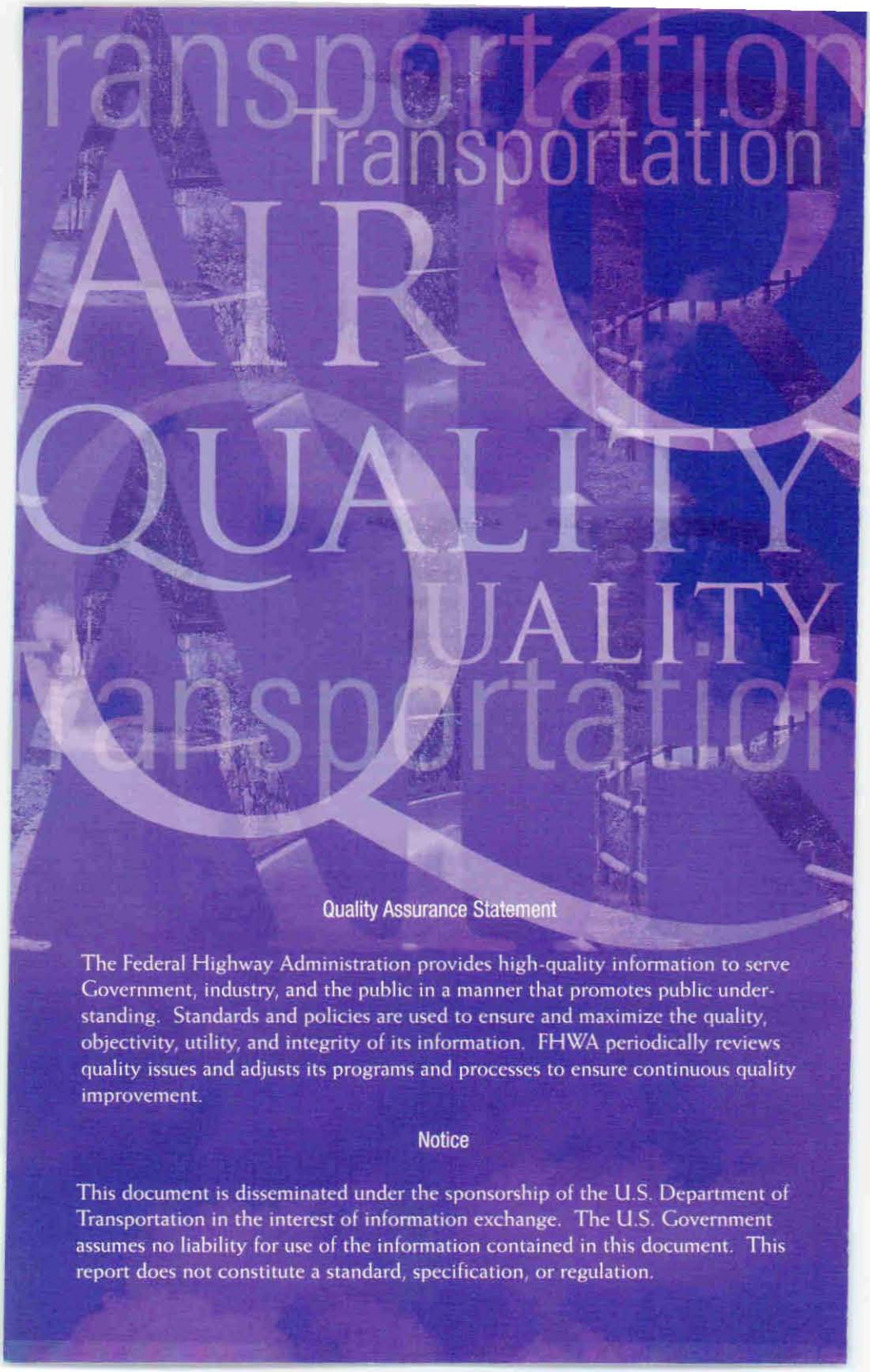
Transportation AIR QUALITY

Selected Facts and Figures

January 2006

U.S. Department of Transportation
Federal Highway Administration



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Notice

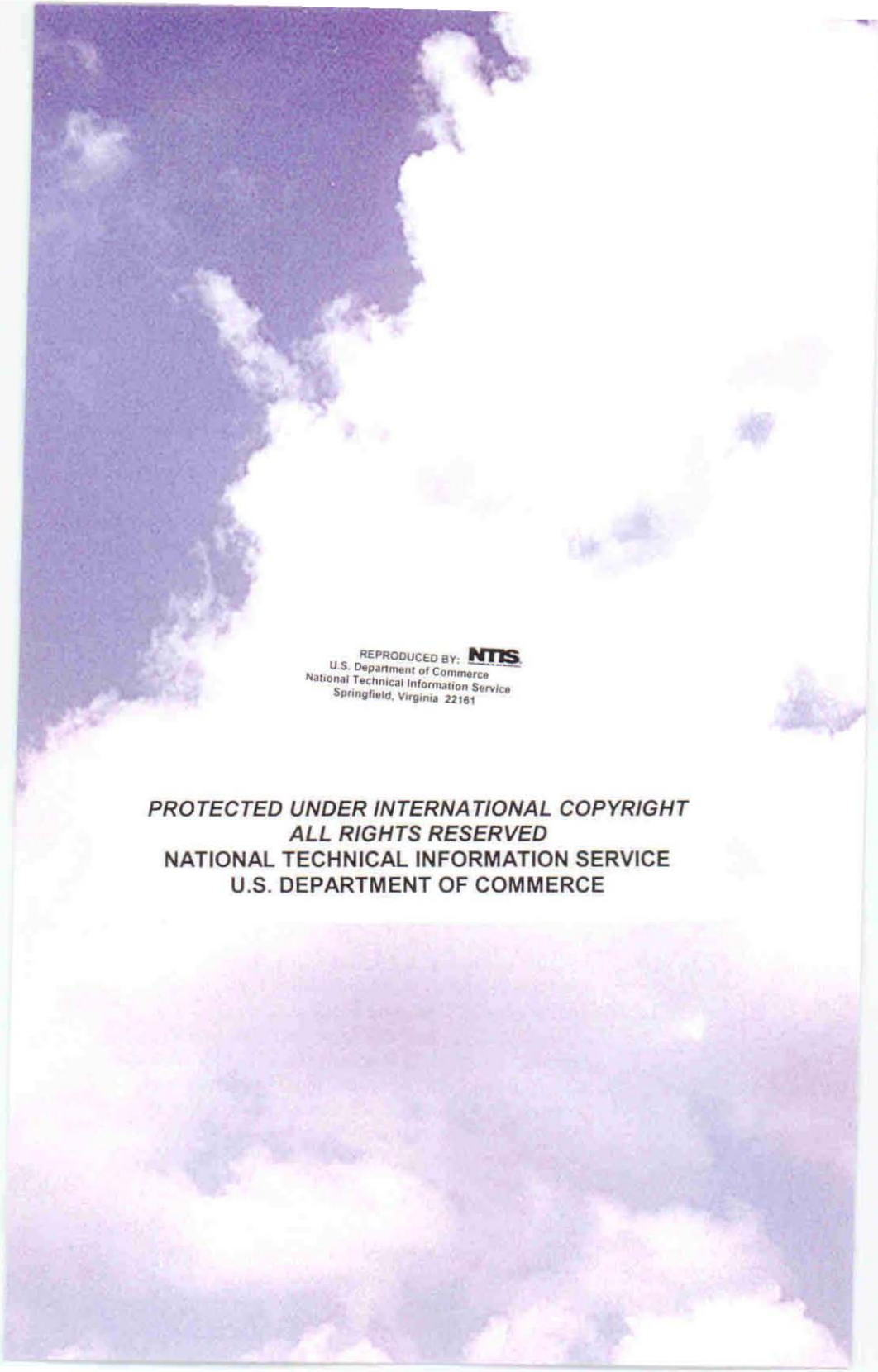
PURPOSE AND TERMS

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 emissions 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 combustion.
CO_2	Carbon dioxide—not a criteria pollutant—a greenhouse gas.
Condensables	$PM_{2.5}$ formed in the atmosphere from 'precursor' gases, such as SO_2 and NO_x.
Fugitive dust	Largely windblown dust from paved and unpaved roads.
HC	Hydrocarbons—gaseous compounds made of carbon and hydrogen (used interchangeably with VOC).
MSAT	Mobile source air toxics.
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.
O_3	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 others.
Precursors	Pollutants that contribute to the formation of other pollutants; HC and NO_x are precursors of ozone and PM.
SO_2	Sulfur dioxide.
VMT	Vehicle Miles Traveled.
VOC	Volatile organic compounds—gaseous compounds made of carbon and hydrogen (used interchangeably with HC).



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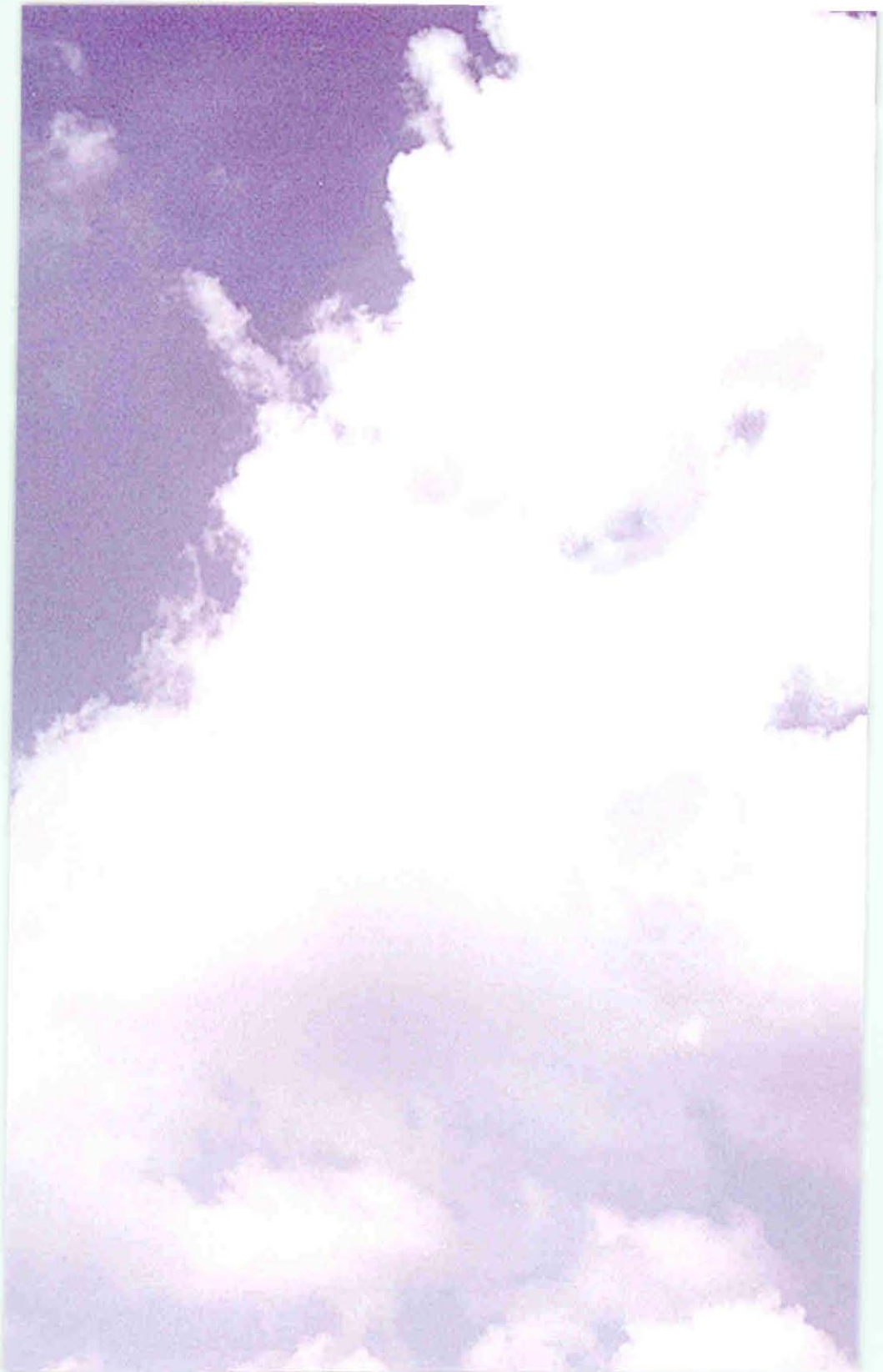


OVERVIEW

Transportation and Air Quality

In response to the Clean Air Act (CAA), 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 that were virtually eliminated as leaded gasoline was phased out.

Although not criteria air pollutants—toxic air pollutants—or air toxics, are pollutants that cause or may cause cancer or other serious health effects, such as reproductive effects or birth defects. Air toxics may also cause adverse environmental and ecological effects. The CAA identifies 188 air toxics. The EPA has identified 21 pollutants as mobile source air toxics, including diesel particulate matter, benzene, and other organic materials and metals.

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 CAA.

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 near tripling of vehicle miles of travel. With the reduction in criteria pollutants, many air toxics have also been reduced.

Still, challenges 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 monitoring data, approximately 146 million people in the United States reside in counties that do not meet the air-quality standards for at least one NAAQS pollutant.

For more detailed data on many of the subjects covered, refer to the sources and Web sites listed on pages 53 to 55 of this publication.

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 the 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 disease. Even healthy individuals may experience impaired lung function from breathing ozone-polluted air. In addition to affecting human health, 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 April 2004, EPA promulgated a new, more stringent ozone standard. This new "8-hour" standard requires ozone levels to be lowered to .08 parts per million (ppm) rather than .12 ppm, and applies the standards to an 8-hour average concentration rather than a 1-hour average.

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 SO_2, NO_x, and VOC.

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

Particulate matter irritates the membranes of the respiratory system, causing increased respiratory problems and disease, decreased lung function, alterations of the body's defense systems, and premature mortality. Sensitive groups 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 United States. There are daily (24-hour) and annual PM NAAQS.

In December 2004, the EPA designated new PM standards. Two new $PM_{2.5}$ standards (annual and 24-hour) were added to the existing standards for PM_{10}. These standards focus on fine particles under 2.5 microns in diameter, which are believed to be the most closely associated with acute health effects.

Carbon Monoxide (CO)

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

The incomplete burning of carbon in fuels such as gasoline produces CO. High concentrations of CO occur along side roads with 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 vehicular emissions of CO are greater and night-time inversion conditions are more frequent.

AIR POLLUTANTS

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 a standard if it exceeds the concentration level for its evaluation time frames. For example, for an area to attain the 8-hour ozone standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within the year must not exceed 0.08 ppm.

Primary Ambient Air Quality Standards for Transportation-Related Pollutants

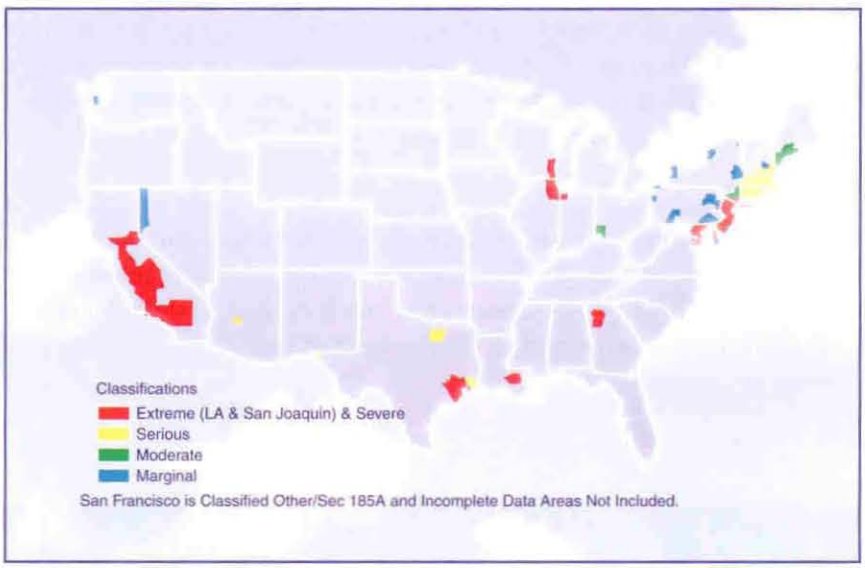
Pollutant	Type of Average	Concentration
CO	8-hour 1-hour	9 ppm (10 mg/m^3) 35 ppm (40 mg/m^3)
O_3	8-hour 1-hour	0.08 ppm (157 $\mu g/m^3$) 0.12 ppm (235 $\mu g/m^3$)
$PM_{2.5}$	Annual 24-hour	15 $\mu g/m^3$ 65 $\mu g/m^3$
PM_{10}	Annual 24-hour	50 $\mu g/m^3$ 150 $\mu g/m^3$

ppm = parts per million.
mg/m3 = milligram per meter cubed.
ug/m^3 = micrograms per meter cubed.

NONATTAINMENT AREAS

Classified 1-Hour Ozone Nonattainment Areas

December 2004



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 CAA required sanctions and other penalties, including 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.

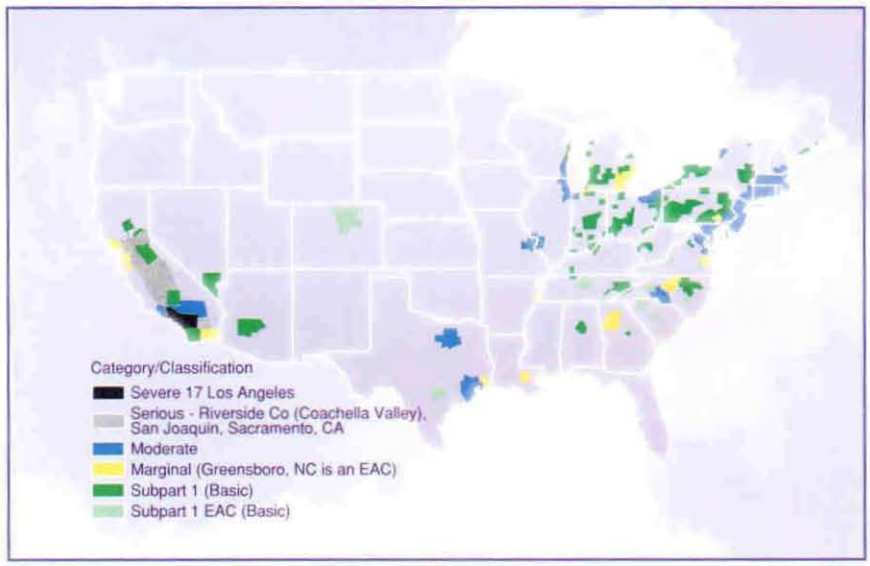
Ozone nonattainment areas were classified under the Clean Air Act Amendments of 1990 based on the severity of the air quality problem—from marginal to extreme—with expected attainment dates corresponding to the severity of the problem. Although most areas of the country now meet the 1-hour standard, many of our largest cities do not. This map shows ozone nonattainment areas under the 1-hour standard in 2004. EPA revoked the 1-hour standard in June 2005.

Source: U.S. Environmental Protection Agency. *Greenbook: Nonattainment Areas for Criteria Pollutants.* Web site: http://www.epa.gov/oar/oaqps/greenbk/onmapc.html, 2 March 2005.
Note: Alaska, Hawaii, and U.S. Territories not shown.

NONATTAINMENT AREAS

Classified 8-Hour Ozone Nonattainment Ozone Areas

November 2004



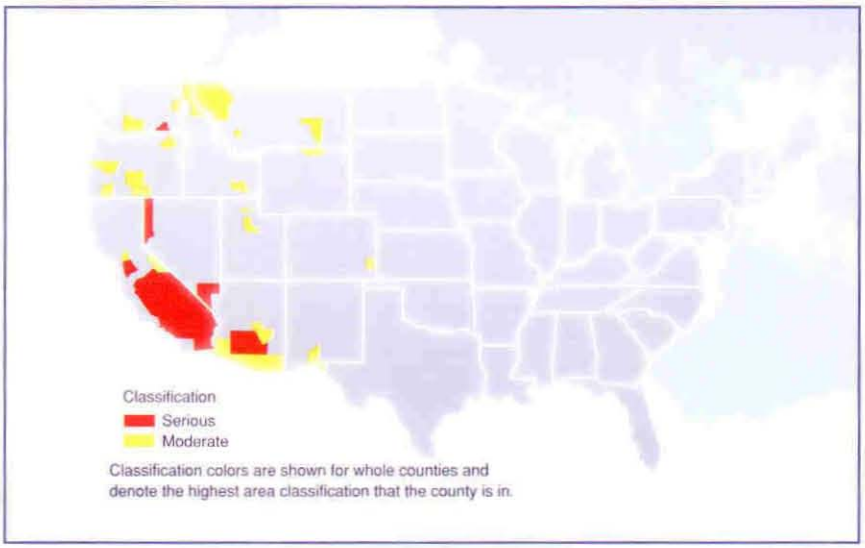
On April 15, 2004, EPA designated as "nonattainment" the areas throughout the country that exceeded the 8-hour ozone health-based standard. To avoid "backsliding," or losing progress towards attaining the 8-hour ozone standard, specific control measures for the 1-hour standard may be required to stay in place until an area attains the 8-hour standard. The above map shows ozone nonattainment areas under the 8-hour standard in 2004.

The classification of 8-hour ozone nonattainment areas can range from Basic Subpart 1 Early Action Compact (EAC) with an 8-hour design value of up to .085 ppm ozone, to Extreme with an 8-hour design value equal to or above .187 ppm ozone.

Sources: U.S. Environmental Protection Agency. *Greenbook: Nonattainment Areas for Criteria Pollutants.* Web site: http://www.epa.gov/oar/oaqps/greenbk/naa8hclass.html 8 February 2005.
U.S. Environmental Protection Agency. *Eight-Hour Ground-Level Ozone Designations Fact Sheet.* April 15, 2004. Web site: http://www.epa.gov/air/oaqps/glo/designations/finrulefs.htm 27 June 2005.
Classification for 8-Hour Ozone NAAQS. 40 *CFR Part* 51.903.
Note: Alaska, Hawaii, and U.S Territories are not shown.

Classified PM_{10} Nonattainment Areas

November 2004

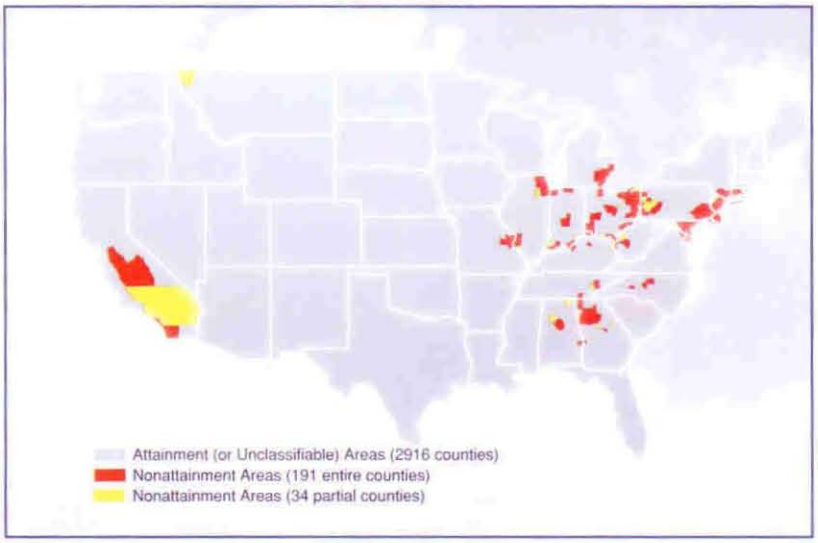


This map shows that a majority of the PM_{10} nonattainment areas are located in the western half of the United States, where a dryer climate contributes to the formation of PM_{10} pollution.

Source: U.S. Environmental Protection Agency. *Greenbook: Nonattainment Areas for Criteria Pollutants*. Web site: http://www.epa.gov/oar/oaqps/greenbk/mappm10.html 8 February 2005.
Note: Alaska, Hawaii, and U.S. Territories are not shown.

Classified $PM_{2.5}$ Nonattainment Areas

December 2004

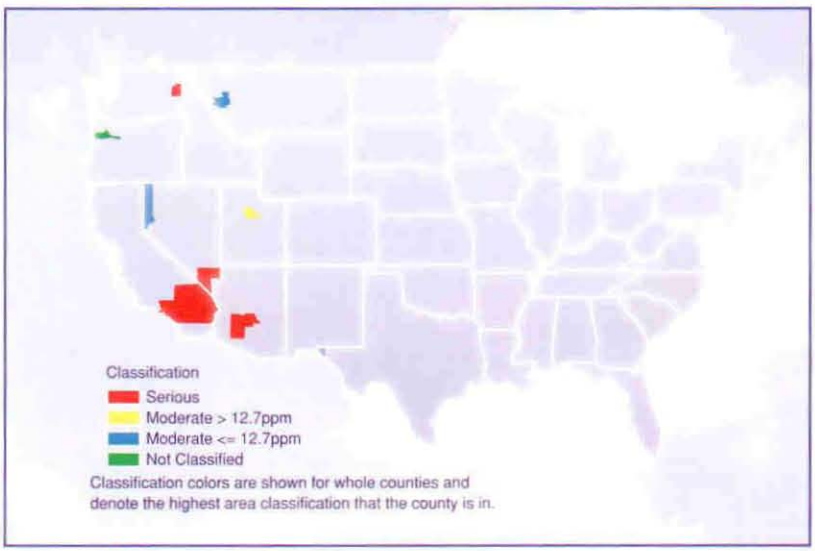


In December 2004, EPA designated 224 counties as nonattainment areas for $PM_{2.5}$. The state and local governments have 3 years to develop implementation plans showing how they will meet the standard by reducing air pollutants that contribute to fine particle concentrations.

Source: U.S. Environmental Protection Agency, *Greenbook: Nonattainment Areas for Criteria Pollutants*, Web site: http://www.epa.gov/pmdesignations/index.htm 8 February 2005.
Note: Alaska, Hawaii, and U.S. Territories are not shown.

Classified CO Nonattainment Areas

2004



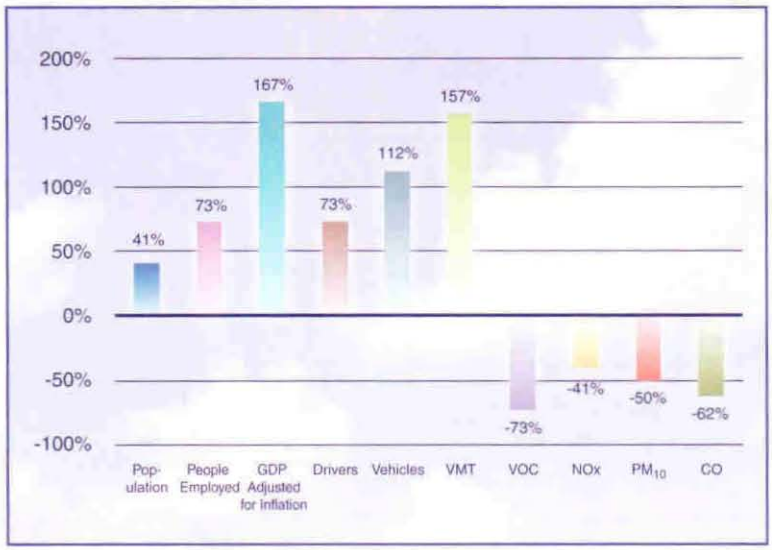
In 2004, none of the remaining CO nonattainment or maintenance areas reported any violations of the CO standard.

Source: U.S. Environmental Protection Agency. *Greenbook: Nonattainment Areas for Criteria Pollutants*. Web site: http://www.epa.gov/oar/oaqps/greenbk/mapco.html 8 February 2005.
Note: Alaska, Hawaii, and U.S. Territories are not shown.

PROGRESS IN REDUCING MOTOR VEHICLE EMISSIONS

Percent Change in Motor Vehicle Emissions, Demographics, and Travel

1970-2002

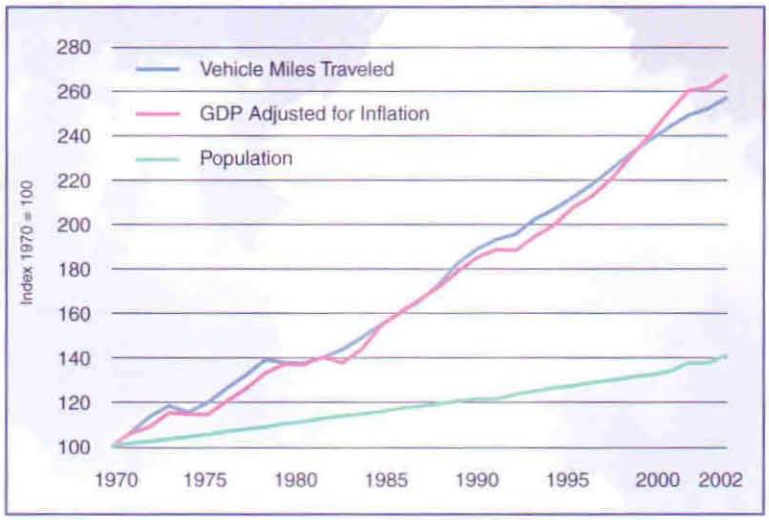


Air pollution emissions from motor vehicles have dropped considerably since 1970—VOC emissions are down 73 percent, NOx emissions are down 41 percent, PM_{10} emissions are down 50 percent, and CO emissions are down 62 percent. This is due primarily to more stringent light-duty engine and fuel standards. These reductions have occurred despite a 41 percent increase in population, 167-percent growth in Gross Domestic Product (GDP), and 157-percent growth in Vehicle Miles Traveled (VMT).

Sources: U.S. Environmental Protection Agency. *Average Annual Emissions, All Criteria Pollutants, Years Including 1980, 1985, 1989–2001*. February 2003. Web site: http://www.epa.gov/ttn/chief/trends/, 28 June 2005.
U.S. Census Bureau. *Selected Historical Census Data Population and Housing Counts, Population 1790-1990*. August 1993. Table 16, 26-27.
Web site: http://www.census.gov/population/censusdata/table-16.pdf, 28 June 2005.
U.S. Census Bureau. *Time Series of National Population Estimates: April 1, 2000 to July 1, 2001*. December 2004. Table 1. Web site: http://www.census.gov/popest/states/NST-ann-est.html, 28 June 2005.
U.S. Census Bureau. *Statistical Abstract of the United States 2003*. Table 587, February 2004.
Web site: http://www.census.gov/prod/2004pubs/03statab/labor.pdf, 28 June 2005.
Bureau of Economic Analysis. *Survey of Current Business*. Volume 83 No. 4. April 2003.
Web site: http://www.bea.gov/bea/ARTICLES/2004/02February/0204GDP&Other.pdf, 28 June 2005.
Federal Highway Administration. *Highway Statistics Summary to 1995*. July 1997.
Web site: http://www.fhwa.dot.gov/ohim/summary95/index.html 29 June 2005.
Federal Highway Administration. *Highway Statistics 2002*. October 2003.
Web site: http://www.fhwa.dot.gov/policy/ohim/hs02/pdf/vm2.pdf, 28 June 2005.
**Note:* Data for PM_{10} is not available through 1970.

Travel, Economic Growth and Population

1970-2002

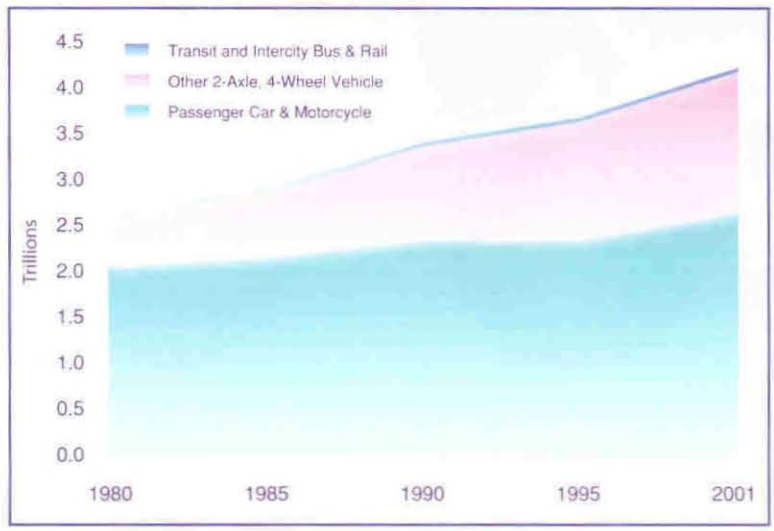


Since 1970, growth in VMT has far outpaced population growth. This tracks closely with economic trends as seen with the Gross Domestic Product (GDP).

Sources: U.S. Census Bureau. *Time Series of National Population Estimates: April 1, 2000 to July 1, 2001*. December 2004, Table 1. Web site: http://www.census.gov/popest/states/NST-ann-est.html, 28 June 2005.
Bureau of Economic Analysis. *Survey of Current Business*. Volume 83 No. 4, April 2003.
Web site: http://www.bea.gov/bea/ARTICLES/2004/02February/0204GDP&Other.pdf, 28 June 2005.
Federal Highway Administration. *Highway Statistics Summary to 1995*, July 1997.
Web site: http://www.fhwa.dot.gov/ohim/summary95/index.html 29 June 2005.
Federal Highway Administration. *Highway Statistics 2002*. October 2003.
Web site: http://www.fhwa.dot.gov/policy/ohim/hs02/pdf/vm2.pdf 28 June 2005.

Surface Passenger Miles by Mode

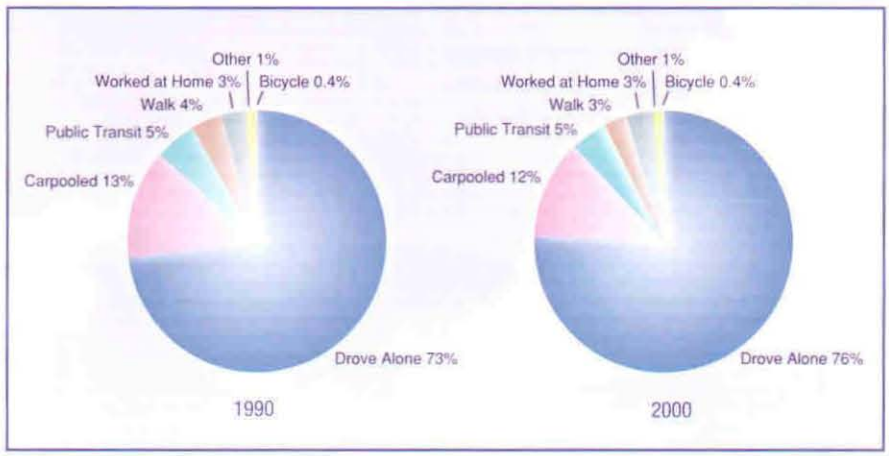
1980-2001



Americans are traveling more than ever. Between 1980 and 2001, the number of surface passenger miles traveled increased by 1.5 trillion. Americans use cars more than any other form of ground transportation—98 percent of all passenger miles were traveled in personal vehicles (automobiles, motorcycles, and light-duty trucks) in 2001. Light-duty trucks, such as minivans, pickups, and sport-utility vehicles, make up an increasing portion of miles traveled. Passenger travel on two-axle, four-tire trucks increased by 970 billion miles, or 186 percent between 1980 and 2001, while travel by automobile and motorcycles increased by only 28 percent or 561 billion miles. From 1980 to 2001, transit and intercity bus and rail use increased by 10 billion passenger miles or 23 percent.

Source: Federal Highway Administration, *National Transportation Statistics 2002*, April 2003, Table 1-34.
Note: Intercity bus figures were not included in transit prior to 1985.

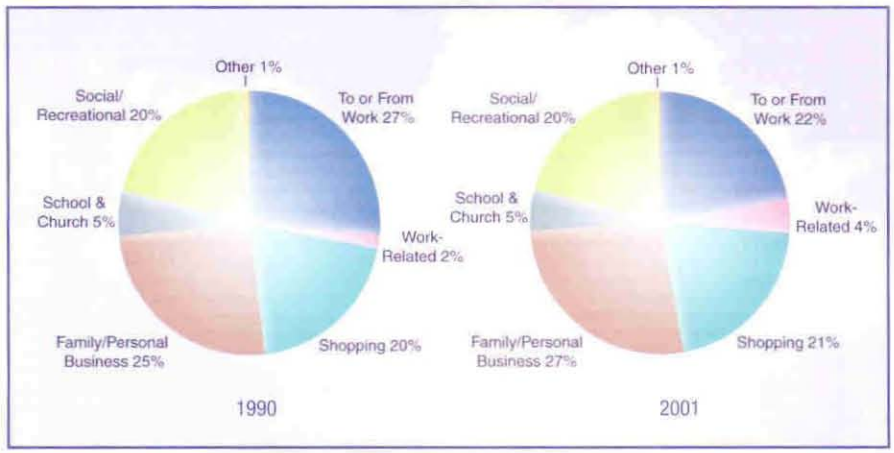
Commuter Mode Split



Americans commute to work in single-occupant vehicles more than by any other method. In 1990, 73 percent of the work force drove to work alone. That percentage increased to 76 percent in 2000. The share of people commuting by walking and carpooling declined, while the percentage 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: 990. June 1992.
U.S. Census Bureau, *2000 Census Supplemental Survey Summary*, Table P047: Means of Transportation to Work for Workers 16 years and over. August 2001.

Vehicle Trips by Purpose



Commuting has declined slightly as a share of all vehicle trips. In 1990, 27 percent of all vehicle trips were made traveling to or from work. By 2001, only 22 percent of all trips were made for traveling to or from work.

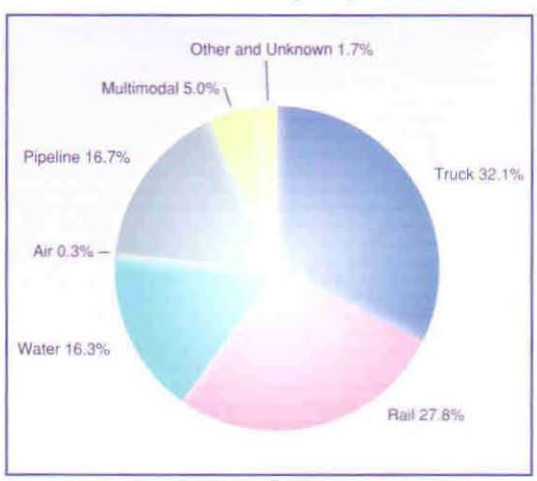
Source: Federal Highway Administration. *1990 National Personal Transportation Survey, Databook* Vol II, Table 5-40. Publication No. FHWA-PL-94-010B. November 2003. Web site: http://npts.ornl.gov/npts/1990/index.html 29 June 2005.
Federal Highway Administration. *2001 National Household Travel Survey.* Data tabulation from Web site: http://nhts.ornl.gov/2001/index.shtml 8 April 2005.

Growth in Freight Movement

The amount of freight moved by truck and rail grew by more than 19 percent and 17 percent respectively between 1993 and 2002.

Source: Bureau of Transportation Statistics, *National Transportation Statistics*, Table 1-52 Freight Activity in the United States: 1993, 1997, and 2002, March 2004.
Web site: http://www.bts.gov/publications/national_transportation_statistics/2004/index.html, 28 June 2005.

U.S. Ton Miles of Freight by Mode 2002

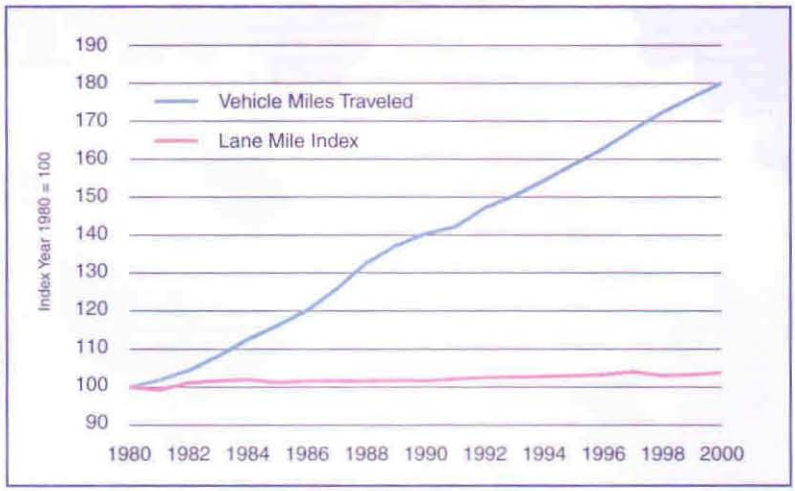


In 2002, trucks carried the largest percentage of the domestic commercial ton-miles, followed by rail, pipeline, water, multimodal, and air cargo.

This growth in freight movement and accompanying increase in emissions has focused attention on related-emissions controls and clean fuel.

Source: Bureau of Transportation Statistics, *Freight Shipments in America*, Figure 3, Modal Shares of U.S. Commercial Freight Shipments by Value, Weight, and Ton-Miles: 1993, 1997, and 2002, April 2004.
Web site: http://www.bts.gov/publications/freight_shipments_in_ america/html/figure_03.html, 28 June 2005.

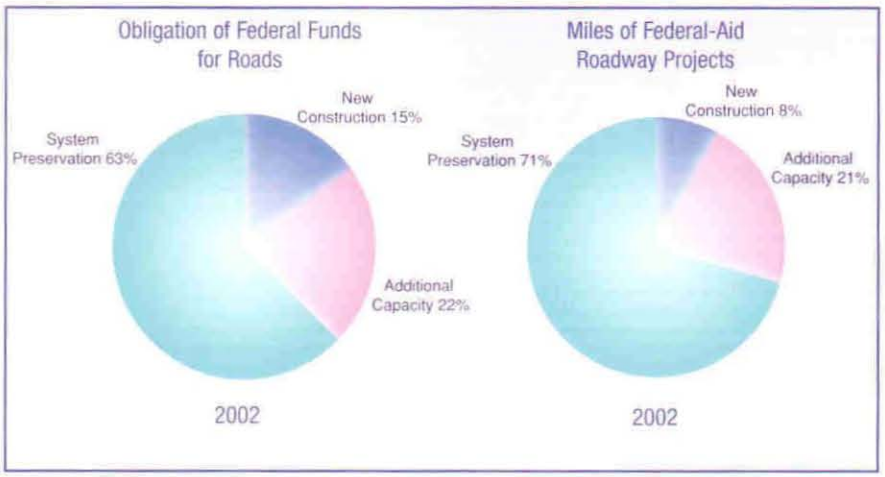
Vehicle Miles Traveled and Lane Mileage



Despite rapid growth in VMT, lane miles have remained relatively constant since 1980. Over the past 20 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. Highway Statistics Summary to 1995*. July 1997. Tables VM-20, HM-48.
Federal Highway Administration. *Highway Statistics 1997*. October 1998. Tables VM-3, HM-48.
Highway Statistics 1999. October 2000. Tables VM-3, HM-48.
Highway Statistics 2000. October 2001. Table VM-3, HM-48.
Highway Statistics 2001. October 2002. Table VM-3, HM-48.
Federal Highway Administration, Office of Highway Policy Information, Highway Systems Performance (HPPI-10). *Rural and Urban Lane-Miles Highway Statistics to 1996* (electronic version, unpublished).

Capital Outlays



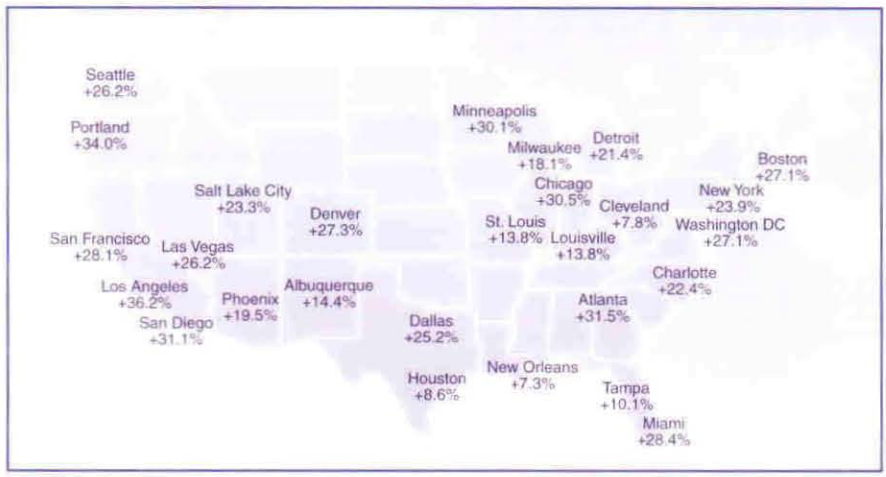
In 2002, $8.1 billion in federal funds were obligated and 37,075 miles of federal-aid roadway projects were underway. Although 63 percent of the funds went toward system preservation, 71 percent of the project miles involved system preservation. Only 21 percent of the miles involved capacity additions and 8 percent involved new construction.

Source: Federal Highway Administration. *Highway Statistics 2002*. October 2003. Table FA-10, Obligation of Federal-aid Highway Funds for Highway Improvements.
Web site: http://www.fhwa.dot.gov/policy/ohim/hs02/fa10.htm 28 June 2005.
Note: This chart excludes funds and miles related to safety and environmentally-related projects, new bridges and bridge replacement/rehabilitation.

TRAFFIC CONGESTION

Percent Change in Urban Congestion

1982–2002

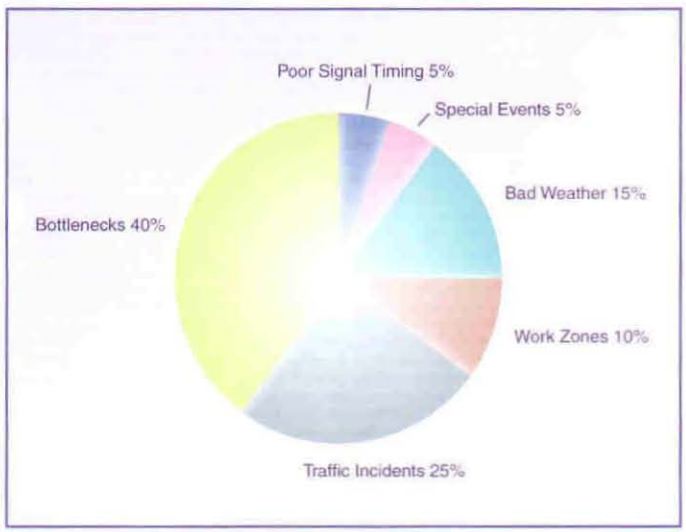


Congestion occurs when the free flow of traffic on a roadway is impeded due to excess vehicle demand, construction, maintenance, traffic incidents, weather, or other road conditions and events. Many urban areas have experienced increases in traffic congestion in recent years. This map shows the percent change in the amount of extra time per trip it took to travel in the peak period from 1982 to 2002, for selected areas.

Source: Texas Transportation Institute, 2004 *Urban Mobility Report*, September 2004, Table 5.

Major Sources of Congestion

2002



Congestion Mitigation and Air Quality Improvement (CMAQ) program funds can be used for projects and programs that help clear traffic incidents and improve signal timing. Surface Transportation, National Highway System, Bridge, and other federal-aid funds can be used to reduce other sources of congestion, such as bottlenecks and work zones.

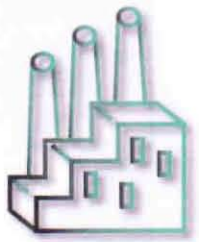
Source: Federal Highway Administration. *Traffic Congestion and Reliability: Linking Solutions to Problems – Executive Summary*. Publication Number: FHWA-HOP-05-004. July 2004.
Web site: http://ops.fhwa.dot.gov/congestion_report/chapter2.htm#2_1. 28 June 2005.

EMISSIONS SOURCES

Emissions Sources 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, gas stations 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

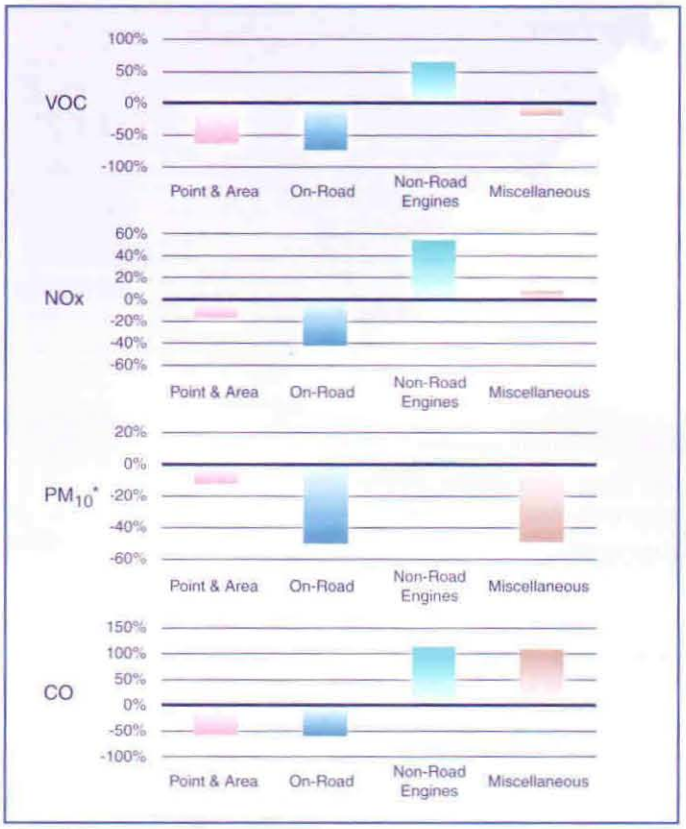
Miscellaneous Sources

- Wildfires and agricultural fires
- Health services
- Cooling towers
- Windblown dust

EMISSIONS TRENDS

Percent of Change in Emissions

1970-2002



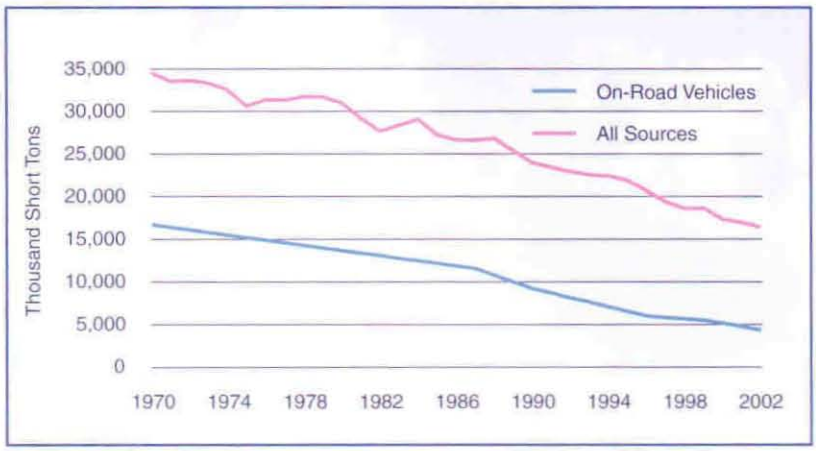
*1985-2002

Americans have made great progress in cleaning the air. For nearly three decades, national emissions trends for point and area sources and on-road sources have been declining. A great deal of the credit for the improvements in on-road sources goes to cleaner cars and trucks, and reformulated fuels. Meanwhile, emissions from non-road engines have increased.

Source: U.S. Environmental Protection Agency, Office of Air and Radiation. 2002 *Air Quality Trends Summary Report. January* 2005.
Web site: http://www.epa.gov/ttn/chief/trends/trends02/trendsreportallpollutants010505.xls, 28 June 2005.

VOC Emissions

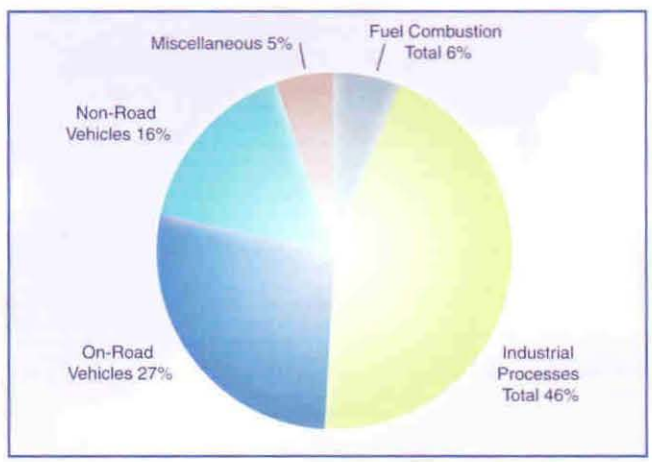
1970-2002



Volatile organic compounds (VOC) are precursors of ground-level ozone. In 2002, on-road vehicles produced 27 percent of all VOC emissions, down from 49 percent in 1970. On-road vehicle emissions are down 73 percent since 1970.

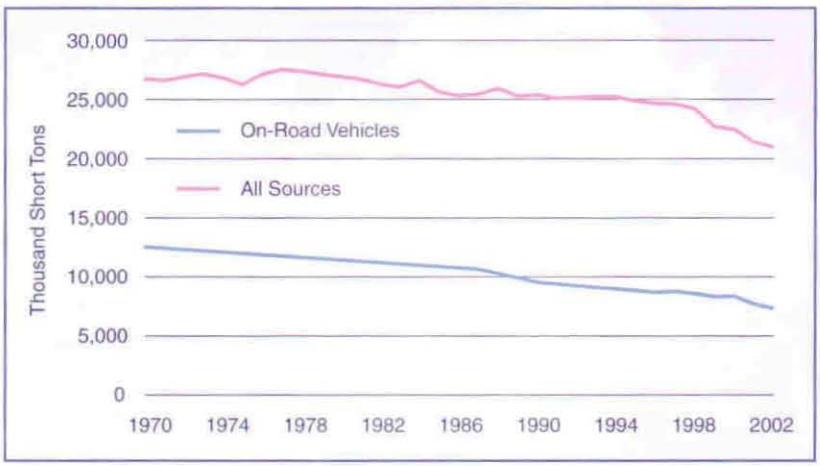
VOC Emissions

2002



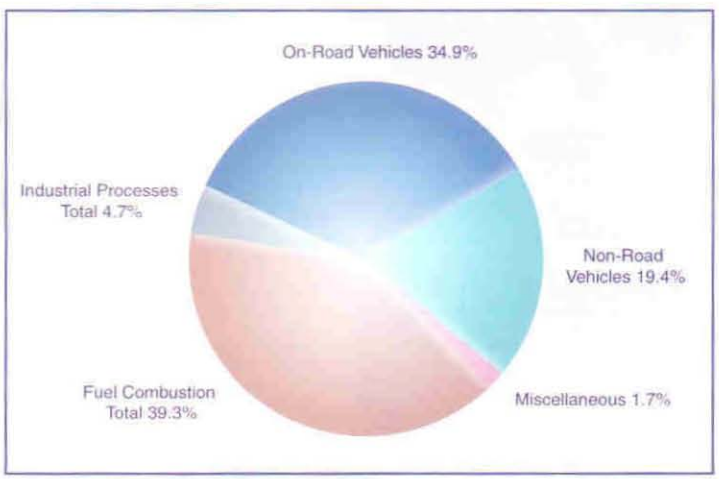
Source: U.S. Environmental Protection Agency, Office of Air and Radiation. *2002 Air Quality Trends Summary Report*. January 2003.
Web site: http://www.epa.gov/ttn/chief/trends/trends02/trendsreportallpollutants010505.xls, 28 June 2005.

NO_x Emissions 1970-2002



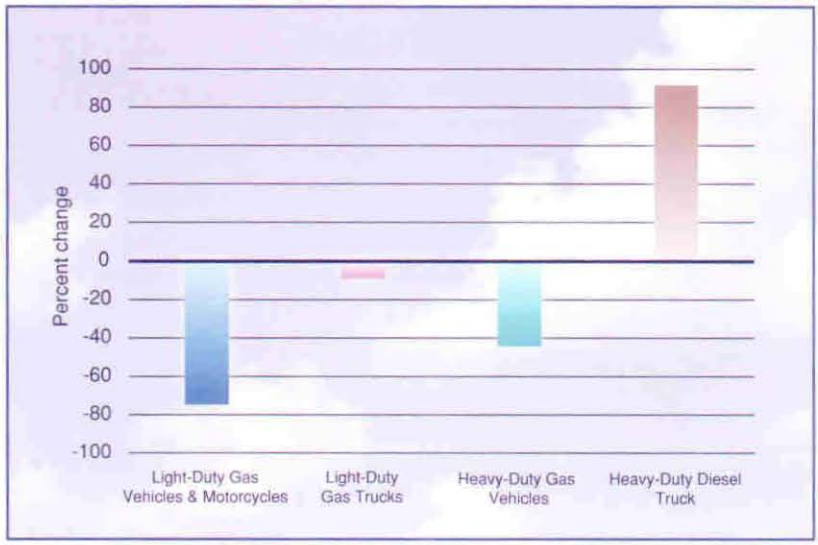
In addition to VOC, oxides of nitrogen (NO_x) contribute to the formation of ozone. In 2002, on-road vehicles produced 35 percent of all NO_x emissions, down from 47 percent in 1970. On-road vehicle emissions of NO_x are down 41 percent since 1970.

NO_x Emissions 2002



Source: U.S. Environmental Protection Agency, Office of Air and Radiation.
2002 Air Quality Trends Summary Report, January 2005.
Web site: http://www.epa.gov/ttn/chief/trends/trends02/trendsreportallpollutants010505.xls, 28 June 2005.

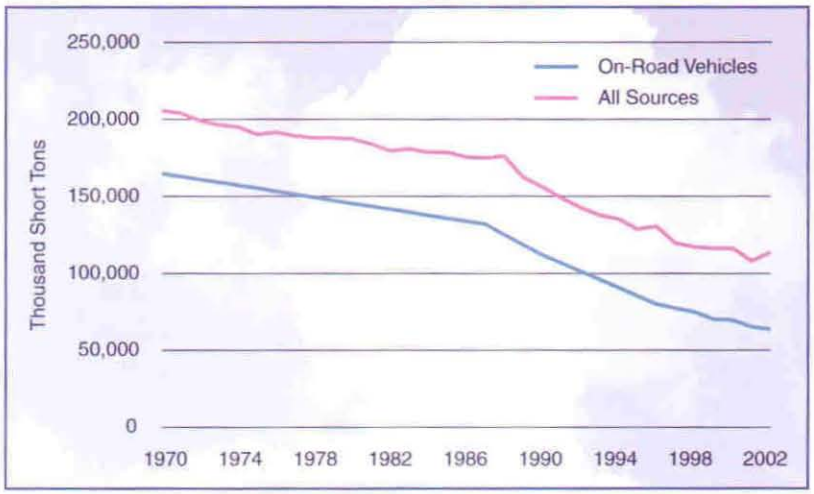
Change in NO_x Emissions by Vehicle Class 1970-2002



Between 1970 and 2002, NO_x emissions from passenger vehicles, light-duty trucks, and heavy-duty gas vehicles decreased by 75, 9, and 44 percent, respectively. By contrast, NO_x emissions from heavy-duty diesel vehicles increased more than 90 percent.

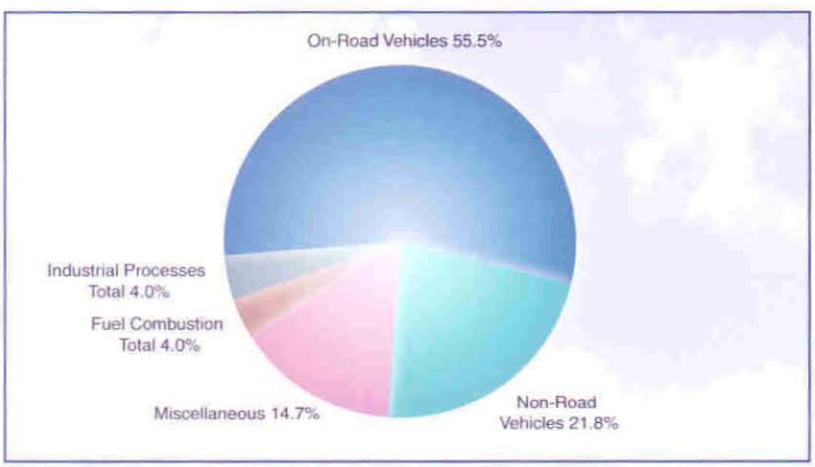
Source: U.S. Environmental Protection Agency, Office of Air and Radiation. 2002 *Air Quality Trends Summary Report*. January 2005.
Web site: http://www.epa.gov/ttn/chief/trends/trends02/trendsreportallpollutants010505.xls 28 June 2005.

CO Emissions 1970–2002



On-road vehicles are the largest source of carbon monoxide (CO) emissions. In 2002, on-road vehicles produced 56 percent of all CO emissions, down from 80 percent in 1970.

CO Emissions 2002

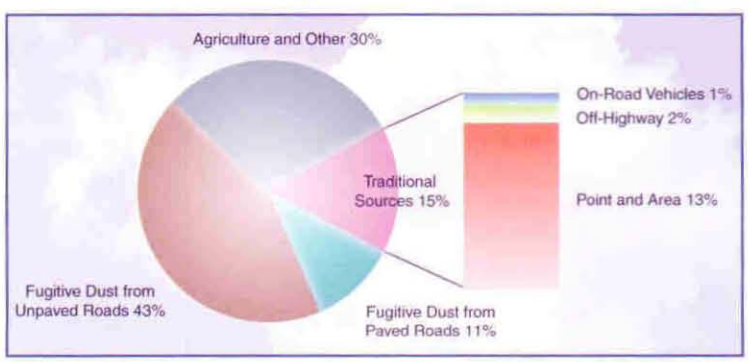


Source: U.S. Environmental Protection Agency, Office of Air and Radiation. *2002 Air Quality Trends Summary Report.* January 2005.
Web site: http://www.epa.gov/ttn/chief/trends/trends02/trendsreportallpollutants010505.xls, 28 June 2005.

PM_{10} Emissions 1985–2002

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 15 percent of total PM_{10} emissions. PM_{10} from all sources declined over 45 percent between 1985 and 2002, and on-road vehicle emissions decreased over 50 percent.

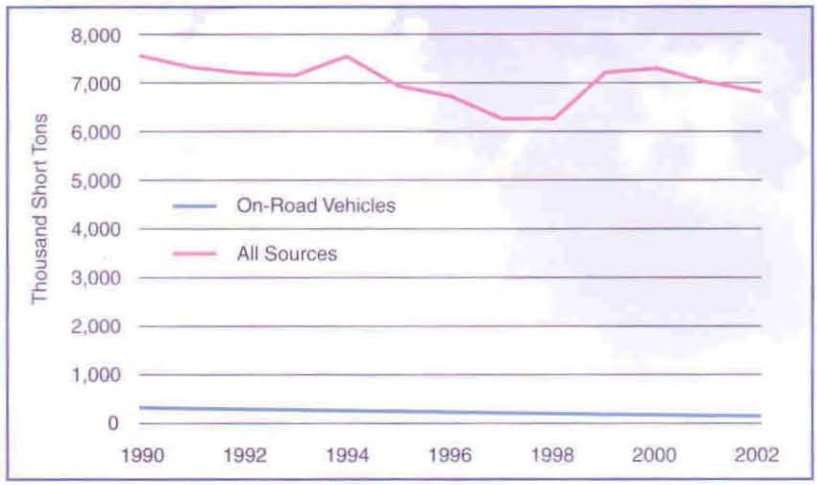
PM_{10} Emissions 2002



The 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.

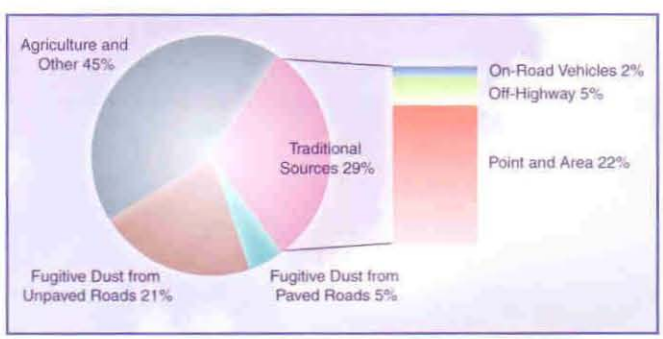
Source: U.S. Environmental Protection Agency, Office of Air and Radiation. *2002 Air Quality Trends Summary Report, January 2003*. Web site: http://www.epa.gov/ttn/chief/trends/trends02/trendsreportallpollutants010505.xls, 28 June 2005. *Note:* 1970–1998 emissions do not include condensibles.

$PM_{2.5}$ Emissions 1990-2002



Fine particulate matter, $PM_{2.5}$, results from motor vehicle fuel combustion and other sources. Since 1990, $PM_{2.5}$ from all sources decreased by almost 10 percent, and on-road vehicle emission declined more than 59 percent.

$PM_{2.5}$ Emissions 2002



The majority of $PM_{2.5}$ emissions come from sources that are not traditionally inventoried. On-road exhaust, and emissions from brake and tire wear accounted for only 2 percent of the direct $PM_{2.5}$ emissions in 2002. Fugitive dust from vehicles traveling on paved and unpaved roads account for 26 percent of $PM_{2.5}$ emissions.

Source: U.S. Environmental Protection Agency, Office of Air and Radiation. *2002 Air Quality Trends Summary Report, January 2005*. Web site: http://www.epa.gov/ttn/chief/trends/trends02/trendsreportallpollutants010505.xls, 28 June 2005.
Note: 1970–1998 emissions do not include condensables. Condensables are the majority of $PM_{2.5}$ that is formed in the atmosphere from 'precursor' gases such as SO_2 and NO_x.

AIR QUALITY TRENDS

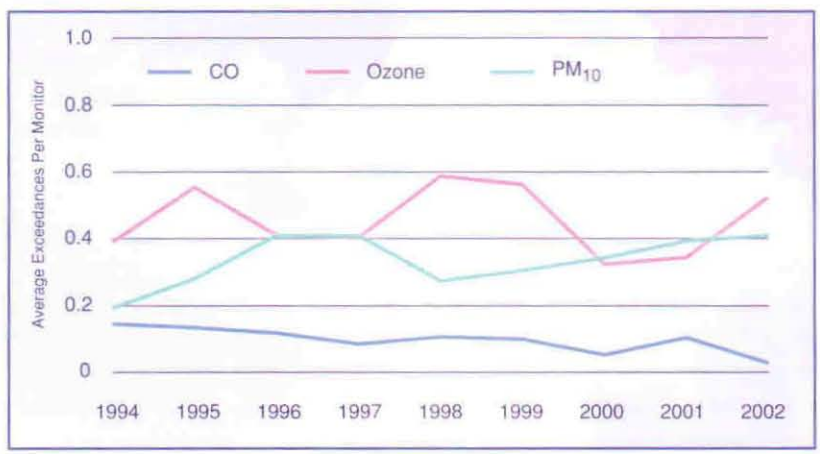
Criteria Pollutant Concentrations (Percent of Decrease in Concentration)	
Pollutant	1983-2002
Carbon Monoxide (CO)	65
Nitrogen Dioxide (NO_2)	21
Ozone (O_3) (1-Hour)	22
Particulate Matter (PM_{10})*	13*

*1993–2002

As air pollutant emissions have declined over time, air quality has improved. Reductions in air pollutant concentrations are impressive, with concentrations of carbon monoxide decreasing by more than 50 percent. All of the years in the 1990s 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 and Radiation. *National Air Quality and Emissions Trends Report 2003 Special Studies Edition.* Publication No. EPA 454/R-03-005, September 2003. http://www.epa.gov/airtrends/ 28 June 2005.

Average Number of Exceedances Per Monitor 1994-2002

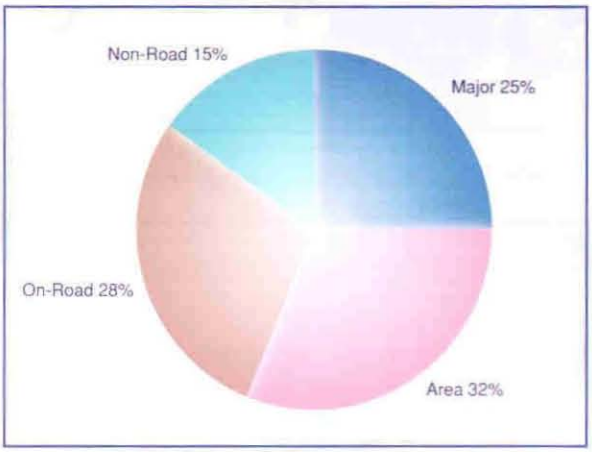


The number of exceedances of the air quality standards remained below an average of one per monitor over the past five years.

Source: U.S. Environmental Protection Agency. *Air Data – Monitor Trends Report.* Web site: http://www.epa.gov/air/data/repsus.html?us~usa~United%20States 14 June 2004.

MOBILE SOURCE AIR TOXICS

188 Hazardous Air Pollutants 1999



Toxic air pollutants, or air toxics, are those pollutants that may cause cancer or other serious health effects, such as reproductive problems or birth defects. Air toxics may also cause other adverse environmental and ecological effects. Examples of toxic air pollutants include benzene, found in gasoline; perchloroethylene, emitted from some dry cleaning facilities; and methylene chloride, used as a solvent by a number of industries. Most air toxics originate from man-made sources, including mobile sources (e.g., cars, trucks, construction equipment) and stationary sources (e.g., factories, refineries, power plants), as well as indoor sources (e.g., some building materials and cleaning solvents). Some air toxics are also released from natural sources, such as volcanic eruptions and forest fires.

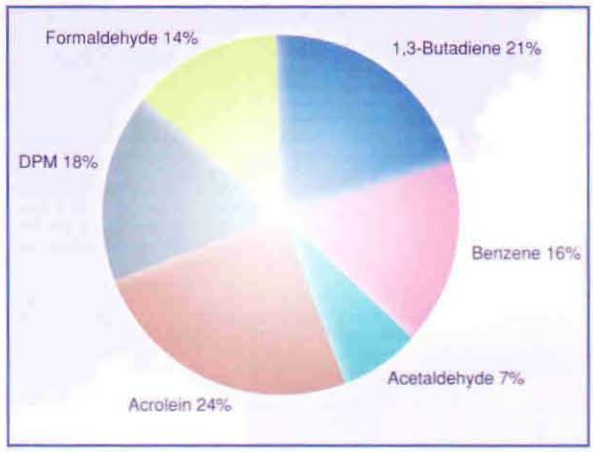
EPA is working with its regulatory partners to build on existing monitoring sites to create a national monitoring network for a number of toxic air pollutants. The goal is to ensure that those compounds posing the greatest risk are measured.

EPA also compiles an air toxics inventory as part of the National Emissions Inventory (NEI), formerly the National Toxics Inventory, to estimate and track national emissions trends for the 188 toxic air pollutants regulated under the Clean Air Act. In the NEI, EPA divides emissions into four types: (1) major (large industrial) sources; (2) area and other sources, which include small industrial sources like dry cleaners and gasoline stations, as well as natural sources like wildfires; (3) on-road mobile sources, and (4) non-road mobile sources like aircraft, locomotives, and construction equipment.

MOBILE SOURCE AIR TOXICS

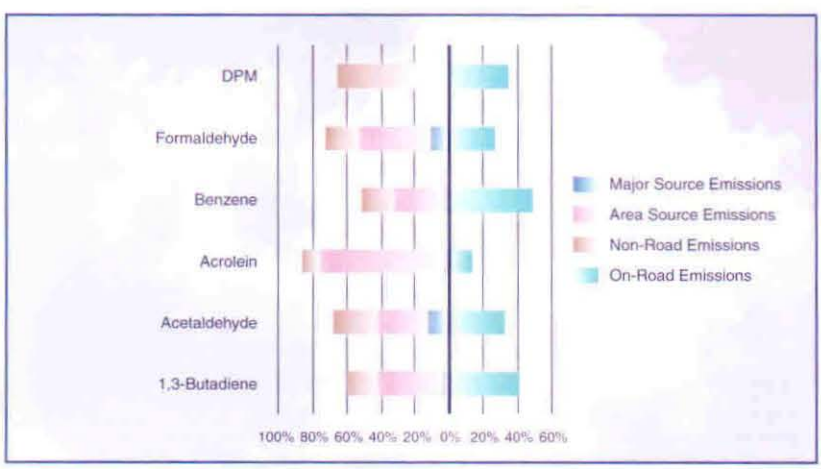
Of the 188 Hazardous Air Pollutants, EPA identified 21 Mobile Source Air Toxics (MSAT), and further designated six (6) as priority MSAT. These are: Acetaldeyde, Acrolein, Benzene, 1,3-Butadiene, Formaldehyde, and Diesel Particulate Matter and Diesel Exhaust Organic Gases (DPM + DEOG).

Priority MSAT On-Road Emissions 1999



The following chart shows the national contribution by emission source for the 6 priority MSAT. This chart is meant to show the percentage of emissions from on-road vehicles as compared to other sources. Pollutants such as DPM and benzene are primarily on-road related, while acrolein is largely an area source related pollutant.

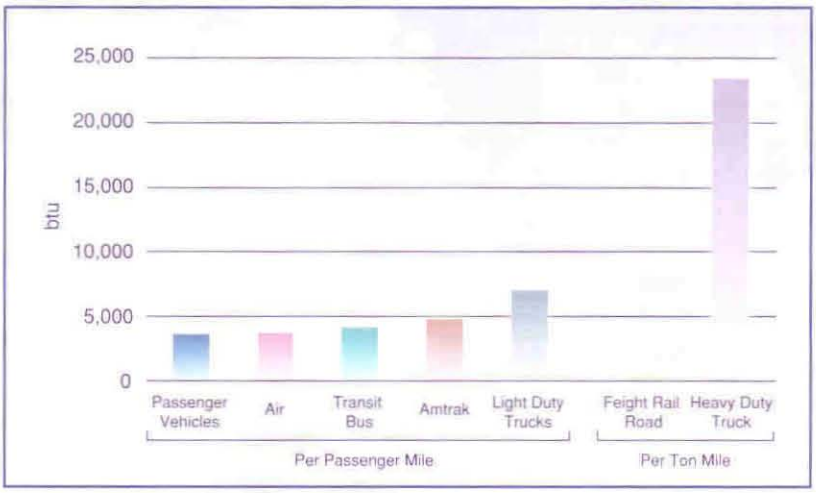
Priority MSAT Emissions 1999—On-Road v Others 1999



Source: U.S. Environmental Protection Agency, *1999 National Emissions Inventory*, Web site: ftp://ftp.epa.gov/pub/EmisInventory/finalnei99ver3/haps/summaries/ from http://www.epa.gov/ttn/chief/net/1999inventory.html, 28 June 2005.

GREENHOUSE GAS EMISSIONS

Energy Intensity 2002

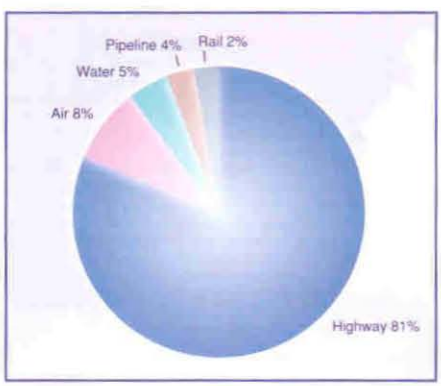


Per passenger mile, light rail and other commuter transportation modes are less energy intense than light-duty passenger vehicles. However, bus transit and light-duty trucks are more energy intense. For freight transport, heavy-duty trucks are considerably more energy intense than rail on a ton-mile basis.

Source: U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, *Transportation Energy Data Book: Edition 24-2004*, Table 2.12, Energy Intensities of Highway Passenger Modes, 1970–2002, Table 2.13, Energy Intensities of Non highway Passenger Modes, 1970–2002, and Table 2.15, Energy Intensities of Freight Modes, 1970–2002, December 2004, Web site: http://cta.ornl.gov/data/chapter2.shtml 28 June 2005.

Transportation Energy Use by Mode 2002

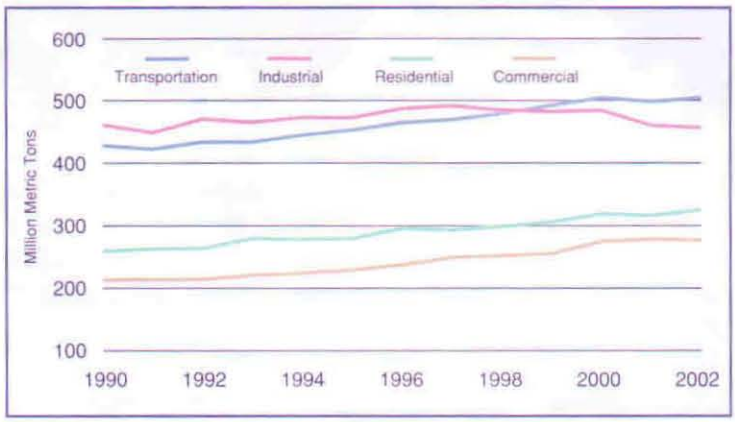
Highway vehicles are the largest users of transportation energy, accounting for 81 percent of the total.



Source: U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, *Transportation Energy Data Book: Edition 24-2004*, Table 2.5, Transportation Energy Use by Mode, 2001–2002, December 2004, Web site: http://cta.ornl.gov/data/tedb24/Spreadsheets/Table2_05.xls 28 June 2005.

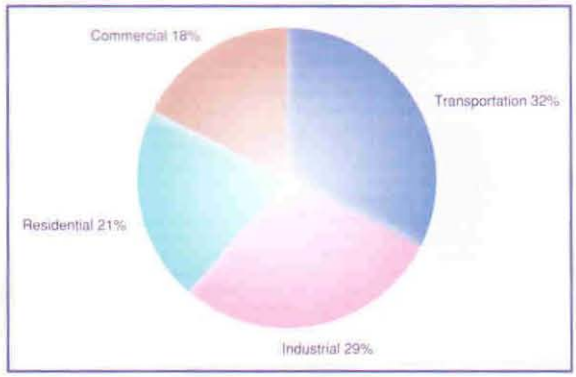
GREENHOUSE GAS EMISSIONS

Carbon Emissions 1990-2002



Greenhouse gases trap heat within the earth's atmosphere. Although most greenhouse gas occurs naturally and helps to keep the earth hospitable to life, it also is generated by human activities. Carbon dioxide (CO_2) emissions account for more than 80 percent of the U.S. greenhouse gas emissions. These emissions are contributing to changes in the planet's temperatures that could lead to harmful effects, such as sea-level rise and changes in global hydrological patterns. Although the United States makes up 4.7 percent of the world's population, it emits about one-fifth of carbon emissions from fossil fuel combustion (5,736 million metric tons of CO_2 in 2002).

Carbon Emissions 2002



In contrast to most criteria pollutants, emissions of greenhouse gases have been rising from all sectors. From 1990 to 2002, carbon emissions from transportation grew by almost 18 percent. Overall, transportation contributes approximately one-third of national carbon emissions.

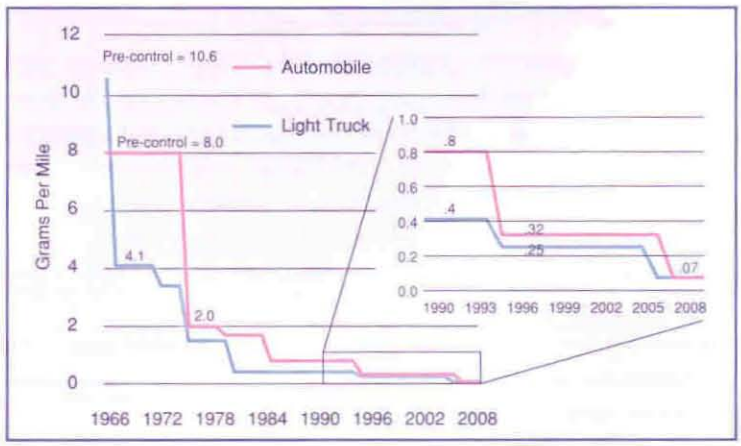
Source: Bureau of Transportation Statistics. *National Transportation Statistics* 2003. Table 4-49. March 2004. Web site: http://www.bts.gov/publications/national_transportation_statistics/2003/index.html 28 February 2005. U.S. Department of Energy, Energy Information Office. June 30, 2004. Web site: http://www.eia.doe.gov/neic/press/press238.html, 28 February 2005.
The United Nations Department of Economic and Social Affairs. *World Population Prospects: The 2004 Revision—Population Database*. Web site: http://esa.un.org/unpp/ 28 February 2005.

EMISSIONS STANDARDS

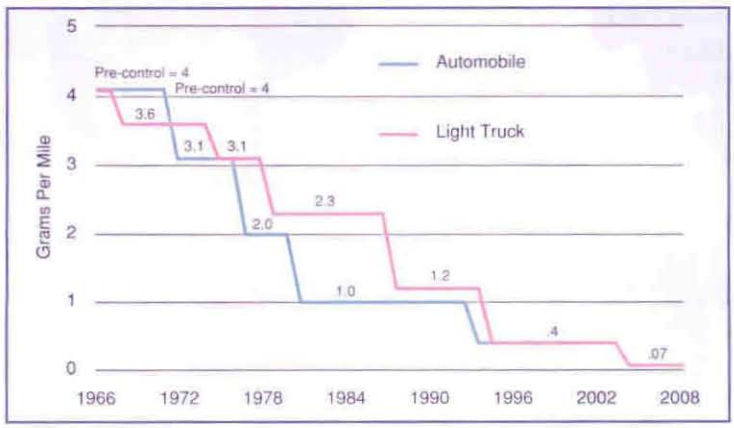
Federal Emissions Standards

The Clean Air Act of 1963 and 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 (CAAA) in 1990 established more stringent "Tier 1" emissions standards, which became effective in 1994. The CAAA also required studying more stringent "Tier 2" emission standards. In 1999, EPA determined that these were needed and cost-effective. Starting in 2004, all classes of passenger vehicles, including sport-utility vehicles, and light trucks, had to comply with new average tailpipe standards of .07 grams per mile for nitrogen oxides.

VOC

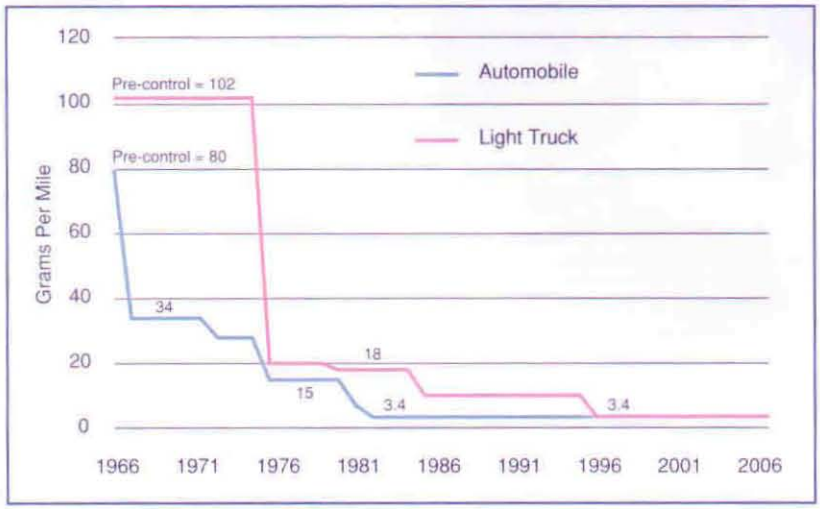


NO_x

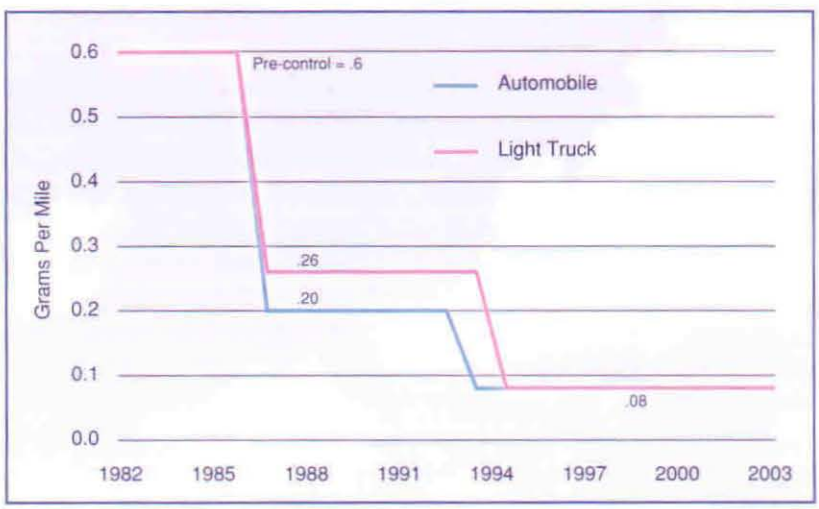


EMISSIONS STANDARDS

CO



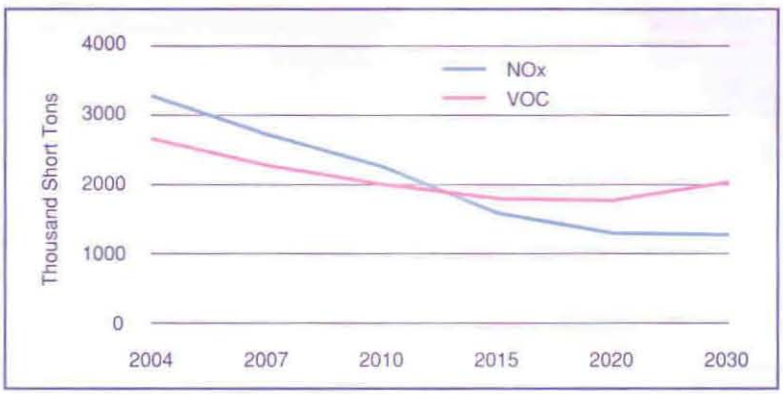
PM_{10}



Source: U.S. Department of Energy, Office of Energy Efficiency and Renewal Energy. *Transportation Energy Data Book: Edition 24*, ORNL-6973. December 2004.
Web site: http://cta.ornl.gov/data/tedb24/Edition24_Chapter12.pdf 28 June 2005.

Tier 2 Emissions Standards

Light-Duty Vehicle Emissions Under Tier 2 and Low-Sulfur Gasoline Rule



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

Source: U.S. Environmental Protection Agency, *Cleaner Vehicles and Cleaner Gasoline Tier 2/Gasoline Sulfur Rule*, 22 December 1999. Web site: http://www.epa.gov/otaq/regs/ld-hwy/tier-2/index.htm 29 June 2005.

EPA's engine and gasoline standards, commonly known as Tier 2, took effect in 2004. The standards were designed to reduce emissions from new passenger cars and light trucks, including pickup trucks, minivans, and sport-utility vehicles (SUVs). In 2004, the Nation's refiners and importers of gasoline began to manufacture gasoline with sulfur levels capped at 300 parts per million (ppm), approximately a 15-percent reduction from the previous industry average of 347 ppm. By 2006, refiners will meet a 30-ppm average sulfur level with a cap of 80 ppm. These fuels will enable vehicles to use emissions controls that will reduce tailpipe emissions of NO_x by 77 percent for passenger cars and by as much as 95 percent for pickup trucks, vans, and SUVs. When fully implemented, this program is expected to reduce mobile source emissions equivalent to taking 164 million cars off the road.

Sources: National Archives and Records Administration, *Code of Federal Regulations*, Title 40 Volume 11 Part 80, 1 July 1999. Web site: http://www.epa.gov/tier2/basicinfo.htm 28 June 2005.
National Archives and Records Administration, Code of Federal Regulations, Title 40 Volume 2 Part 86, 1 July 1999. Web site: http://www.access.gpo.gov/cgi-bin/cfrassemble.cgi?title=199940 28 June 2005.
U.S. Environmental Protection Agency, Transportation and Air Quality, *Tier 2 Vehicle & Gasoline Sulfur Program – Clean Vehicles + Clean Fuel = Cleaner Air*, Publication No. EPA420-F-04-002, January 2004. Web site: http://www.epa.gov/otaq/regs/ld-hwy/tier-2/420f04002.pdf 28 February 2005.

Heavy-Duty Diesel Emissions Standards

Due to the growth in freight movement, regulation of vehicles used to transport freight, as in the Clean Diesel Truck and Bus Rule, is becoming increasingly important.

In December 2000, EPA issued the final rule for a two-part strategy to reduce diesel emissions from heavy-duty trucks and buses. This included new diesel-engine standards 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 emissions-control devices are damaged by sulfur, EPA also initiated a program requiring cleaner diesel fuels. Refiners are required to start producing diesel fuel for highway vehicles with a sulfur content of no more than 15 ppm, beginning in 2006. This is down from the current level of 500 ppm, a 97 percent reduction. In order to ensure a smooth transition, these rules will be phased in between 2006 to 2010.

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

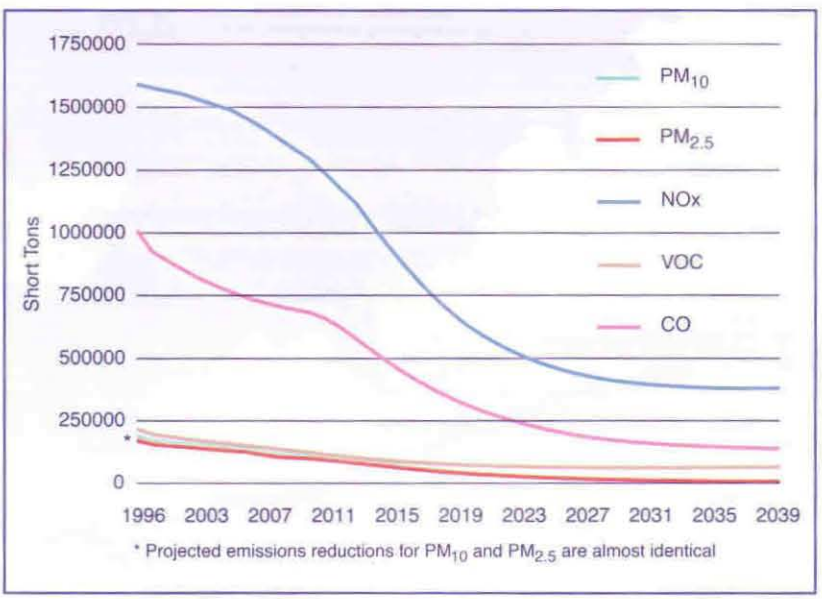
Source: U.S. Environmental Protection Agency, *Control of Air Pollution from New Motor Vehicles: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements, Regulatory Impact Analysis*, Tables II.B-19, II.B-20, II.B-21, December 2000.
Web site: http://www.epa.gov/otaq/regs/hd2007/frm/ria-ii.pdf February 28, 2005.
Note: Assumes a variable growth rate for VMT by Heavy-Duty Diesel Engines that averages 2.5 percent per year.

Non-Road Emissions Standards

In May 2004, EPA issued the Non-Road Diesel Rule, which will cut emissions from construction, agricultural, and industrial diesel-powered equipment by more than 90 percent. The new rule will also remove 99 percent of the sulfur in diesel fuel by 2010, resulting in dramatic reductions in soot from all diesel engines. The Non-Road Diesel Rule complements the Clean Diesel Truck and Bus Rule.

The Non-Road Diesel Rule will result in the widespread introduction of emissions control systems, which is comparable to the advent of catalytic converters for cars in the 1970s. The new standards, to be phased in over the next several years, will result in reductions of pollution equivalent to having some two million fewer trucks on the road.

Non-Road Diesel Emissions Reductions



Source: U.S. Environmental Protection Agency, *Nonroad Diesel Rule Summary*, May 2004, Web site: http://www.epa.gov/otaq/regs/nonroad/equip-hd/2004fr/420f04029.htm 14 June 2004, and *Clean Air Nonroad Diesel Rule–Facts and Figures*, Publication No. EPA420-F-04-037, May 2004.

VEHICLE EMISSIONS

Sources of Vehicle Emissions

The power to move a motor vehicle comes from burning fuel in an engine. Emissions from vehicles are the by-products of this combustion process. In addition, 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 VOC, NOx, PM, and CO, which are released from the tailpipe while a vehicle is operating. Exhaust emissions occur during two modes:

- Cold Start Emissions—starting a vehicle and the first few minutes of driving generate 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

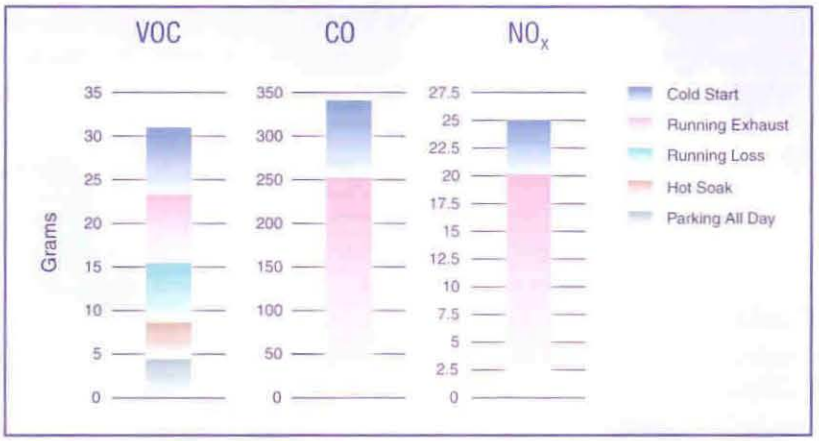
VOC also escape into the air through fuel evaporation. Despite evaporative emissions controls, evaporative losses can still account, on hot days, for a majority of the total VOC pollution from current model cars. Evaporative emissions occur in several ways:

- 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 evaporates 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

Average Emissions of a Typical Car on the Road in 2002



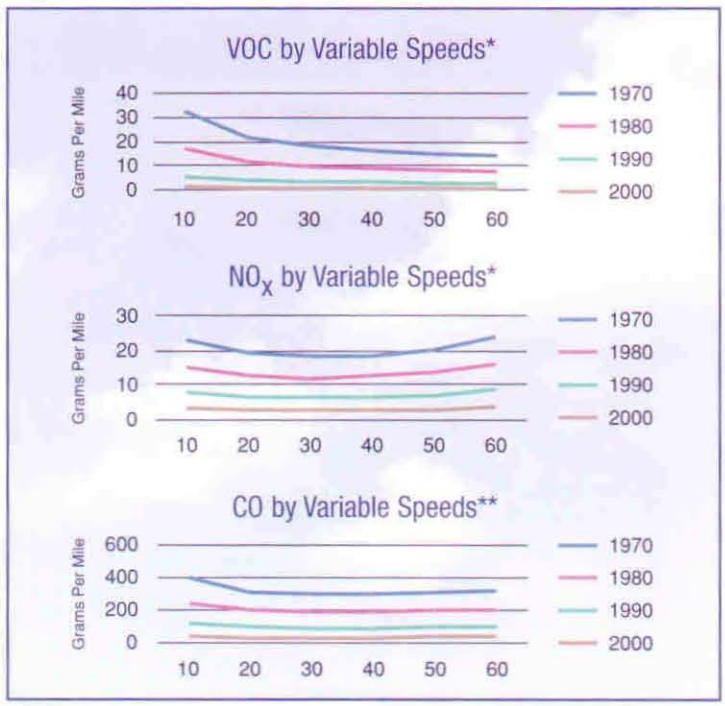
Starting a car cold increases trip emissions compared to starting an engine that is already warm. A typical automobile on the road in 2002 had an average trip length of 4.0 miles, and, with slightly more than 7 trips per day, an average of about 29 vehicle miles traveled per day. On a given weekday, cold starts of a typical vehicle produces 7.7 grams of VOC (25 percent of the typical daily emissions), 88 grams of CO (26 percent of the typical daily emissions), and 5 grams of NO_x (19 percent of the typical daily emissions). Running exhaust accounts for another 7.8 grams of VOC, 251 grams of CO, and 20.2 grams of NOx.

VOC are also emitted through fuel evaporation. For example, parking the car all day produces 4.3 grams of VOC.

Source: U.S. Environmental Protection Agency. MOBILE6.2 Model run assumed IDLE Test, *National Low Emission Vehicle Standards*, summer temperature 64-92 degrees, and United States average vehicle operations. 20 April 2004.

Emissions Rates at Different Operating Speeds

Emissions rates vary based on the speed a vehicle is traveling. EPA's model for highway vehicle emissions—MOBILE 6.2—shows how speed affects emissions rates. VOC and CO emissions rates typically drop as speed increases. NO_x emissions rates turn up at higher speeds. Emissions rates at all speeds have been falling over time as newer, more controlled vehicles enter the fleet.



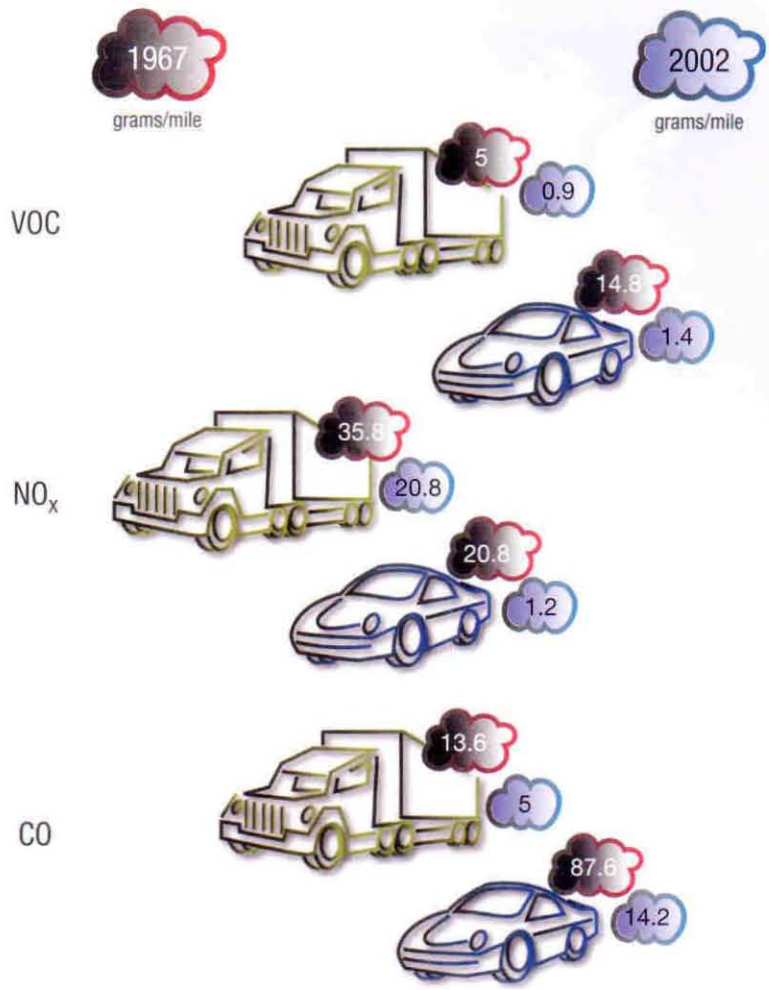
*Note: summer, freeway assumption used.
**Note: winter, freeway assumption used.

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

Source: U.S. Environmental Protection Agency. MOBILE 6.2 Model run 24 September 2003.

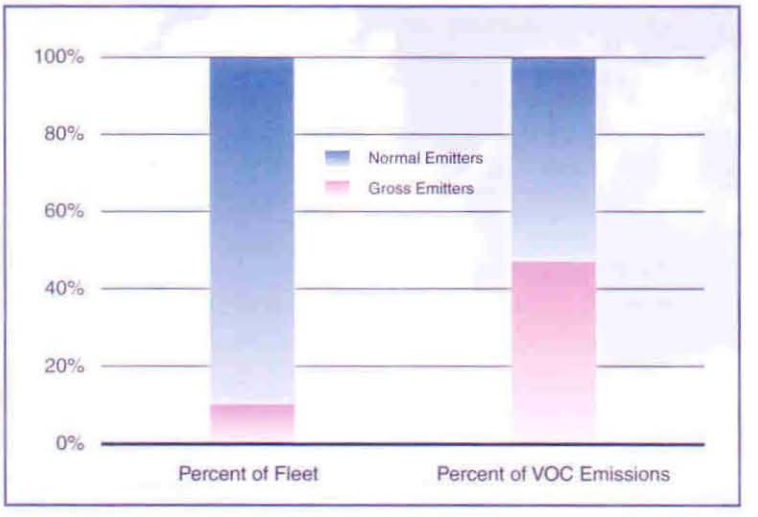
Car and Truck Emissions

These comparisons show estimated in-use emissions rates, in grams/mile, for cars and heavy-duty diesel trucks with 2002 control technology versus 1967 vehicles (before significant controls). Car emissions rates have declined by 80 percent to 95 percent depending on pollutant, while heavy-duty diesel truck emissions rates have declined by 82 percent for VOC, 42 percent for NO_x, and 63 percent for CO.



Source: U.S. Environmental Protection Agency, MOBILE6.2 Model run, 2 March 2005.

Gross Emitters



A small percentage of vehicles emit a large percentage of the pollution from on-road vehicles. These "gross emitters" include not only older model cars, but also some new 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, NOx , and others. Additionally, 10 percent to 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): 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 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. Two 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 National Ambient Air Quality Standards (NAAQS). Meeting the NAAQS often requires emissions reductions from mobile sources. Several transportation emissions reduction strategies are available and, in some regions, required to help regions attain the standards.

Inspection and Maintenance Programs

An Inspection and Maintenance Program (I&M) can help to identify excessive vehicle emissions so that the owner can get the vehicle repaired. I&M programs fall into two categories.

- 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 is required in areas with more severe air quality problems, and includes inspection for tampering with emissions controls or misfueling, use of computerized emissions analyzers, and inspection of on-board diagnostic systems.

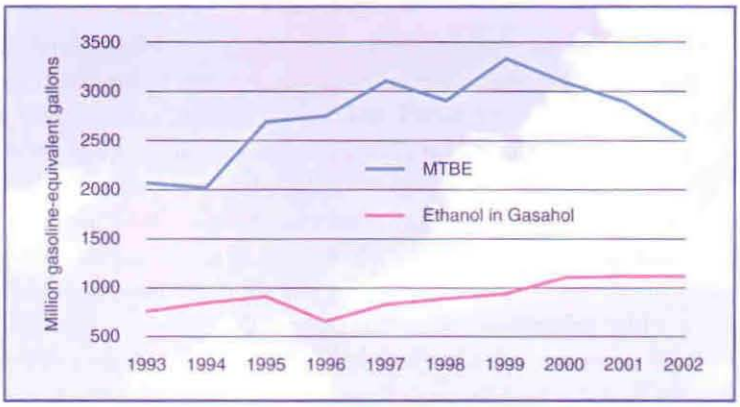
Technology Improvements

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. High sulfur content in fuel, like lead in the 1970s, 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 2. Researchers are exploring ways to reduce the time needed to heat the catalytic converter. At least one manufacturer has changed the placement of the catalytic converter so that it heats up and functions more quickly.

Idle Reduction—there is a concerted effort to establish and fund projects that reduce continuous idling of heavy-duty diesel truck engines at truck stops. These projects provide electric power for cab space cooling and heating, as well as other amenities, such as Internet access and television viewing. Idle-reduction measures can help meet multiple goals, including energy conservation, energy security and environmental stewardship. There are several technologies available to reduce idling including direct-fired heaters, Auxiliary Power Units (APUs), automatic engine idle management systems, and Truck Stop Electrification (TSE).

Diesel Retrofit—the growth in interstate commerce has spawned a corresponding growth in diesel truck traffic. As new measures and strategies are implemented to help meet the motor-vehicle emissions budgets in SIPs, expanded application of the diesel engine retrofit program could be an opportunity in many areas. Several retrofit emissions control technologies are available with varying levels of demonstrated effectiveness at reducing PM, VOC, CO, and air toxics. The diesel particulate filter has the potential to reduce particulates to near zero. Advanced diesel oxidation catalysts result in less dramatic reductions, but are less expensive and can run on diesel with higher sulfur levels. Various fuel additives can also help reduce emissions of some pollutants compared to regular diesel fuel.

Use of Reformulated Fuels 1993-2002



Oxygenates such as Methyl Tertiary Butyl Ether (MTBE) or Ethyl Tertiary Butyl Ether (ETBE) are blended with gasoline (reformulated fuel) to increase the oxygen content for more complete combustion in engines, resulting in decreased tailpipe emissions.

EPA has implemented two "cleaner burning" fuel programs. One is the Winter Oxyfuel Program that requires oxygenated fuel during the cold months in cities, which 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.

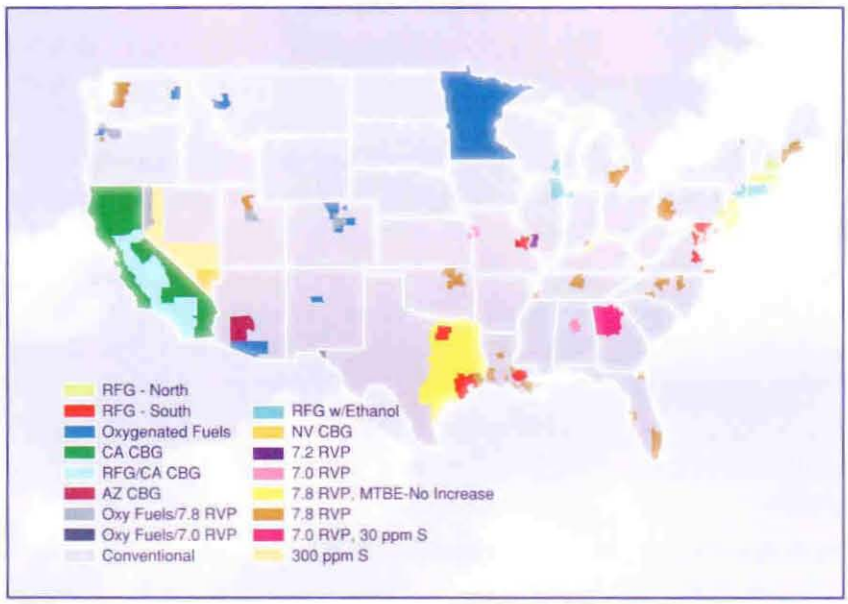
The Year-Round Reformulated Gasoline Program requires reformulated gasoline (RFG) year-round in cities with the worst ground-level ozone (smog). RFG is oxygenated fuel that is specially blended to have fewer polluting compounds than conventional gasoline.

As a result of its use in the nation's fuel supply, MTBE 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 2000.* Table 10. September 2002.
Web site: http://www.eia.doe.gov/cneaf/alternate/page/datatables/table10.html, 28 June 2005.

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

Gasoline Requirements



Gasoline requirements vary across the country. The map above depicts the 20 different fuel requirements currently used in the United States.

Source: ExxonMobil. U.S. Gasoline Requirements. K.W. Gardner, January 2004. Used with permission.

Alternative Fuels

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

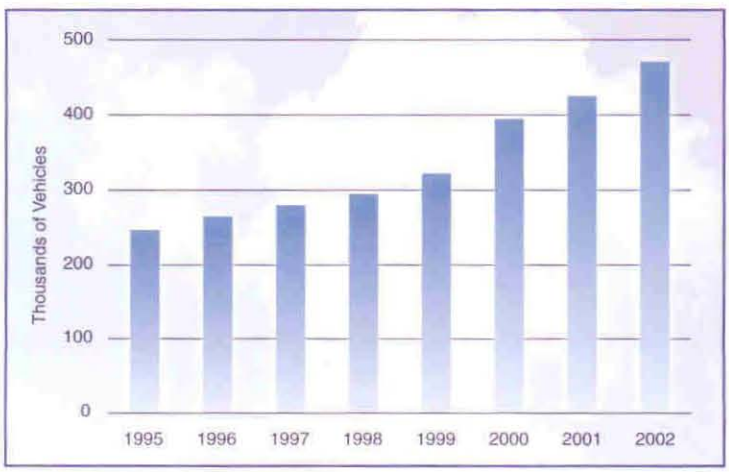
Natural Gas—A fuel that can be in compressed (CNG) or liquefied (LNG). The CNG form, more common in the transportation sector, is stored in high-pressure cylinders. CNG generates lower CO and VOC emissions than conventional gasoline, and lower NOx and PM than diesel fuels.

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 either 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—There are two types of engines that burn hydrogen. One is an internal combustion engine, the other is a fuel cell. Hydrogen is clean-burn-

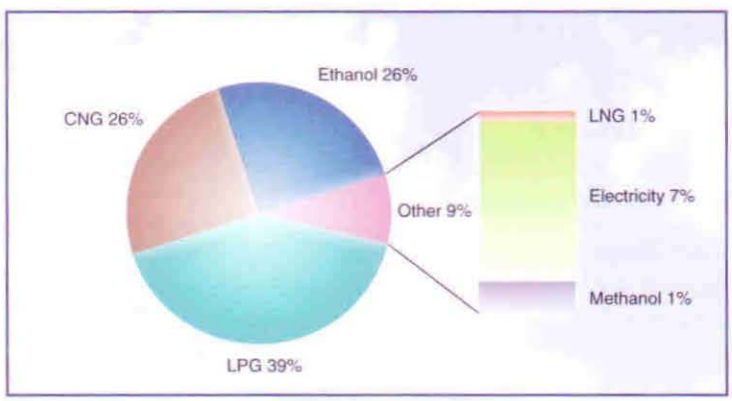
Alternative Fueled Vehicles in Use 1995-2002



ing fuel that can be produced from coal, natural gas, petroleum, 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 NOx emissions.

Use of alternative fuels for motor vehicles has increased in recent years. More than 471,000 alternative fuel vehicles (AFVs) were on the road in 2002, a 90 percent increase since 1995. These increases are due to a number of policies including the Energy Policy Act of 1992, Presidential Executive Order 12844, which requires minimum AFVs purchases for vehicle fleets, and the availability of federal funding under the Congestion Mitigation and Air Quality Improvement (CMAQ) program. Energy policy mandates requiring state and fuel provider fleets to acquire AFVs also took effect starting in model year 1997.

Share of Alternative Fuel Vehicle by Fuel Type 2002



AFVs designed to operate on Liquefied Petroleum Gas (LPG) were the most popular in 2002, followed by CNG and ethanol.

Source: U.S. Department of Energy, Energy Information Administration. *Alternatives to Traditional Transportation Fuels*. Table 1. September 2002.
Web site: http://www.eia.doe.gov/cneaf/alternate/page/datatables/table1.html 28 June 2005.

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 Measures (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—provision 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 the 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 arterials (i.e., major streets).

POLICY RESPONSES

Market-Based 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 their 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—vehicle registration fees based on emissions rates and/or miles driven.
- Fuel Taxes—taxes paid at the pump on motor vehicle fuels.

Employer-Based Measures

Measures that employers implement:

- 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, such as transit and vanpool vouchers, biking, walking, teleworking, roller blading, and others.

Non-Traditional Measures

- Episodic—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/or eliminating on-street parking.
- Car Sharing—establishes programs for people to use a shared vehicle for a short period of time as an incentive to forgo owning a vehicle altogether, or to leave their personal vehicle at home. Encourages use of alternative modes of transportation: transit, walking, etc.

EPA's Voluntary Programs

EPA developed a number of voluntary programs aimed at reducing emissions from diesel vehicles on the road today. Some of these include Clean School Bus USA, SmartWay Transport, and the Diesel Retrofit and Replacement Program.

Funding

Numerous sources are available to fund measures that reduce transportation-related emissions,including traditional funding sources, state and local sources, user fees, and private sector resources. One major soure of funds, the Congestion Mitigation and Air Quality Improvement (CMAQ) program, was authorized under the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991, and reauthorized under the Transportation Equity Act for the 21st Century (TEA-21), and the Safe, Accountable, Flexible, and Efficient Transportation Act:—A Legacy for Users (SAFETEA-LU).

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. The actual amount of funding is based on the severity of the air quality problem and the population of the area. 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 idle reduction, diesel retrofit and education and outreach programs, may also be eligible for CMAQ funds if they contribute to reductions in on-road mobile source emissions.

RESOURCES

Web Sites

U.S. Department of Transportation (DOT)
http://www.dot.gov

U.S. DOT, Federal Highway Administration (FHWA), Planning, Environment and Realty
http://www.fhwa.dot.gov/hep/

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

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. DOT, Center for Climate Change and Environmental Forecasting
http://climate.dot.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, 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

Other Potential Contacts

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

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

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

Transportation Research Board (TRB)
http://gulliver.trb.org/

Statistical Publications

Emissions of Greenhouse Gases in the United States 2003
http://www.eia.doe.gov/oiaf/1605/ggrpt/index.html

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

Highway Statistics 2003
http://www.fhwa.dot.gov/policy/ohim/hs03/index.htm

Latest Findings on National Air Quality: 2002 Status and Trends
http://www.epa.gov/ttn/chief/trends/

National Transportation Statistics
http://www.bts.gov/publications/national_transportation_statistics/

Statistical Abstract of the United States
http://www.census.gov/prod/www/statistical-abstract-04.html

Transportation Energy Data Book, Edition 24
http://cta.ornl.gov/data/index.shtml

Transportation Statistics Annual Report
http://www.bts.gov/publications/transportation_statistics_annual_report/

Other Publications

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

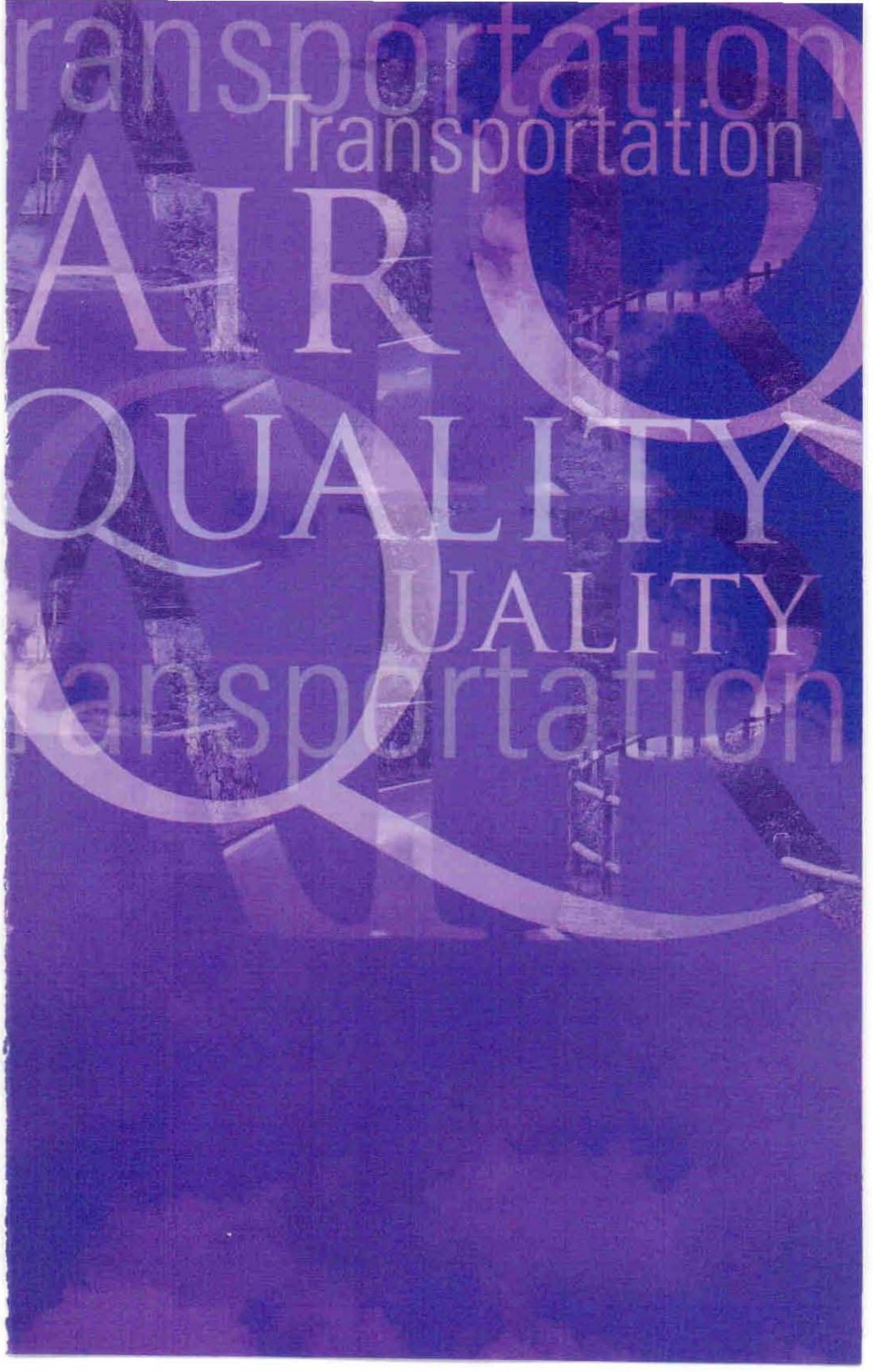
Emission Standards Reference Guide for Heavy-Duty and Nonroad Engines
http://www.epa.gov/otaq/cert/hd-cert/stds-eng.pdf

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/cmaq99gm.htm

States Guidance Document: Policy Planning to Reduce Greenhouse Gas Emissions, Second Edition
http://yosemite.epa.gov/oar/globalwarming.nsf/content/ResourceCenterPublications ReferenceStateGuidanceDocument.html

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

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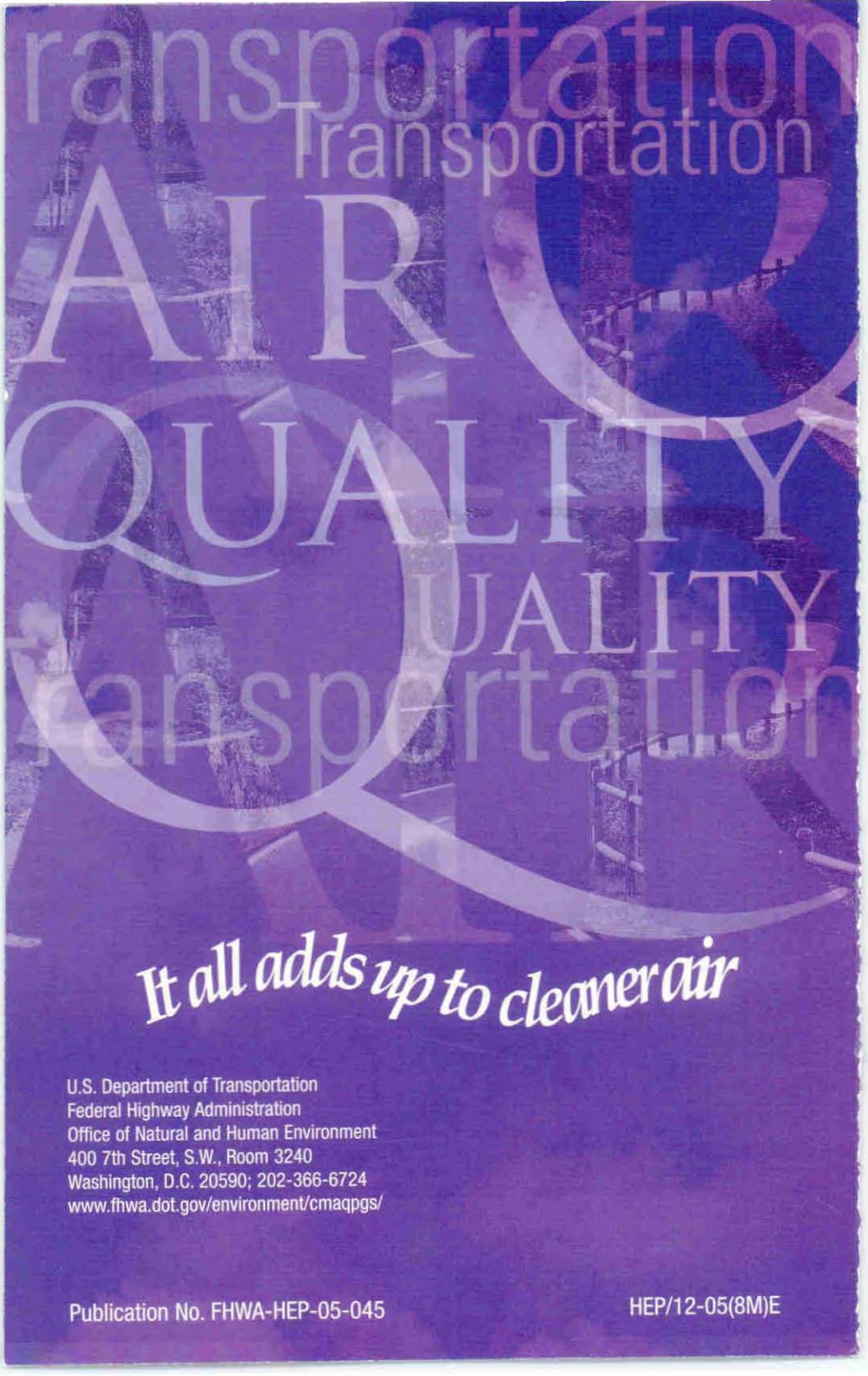

It all adds up to cleaner air

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Federal Highway Administration
Office of Natural and Human Environment
400 7th Street, S.W., Room 3240
Washington, D.C. 20590; 202-366-6724
www.fhwa.dot.gov/environment/cmaqpgs/

Publication No. FHWA-HEP-05-045

HEP/12-05(8M)E