fhwa.dot.gov/environment.htm

U.S. DOT, Federal Highway Administration (FHWA), Office of Highway Policy Information
http://www.fhwa.dot.gov/ohim/index.htm

U.S. DOT, Federal Transit Administration (FTA)
http://www.fta.dot.gov

U.S. DOT, Bureau of Transportation Statistics (BTS)
http://www.bts.gov

U.S. Environmental Protection Agency (EPA)

http://www.epa.gov

U.S. EPA, Office of Air and Radiation
http://www.epa.gov/oar/

U.S. EPA, Office of Air Quality Planning and Standards
http://www.epa.gov/oar/oaqps

U.S. EPA, Office of Transportation and Air Quality
http://www.epa.gov/otaq

U.S. EPA, Office of Transportation Air Quality (TRAQ) Center
http://www.epa.gov/otaq/transp.htm

U.S. EPA, Global Warming Site
http://www.epa.gov/globalwarming

Other Government Agencies

U.S. Department of Energy (DOE), Energy Information Administration (EIA)
http://www.eia.doe.gov

U.S. Census Bureau
http://www.census.gov

Oak Ridge National Laboratory, Center for Transportation Analysis
http://www-cta.ornl.gov

Resources

Organizations, Programs and Academic Sites

Center for Transportation and the Environment, North Carolina State University
http://itre.ncsu.edu/cte

Ozone Transport Commission (OTC)
http://www.sso.org/otc

Partnership for a New Generation of Vehicles
http://www.ta.doc.gov/pngv

State and Territorial Air Pollution Program Administrators/Association of Local Air Pollution Control Officials (STAPPA/ALAPCO)
http://www.4cleanair.org

Texas Transportation Institute
http://tti.tamu.edu

Transportation Research Board (TRB)
http://www.nas.edu/trb

Statistical Publications

Emissions of Greenhouse Gases in the United States 1999
http://www.eia.doe.gov/oiaf/1605/ggrpt/index.html

Highway Statistics Series
http://www.fhwa.dot.gov/ohim/ohimstat.htm

Highway Statistics 1999
http://www.fhwa.dot.gov/ohim/hs99/index.htm

Latest Findings on National Air Quality: 2000 Status and Trends
http://www.epa.gov/oar/aqtrnd00/brochure/00brochure.pdf

National Transportation Statistics 2000 (web site to access individual sections)
http://www.bts.gov/btsprod/nts

National Transportation Statistics 2000 (whole document)
http://www.bts.gov/btsprod/nts/entire.pdf

Our Nation's Highways, Selected Facts and Figures—1998
http://www.fhwa.dot.gov/ohim/onh.htm

Statistical Abstract of the United States
http://www.census.gov/prod/www/statistical-abstract-us.html

Resources

Transportation Energy Data Book, Edition 20 November 2000
http://www-cta.ornl.gov/data/tedb20

Transportation Statistics Annual Report, 1999
http://www.bts.gov/programs/transtu/tsar/tsar99/tsar99.pdf

Other Publications

Literature Review: Cost Effectiveness of Transportation Control Measures
http://itre.ncsu.edu/cte/tcmpub.htm#center

Emission Standards Reference Guide for Heavy-Duty and Nonroad Engines
http://www.epa.gov/otaq/cert/hd-cert/stds-eng.pdf

States Guidance Document: Policy Planning to Reduce Greenhouse Gas Emissions, Second Edition
http://www.epa.gov/globalwarming/publications/reference/stateguidance/guid_doc.pdf

Can Transportation Pricing Strategies be Used for Reducing Emissions?
http://www.arb.ca.gov/research/resnotes/notes/98-1.htm

Transportation Conformity: A Basic Guide for State and Local Officials.
http://www.fhwa.dot.gov/environment/conformity/basic_gd.htm

Guidance on Congestion Mitigation and Air Quality Improvement (CMAQ) Program Under the Transportation Equity Act of the 21st Century (TEA-21)
http://www.fhwa.dot.gov/environment/cmaq99.htm

The Congestion Mitigation and Air Quality Improvement Program
http://www.fhwa.dot.gov/environment/cmaq/cmaqbroc.pdf

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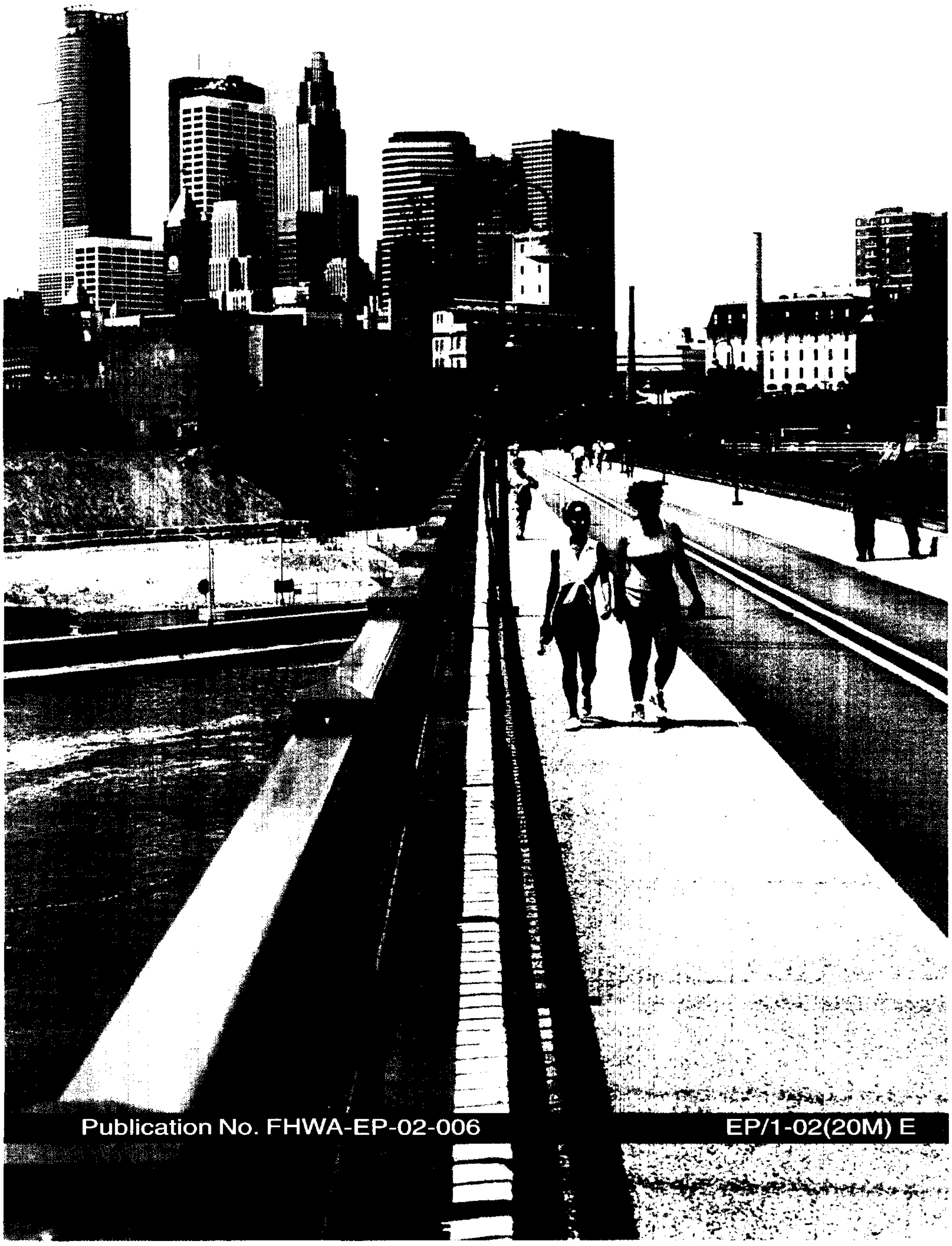

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