March 2004

More Highways, More Pollution

Road-Building and Air Pollution in America's Cities

U.S. PIRG
Education Fund

MORE HIGHWAYS, MORE POLLUTION

ROAD-BUILDING AND AIR POLLUTION IN AMERICA’S CITIES

U.S. PIRG EDUCATION FUND

MARCH 2004

ACKNOWLEDGEMENTS

Written by Alison Cassady, Research Director with the U.S. PIRG Education Fund; Tony Dutzik, Policy Analyst with the State Public Interest Research Groups; and Emily Figdor, Clean Air Advocate with the U.S. PIRG Education Fund.

The authors would like to thank Brad Heavner, Director of MaryPIRG, and Michael Replogle, Transportation Director at Environmental Defense, for reviewing this report and offering comments.

Special thanks to the McKnight Foundation, New York Community Trust, and Surdna Foundation for supporting the environmental community's work on transportation issues. The views expressed in this report are those of the authors only and do not necessarily reflect the views of the funders.

For a copy of this report, visit our website or send a check for $25 made payable to U.S. PIRG Education Fund to the following address:

U.S. PIRG Education Fund
218 D Street, SE
Washington, DC 20003
(202) 546-9707
www.uspirg.org

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Building new highways will do little to alleviate traffic congestion in the long run and likely will exacerbate already severe air pollution problems in metropolitan areas across the country.

Despite tougher limits on tailpipe emissions and federal rules requiring that air quality play a role in transportation decision-making, cars and trucks remain a leading source of air pollution, particularly in urban areas, because of the dramatic rise in vehicle-miles traveled (VMT).

- Today's vehicles are 80 to 99 percent cleaner *per mile* than vehicles produced in the late 1960s. However, since 1970, the number of vehicle-miles traveled nationwide has increased by 159 percent, from 1.1 trillion in 1970 to 2.87 trillion in 2002, wiping out many of these potential gains.

- VMT has increased most rapidly in urban areas, where exposure to ozone smog and toxic air contaminants can have the greatest impacts on health. Between 1970 and 2002, VMT on urban roads and highways tripled from 570 billion to 1.73 trillion.

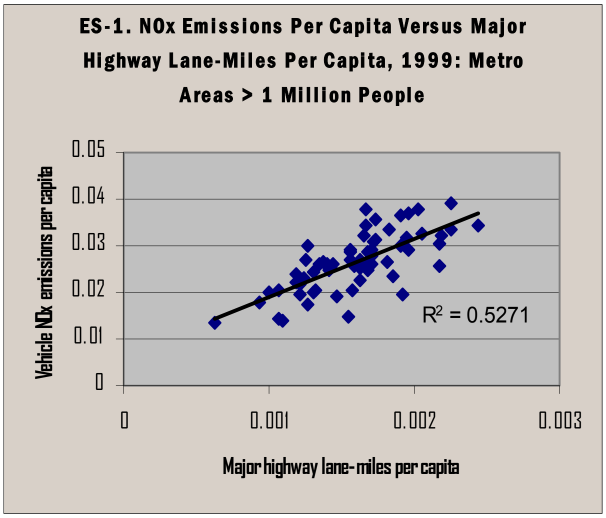
A growing body of evidence suggests that expansion of the nation's highway network has helped fuel the increase in driving. The expansion of highways triggers changes in driver behavior and land use that spur additional vehicle travel – a phenomenon called "induced travel."

To examine the link between highways and air pollution, we analyzed data on highway capacity and vehicle emissions for 314 metropolitan areas in the U.S. Key findings include the following:

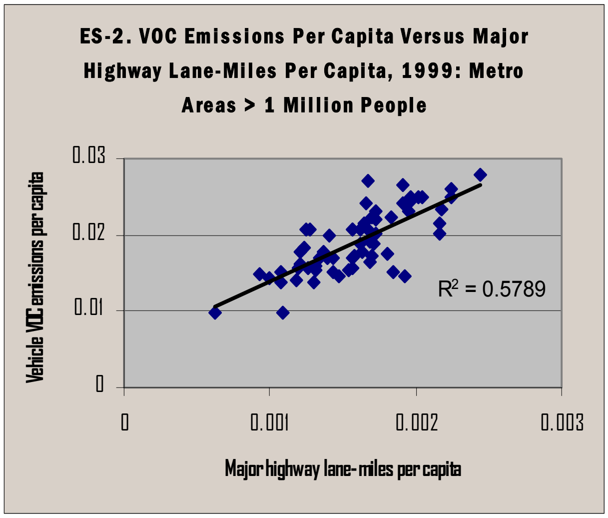
- Per capita, cities with more major highway capacity have higher levels of air pollution from vehicles. The correlation holds for small (under 250,000 population), medium (250,000 to one million), and large (one million and up) metropolitan areas. In all cases, the relationship between highway capacity and air pollution from vehicles is highly significant. The probability that these two factors are directly correlated is greater than 99.9%.

- The link between highway capacity and air pollution from cars and trucks is strongest in America's largest cities – those with at least one million people (see Figures ES-1 and ES-2.)

- All other things being equal, this correlation suggests that an average large city that expands its highway capacity by 14.6 percent – the national rate of growth in urban areas during the 1990s – could expect a 10.9 percent increase in emissions of nitrogen oxides (NOx) and a 10.7 percent increase in emissions of volatile organic compounds (VOCs). Both pollutants contribute to the formation of smog, and many VOCs are toxic to humans. Small and medium-sized cities could expect emissions of each of these pollutants to climb by 2.1 to 5.7 percent.



ES-1. NOx Emissions Per Capita Versus Major Highway Lane-Miles Per Capita, 1999: Metro Areas > 1 Million People



ES-2. VOC Emissions Per Capita Versus Major Highway Lane-Miles Per Capita, 1999: Metro Areas > 1 Million People

To check the growth of vehicular air pollution in metropolitan areas, state and federal officials should allocate a greater share of transportation resources to programs to reduce growth in the number of cars on the road and encourage alternative transportation modes such as transit. In addition, federal and state law must ensure that new transportation projects do not worsen air quality in metropolitan areas.

- The Transportation Equity Act for the 21st Century (TEA-21) gives states flexibility to spend federal transportation dollars to upgrade transportation alternatives and improve air quality. However, many states have failed to use this flexibility and continue to dedicate the lion's share of transportation funding to highway expansion. Rather than investing billions in new highway capacity, states should move forward with prudent, reasonable investments in transportation infrastructure while working to reduce the growth in vehicle-miles traveled on our highways.

- The Clean Air Act requires states to demonstrate that their planned transportation investments will not cause or exacerbate violations of national health-based air quality standards. State and federal officials must vigorously enforce this "transportation conformity" requirement to ensure improvements in air quality in metropolitan areas.

CURBING TAILPIPE EMISSIONS FROM CARS AND TRUCKS

Tailpipe Emissions, Human Health, and the Environment

The 1970 Clean Air Act, one of the nation's preeminent public health laws, has substantially improved air quality in the U.S. Despite this progress, the air in many metropolitan areas remains unhealthy to breathe. According to the American Lung Association, nearly half (49 percent) of all Americans live in places with unhealthy levels of ground-level ozone or "smog."[1] In 2002, air pollution monitors in 41 states and the District of Columbia registered more than 8,800 exceedances of the federal health standard for smog on 163 different days – the worst smog season in at least four years.[2]

The millions of cars, trucks, buses, and motorcycles traversing America's network of roads and highways remain a leading source of air pollution, particularly in urban areas, despite tighter emissions standards. Tailpipe emissions contain harmful pollutants, including:

Volatile Organic Compounds

Emissions of volatile organic compounds (VOCs) result from fuel evaporation and incomplete fuel combustion. VOCs are a precursor to ground-level ozone, a serious air pollutant in cities across the U.S. Ozone pollution contributes to health problems such as breathing difficulty, lung damage, and reduced cardiovascular functioning. Many VOCs also are considered toxic, meaning they can cause cancer or other health problems. On-road mobile sources – cars, trucks, and buses – were responsible for 29 percent of all VOC emissions in 1999.[3]

Nitrogen Oxides

Nitrogen oxides (NOx) form when fuel burns at high temperatures, such as in motor vehicle engines. Nitrogen oxides react with VOCs in the presence of sunlight to form ground-level ozone, a key component of smog. Children, people with lung diseases such as asthma, and people who work or exercise outside are particularly susceptible to adverse effects such as damage to lung tissue and reduction in lung function. Nitrogen oxides and sulfur dioxide also react with other substances in the air to form acid rain, which damages forests, lakes, rivers, and streams. On-road mobile sources were responsible for 34 percent of all NOx emissions in 1999.[4]

Particulate Matter

Particulate matter (PM) or "soot" is the term for solid or liquid particles in the air. The very tiny particles in soot can reach the deepest regions of the lungs and even pass through the lung into the blood. Particulate pollution is the deadliest pollutant, contributing to tens of thousands of premature deaths each year, as well as asthma attacks and other respiratory problems, heart attacks, and lung cancer. Fine PM can travel long distances on air currents and also is a major cause of the brownish haze that degrades visibility, destroying the spectacular scenic vistas of our national parks. On-road mobile sources were responsible for 10 percent of all fine PM ($PM_{2.5}$) emissions in 1999.[5] Tailpipe emissions account for a substantially higher portion of PM in urban areas, where the majority of mobile source emissions occur, such as nearly 40 percent of fine PM in Denver and Los Angeles.[6]

Air Toxics

Toxic or hazardous air pollutants, such as benzene, diesel exhaust, and formaldehyde, are known or suspected to cause cancer, birth defects, neurological damage, and other serious health effects.[7] On-road mobile sources were responsible for 30 percent of the 4.6 million tons of air toxics released in 1996.[8] The California Air Resources Board estimates that 90 percent of the cancer risk from air pollution in the state results from mobile source air toxics.[9]

Carbon Monoxide

Carbon monoxide forms when carbon in fuel does not burn completely. Carbon monoxide reduces oxygen delivery to the body's organs and tissues, particularly endangering those who suffer from heart and respiratory disease. On-road mobile sources were responsible for 51 percent of all carbon monoxide emissions in 1999.[10]

Tougher Tailpipe Standards, Limited Results

In the early 1960s, California became the first state to require pollution controls on vehicles. The federal government followed suit with passage of the original Clean Air Act in 1970. In the three decades since, California and federal officials have progressively tightened emissions standards for cars and trucks. As a result, vehicles manufactured today emit 80 to 99 percent less pollution than their 1960s counterparts.[11]

Cars and trucks remain a leading source of air pollution – despite tighter standards on tailpipe pollution – because of the dramatic growth in the number of miles traveled in motor vehicles in the U.S. The number of vehicle-miles traveled (VMT) on America's roads increased from 1.1 trillion miles in 1970 to 2.87 trillion miles in 2002 – a jump of 159 percent and almost four times faster than the rate of population growth.[12]

Much of that increase in travel has taken place in urban areas. Between 1970 and 2002, the amount of VMT on urban roads tripled – from 570 billion miles to 1.73 trillion miles.[13] (See Appendix B for data on daily VMT by urbanized area.)

The experience of the last 30 years has shown that limits on tailpipe emissions – while necessary – are not enough to resolve the problem of vehicular air pollution. Any strategy to reduce health threats from air pollution must include a strategy to curtail the growth of vehicle travel. In the early 1990s, federal lawmakers acknowledged the need for such a strategy in two groundbreaking laws: the Clean Air Act of 1990 and the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991.

The Clean Air Act and ISTEA

The Clean Air Act of 1990 prevented the federal government from funding or supporting any transportation plan or project that fails to conform to a state's plan for implementing the requirements of the Act. Specifically, transportation plans or programs cannot:

- cause or contribute to any new violation of any [air pollution health] standard in any area;

- increase the frequency or severity of any existing violation of any standard in any area; or

- delay timely attainment of any standard or any required interim emission reductions or other milestones in any area.[14]

Essentially, in areas with poor air quality, these "transportation conformity" rules prohibit motor vehicle emissions from exceeding a regional cap needed to meet or maintain national health-based air quality standards. If current or projected vehicle emissions exceed the regional cap, public funds for new highway construction are redirected to safety and transit projects until transportation plans are adjusted to meet air quality goals. Opponents of the rules often falsely claim that areas in a "conformity lapse" lose their highway funding. In 2003, EPA Assistant Administrator for Air and Radiation

Jeffrey Holmstead testified, “EPA has no knowledge of any state that has lost its highway funding due to an area’s inability to demonstrate conformity.”[15]

While these rules were created as a “stick,” the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 provided a “carrot” to encourage states to invest in transportation measures with the potential to reduce air pollution. Historically, states had enjoyed little flexibility in the allocation of federal transportation funding, and funding formulas tended to favor highway construction over transit. For the first time, ISTEA gave states and metropolitan areas the flexibility to use federal transportation funds for a wide range of projects. ISTEA ushered in a host of new concepts to transportation planning, including giving metropolitan planning organizations (MPOs) a leading role in planning, creating funding equity for highway and transit projects, and creating a new source of funds – the Congestion Mitigation and Air Quality Improvement (CMAQ) program – dedicated solely to reducing transportation’s role in air pollution.

The CMAQ Program

Enacted in 1991, the CMAQ program serves to achieve the air quality goals of the 1990 Clean Air Act Amendments by assisting nonattainment and maintenance areas in meeting the law’s requirements. CMAQ is the first and only federally funded transportation program explicitly targeting air quality improvements. Funding is apportioned to states based on the severity of their air quality problem and the size of the affected population.

CMAQ funding can be used for a range of activities, such as transit improvements, programs to encourage carpooling and otherwise reduce the number of cars on the road, public vehicle fleet conversions to cleaner fuels, and bicycle and pedestrian facilities, among other activities, but cannot be used to increase capacity for single-occupant vehicles.

For example, the CMAQ program allowed Chicago to add the first new commuter rail service in Northeastern Illinois since 1926. By reducing the number of commuters who drive, the project eliminates approximately 1040 pounds of smog-forming pollutants from the air each day.[16]

Despite the magnitude of the air quality problem in the U.S., CMAQ funds amount to just four percent of federal surface transportation dollars.[17] A 2002 National Academy of Sciences (NAS) report on the CMAQ program concluded that even at this modest funding level the program can make a critical difference in whether an area meets its air quality goals and recommended expanding the program.[18] According to the report, “Local agencies view the restrictions imposed on the use of CMAQ funds as one of the program’s most important strengths,” since a much larger share of highway funds are already available for road building.[19] Unfortunately, the NAS study found that state air agencies are neither consulted nor heavily involved in the development and evaluation of CMAQ projects, despite their mandate and expertise.

The need for CMAQ funds will soon increase, as EPA implements more protective air quality standards for soot ($PM_{2.5}$) and smog.

Looking Ahead

ISTEA and its successor, the Transportation Equity Act for the 21st Century (TEA-21), have sparked many positive developments – from a significant increase in new transit starts and transit ridership to the creation of bike lanes and other alternatives to the single-passenger automobile. However, many states have failed to take full advantage of the opportunity presented by ISTEA and TEA-21 to create transportation projects that reduce air pollution and protect public health.

Both the 1990 Clean Air Act and TEA-21 include important principles that have led to significant improvements in air quality and mobility in many regions of the country. However, the promise of these two laws has not yet been fulfilled, as evidenced by the continued dramatic growth in vehicle travel – and vehicular air pollution – in many metropolitan areas.

HOW HIGHWAY CONSTRUCTION SPURS TRAVEL ... AND CONGESTION

Despite the improvements in the last decade, federal transportation policy is overwhelmingly geared towards road-building, with $4 spent on highways for every $1 spent on public transit. From 1998 to 2003, federal funding for highways increased by more than 40 percent, while traffic congestion has continued to worsen, particularly in urban areas.[20]

The American Highway Users Alliance (AHUA), a large trade association representing car manufacturers, contractors, developers and other corporations with a financial stake in highway construction, argues that the solution is to build more roads, even at the expense of transit and other alternative forms of transportation.[21] In recent years, however, scholars and an increasing number of transportation planners have come to realize that building new roads actually spurs vehicle travel, creating new traffic.

Extending a highway into a new area effectively opens that area to large-scale development – often of the sprawling, auto-dependent variety. Meanwhile, the expansion of highway capacity can speed travel times to allow drivers to take more or longer trips in the same amount of time – or even encourage those who had shifted to other modes of transportation to return to driving. The end product of these decisions is more vehicle travel – a phenomenon known as "generated traffic."

Generated Traffic

The theory of generated traffic is straight out of basic economic theory – specifically, the concept of supply and demand, which holds that as supply of a given item increases, prices will drop, leading to increased consumption.

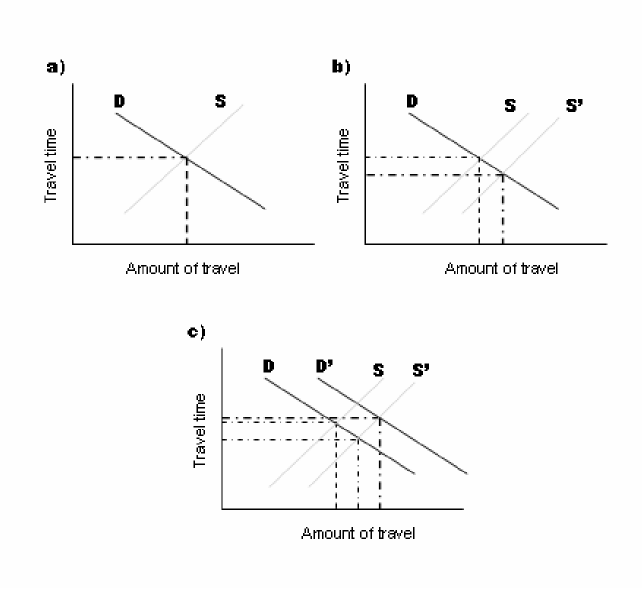
In the first graph below (Figure 1(a)), the curve D represents demand for a service and S represents supply. In the case of highway use, price can be expressed in terms of time – the longer it takes to get somewhere via a particular highway, the less likely people are to use it. The supply curve S represents the amount of travel possible on a highway at a particular cost in time.

Shifting the supply curve to S' by increasing the capacity of a highway decreases the cost of travel, leading in turn to increased travel on the highway. (See Figure 1(b).)

Yet the increase in travel along the existing demand curve is not the only effect of road expansion. The creation of a new or expanded highway not only results in a greater allocation of existing trips to the newly expanded highway, but it actually *expands the pool of potential trips* by attracting new development to the highway corridor and squeezing out other modes of travel (for example, causing a significant decrease in ridership that forces the elimination of a bus line).

The result is the creation of a new demand curve (D'). The new equilibrium (in Figure 1(c)) is the junction between the new, expanded supply curve (S') and the new demand curve (D'). In this example, not only has the amount of travel increased, but so has the price in terms of travel time. In short, each trip on the expanded highway takes longer than it did before the highway was expanded. This increased congestion is the result of generated traffic.

Figure 1. Supply and Demand Before Road Construction, After Highway Expansion, and After Generated Traffic



Of course, each situation will have its own unique supply and demand curves. In some cases, as in the hypothetical example above, the cost of travel may actually increase as a result of highway expansion, while in others it may be equal to or somewhat below what it was pre-expansion. The point of this example is that induced travel severely reduces the effectiveness of highway expansion as a means to reducing congestion in the long run.[a] Thus, not only does the highway expansion project in question lead to additional travel, it also does little to solve the initial congestion problem.

DIVERTED AND INDUCED TRAFFIC

There are two main categories of generated traffic: diverted traffic and induced traffic.

Diverted traffic is the shifting of existing trips to a different time, route, or destination. Diverted traffic can occur for several reasons:

- Travelers will alter the time of their trip to avoid congested periods. Expansion of capacity enables some drivers that had previously avoided "rush hour" to travel during the peak period.
- Travelers who typically use other routes will choose a highway with expanded capacity if they perceive their trip will be quicker.
- Travelers will sometimes alter their destination (choose to eat in a different restaurant, shop in a different mall, or live in a different neighborhood) if they perceive a reduction in travel time.

Induced traffic is the creation of entirely new automobile travel. Induced traffic also has several forms:

- Travelers switch from other modes of transport to automobile (for example, a bus passenger who decides to drive to work rather than ride the bus once new highway capacity is created).
- Travelers make entirely new trips.
- Residential and commercial development springs up along new highways and beyond their termini, attracting drivers to make trips that would otherwise not have been made. The perceived reduction in travel time allows this development to take place in more remote areas than would otherwise be possible.

Table A summarizes some of the types of driving behavior changes that can result from added highway capacity.

---

[a] It should be noted that the theory of generated traffic applies to other modes of travel as well. For example, the creation of a new transit line will spark commercial and residential development near the line that will result in increased ridership. In some cities, transit has become widely popular, resulting sometimes in overcrowded transit vehicles, full park-and-ride lots, and travel delays.

Table A. Sources of Generated Traffic

Type of Generated Traffic	Category	Time Frame	Travel Impacts	Cost Impacts
Shorter Route Improved road allows drivers to use more direct route.	Diverted trip	Short term	Reduction	Reduction
Longer Route Improved road attracts traffic from more direct routes.	Diverted trip	Short term	Small increase	Slight increase
Time Change Reduced peak period congestion reduces the need to defer trips to off-peak periods.	Diverted trip	Short term	None	Slight increase
Mode Shift: Existing Travel Choices Improved traffic flow makes driving relatively more attractive than other modes.	Induced vehicle trip	Short term	Increased driving	Moderate to large increase
Mode Shift: Changes in Travel Choice Less demand leads to reduced rail and bus service, less suitable conditions for walking and cycling, and more automobile ownership	Induced vehicle trip	Long term	Increased driving, reduced alternatives	Large increase, reduced equity
Destination Change: Existing Land Use Reduced travel costs allow drivers to choose farther destinations. No change in land use patterns.	Longer trip	Short term	Increase	Moderate to large increase
Destination Change: Land Use Changes Improved access allows land use changes, especially urban fringe development.	Longer trip	Long term	Increased driving and auto dependency	Moderate to large increase
New Trip: No Land Use Changes Improved travel time allows driving to substitute for non-travel activities.	Induced trip	Short term	Increase	Large increase, reduced equity
Automobile Dependency Synergetic effects of increased automobile oriented land use and transportation system.	Induced trip	Long term	Increased, driving fewer alternatives	Large increase, reduced equity

Source: Todd Litman, "Generated Traffic: Implications for Transport Planning," ITE Journal, *71(4), 38-47, Institute of Transportation Engineers, 2001. Also available at Victoria Transport Policy Institute (http://www.vtpi.org/gentraf.pdf).*

GENERATED TRAFFIC IN PRACTICE

Ample academic and anecdotal evidence suggests that the phenomenon of generated traffic is real – that significant increases in highway capacity lead to both increased driving in the short run and altered land-use patterns that promote automobile dependency in the long run.

- A 2000 study investigated the concept of induced travel by reviewing 26 years of data from every county in Maryland, Virginia, and North Carolina. The researchers found that a 10 percent increase in lane-miles resulted in an increase in vehicle-miles traveled of between two and six percent.[22] In the Baltimore-Washington area, the study found that about one-third of all additional road capacity was used up by induced travel. The results were similar for both urban (Baltimore/Washington) and mainly rural (North Carolina) areas studied. The researchers also concluded that the growth in lane-miles preceded the increase in vehicle travel.[23] Other studies have found even greater induced travel effects, estimating long-run travel increases at between six and 10 percent for every 10 percent expansion of highway lane-miles.[24]

- A 1999 study by the Surface Transportation Policy Project made the link between road construction and generated traffic even more explicit. Researchers contrasted levels of rush-hour congestion between metropolitan areas with "high" and "low" levels of road capacity expansion per capita. Their conclusion: rush-hour congestion was about the same in both types of metropolitan areas and was, in fact, slightly worse in those areas that had added the most highway capacity. The study found that a 10 percent increase in highway capacity was associated with a 5.3 percent increase in the amount of driving.[25]

- A 2000 study by the MaryPIRG Foundation documented that large-scale development has typically followed – not preceded – the construction of highways in Maryland. The study found that between 64 percent and 94 percent of properties in nine Maryland highway corridors were developed after completion of a major highway. Land near highways has developed more quickly than land outside highway corridors – and the difference becomes greater the farther one gets from the city center. For example, two percent more land has been developed in highway corridors five to 10 miles away from Baltimore than in non-corridor areas the same distance from the city. But when the distance becomes 15 to 20 miles, the difference in the amount of developed land reaches 13 percent.[26]

In 2002, Robert Noland of the Centre for Transport Studies at London's Imperial College of Science, Technology, and Medicine reviewed all of the recent research published in the U.S. and U.K. on the demand-inducing effects of increased highway capacity. He concludes that the most recent and peer-reviewed research shows "strong evidence that new transportation capacity induces increased travel, both due to short run effects and long run changes in land use development patterns." Noland adds that transportation planners in the U.S. and U.K. should shift the context of transportation policy from "congestion reduction to one of directing the growth of urbanized areas."[27]

FINDINGS: LINKING HIGHWAY CONSTRUCTION AND AIR POLLUTION

The American Highway Users Alliance and other advocates for new roads often claim that increasing highway capacity will reduce vehicular air pollution, arguing that "congestion is a serious barrier to the nation's otherwise impressive air quality progress."[28] However, studies of generated traffic outlined in the previous section show that highway expansions are far from a magic-bullet cure for congestion and may well increase overall vehicle travel.

To examine the link between highways and air pollution, we analyzed data on highway capacity and vehicle emissions for 314 metropolitan areas in the U.S. Our analysis shows that, per capita, cities with more highway capacity tend to have higher levels of air pollution from vehicles, casting further doubt on the assertion that increasing highway capacity will reduce vehicular pollution.

More Highways, More Pollution

The 314 metropolitan areas examined in this report vary in population from 60,000 to 9 million and in size from the sprawl of the Los Angeles metropolitan region to single-county urban centers in otherwise rural areas. Drawing valid comparisons among these areas is difficult. To do so, it is necessary first to correct for population by using per-capita figures, then to examine metropolitan areas of differing sizes (under the theory that more populous metropolitan areas will tend to be more dense than less populous areas) to ensure that the conclusions are applicable across all classes of areas.

The metropolitan-level data for 1999 show positive correlations between major highway capacity (as measured in lane-miles) and air pollution from all vehicles across metropolitan areas (see Figures 2 and 3). The correlations hold for small (under 250,000 population), medium (250,000 to one million), and large (one million and up) metropolitan areas (see Figures 4-9). In all cases, the relationship between highway capacity and air pollution from vehicles is highly significant. The probability that these two factors are directly correlated is greater than 99.9%.[29]

Figure 2. Vehicular NOx Emissions Per Capita Versus Major Highway Lane-Miles Per Capita, 1999, All Metro Areas

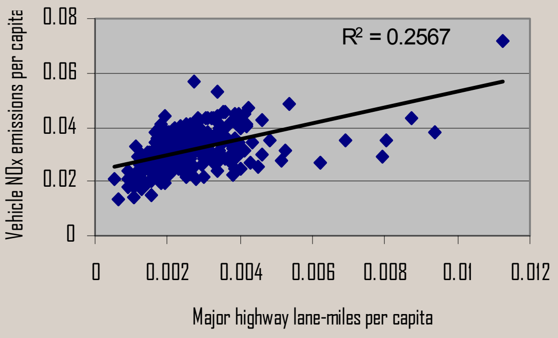
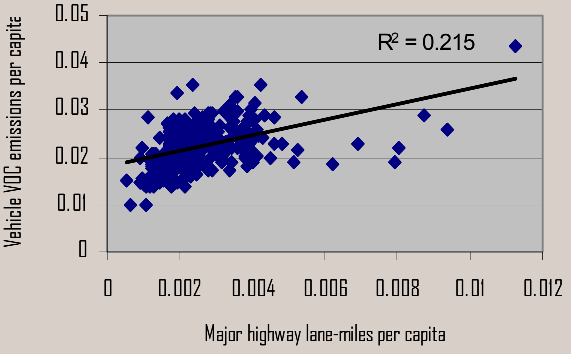


Figure 3. Vehicular VOC Emissions Per Capita Versus Major Highway Lane-Miles Per Capita, 1999, All Metro Areas



Figures 4-9. Vehicular NOx and VOC Emissions Per Capita Versus Lane-Miles of Major Highways Per Capita by Size of Metropolitan Area, 1999

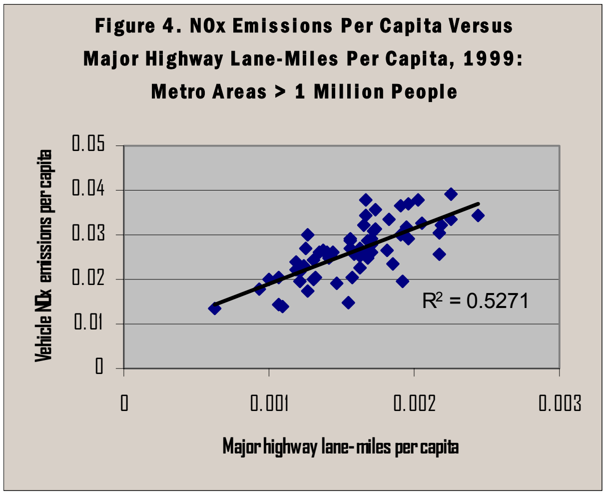


Figure 4. NOx Emissions Per Capita Versus Major Highway Lane-Miles Per Capita, 1999: Metro Areas > 1 Million People

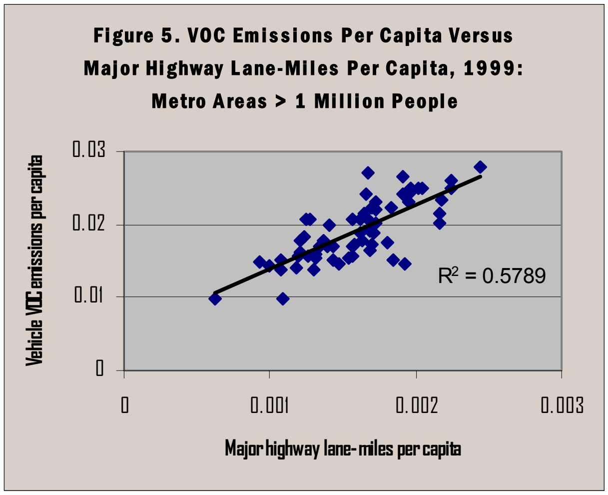


Figure 5. VOC Emissions Per Capita Versus Major Highway Lane-Miles Per Capita, 1999: Metro Areas > 1 Million People

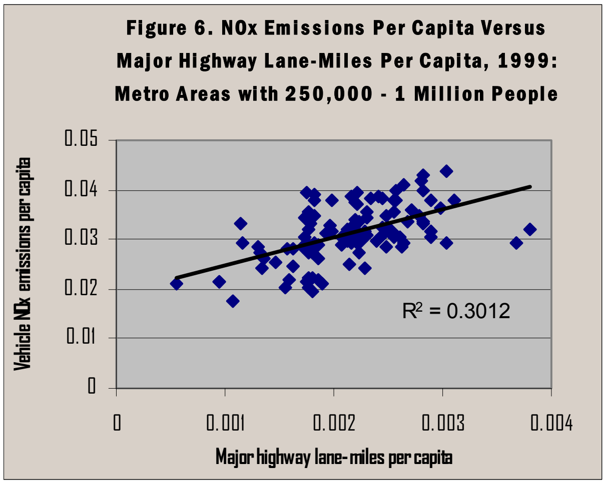


Figure 6. NOx Emissions Per Capita Versus Major Highway Lane-Miles Per Capita, 1999: Metro Areas with 250,000 - 1 Million People

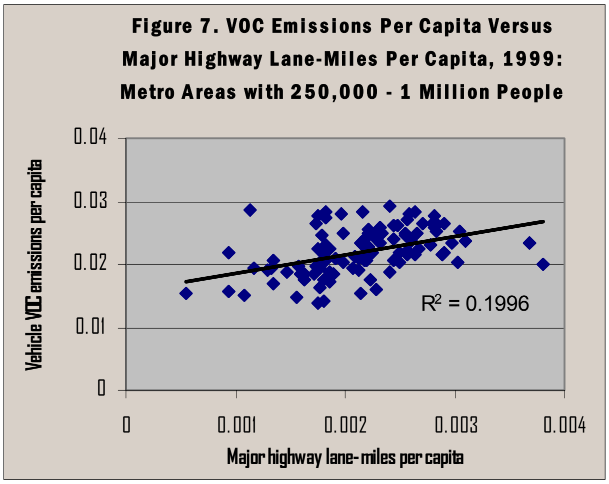


Figure 7. VOC Emissions Per Capita Versus Major Highway Lane-Miles Per Capita, 1999: Metro Areas with 250,000 - 1 Million People

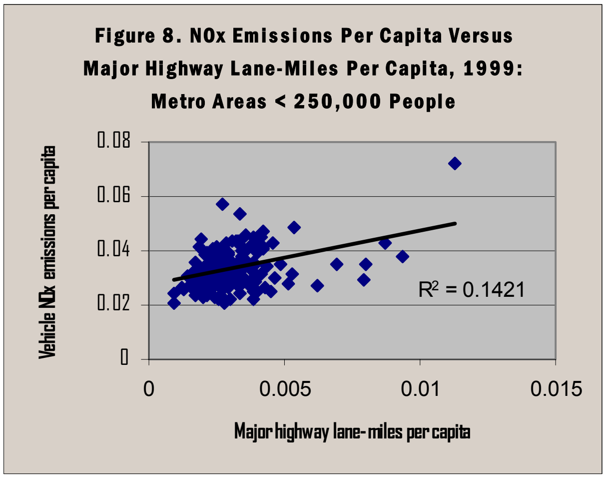


Figure 8. NOx Emissions Per Capita Versus Major Highway Lane-Miles Per Capita, 1999: Metro Areas < 250,000 People

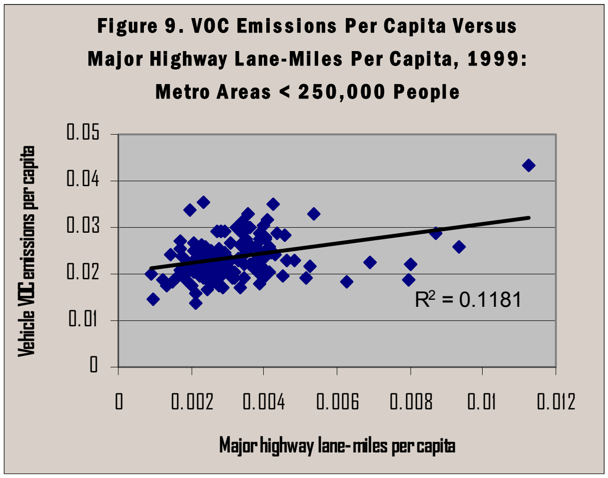


Figure 9. VOC Emissions Per Capita Versus Major Highway Lane-Miles Per Capita, 1999: Metro Areas < 250,000 People

As shown in Figures 4 and 5, the relationship between highway capacity and vehicular air pollution, per capita, is strongest in America's largest cities—those with at least one million people. See Appendices A and B for data on highway capacity, driving, and air pollution for each metropolitan area.

The positive correlation between highway capacity and vehicular air pollution suggests that highway expansion will lead to increased air pollution, all other factors held constant. For example, assume that an average large city expands its highway capacity by 14.6 percent – the national rate of growth in urban areas in the 1990s.[30] Based on the relationship between highway capacity and air pollution shown above, an average large city could expect a 10.9 percent increase in NOx emissions and a 10.7 percent increase in VOC emissions, assuming similar levels of per-vehicle pollution. Small and medium-sized cities could expect emissions of each of these pollutants to climb by 2.1 to 5.7 percent (see Tables B and C).

While road construction is not the only factor affecting per-capita emissions—population growth, air pollution standards, vehicle choice, and other factors also play a role, as do land-use patterns, which are in part driven by road construction—our analysis of 1999 data on highway capacity and air pollution suggests that metropolitan areas can directly influence their levels of vehicular air pollution by choosing to expand—or not expand—local highway capacity. These decisions will significantly affect regional efforts to meet health standards for smog and soot required under the Clean Air Act and needed to protect public health.

Table B. Increase in NOx Emissions (pounds) Associated with Hypothetical 14.6 Percent Increase in Highway Capacity (lane miles), By Population of Metropolitan Area

	Above 1 million	250,000-1 million	up to 250,000
Avg lane miles per capita 1999	0.00159	0.00214	0.00324
NOx emissions per capita 1999	53.0545	62.2665	68.1101
NOx emissions per capita after 15% increase	58.8639	65.7922	69.9721
% increase in NOx emissions	10.9%	5.7%	2.7%

Table C. Increase in VOC Emissions (pounds) Associated with Hypothetical 14.6 Percent Increase in Highway Capacity (lane miles), By Population of Metropolitan Area

	Above 1 million	250,000-1 million	up to 250,000
Avg lane miles per capita 1999	0.00159	0.00214	0.00324
VOC emissions per capita 1999	38.1111	44.0206	47.0647
VOC emissions per capita after 15% increase	42.2001	45.8695	48.0703
% increase in VOC emissions	10.7%	4.2%	2.1%

CONCLUSION AND RECOMMENDATIONS

The addition of new highway capacity brings with it the risk of generated traffic and increased vehicular air pollution. Such a risk is very real, even during a period of progressively tighter tailpipe emission standards. Adding new highway capacity, as the American Highway Users Alliance and other highway interests advocate, will do little to alleviate congestion in the long run and likely will exacerbate already severe air pollution problems in metropolitan areas across the country.

To prevent an increase in vehicular air pollution from further endangering public health, transportation planners must consider the air pollution impacts of transportation decisions and should pursue transportation alternatives – such as transportation demand management programs and transit investments – that reduce vehicle travel and promote the shift to other modes of transportation.

At the federal level, key air quality provisions of the Clean Air Act and TEA-21 that require transportation plans to adhere to clean air goals, provide a level fiscal playing field for transit and other alternatives, and dedicate CMAQ funding to projects that can make a significant impact on air pollution must be preserved.

At the state level, transportation planners should use the flexibility provided by TEA-21 to undertake projects that reduce vehicle travel, promote alternative modes of transportation, and pioneer new approaches such as the use of cleaner fuels to achieve air quality goals. There are numerous examples of states and regions that have used this flexibility to great effect. However, there are many others that have continued to treat highway expansion as the default solution to congestion and increased travel demand. Investing in transportation alternatives – at both the state and federal levels – is necessary to guarantee good air quality to residents of all of America's metropolitan areas.

SOURCES AND METHODOLOGY

Data for this report was collected from the following sources:

Road construction and vehicle-miles traveled data
Highway lane-miles data for 1999 were obtained from the Federal Highway Administration's (FHWA) Highway Performance Monitoring System (HPMS) database, downloaded from http://www.transtats.bts.gov/, September 25, 2003. "Major highways" as defined in this report include rural and urban interstates, freeways, and principal arterial roads within metropolitan areas, as defined by the FHWA's functional classification system.

Vehicle-miles traveled data for 2002 were obtained from the FHWA *Highway Statistics 2002* report, available at http://www.fhwa.dot.gov/policy/ohim/hs02/index.htm.

Air pollution data
Except when otherwise noted, all emissions data are based on Tier reports from the Environmental Protection Agency's AirData database, supplied by U.S. EPA on November 7, 2003. The county-level data supplied by EPA was then aggregated on a metropolitan level as described below.

Population data
County-level population estimates for 1999 were obtained from the U.S. Census Bureau at http://eire.census.gov/popest/archives/county/co_99_8.php, September 26, 2003.

Calculations of potential increases in NOx and VOC emissions from 14.6 percent increase in lane miles
In order to estimate the increase in NOx and VOC emissions that could be expected from a 14.65 percent increase in highway capacity (as measured in lane miles), we first averaged the number of lane miles per capita in 1999 for each size of metropolitan area studied and then multiplied each average by 1.1465. Then, using the equations generated from our analysis displayed in Figures 4 through 9, we plugged in the new number of lane miles per capita to determine the increase in per capita NOx or VOC emissions associated with the assumed increase in highway capacity.

Metropolitan area definitions and data aggregation
Except in the New England states, metropolitan areas referenced in this report are based on Metropolitan Statistical Areas (MSAs) defined by the U.S. Census Bureau, as obtained from http://www.census.gov/datamap/fipslist/mafips96.txt. Changes made to metropolitan area definitions after 1996 may not be reflected in this analysis. The urbanized areas referenced in the data presented in Appendix B do not share the same definitions as the metropolitan areas referenced elsewhere in the report.

For the New England states, Census Bureau MSA definitions are based on town boundaries, not county boundaries as is true in the rest of the country. Because town-level population estimates, VMT and road extent data, and air pollution data were not available, we revised the Census Bureau's boundaries for New England metropolitan areas. We also created new definitions roughly equivalent to the Boston Consolidated Metropolitan Statistical Area (CMSA) and the Connecticut portion of the New York CMSA. The New England metropolitan areas, as defined in this report, are as follows:

Bangor, Maine: Penobscot County

Barnstable/Yarmouth, Mass.: Barnstable County

Boston/Worcester/Lawrence, Mass.-N.H.-Maine:

In Massachusetts: Essex County, Middlesex County, Norfolk County, Plymouth County, Suffolk County, Worcester County

In New Hampshire: Hillsborough County, Merrimack County, Rockingham County, Strafford County

In Maine: York County

Burlington, Vt.: Chittenden County, Franklin County, Grand Isle County

Hartford, Conn.: Hartford County, Litchfield County, Middlesex County, Tolland County, Windham County

Lewiston/Auburn, Maine: Androscoggin County

New London/Norwich, Conn.: New London County

Bridgeport/Danbury/New Haven/Stamford, Conn.: Fairfield County, New Haven County, Litchfield County

Pittsfield, Mass.: Berkshire County

Portland, Maine: Cumberland County

Providence/Fall River/Warwick, Mass.-R.I.:

In Massachusetts: Bristol County

In Rhode Island: Bristol County, Kent County, Newport County, Providence County, Washington County

Springfield, Mass.: Hampden County, Hampshire County

APPENDIX A: MILES OF MAJOR HIGHWAY AND PER CAPITA EMISSIONS, BY METROPOLITAN AREA, 1999

METROPOLITAN AREAS WITH POPULATION OF MORE THAN 1 MILLION PEOPLE

Metropolitan area*	Rank (Lane miles per capita)	Lane miles of major highway 1999	Lane miles per capita 1999	Road miles of major highway 1999	Rank (Vehicular NOx per capita)	Vehicular NOx per capita 1999 (tons)	Rank (Vehicular VOCs per capita)	Vehicular VOCs per capita 1999 (tons)	1999 population
OKLAHOMA CITY, OK MSA	**1**	2,553	0.00244	615	**8**	0.0342	**1**	0.0278	1,046,283
NASHVILLE, TN MSA	**2**	2,642	0.00225	671	**1**	0.0391	**4**	0.0259	1,171,755
KANSAS CITY, MO-KS MSA	**3**	3,959	0.00225	1,110	**9**	0.0336	**7**	0.0250	1,755,899
FORT WORTH-ARLINGTON, TX PMSA	**4**	3,558	0.00218	886	**12**	0.0322	**12**	0.0233	1,629,213
LAS VEGAS, NV-AZ MSA	**5**	3,001	0.00217	905	**37**	0.0255	**26**	0.0201	1,381,086
MEMPHIS, TN-AR-MS MSA	**6**	2,395	0.00217	553	**17**	0.0306	**18**	0.0214	1,105,058
JACKSONVILLE, FL MSA	**7**	2,170	0.00205	553	**11**	0.0328	**8**	0.0249	1,056,332
GREENSBORO--WINSTON-SALEM--HIGH POINT, NC MSA	**8**	2,387	0.00202	596	**3**	0.0379	**5**	0.0250	1,179,384
ORLANDO, FL MSA	**9**	3,009	0.00196	767	**20**	0.0293	**6**	0.0250	1,535,004
RALEIGH-DURHAM-CHAPEL HILL, NC MSA	**10**	2,164	0.00196	556	**4**	0.0368	**9**	0.0246	1,105,535
DALLAS, TX PMSA	**11**	6,385	0.00195	1,532	**14**	0.0315	**13**	0.0232	3,280,310
RIVERSIDE-SAN BERNARDINO, CA PMSA	**12**	6,129	0.00192	1,469	**55**	0.0196	**55**	0.0145	3,200,587
AUSTIN-SAN MARCOS, TX MSA	**13**	2,191	0.00191	524	**19**	0.0300	**11**	0.0241	1,146,050
INDIANAPOLIS, IN MSA	**14**	2,937	0.00191	756	**5**	0.0365	**3**	0.0265	1,536,665
PHOENIX-MESA, AZ MSA	**15**	5,565	0.00185	1,214	**44**	0.0236	**52**	0.0151	3,013,696
ST. LOUIS, MO-IL MSA	**16**	4,709	0.00183	1,398	**10**	0.0334	**16**	0.0223	2,569,029
PITTSBURGH, PA MSA	**17**	4,224	0.00181	1,245	**31**	0.0263	**36**	0.0175	2,331,336
LOUISVILLE, KY-IN MSA	**18**	1,744	0.00173	427	**6**	0.0358	**14**	0.0230	1,005,849
GRAND RAPIDS-MUSKEGON-HOLLAND, MI MSA	**19**	1,816	0.00173	486	**15**	0.0314	**17**	0.0220	1,052,092
CINCINNATI, OH-KY-IN PMSA	**20**	2,801	0.00172	690	**16**	0.0307	**27**	0.0201	1,627,509
DENVER, CO PMSA	**21**	3,378	0.00171	801	**34**	0.0261	**30**	0.0189	1,978,991
SAN ANTONIO, TX MSA	**22**	2,666	0.00170	706	**25**	0.0279	**15**	0.0224	1,564,949

Metropolitan area*	Rank (Lane miles per capita)	Lane miles of major highway 1999	Lane miles per capita 1999	Road miles of major highway 1999	Rank (Vehicular NOx per capita)	Vehicular NOx per capita 1999 (tons)	Rank (Vehicular VOCs per capita)	Vehicular VOCs per capita 1999 (tons)	1999 population
HARTFORD, CT MSA	**23**	2,073	0.00170	559	**21**	0.0293	**37**	0.0173	1,219,041
BUFFALO-NIAGARA FALLS, NY MSA	**24**	1,924	0.00168	521	**29**	0.0266	**25**	0.0205	1,142,121
MILWAUKEE-WAUKESHA, WI PMSA	**25**	2,459	0.00168	690	**24**	0.0287	**29**	0.0190	1,462,422
PROVIDENCE-FALL RIVER-WARWICK, RI-MA MSA	**26**	2,538	0.00168	752	**41**	0.0249	**43**	0.0164	1,511,077
ATLANTA, GA MSA	**27**	6,435	0.00167	1,494	**2**	0.0379	**2**	0.0270	3,857,097
CHARLOTTE-GASTONIA-ROCK HILL, NC-SC MSA	**28**	2,356	0.00166	645	**7**	0.0343	**10**	0.0242	1,417,217
ROCHESTER, NY MSA	**29**	1,776	0.00165	545	**13**	0.0320	**19**	0.0214	1,079,073
WEST PALM BEACH-BOCA RATON, FL MSA	**30**	1,708	0.00163	395	**46**	0.0227	**35**	0.0178	1,049,420
SACRAMENTO, CA PMSA	**31**	2,574	0.00162	632	**38**	0.0251	**31**	0.0188	1,585,429
DETROIT, MI PMSA	**32**	7,253	0.00162	1,579	**28**	0.0268	**22**	0.0207	4,474,614
CLEVELAND-LORAIN-ELYRIA, OH PMSA	**33**	3,507	0.00158	874	**36**	0.0256	**38**	0.0173	2,221,181
NEW ORLEANS, LA MSA	**34**	2,051	0.00157	468	**49**	0.0206	**48**	0.0156	1,305,479
HOUSTON, TX PMSA	**35**	6,248	0.00156	1,403	**23**	0.0288	**24**	0.0207	4,010,969
COLUMBUS, OH MSA	**36**	2,319	0.00156	555	**22**	0.0292	**23**	0.0207	1,489,487
BALTIMORE, MD PMSA	**37**	3,877	0.00156	888	**27**	0.0269	**42**	0.0169	2,491,254
SAN JOSE, CA PMSA	**38**	2,540	0.00154	504	**59**	0.0148	**49**	0.0153	1,647,419
ORANGE COUNTY, CA PMSA	**39**	4,045	0.00147	753	**56**	0.0191	**56**	0.0145	2,760,948
WASHINGTON, DC-MD-VA-WV PMSA	**40**	6,805	0.00144	1,503	**33**	0.0261	**39**	0.0170	4,739,999
MIDDLESEX-SOMERSET-HUNTERDON, NJ PMSA	**41**	1,616	0.00143	336	**39**	0.0251	**51**	0.0151	1,130,592
TAMPA-ST. PETERSBURG-CLEARWATER, FL MSA	**42**	3,213	0.00141	790	**40**	0.0249	**28**	0.0199	2,278,169
BOSTON-WORCESTER-LAWRENCE, MA-NH-ME *	**43**	7,970	0.00140	2,323	**32**	0.0261	**41**	0.0169	5,688,850
SEATTLE-BELLEVUE-EVERETT, WA PMSA	**44**	3,204	0.00137	843	**30**	0.0264	**34**	0.0178	2,334,934
PORTLAND-VANCOUVER, OR-WA PMSA	**45**	2,476	0.00134	683	**35**	0.0261	**40**	0.0170	1,845,840
LOS ANGELES-LONG BEACH, CA PMSA	**46**	12,324	0.00132	2,452	**50**	0.0205	**45**	0.0159	9,329,989
BRIDGEPORT-DANBURY-NEW HAVEN-STAMFORD, CT *	**47**	2,388	0.00131	689	**42**	0.0242	**50**	0.0153	1,816,941
PHILADELPHIA, PA-NJ PMSA	**48**	6,447	0.00130	1,820	**52**	0.0201	**59**	0.0137	4,949,867
MINNEAPOLIS-ST. PAUL, MN-WI MSA	**49**	3,661	0.00127	949	**18**	0.0302	**20**	0.0208	2,872,109
OAKLAND, CA PMSA	**50**	2,971	0.00126	609	**58**	0.0175	**47**	0.0156	2,348,723
NORFOLK-VIRGINIA BEACH-NEWPORT NEWS, VA-NC MSA	**51**	1,952	0.00125	481	**26**	0.0269	**21**	0.0207	1,562,635

Metropolitan area*	Rank (Lane miles per capita)	Lane miles of major highway 1999	Lane miles per capita 1999	Road miles of major highway 1999	Rank (Vehicular NOx per capita)	Vehicular NOx per capita 1999 (tons)	Rank (Vehicular VOCs per capita)	Vehicular VOCs per capita 1999 (tons)	1999 population
FORT LAUDERDALE, FL PMSA	**52**	1,909	0.00124	331	**45**	0.0229	**32**	0.0182	1,535,468
SAN DIEGO, CA MSA	**53**	3,418	0.00121	623	**54**	0.0198	**44**	0.0162	2,820,844
SALT LAKE CITY-OGDEN, UT MSA	**54**	1,541	0.00121	327	**48**	0.0216	**33**	0.0179	1,275,076
NEWARK, NJ PMSA	**55**	2,317	0.00119	551	**43**	0.0241	**46**	0.0157	1,954,671
MONMOUTH-OCEAN, NJ PMSA	**56**	1,305	0.00118	339	**47**	0.0224	**58**	0.0140	1,108,977
NASSAU-SUFFOLK, NY PMSA	**57**	2,935	0.00109	693	**61**	0.0139	**61**	0.0098	2,688,904
SAN FRANCISCO, CA PMSA	**58**	1,807	0.00107	359	**60**	0.0142	**60**	0.0137	1,685,647
CHICAGO, IL PMSA	**59**	8,547	0.00107	2,296	**51**	0.0203	**53**	0.0151	8,008,507
BERGEN-PASSAIC, NJ PMSA	**60**	1,335	0.00100	338	**53**	0.0199	**57**	0.0143	1,342,116
MIAMI, FL PMSA	**61**	2,018	0.00093	426	**57**	0.0179	**54**	0.0148	2,175,634
NEW YORK, NY PMSA	**62**	5,380	0.00062	1,474	**62**	0.0136	**62**	0.0098	8,712,600

* Metropolitan area definitions differ from standard Census Bureau definitions. See “Sources and Methodology.”

METROPOLITAN AREAS WITH POPULATION OF 250,000-1 MILLION PEOPLE

Metropolitan area*	Rank (Lane miles per capita)	Lane miles of major highway 1999	Lane miles per capita 1999	Road miles of major highway 1999	Rank (Vehicular NOx per capita)	Vehicular NOx per capita 1999 (tons)	Rank (Vehicular VOCs per capita)	Vehicular VOCs per capita 1999 (tons)	1999 population
BAKERSFIELD, CA MSA	**1**	2,438	0.00380	684	**44**	0.0321	**77**	0.0199	642,495
FORT PIERCE-PORT ST. LUCIE, FL MSA	**2**	1,104	0.00368	298	**71**	0.0291	**38**	0.0235	299,967
HUNTINGTON-ASHLAND, WV-KY-OH MSA	**3**	968	0.00310	308	**16**	0.0379	**36**	0.0236	312,447
JACKSON, MS MSA	**4**	1,313	0.00304	350	**1**	0.0437	**22**	0.0254	432,647
WICHITA, KS MSA	**5**	1,664	0.00303	462	**69**	0.0293	**71**	0.0204	548,714
MACON, GA MSA	**6**	959	0.00298	251	**22**	0.0362	**40**	0.0234	321,586
JOHNSON CITY-KINGSPORT-BRISTOL, TN-VA MSA	**7**	1,341	0.00290	349	**15**	0.0379	**13**	0.0264	462,769
DES MOINES, IA MSA	**8**	1,285	0.00290	357	**60**	0.0304	**53**	0.0220	443,496
DAVENPORT-MOLINE-ROCK ISLAND, IA-IL MSA	**9**	1,037	0.00289	290	**52**	0.0315	**59**	0.0215	358,842
BEAUMONT-PORT ARTHUR, TX MSA	**10**	1,066	0.00283	288	**38**	0.0330	**23**	0.0254	376,256
BILOXI-GULFPORT-PASCAGOULA, MS MSA	**11**	996	0.00282	256	**2**	0.0430	**20**	0.0258	353,205
DAYTONA BEACH, FL MSA	**12**	1,337	0.00282	392	**34**	0.0336	**16**	0.0263	474,711
CHARLESTON, WV MSA	**13**	707	0.00282	188	**6**	0.0398	**12**	0.0268	251,199
EVANSVILLE-HENDERSON, IN-KY MSA	**14**	818	0.00281	225	**3**	0.0417	**8**	0.0278	291,181
UTICA-ROME, NY MSA	**15**	814	0.00278	241	**28**	0.0347	**42**	0.0231	293,068
SAVANNAH, GA MSA	**16**	781	0.00271	213	**23**	0.0360	**14**	0.0264	288,426
PEORIA-PEKIN, IL MSA	**17**	927	0.00267	256	**35**	0.0335	**49**	0.0223	346,480
CORPUS CHRISTI, TX MSA	**18**	1,027	0.00265	256	**72**	0.0291	**26**	0.0250	387,105
CHATTANOOGA, TN-GA MSA	**19**	1,193	0.00264	318	**4**	0.0409	**3**	0.0283	452,034
ALBUQUERQUE, NM MSA	**20**	1,786	0.00263	447	**76**	0.0286	**60**	0.0215	678,820
COLUMBUS, GA-AL MSA	**21**	707	0.00260	196	**62**	0.0303	**35**	0.0236	271,417
LEXINGTON, KY MSA	**22**	1,174	0.00258	297	**5**	0.0399	**6**	0.0280	455,617
LITTLE ROCK-NORTH LITTLE ROCK, AR MSA	**23**	1,439	0.00257	405	**18**	0.0378	**11**	0.0271	559,074
ROCKFORD, IL MSA	**24**	919	0.00256	276	**54**	0.0312	**51**	0.0221	358,640
OMAHA, NE-IA MSA	**25**	1,787	0.00256	506	**59**	0.0304	**61**	0.0214	698,875
SPRINGFIELD, MO MSA	**26**	787	0.00255	252	**19**	0.0377	**30**	0.0247	308,332
AUGUSTA-AIKEN, GA-SC MSA	**27**	1,174	0.00255	346	**26**	0.0354	**27**	0.0249	460,826

Metropolitan area*	Rank (Lane miles per capita)	Lane miles of major highway 1999	Lane miles per capita 1999	Road miles of major highway 1999	Rank (Vehicular NOx per capita)	Vehicular NOx per capita 1999 (tons)	Rank (Vehicular VOCs per capita)	Vehicular VOCs per capita 1999 (tons)	1999 population
SAGINAW-BAY CITY-MIDLAND, MI MSA	**28**	1,002	0.00250	265	**40**	0.0325	**56**	0.0217	400,753
APPLETON-OSHKOSH-NEENAH, WI MSA	**29**	868	0.00249	310	**78**	0.0286	**73**	0.0202	348,100
MONTGOMERY, AL MSA	**30**	799	0.00248	230	**27**	0.0349	**17**	0.0262	322,441
RICHMOND-PETERSBURG, VA MSA	**31**	2,357	0.00245	512	**12**	0.0382	**18**	0.0260	961,416
EUGENE-SPRINGFIELD, OR MSA	**32**	771	0.00245	291	**55**	0.0309	**68**	0.0205	314,901
MOBILE, AL MSA	**33**	1,309	0.00244	360	**41**	0.0324	**34**	0.0239	535,472
TULSA, OK MSA	**34**	1,893	0.00241	516	**11**	0.0386	**1**	0.0294	786,117
SALEM, OR PMSA	**35**	804	0.00240	273	**65**	0.0296	**86**	0.0189	335,156
FORT WAYNE, IN MSA	**36**	1,135	0.00234	349	**13**	0.0381	**28**	0.0249	484,320
COLUMBIA, SC MSA	**37**	1,194	0.00231	290	**25**	0.0355	**24**	0.0253	516,251
MELBOURNE-TITUSVILLE-PALM BAY, FL MSA	**38**	1,088	0.00231	286	**56**	0.0309	**19**	0.0260	470,365
ALBANY-SCHENECTADY-TROY, NY MSA	**39**	2,010	0.00231	546	**31**	0.0343	**41**	0.0233	869,474
SHREVEPORT-BOSSIER CITY, LA MSA	**40**	863	0.00229	236	**48**	0.0318	**33**	0.0240	377,673
SPOKANE, WA MSA	**41**	934	0.00228	260	**92**	0.0243	**99**	0.0159	409,736
CHARLESTON-NORTH CHARLESTON, SC MSA	**42**	1,244	0.00225	339	**64**	0.0298	**55**	0.0217	552,803
DUTCHESS COUNTY, NY PMSA	**43**	598	0.00223	196	**33**	0.0338	**54**	0.0219	268,237
STOCKTON-LODI, CA MSA	**44**	1,254	0.00223	349	**85**	0.0274	**94**	0.0175	563,183
LAFAYETTE, LA MSA	**45**	839	0.00222	225	**7**	0.0393	**21**	0.0256	377,238
HARRISBURG-LEBANON-CARLISLE, PA MSA	**46**	1,372	0.00222	395	**21**	0.0373	**29**	0.0248	618,375
HUNTSVILLE, AL MSA	**47**	759	0.00221	200	**66**	0.0294	**45**	0.0228	343,418
TALLAHASSEE, FL MSA	**48**	574	0.00221	176	**50**	0.0316	**50**	0.0222	260,003
MADISON, WI MSA	**49**	944	0.00220	251	**46**	0.0320	**57**	0.0216	428,563
LANSING-EAST LANSING, MI MSA	**50**	992	0.00220	252	**32**	0.0340	**46**	0.0226	450,789
SCRANTON--WILKES-BARRE--HAZLETON, PA MSA	**51**	1,344	0.00220	386	**51**	0.0316	**69**	0.0205	611,492
KALAMAZOO-BATTLE CREEK, MI MSA	**52**	980	0.00219	258	**20**	0.0375	**32**	0.0242	447,164
PORTLAND, ME MSA	**53**	560	0.00218	184	**61**	0.0304	**66**	0.0207	256,437
FAYETTEVILLE-SPRINGDALE-ROGERS, AR MSA	**54**	617	0.00216	176	**42**	0.0323	**43**	0.0230	285,017
LAKELAND-WINTER HAVEN, FL MSA	**55**	990	0.00216	272	**70**	0.0291	**37**	0.0235	457,347
KNOXVILLE, TN MSA	**56**	1,453	0.00216	367	**10**	0.0387	**5**	0.0282	672,087

Metropolitan area*	Rank (Lane miles per capita)	Lane miles of major highway 1999	Lane miles per capita 1999	Road miles of major highway 1999	Rank (Vehicular NOx per capita)	Vehicular NOx per capita 1999 (tons)	Rank (Vehicular VOCs per capita)	Vehicular VOCs per capita 1999 (tons)	1999 population
ATLANTIC-CAPE MAY, NJ PMSA	**57**	725	0.00215	209	**90**	0.0250	**101**	0.0155	337,635
TOLEDO, OH MSA	**58**	1,307	0.00215	384	**49**	0.0317	**39**	0.0234	608,976
ERIE, PA MSA	**59**	591	0.00213	185	**63**	0.0298	**84**	0.0192	276,993
SYRACUSE, NY MSA	**60**	1,560	0.00213	450	**43**	0.0322	**63**	0.0210	732,920
YOUNGSTOWN-WARREN, OH MSA	**61**	1,225	0.00208	339	**57**	0.0306	**62**	0.0212	589,236
GARY, IN PMSA	**62**	1,299	0.00207	344	**74**	0.0290	**81**	0.0193	628,377
GREENVILLE-SPARTANBURG-ANDERSON, SC MSA	**63**	1,854	0.00199	461	**17**	0.0378	**25**	0.0251	929,565
WILMINGTON-NEWARK, DE-MD PMSA	**64**	1,132	0.00198	269	**47**	0.0318	**72**	0.0204	571,420
FAYETTEVILLE, NC MSA	**65**	558	0.00197	139	**39**	0.0328	**7**	0.0279	283,650
BOISE CITY, ID MSA	**66**	783	0.00192	228	**53**	0.0313	**64**	0.0209	407,844
SANTA BARBARA-SANTA MARIA-LOMPOC, CA MSA	**67**	737	0.00189	201	**102**	0.0210	**89**	0.0186	391,071
AKRON, OH PMSA	**68**	1,285	0.00186	344	**73**	0.0290	**88**	0.0187	689,435
SALINAS, CA MSA	**69**	691	0.00186	188	**96**	0.0221	**96**	0.0173	371,756
SARASOTA-BRADENTON, FL MSA	**70**	1,017	0.00185	257	**87**	0.0263	**48**	0.0224	550,077
NEWBURGH, NY-PA PMSA	**71**	689	0.00183	189	**9**	0.0389	**44**	0.0230	375,556
BIRMINGHAM, AL MSA	**72**	1,671	0.00183	410	**14**	0.0380	**10**	0.0273	915,077
BATON ROUGE, LA MSA	**73**	1,057	0.00183	270	**67**	0.0294	**70**	0.0205	578,946
PENSACOLA, FL MSA	**74**	734	0.00182	209	**29**	0.0346	**4**	0.0282	403,384
KILLEEN-TEMPLE, TX MSA	**75**	535	0.00180	143	**83**	0.0274	**58**	0.0216	296,316
EL PASO, TX MSA	**76**	1,265	0.00180	307	**105**	0.0194	**105**	0.0142	701,908
SOUTH BEND, IN MSA	**77**	465	0.00180	145	**84**	0.0274	**65**	0.0208	258,537
BROWNSVILLE-HARLINGEN-SAN BENITO, TX MSA	**78**	592	0.00180	160	**95**	0.0223	**95**	0.0175	329,131
FLINT, MI PMSA	**79**	782	0.00179	174	**37**	0.0331	**31**	0.0247	437,349
FRESNO, CA MSA	**80**	1,560	0.00177	468	**75**	0.0290	**74**	0.0202	879,829
VALLEJO-FAIRFIELD-NAPA, CA PMSA	**81**	897	0.00177	214	**94**	0.0223	**83**	0.0193	506,685
TRENTON, NJ PMSA	**82**	590	0.00177	159	**45**	0.0320	**75**	0.0200	333,861
VENTURA, CA PMSA	**83**	1,317	0.00177	321	**103**	0.0204	**98**	0.0163	745,063
RENO, NV MSA	**84**	565	0.00177	137	**82**	0.0275	**76**	0.0200	319,816
ANN ARBOR, MI PMSA	**85**	979	0.00176	283	**24**	0.0355	**47**	0.0225	557,349

Metropolitan area*	Rank (Lane miles per capita)	Lane miles of major highway 1999	Lane miles per capita 1999	Road miles of major highway 1999	Rank (Vehicular NOx per capita)	Vehicular NOx per capita 1999 (tons)	Rank (Vehicular VOCs per capita)	Vehicular VOCs per capita 1999 (tons)	1999 population
HICKORY-MORGANTON-LENOIR, NC MSA	**86**	571	0.00175	173	**8**	0.0393	**9**	0.0278	325,821
COLORADO SPRINGS, CO MSA	**87**	876	0.00175	256	**99**	0.0213	**106**	0.0137	499,994
READING, PA MSA	**88**	623	0.00174	185	**58**	0.0305	**78**	0.0198	358,211
VISALIA-TULARE-PORTERVILLE, CA MSA	**89**	621	0.00173	205	**30**	0.0345	**15**	0.0263	358,470
ALLENTOWN-BETHLEHEM-EASTON, PA MSA	**90**	1,058	0.00171	336	**79**	0.0285	**92**	0.0184	618,350
SPRINGFIELD, MA MSA	**91**	959	0.00163	312	**81**	0.0281	**90**	0.0185	589,171
TUCSON, AZ MSA	**92**	1,308	0.00163	320	**91**	0.0244	**93**	0.0175	803,618
PROVO-OREM, UT MSA	**93**	551	0.00159	145	**97**	0.0220	**91**	0.0185	346,997
DAYTON-SPRINGFIELD, OH MSA	**94**	1,519	0.00158	402	**80**	0.0281	**79**	0.0197	958,698
BOULDER-LONGMONT, CO PMSA	**95**	422	0.00155	124	**104**	0.0201	**104**	0.0149	273,112
CANTON-MASSILLON, OH MSA	**96**	590	0.00147	186	**89**	0.0255	**87**	0.0188	402,460
MCALLEN-EDINBURG-MISSION, TX MSA	**97**	722	0.00135	198	**88**	0.0262	**67**	0.0206	534,907
TACOMA, WA PMSA	**98**	926	0.00134	238	**93**	0.0242	**97**	0.0169	688,807
MODESTO, CA MSA	**99**	578	0.00132	155	**86**	0.0273	**82**	0.0193	436,790
LANCASTER, PA MSA	**100**	599	0.00130	202	**77**	0.0286	**85**	0.0190	460,035
YORK, PA MSA	**101**	437	0.00116	136	**68**	0.0293	**80**	0.0194	376,586
FORT MYERS-CAPE CORAL, FL MSA	**102**	456	0.00114	112	**36**	0.0331	**2**	0.0287	400,542
HONOLULU, HI MSA	**103**	931	0.00108	226	**106**	0.0176	**103**	0.0151	864,571
HAMILTON-MIDDLETOWN, OH PMSA	**104**	314	0.00094	94	**98**	0.0214	**100**	0.0156	333,486
SANTA ROSA, CA PMSA	**105**	415	0.00094	114	**100**	0.0213	**52**	0.0220	439,970
JERSEY CITY, NJ PMSA	**106**	305	0.00055	65	**101**	0.0212	**102**	0.0153	552,819

* Metropolitan area definitions differ from standard Census Bureau definitions. See “Sources and Methodology.”

METROPOLITAN AREAS WITH POPULATION OF UNDER 250,000 PEOPLE

Metropolitan area*	Rank (Lane miles per capita)	Lane miles of major highway 1999	Lane miles per capita 1999	Road miles of major highway 1999	Rank (Vehicular NOx per capita)	Vehicular NOx per capita 1999 (tons)	Rank (Vehicular VOCs per capita)	Vehicular VOCs per capita 1999 (tons)	1999 population
FLAGSTAFF, AZ-UT MSA	**1**	1,360	0.01127	522	**1**	0.0718	**1**	0.0434	120,652
CASPER, WY MSA	**2**	592	0.00937	207	**43**	0.0378	**37**	0.0257	63,157
CHEYENNE, WY MSA	**3**	688	0.00872	202	**17**	0.0432	**19**	0.0290	78,877
BISMARCK, ND MSA	**4**	736	0.00801	231	**63**	0.0350	**87**	0.0220	91,939
GRAND FORKS, ND-MN MSA	**5**	758	0.00794	208	**104**	0.0292	**128**	0.0190	95,461
RAPID CITY, SD MSA	**6**	610	0.00692	179	**66**	0.0348	**82**	0.0227	88,117
GREAT FALLS, MT MSA	**7**	488	0.00624	162	**118**	0.0273	**134**	0.0184	78,282
TEXARKANA, TX-TEXARKANA, AR MSA	**8**	656	0.00534	200	**4**	0.0489	**7**	0.0327	122,886
DULUTH-SUPERIOR, MN-WI MSA	**9**	1,244	0.00526	358	**86**	0.0316	**94**	0.0216	236,400
BILLINGS, MT MSA	**10**	656	0.00515	202	**117**	0.0276	**127**	0.0190	127,258
POCATELLO, ID MSA	**11**	362	0.00484	109	**60**	0.0351	**78**	0.0229	74,881
PINE BLUFF, AR MSA	**12**	373	0.00462	122	**99**	0.0300	**76**	0.0230	80,785
ALEXANDRIA, LA MSA	**13**	582	0.00459	185	**18**	0.0429	**23**	0.0285	126,775
ENID, OK MSA	**14**	257	0.00451	66	**130**	0.0253	**115**	0.0198	56,954
AMARILLO, TX MSA	**15**	904	0.00433	223	**70**	0.0343	**21**	0.0288	208,691
WICHITA FALLS, TX MSA	**16**	585	0.00429	159	**122**	0.0266	**54**	0.0243	136,493
LAS CRUCES, NM MSA	**17**	723	0.00424	186	**5**	0.0475	**3**	0.0352	170,361
BLOOMINGTON-NORMAL, IL MSA	**18**	611	0.00420	183	**29**	0.0405	**52**	0.0246	145,477
YUMA, AZ MSA	**19**	568	0.00419	174	**28**	0.0412	**46**	0.0250	135,614
GREELEY, CO PMSA	**20**	684	0.00413	186	**9**	0.0450	**39**	0.0257	165,805
FARGO-MOORHEAD, ND-MN MSA	**21**	701	0.00412	183	**91**	0.0312	**108**	0.0203	170,122
SANTA FE, NM MSA	**22**	581	0.00408	164	**25**	0.0414	**8**	0.0316	142,509
ST. JOSEPH, MO MSA	**23**	394	0.00405	136	**23**	0.0415	**24**	0.0281	97,220
LUBBOCK, TX MSA	**24**	914	0.00401	220	**94**	0.0307	**28**	0.0275	227,890
WAUSAU, WI MSA	**25**	495	0.00400	156	**34**	0.0395	**63**	0.0240	123,584
GRAND JUNCTION, CO MSA	**26**	460	0.00400	127	**131**	0.0250	**124**	0.0191	115,147
JAMESTOWN, NY MSA	**27**	549	0.00399	182	**20**	0.0425	**70**	0.0232	137,431

Metropolitan area*	Rank (Lane miles per capita)	Lane miles of major highway 1999	Lane miles per capita 1999	Road miles of major highway 1999	Rank (Vehicular NOx per capita)	Vehicular NOx per capita 1999 (tons)	Rank (Vehicular VOCs per capita)	Vehicular VOCs per capita 1999 (tons)	1999 population
TERRE HAUTE, IN MSA	**28**	592	0.00399	166	**8**	0.0452	**10**	0.0303	148,206
RICHLAND-KENNEWICK-PASCO, WA MSA	**29**	729	0.00395	192	**67**	0.0347	**93**	0.0216	184,626
GAINESVILLE, FL MSA	**30**	779	0.00392	203	**84**	0.0316	**75**	0.0230	198,484
REDDING, CA MSA	**31**	645	0.00392	224	**107**	0.0289	**25**	0.0278	164,530
EAU CLAIRE, WI MSA	**32**	565	0.00391	156	**13**	0.0440	**26**	0.0276	144,463
LONGVIEW-MARSHALL, TX MSA	**33**	818	0.00390	223	**24**	0.0414	**20**	0.0289	209,493
DECATUR, IL MSA	**34**	440	0.00388	126	**98**	0.0302	**99**	0.0209	113,219
DECATUR, AL MSA	**35**	556	0.00387	172	**54**	0.0356	**29**	0.0274	143,460
DUBUQUE, IA MSA	**36**	340	0.00386	112	**132**	0.0248	**137**	0.0180	88,112
ST. CLOUD, MN MSA	**37**	633	0.00384	205	**10**	0.0448	**40**	0.0256	164,913
SAN ANGELO, TX MSA	**38**	392	0.00383	107	**142**	0.0223	**105**	0.0205	102,300
BANGOR, ME MSA	**39**	549	0.00380	157	**77**	0.0331	**77**	0.0230	144,432
HATTIESBURG, MS MSA	**40**	426	0.00377	116	**21**	0.0421	**38**	0.0257	113,054
VICTORIA, TX MSA	**41**	309	0.00376	83	**110**	0.0284	**74**	0.0230	82,087
PUEBLO, CO MSA	**42**	505	0.00369	139	**115**	0.0277	**89**	0.0219	136,987
LAWTON, OK MSA	**43**	391	0.00367	96	**59**	0.0353	**35**	0.0260	106,621
WATERLOO-CEDAR FALLS, IA MSA	**44**	434	0.00361	113	**111**	0.0281	**88**	0.0219	119,959
ROCKY MOUNT, NC MSA	**45**	528	0.00359	139	**32**	0.0400	**44**	0.0252	147,028
GADSDEN, AL MSA	**46**	372	0.00359	119	**48**	0.0364	**13**	0.0299	103,472
TYLER, TX MSA	**47**	608	0.00358	151	**7**	0.0454	**6**	0.0328	169,693
TUSCALOOSA, AL MSA	**48**	571	0.00354	155	**6**	0.0456	**5**	0.0328	161,435
FLORENCE, AL MSA	**49**	478	0.00349	131	**73**	0.0337	**27**	0.0275	136,879
SIOUX CITY, IA-NE MSA	**50**	417	0.00345	126	**114**	0.0278	**122**	0.0191	120,577
PARKERSBURG-MARIETTA, WV-OH MSA	**51**	513	0.00344	158	**33**	0.0399	**59**	0.0241	149,366
TOPEKA, KS MSA	**52**	585	0.00343	172	**92**	0.0310	**86**	0.0222	170,773
FORT SMITH, AR-OK MSA	**53**	666	0.00340	188	**12**	0.0442	**22**	0.0286	195,547
DOTHAN, AL MSA	**54**	459	0.00340	129	**42**	0.0381	**9**	0.0312	135,243
CUMBERLAND, MD-WV MSA	**55**	331	0.00337	100	**3**	0.0533	**11**	0.0302	98,231
DANVILLE, VA MSA	**56**	363	0.00337	95	**134**	0.0243	**141**	0.0172	107,555

Metropolitan area*	Rank (Lane miles per capita)	Lane miles of major highway 1999	Lane miles per capita 1999	Road miles of major highway 1999	Rank (Vehicular NOx per capita)	Vehicular NOx per capita 1999 (tons)	Rank (Vehicular VOCs per capita)	Vehicular VOCs per capita 1999 (tons)	1999 population
FLORENCE, SC MSA	**57**	420	0.00335	124	**22**	0.0420	**33**	0.0264	125,229
ROCHESTER, MN MSA	**58**	391	0.00328	107	**51**	0.0359	**73**	0.0230	119,077
ODESSA-MIDLAND, TX MSA	**59**	794	0.00328	215	**121**	0.0269	**67**	0.0235	242,238
JACKSON, TN MSA	**60**	332	0.00327	85	**15**	0.0434	**14**	0.0296	101,611
JOPLIN, MO MSA	**61**	483	0.00322	167	**16**	0.0433	**12**	0.0299	149,981
SIOUX FALLS, SD MSA	**62**	526	0.00320	136	**106**	0.0290	**118**	0.0193	164,481
STATE COLLEGE, PA MSA	**63**	422	0.00319	144	**72**	0.0340	**104**	0.0206	132,190
JOHNSTOWN, PA MSA	**64**	736	0.00315	241	**83**	0.0318	**123**	0.0191	233,794
IOWA CITY, IA MSA	**65**	324	0.00312	99	**79**	0.0324	**109**	0.0203	103,813
BENTON HARBOR, MI MSA	**66**	493	0.00309	116	**14**	0.0436	**31**	0.0267	159,709
SUMTER, SC MSA	**67**	342	0.00304	98	**74**	0.0336	**84**	0.0224	112,412
PANAMA CITY, FL MSA	**68**	441	0.00298	148	**144**	0.0219	**100**	0.0209	147,958
JONESBORO, AR MSA	**69**	231	0.00298	85	**109**	0.0284	**102**	0.0206	77,668
BRYAN-COLLEGE STATION, TX MSA	**70**	396	0.00295	112	**123**	0.0265	**65**	0.0239	134,213
MERCED, CA MSA	**71**	590	0.00294	160	**45**	0.0373	**85**	0.0223	200,746
WHEELING, WV-OH MSA	**72**	449	0.00292	131	**38**	0.0387	**71**	0.0232	153,946
CLARKSVILLE-HOPKINSVILLE, TN-KY MSA	**73**	584	0.00290	163	**65**	0.0348	**50**	0.0247	201,352
SHERMAN-DENISON, TX MSA	**74**	300	0.00290	80	**35**	0.0395	**16**	0.0293	103,728
SHARON, PA MSA	**75**	350	0.00288	98	**19**	0.0428	**61**	0.0240	121,458
YOLO, CA PMSA	**76**	447	0.00287	111	**40**	0.0387	**142**	0.0171	155,573
CHAMPAIGN-URBANA, IL MSA	**77**	487	0.00286	136	**80**	0.0322	**112**	0.0200	170,272
JANESVILLE-BELOIT, WI MSA	**78**	431	0.00285	138	**69**	0.0344	**72**	0.0232	151,121
MUNCIE, IN MSA	**79**	328	0.00284	101	**56**	0.0355	**66**	0.0237	115,472
ABILENE, TX MSA	**80**	346	0.00283	98	**76**	0.0332	**17**	0.0292	122,478
WACO, TX MSA	**81**	572	0.00280	152	**49**	0.0364	**15**	0.0294	204,244
PITTSFIELD, MA MSA	**82**	366	0.00277	140	**30**	0.0405	**41**	0.0254	132,218
LAREDO, TX MSA	**83**	534	0.00276	178	**146**	0.0208	**140**	0.0173	193,180
MYRTLE BEACH, SC MSA	**84**	492	0.00276	129	**71**	0.0341	**45**	0.0251	178,550
SPRINGFIELD, IL MSA	**85**	562	0.00276	137	**55**	0.0356	**69**	0.0233	204,030

Metropolitan area*	Rank (Lane miles per capita)	Lane miles of major highway 1999	Lane miles per capita 1999	Road miles of major highway 1999	Rank (Vehicular NOx per capita)	Vehicular NOx per capita 1999 (tons)	Rank (Vehicular VOCs per capita)	Vehicular VOCs per capita 1999 (tons)	1999 population
ROANOKE, VA MSA	**86**	626	0.00275	164	**64**	0.0348	**43**	0.0253	227,741
CEDAR RAPIDS, IA MSA	**87**	507	0.00274	143	**127**	0.0256	**125**	0.0190	184,891
HAGERSTOWN, MD PMSA	**88**	349	0.00273	99	**2**	0.0570	**18**	0.0290	127,791
OWENSBORO, KY MSA	**89**	246	0.00270	74	**101**	0.0297	**90**	0.0218	91,179
OCALA, FL MSA	**90**	663	0.00270	170	**37**	0.0392	**53**	0.0245	245,975
ALBANY, GA MSA	**91**	312	0.00265	81	**137**	0.0237	**131**	0.0187	117,421
SHEBOYGAN, WI MSA	**92**	292	0.00265	87	**68**	0.0344	**135**	0.0184	110,136
STEUBENVILLE-WEIRTON, OH-WV MSA	**93**	352	0.00264	107	**108**	0.0288	**117**	0.0194	133,292
GALVESTON-TEXAS CITY, TX PMSA	**94**	657	0.00264	158	**125**	0.0262	**92**	0.0217	248,469
LIMA, OH MSA	**95**	407	0.00264	119	**52**	0.0358	**81**	0.0228	154,065
KANKAKEE, IL PMSA	**96**	271	0.00263	88	**105**	0.0291	**121**	0.0192	102,720
GREEN BAY, WI MSA	**97**	568	0.00262	156	**81**	0.0321	**62**	0.0240	216,522
LEWISTON-AUBURN, ME MSA	**98**	264	0.00261	89	**140**	0.0228	**130**	0.0187	101,337
ALTOONA, PA MSA	**99**	334	0.00257	101	**89**	0.0313	**113**	0.0199	129,937
WILLIAMSPORT, PA MSA	**100**	299	0.00256	84	**85**	0.0316	**96**	0.0210	116,709
YAKIMA, WA MSA	**101**	564	0.00256	180	**82**	0.0319	**126**	0.0190	220,785
FORT COLLINS-LOVELAND, CO MSA	**102**	602	0.00254	204	**143**	0.0219	**136**	0.0180	236,849
GLENS FALLS, NY MSA	**103**	307	0.00253	96	**26**	0.0413	**48**	0.0249	121,582
CHARLOTTESVILLE, VA MSA	**104**	381	0.00252	106	**46**	0.0372	**95**	0.0214	151,267
NAPLES, FL MSA	**105**	519	0.00250	168	**47**	0.0371	**49**	0.0248	207,029
COLUMBIA, MO MSA	**106**	320	0.00246	88	**61**	0.0351	**60**	0.0240	130,179
LAWRENCE, KS MSA	**107**	240	0.00244	73	**139**	0.0229	**143**	0.0166	98,343
LYNCHBURG, VA MSA	**108**	502	0.00240	135	**95**	0.0305	**101**	0.0208	208,835
BINGHAMTON, NY MSA	**109**	592	0.00239	144	**39**	0.0387	**36**	0.0259	247,462
LA CROSSE, WI-MN MSA	**110**	291	0.00239	87	**53**	0.0357	**57**	0.0241	121,927
FORT WALTON BEACH, FL MSA	**111**	400	0.00235	110	**102**	0.0297	**58**	0.0241	170,049
LAFAYETTE, IN MSA	**112**	411	0.00234	145	**58**	0.0354	**80**	0.0228	175,439
ANNISTON, AL MSA	**113**	273	0.00234	86	**31**	0.0404	**2**	0.0353	116,541
LINCOLN, NE MSA	**114**	551	0.00232	151	**128**	0.0256	**120**	0.0193	237,657

Metropolitan area*	Rank (Lane miles per capita)	Lane miles of major highway 1999	Lane miles per capita 1999	Road miles of major highway 1999	Rank (Vehicular NOx per capita)	Vehicular NOx per capita 1999 (tons)	Rank (Vehicular VOCs per capita)	Vehicular VOCs per capita 1999 (tons)	1999 population
BRAZORIA, TX PMSA	**115**	538	0.00230	162	**103**	0.0295	**111**	0.0200	234,303
BURLINGTON, VT MSA	**116**	445	0.00229	148	**44**	0.0378	**34**	0.0261	194,748
ELMIRA, NY MSA	**117**	208	0.00226	63	**116**	0.0277	**107**	0.0203	91,738
WILMINGTON, NC MSA	**118**	501	0.00226	131	**90**	0.0313	**55**	0.0243	222,109
NEW LONDON-NORWICH, CT-RI MSA*	**119**	554	0.00225	164	**62**	0.0350	**110**	0.0201	246,049
MONROE, LA MSA	**120**	329	0.00224	90	**87**	0.0314	**68**	0.0235	146,672
MEDFORD-ASHLAND, OR MSA	**121**	389	0.00221	117	**50**	0.0360	**116**	0.0196	175,822
JACKSON, MI MSA	**122**	338	0.00215	97	**36**	0.0392	**51**	0.0247	157,271
BARNSTABLE-YARMOUTH, MA MSA	**123**	453	0.00213	168	**88**	0.0313	**91**	0.0217	212,519
RACINE, WI PMSA	**124**	395	0.00213	130	**138**	0.0236	**146**	0.0137	185,777
KENOSHA, WI PMSA	**125**	310	0.00212	84	**119**	0.0271	**144**	0.0160	146,315
YUBA CITY, CA MSA	**126**	289	0.00209	112	**129**	0.0254	**47**	0.0249	138,030
ELKHART-GOSHEN, IN MSA	**127**	361	0.00207	120	**41**	0.0384	**32**	0.0266	174,680
ATHENS, GA MSA	**128**	288	0.00205	96	**97**	0.0302	**103**	0.0206	140,372
LAKE CHARLES, LA MSA	**129**	367	0.00203	93	**75**	0.0333	**83**	0.0225	180,607
JACKSONVILLE, NC MSA	**130**	289	0.00203	82	**141**	0.0228	**138**	0.0175	142,480
ASHEVILLE, NC MSA	**131**	420	0.00195	114	**11**	0.0442	**4**	0.0336	215,180
GREENVILLE, NC MSA	**132**	243	0.00190	63	**120**	0.0270	**106**	0.0204	127,960
MANSFIELD, OH MSA	**133**	331	0.00188	102	**100**	0.0300	**129**	0.0188	176,617
DOVER, DE MSA	**134**	232	0.00184	58	**27**	0.0412	**79**	0.0228	126,048
PUNTA GORDA, FL MSA	**135**	241	0.00176	63	**113**	0.0279	**97**	0.0210	136,992
SAN LUIS OBISPO-ATASCADERO-PASO ROBLES, CA MSA	**136**	413	0.00174	126	**133**	0.0247	**64**	0.0239	236,953
OLYMPIA, WA PMSA	**137**	352	0.00171	85	**78**	0.0329	**98**	0.0209	205,459
CHICO-PARADISE, CA MSA	**138**	334	0.00171	120	**136**	0.0239	**30**	0.0269	195,220
KOKOMO, IN MSA	**139**	171	0.00170	61	**57**	0.0354	**42**	0.0253	100,377
BLOOMINGTON, IN MSA	**140**	187	0.00160	64	**112**	0.0280	**119**	0.0193	116,923
BELLINGHAM, WA MSA	**141**	237	0.00148	77	**96**	0.0303	**133**	0.0185	160,310
GOLDSBORO, NC MSA	**142**	162	0.00145	43	**93**	0.0310	**56**	0.0242	111,711
BREMERTON, WA PMSA	**143**	310	0.00131	101	**126**	0.0258	**139**	0.0175	236,560

Metropolitan area*	Rank (Lane miles per capita)	Lane miles of major highway 1999	Lane miles per capita 1999	Road miles of major highway 1999	Rank (Vehicular NOx per capita)	Vehicular NOx per capita 1999 (tons)	Rank (Vehicular VOCs per capita)	Vehicular VOCs per capita 1999 (tons)	1999 population
HOUMA, LA MSA	**144**	235	0.00121	72	**124**	0.0263	**132**	0.0186	194,591
VINELAND-MILLVILLE-BRIDGETON, NJ PMSA	**145**	130	0.00093	46	**135**	0.0241	**145**	0.0148	140,112
SANTA CRUZ-WATSONVILLE, CA PMSA	**146**	221	0.00090	62	**145**	0.0209	**114**	0.0198	245,201

* Metropolitan area definitions differ from standard Census Bureau definitions. See "Sources and Methodology."

APPENDIX B: TOTAL AND PER CAPITA DAILY VEHICLE-MILES TRAVELED, BY URBANIZED AREA, 2002

					Daily Vehicle-Miles Traveled (1000)						
Rank (VMT Per Capita)	**Urbanized Area***	**State**	**Total Daily VMT Per Capita**	**Population (1000)**	**Interstate**	**Other freeways and expressways**	**Other principal arterial**	**Minor arterial**	**Collector**	**Local**	**Total**
1	Houston	TX	**39.25**	2,487	23,022	22,143	19,691	20,169	8,421	4,167	**97,613**
2	Poughkeepsie-Newburgh	NY	**37.53**	206	1,932	481	1,423	1,740	1,073	1,083	**7,732**
3	Nashville-Davidson	TN	**35.36**	659	9,035	1,692	4,164	4,153	1,445	2,813	**23,302**
4	Atlanta	GA	**35.29**	2,873	37,443	5,945	10,553	22,955	7,109	17,397	**101,402**
5	Birmingham	AL	**35.14**	664	8,571	191	3,679	3,667	1,716	5,508	**23,332**
6	Knoxville	TN	**35.12**	363	4,240	25	3,198	1,529	899	2,859	**12,750**
7	Indianapolis	IN	**33.83**	915	10,368	601	7,743	5,444	1,513	5,281	**30,950**
8	Pensacola	FL,AL	**32.89**	300	1,151	-	2,393	2,224	812	3,287	**9,867**
9	Orlando	FL	**32.70**	1,235	5,414	4,520	10,434	7,140	3,837	9,039	**40,384**
10	Harrisburg	PA	**32.05**	310	3,227	1,393	1,838	1,483	923	1,072	**9,936**
11	Greensboro	NC	**31.99**	240	2,238	973	751	1,480	245	1,990	**7,677**
12	Austin	TX	**31.87**	641	4,024	5,178	5,157	1,875	2,781	1,416	**20,431**
13	Raleigh	NC	**31.40**	507	4,178	944	3,218	2,716	883	3,980	**15,919**
14	Chattanooga	TN,GA	**31.29**	348	2,982	1,254	1,978	2,910	662	1,103	**10,889**
15	Jacksonville	FL	**31.01**	906	7,088	2,875	4,691	4,184	2,330	6,928	**28,096**
16	Durham	NC	**30.37**	274	1,887	981	1,247	1,575	386	2,246	**8,322**
17	Port St. Lucie	FL	**30.14**	275	927	596	2,724	1,238	1,094	1,710	**8,289**
18	Palm Bay-Melbourne	FL	**29.99**	379	452	377	3,569	1,574	1,200	4,193	**11,365**
19	Lexington-Fayette	KY	**29.46**	254	1,857	859	1,765	1,757	689	555	**7,482**
20	Richmond	VA	**29.41**	838	8,151	1,813	4,764	4,557	1,693	3,669	**24,647**
21	Cape Coral	FL	**29.27**	313	229	-	2,009	2,064	1,220	3,640	**9,162**
22	St. Louis	MO,IL	**29.17**	2,067	22,093	3,680	11,250	7,496	3,936	11,837	**60,292**
23	Winston-Salem	NC	**28.78**	265	1,048	2,082	246	1,186	891	2,174	**7,627**
24	Flint	MI	**28.75**	339	3,162	156	1,771	2,926	742	990	**9,747**
25	Kansas City	MO,KS	**28.67**	1,474	14,333	5,734	5,568	7,335	2,173	7,118	**42,261**

					Daily Vehicle-Miles Traveled (1000)						
Rank (VMT Per Capita)	**Urbanized Area***	**State**	**Total Daily VMT Per Capita**	**Population (1000)**	**Interstate**	**Other freeways and expressways**	**Other principal arterial**	**Minor arterial**	**Collector**	**Local**	**Total**
26	Dallas-Fort Worth-Arlington	TX	**28.64**	3,746	32,705	18,260	25,018	17,104	10,405	3,806	**107,298**
27	Albany	NY	**27.80**	524	5,229	589	3,324	2,386	1,103	1,937	**14,568**
28	Little Rock	AR	**27.56**	338	3,982	731	1,554	1,919	533	595	**9,314**
29	Charlotte	NC,SC	**27.47**	721	6,130	1,732	3,711	2,337	661	5,236	**19,807**
30	Columbus	OH	**27.47**	961	11,314	2,040	3,588	4,821	1,478	3,153	**26,394**
31	Tampa-St. Petersburg	FL	**27.45**	2,023	7,960	1,420	13,224	11,089	6,686	15,161	**55,540**
32	Boise City	ID	**27.27**	221	1,309	-	1,829	1,546	589	754	**6,027**
33	Mobile	AL	**27.23**	318	2,593	-	1,712	1,244	934	2,176	**8,659**
34	Louisville	KY,IN	**26.99**	841	9,751	691	4,124	4,221	1,675	2,233	**22,695**
35	Dayton	OH	**26.96**	596	4,929	889	3,262	2,754	1,297	2,938	**16,069**
36	Augusta-Richmond County	GA,SC	**26.87**	285	1,366	349	2,549	1,843	526	1,025	**7,658**
37	Ann Arbor	MI	**26.70**	277	2,253	1,365	1,321	1,357	614	487	**7,397**
38	Huntsville	AL	**26.70**	214	840	554	1,398	1,104	537	1,281	**5,714**
39	Cincinnati	OH,KY,IN	**26.55**	1,327	14,775	1,353	4,998	6,133	2,496	5,481	**35,236**
40	Trenton	NJ	**26.47**	313	2,495	467	2,295	1,490	453	1,086	**8,286**
41	Shreveport	LA	**26.27**	262	2,103	398	1,877	1,676	481	348	**6,883**
42	Daytona Beach-Port Orange	FL	**26.21**	274	935	-	2,822	816	573	2,035	**7,181**
43	Corpus Christi	TX	**26.16**	297	869	2,092	1,179	1,322	692	1,615	**7,769**
44	Tallahassee	FL	**26.09**	201	540	-	1,754	1,298	657	995	**5,244**
45	Memphis	TN,MS,AR	**25.81**	907	6,423	832	6,146	5,945	1,504	2,563	**23,413**
46	Worcester	MA,CT	**25.68**	383	4,159	299	2,123	1,721	707	828	**9,837**
47	Minneapolis-St. Paul	MN	**25.59**	2,440	19,138	7,922	5,550	17,459	5,125	7,235	**62,429**
48	Denton-Lewisville	TX	**25.43**	233	2,580	165	966	1,403	647	164	**5,925**
49	Detroit	MI	**25.13**	3,835	24,731	6,882	31,856	18,363	3,729	10,827	**96,388**
50	Oklahoma City	OK	**25.13**	1,083	8,005	1,491	5,636	5,595	1,632	4,857	**27,216**
51	Fort Wayne	IN	**25.04**	248	984	69	1,716	1,936	488	1,017	**6,210**
52	Hartford	CT	**24.93**	873	7,524	2,834	3,490	3,958	1,928	2,030	**21,764**
53	San Antonio	TX	**24.90**	1,259	11,467	4,441	5,217	5,288	3,067	1,874	**31,354**
54	New Haven	CT	**24.84**	546	5,725	1,779	1,704	2,470	996	890	**13,564**
55	Savannah	GA	**24.82**	234	1,399	65	1,957	1,202	273	911	**5,807**

					Daily Vehicle-Miles Traveled (1000)						
Rank (VMT Per Capita)	**Urbanized Area***	**State**	**Total Daily VMT Per Capita**	**Population (1000)**	**Interstate**	**Other freeways and expressways**	**Other principal arterial**	**Minor arterial**	**Collector**	**Local**	**Total**
56	Salt Lake City	UT	**24.81**	910	8,073	220	3,248	5,107	2,558	3,372	**22,578**
57	Seattle	WA	**24.52**	2,746	21,726	8,739	12,680	11,743	5,036	7,406	**67,330**
58	Rockford	IL	**24.45**	208	632	295	1,645	1,429	421	664	**5,086**
59	Toledo	OH,MI	**24.44**	499	3,911	180	2,195	2,079	978	2,852	**12,195**
60	Syracuse	NY	**24.29**	390	2,945	700	1,291	2,213	930	1,394	**9,473**
61	Baton Rouge	LA	**24.04**	375	2,761	-	3,094	2,226	586	348	**9,015**
62	Miami	FL	**23.93**	5,021	20,977	14,722	23,315	22,203	15,618	23,296	**120,131**
63	McAllen	TX	**23.92**	330	-	2,572	1,962	1,346	1,631	382	**7,893**
64	Grand Rapids	MI	**23.89**	529	2,443	1,399	3,560	3,104	882	1,248	**12,636**
65	Akron	OH	**23.86**	551	3,892	1,445	2,236	1,673	893	3,006	**13,145**
66	San Jose	CA	**23.83**	1,663	6,464	10,295	11,210	6,507	1,701	3,460	**39,637**
67	Columbia	SC	**23.78**	425	4,211	327	1,923	2,161	839	645	**10,106**
68	Los Angeles-Long Beach-Santa Ana	CA	**23.66**	12,365	83,630	51,710	74,253	50,406	11,627	20,891	**292,517**
69	Jackson	MS	**23.64**	390	3,538	-	2,786	912	652	1,331	**9,219**
70	Bridgeport-Stamford	CT,NY	**23.63**	852	6,181	3,987	2,381	3,759	1,554	2,274	**20,136**
71	Tulsa	OK	**23.63**	803	2,453	4,141	2,633	5,841	707	3,198	**18,973**
72	Albuquerque	NM	**23.62**	529	3,376	21	5,134	1,678	1,024	1,260	**12,493**
73	San Diego	CA	**23.52**	2,823	23,726	9,776	8,204	14,738	4,651	5,296	**66,391**
74	Madison	WI	**23.46**	288	676	1,728	1,679	721	406	1,547	**6,757**
75	Oxnard	CA	**23.32**	567	-	6,592	3,230	1,517	610	1,274	**13,223**
76	Virginia Beach	VA	**23.29**	1,530	10,554	1,903	8,418	7,703	2,488	4,574	**35,640**
77	Rochester	NY	**23.16**	658	3,576	1,884	1,109	5,307	1,191	2,169	**15,236**
78	Pittsburgh	PA	**23.04**	1,569	8,244	3,456	9,227	7,581	3,202	4,444	**36,154**
79	Denver-Aurora	CO	**22.86**	1,989	10,446	6,633	14,278	6,689	2,884	4,548	**45,478**
80	Lorain-Elyria	OH	**22.78**	240	1,366	660	826	1,329	453	832	**5,466**
81	Washington	DC,MD,VA	**22.73**	3,807	26,987	9,213	21,463	16,110	5,799	6,947	**86,519**
82	Lancaster	PA	**22.49**	203	-	1,491	655	1,425	522	473	**4,566**
83	San Francisco-Oakland	CA	**22.32**	4,120	31,159	17,424	15,139	14,975	5,580	7,668	**91,945**
84	Lansing	MI	**22.25**	284	1,682	308	1,680	1,515	729	404	**6,318**
85	Greenville	SC	**22.25**	305	1,700	43	1,814	1,812	1,048	368	**6,785**

					Daily Vehicle-Miles Traveled (1000)						
Rank (VMT Per Capita)	**Urbanized Area***	**State**	**Total Daily VMT Per Capita**	**Population (1000)**	**Interstate**	**Other freeways and expressways**	**Other principal arterial**	**Minor arterial**	**Collector**	**Local**	**Total**
86	Riverside-San Bernardino	CA	**22.18**	1,599	10,848	7,469	3,704	7,016	2,729	3,692	**35,458**
87	Wichita	KS	**22.10**	378	1,768	1,368	1,542	2,233	292	1,150	**8,353**
88	Gulfport-Biloxi	MS	**22.03**	217	809	-	1,821	686	543	922	**4,781**
89	Milwaukee	WI	**22.01**	1,443	7,204	2,100	6,679	6,937	782	8,052	**31,754**
90	Baltimore	MD	**21.90**	2,295	17,108	8,320	9,807	8,109	3,394	3,518	**50,256**
91	South Bend	IN,MI	**21.83**	240	385	579	1,884	1,308	402	681	**5,239**
92	Peoria	IL	**21.70**	244	1,021	92	1,726	1,355	531	571	**5,296**
93	Charleston-North Charleston	SC	**21.65**	428	2,517	481	3,026	1,702	837	704	**9,267**
94	Columbus	GA,AL	**21.58**	251	627	30	2,023	1,088	400	1,248	**5,416**
95	Fayetteville	NC	**21.57**	314	65	458	1,943	1,612	252	2,443	**6,773**
96	Des Moines	IA	**21.54**	394	2,906	-	1,962	2,004	560	1,055	**8,487**
97	Davenport	IL,IA	**21.49**	267	1,260	34	1,438	1,786	485	735	**5,738**
98	Chicago	IL,IN	**21.49**	7,702	48,569	2,854	43,903	33,302	17,683	19,183	**165,494**
99	Springfield	MA,CT	**21.49**	653	4,382	421	3,052	3,361	1,068	1,746	**14,030**
100	Sarasota-Bradenton	FL	**21.43**	561	759	20	3,490	1,741	2,154	3,859	**12,023**
101	Allentown-Bethlehem	PA,NJ	**21.33**	448	1,829	1,866	2,129	1,361	1,273	1,096	**9,554**
102	Phoenix-Mesa	AZ	**21.22**	2,949	8,998	13,530	17,890	10,308	5,636	6,204	**62,566**
103	Provo-Orem	UT	**21.19**	345	2,844	-	1,572	1,034	498	1,361	**7,309**
104	Fresno	CA	**20.97**	586	-	3,216	2,967	3,461	863	1,782	**12,289**
105	Boston	MA,NH,RI	**20.94**	3,854	25,528	7,602	19,863	12,383	4,646	10,671	**80,693**
106	Scranton	PA	**20.66**	349	2,053	692	1,687	1,453	518	807	**7,210**
107	Cleveland	OH	**20.59**	1,785	14,429	2,354	5,456	6,749	1,579	6,191	**36,758**
108	Spokane	WA,ID	**20.58**	328	1,480	92	2,559	1,534	343	743	**6,751**
109	Canton	OH	**20.56**	249	848	564	1,069	946	592	1,100	**5,119**
110	Omaha	NE,IA	**20.49**	625	3,036	600	4,335	2,418	1,106	1,314	**12,809**
111	Colorado Springs	CO	**20.43**	439	1,444	1,136	2,515	2,318	659	897	**8,969**
112	Sacramento	CA	**20.24**	1,508	6,533	6,689	7,641	3,757	2,123	3,778	**30,521**
113	Providence	RI,MA	**20.18**	1,233	7,791	2,797	6,151	4,219	2,180	1,743	**24,881**
114	Victorville-Hesperia-Apple Valley	CA	**20.15**	220	991	-	904	1,452	306	781	**4,434**
115	Portland	OR,WA	**19.77**	1,610	9,563	3,338	6,424	5,224	3,179	4,099	**31,827**

					Daily Vehicle-Miles Traveled (1000)						
Rank (VMT Per Capita)	**Urbanized Area***	**State**	**Total Daily VMT Per Capita**	**Population (1000)**	**Interstate**	**Other freeways and expressways**	**Other principal arterial**	**Minor arterial**	**Collector**	**Local**	**Total**
116	Tucson	AZ	**19.76**	709	1,828	532	5,354	4,309	864	1,124	**14,011**
117	Philadelphia	PA,NJ,DE,MD	**19.42**	4,813	22,252	8,520	25,579	17,718	8,448	10,928	**93,445**
118	Buffalo	NY	**19.29**	1,123	4,477	1,958	4,957	5,343	1,984	2,944	**21,663**
119	Youngstown	OH,PA	**19.28**	423	1,151	584	1,734	1,659	859	2,168	**8,155**
120	Ogden-Layton	UT	**18.31**	418	2,564	-	1,449	1,456	735	1,448	**7,652**
121	Las Vegas	NV	**18.14**	1,456	4,659	3,325	4,065	7,794	3,416	3,148	**26,407**
122	Lincoln	NE	**18.12**	227	295	130	1,464	1,257	386	582	**4,114**
123	Bakersfield	CA	**17.89**	425	-	2,047	2,629	1,425	536	966	**7,603**
124	Stockton	CA	**17.69**	337	1,432	1,187	1,468	458	495	921	**5,961**
125	Indio-Cathedral City-Palm Springs	CA	**17.46**	283	302	89	1,655	1,373	601	920	**4,940**
126	Anchorage	AK	**17.38**	269	1,496	-	721	1,538	394	525	**4,674**
127	El Paso	TX,NM	**17.34**	657	3,163	849	3,595	1,880	1,336	572	**11,395**
128	Eugene	OR	**17.23**	236	497	797	784	1,064	397	527	**4,066**
129	Honolulu	HI	**17.02**	694	4,540	1,237	1,891	1,010	974	2,162	**11,814**
130	Lancaster-Palmdale	CA	**17.00**	283	-	924	1,298	1,758	267	564	**4,811**
131	Santa Rosa	CA	**16.15**	296	-	2,020	725	1,003	351	682	**4,781**
132	Salem	OR	**16.07**	211	929	292	1,427	273	222	247	**3,390**
133	New York-Newark	NY,NJ,CT	**15.88**	17,307	49,930	55,267	57,626	52,072	18,536	41,336	**274,767**
134	Modesto	CA	**15.36**	334	-	1,485	1,181	1,400	405	660	**5,131**
135	New Orleans	LA	**14.97**	1,065	5,600	364	5,475	2,729	904	873	**15,945**
136	Reno	NV	**14.44**	380	1,517	654	1,237	1,342	281	456	**5,487**
137	San Juan	PR	**14.30**	1,824	7,455	2,556	5,609	4,311	3,174	2,977	**26,082**
138	Antioch	CA	**13.63**	243	-	1,353	771	322	288	578	**3,312**

*Urbanized area is an area (with 50,000 or more persons) that at a minimum encompasses the land area delineated as the urbanized area by the Bureau of the Census. The urbanized areas do not share the same definitions as the metropolitan areas referenced elsewhere in the report.

END NOTES

---

[1] American Lung Association (ALA), *State of the Air 2003*, May 2003.

[2] U.S. PIRG Education Fund, *Danger in the Air: Unhealthy Levels of Smog in 2002*, August 2003.

[3] U.S. EPA, Office of Transportation and Air Quality, http://www.epa.gov/otaq/invntory/overview/pollutants/hydrocarbons.htm. Accessed December 8, 2003.

[4] U.S. EPA, Office of Transportation and Air Quality, http://www.epa.gov/otaq/invntory/overview/pollutants/nox.htm. Accessed December 8, 2003.

[5] U.S. EPA, Office of Transportation and Air Quality, http://www.epa.gov/otaq/invntory/overview/pollutants/pm.htm. Accessed December 8, 2003.

[6] Transportation Research Board, National Research Council, 2002. *The Congestion Mitigation and Air Quality Improvement Program: Assessing 10 Years of Experience.* Special Report #264. Available at http://www.nap.edu/html/SR264/SR264.pdf.

[7] U.S. EPA, Office of Air & Radiation, http://www.epa.gov/air/toxicair/newtoxics.html#what. Accessed December 8, 2003.

[8] U.S. EPA, *National Air Quality and Emissions Trends Report, 1999.* EPA454-R-01-004. Office of Air Quality Planning and Standards, Research Triangle Park, NC, 2001.

[9] California Air Resources Board, *Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles*, October 2000.

[10] U.S. EPA, Office of Transportation and Air Quality, http://www.epa.gov/otaq/invntory/overview/pollutants/carbonmon.htm#. Accessed December 8, 2003.

[11] Transportation Research Board, National Research Council, 2002. *The Congestion Mitigation and Air Quality Improvement Program: Assessing 10 Years of Experience.* Special Report #264. Available at http://www.nap.edu/html/SR264/SR264.pdf.

[12] U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics*. 2002 data available at http://www.fhwa.dot.gov/policy/ohim/hs02/index.htm. Historical data available at http://www.fhwa.dot.gov/ohim/summary95/vm201.pdf. Testimony of Jeffrey Holmstead, Assistant Administrator, Office of Air and Radiation, U.S. EPA, before the Senate Environment and Public Works Subcommittee on Clean Air, Climate Change, and Nuclear Safety, March 13, 2003.

[13] U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics*. 2002 data available at http://www.fhwa.dot.gov/policy/ohim/hs02/xls/vm1.xls. Historical data available at http://www.fhwa.dot.gov/ohim/summary95/vm201.pdf.

[14] Clean Air Act, (42 U.S.C. 7410), Section 110 as amended by the Clean Air Act Amendments of 1990. Full text of the amendments available on EPA's web site at http://www.epa.gov/oar/caa/caaa.txt.

[15] Testimony of Jeffrey Holmstead, Assistant Administrator, Office of Air and Radiation, U.S. EPA, before the Senate Environment and Public Works Subcommittee on Clean Air, Climate Change, and Nuclear Safety, March 13, 2003.

[16] Federal Highway Administration, *CMAQ: Advancing Mobility and Air Quality*, May 2003.

[17] Transportation Research Board, National Research Council, 2002. *The Congestion Mitigation and Air Quality Improvement Program: Assessing 10 Years of Experience.* Special Report #264. Available at http://www.nap.edu/html/SR264/SR264.pdf.

[18] Transportation Research Board, National Research Council, 2002. *The Congestion Mitigation and Air Quality Improvement Program: Assessing 10 Years of Experience.* Special Report #264. Available at http://www.nap.edu/html/SR264/SR264.pdf.

[19] Transportation Research Board, National Research Council, 2002. *The Congestion Mitigation and Air Quality Improvement Program: Assessing 10 Years of Experience.* Special Report #264. Available at http://www.nap.edu/html/SR264/SR264.pdf.

[20] Funding analysis by Surface Transportation Policy Project, http://www.transact.org/library/raba.asp; Timothy J. Lomax and David L. Schrank, *The 2002 Urban Mobility Report*, Texas Transportation Institute, Texas A&M University, College Station, TX, 2002.

[21] American Highway Users Alliance, *Keeping the Trust in the Highway Trust Fund: TEA 21 Issue Briefs*. Available at http://www.highways.org/pdfs/pga-papers.pdf.

[22] Alan Sipress, "More Lanes Better? Not Necessarily," *Washington Post*, 13 January 2001.

[23] Lewis M. Fulton, Robert B. Noland, Daniel J. Meszler, John V. Thomas, "A Statistical Analysis of Induced Travel Effects in the U.S. Mid-Atlantic Region," *Journal of Transportation Statistics*, April 2000.

[24] Lewis M. Fulton, Robert B. Noland, Daniel J. Meszler, John V. Thomas, "A Statistical Analysis of Induced Travel Effects in the U.S. Mid-Atlantic Region," *Journal of Transportation Statistics*, April 2000.

[25] Surface Transportation Policy Project, *Why Are the Roads So Congested? An Analysis of the Texas Transportation Institute's Data on Metropolitan Congestion*, 7 November 1999.

[26] Brad Heavner, MaryPIRG Foundation, *Paving the Way*, November 2000.

---

[27] Robert B. Noland and Lewison L. Lem, "A review of the evidence for induced travel and changes in transportation and environmental policy in the US and the UK," 2002, *Transportation Research D*, 7(1), 1-26.

[28] American Highway Users Alliance, *Unclogging America's Arteries: Prescriptions for Healthier Highways*. November 1999. Available at www.highways.org.

[29] Probability figures were derived from a comparison of the linear correlation coefficient displayed on each chart (the R-squared value), the number of data points in each graph, and a probability table for correlation. The number of data points in each chart is as follows: all metropolitan areas, 314; large metropolitan areas, 62; intermediate metropolitan areas, 106; small metropolitan areas, 146. For a table of correlation probability, see: John Taylor, University of Colorado at Boulder, *An Introduction to Error Analysis*, (University Science Books, Sausalito CA) 1997.

[30] U.S. Department of Transportation, Bureau of Transportation Statistics, *National Transportation Statistics 2002.* Available at http://www.bts.gov/publications/national_transportation_statistics/2002/html/table_01_06.html.