

**March 2004**



# **More Highways, More Pollution**

**Road-Building and Air  
Pollution in America's Cities**



**U.S. PIRG  
Education Fund**

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U.S. PIRG EDUCATION FUND

MARCH 2004

# ACKNOWLEDGEMENTS

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## EXECUTIVE SUMMARY

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**B**uilding 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.

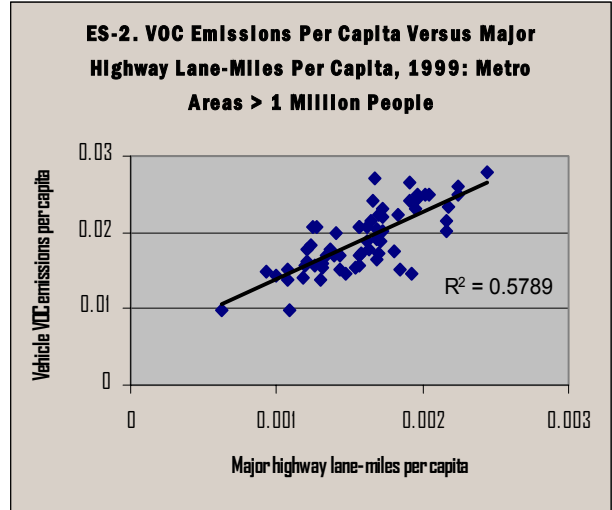
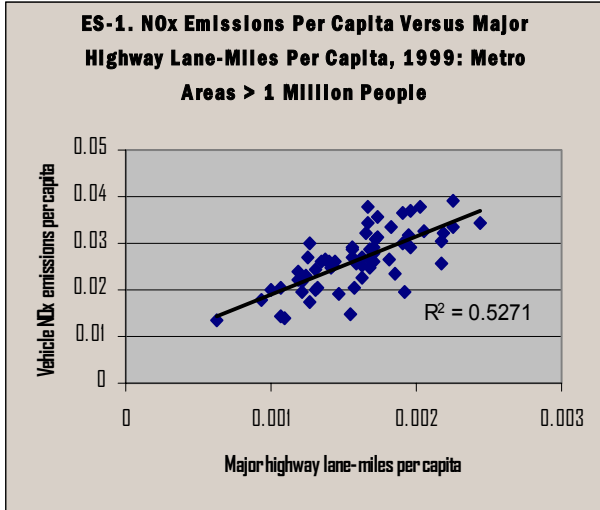
Despite tougher limits on tailpipe emissions and federal rules requiring that air quality play a role in transportation decision-making, cars and trucks remain a leading source of air pollution, particularly in urban areas, because of the dramatic rise in vehicle-miles traveled (VMT).

- ◆ 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 (NO<sub>x</sub>) 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.



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 21<sup>st</sup> 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**

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## **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."<sup>1</sup> 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.<sup>2</sup>

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.<sup>3</sup>

### *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.<sup>4</sup>

### *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<sub>2.5</sub>) emissions in 1999.<sup>5</sup> 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.<sup>6</sup>

### *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.<sup>7</sup> On-road mobile sources were responsible for 30 percent of the 4.6 million tons

of air toxics released in 1996.<sup>8</sup> 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.<sup>9</sup>

### *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.<sup>10</sup>

## **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.<sup>11</sup>

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.<sup>12</sup>

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.<sup>13</sup> (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.<sup>14</sup>

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.”<sup>15</sup>

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.<sup>16</sup>

Despite the magnitude of the air quality problem in the U.S., CMAQ funds amount to just four percent of federal surface transportation dollars.<sup>17</sup> 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.<sup>18</sup> 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.<sup>19</sup> 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<sub>2.5</sub>) and smog.

## Looking Ahead

ISTEA and its successor, the Transportation Equity Act for the 21<sup>st</sup> 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

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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.<sup>20</sup>

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.<sup>21</sup> 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.

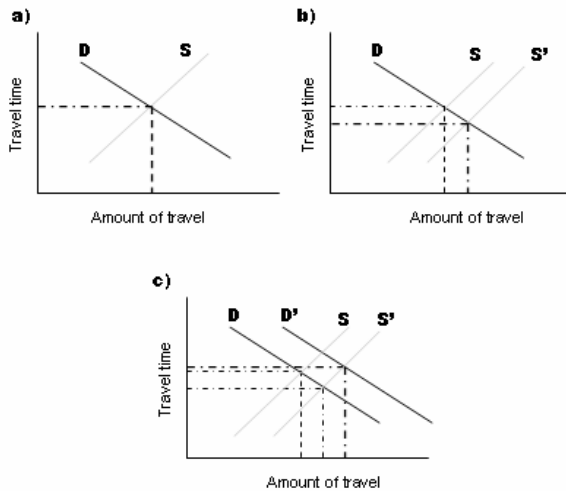
In the first graph below (Figure 1(a)), the curve D represents demand for a service and S represents supply. In the case of highway use, price can be expressed in terms of time – the longer it takes to get somewhere via a particular highway, the less likely people are to use it. The supply curve S represents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

<sup>a</sup> 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.

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.

**Table A. Sources of Generated Traffic**

Type of Generated Traffic	Category	Time Frame	Travel Impacts	Cost Impacts
<i>Shorter Route</i> Improved road allows drivers to use more direct route.	Diverted trip	Short term	Reduction	Reduction
<i>Longer Route</i> Improved road attracts traffic from more direct routes.	Diverted trip	Short term	Small increase	Slight increase
<i>Time Change</i> Reduced peak period congestion reduces the need to defer trips to off-peak periods.	Diverted trip	Short term	None	Slight increase
<i>Mode Shift: Existing Travel Choices</i> Improved traffic flow makes driving relatively more attractive than other modes.	Induced vehicle trip	Short term	Increased driving	Moderate to large increase
<i>Mode Shift: Changes in Travel Choice</i> 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
<i>Destination Change: Existing Land Use</i> Reduced travel costs allow drivers to choose farther destinations. No change in land use patterns.	Longer trip	Short term	Increase	Moderate to large increase
<i>Destination Change: Land Use Changes</i> Improved access allows land use changes, especially urban fringe development.	Longer trip	Long term	Increased driving and auto dependency	Moderate to large increase
<i>New Trip: No Land Use Changes</i> Improved travel time allows driving to substitute for non-travel activities.	Induced trip	Short term	Increase	Large increase, reduced equity
<i>Automobile Dependency</i> 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.<sup>22</sup> 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.<sup>23</sup> 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.<sup>24</sup>
- ◆ 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.<sup>25</sup>

- ◆ 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.<sup>26</sup>

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.”<sup>27</sup>

# 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.”<sup>28</sup> 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.

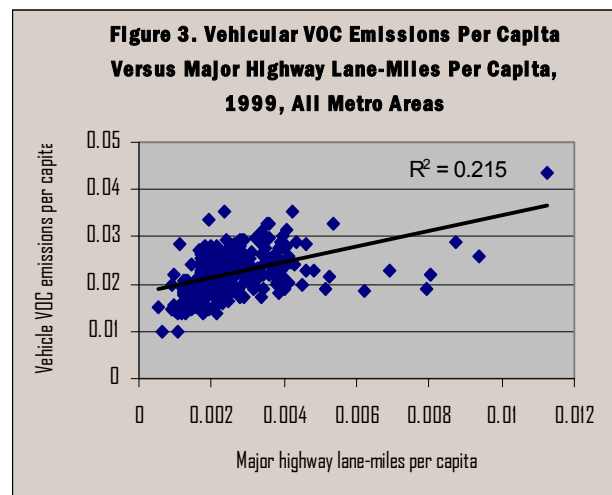
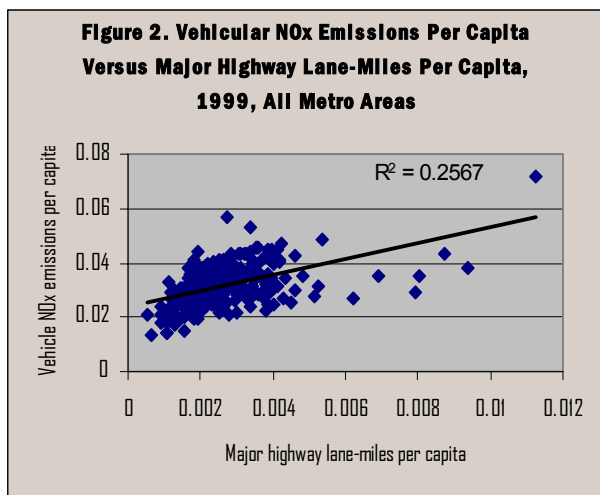
To examine the link between highways and air pollution, we analyzed data on highway capacity and vehicle emissions for 314 metropolitan areas in the U.S. Our analysis shows that, per capita, cities with more highway capacity tend to have higher levels of air pollution from vehicles, casting further doubt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

## More Highways, More Pollution

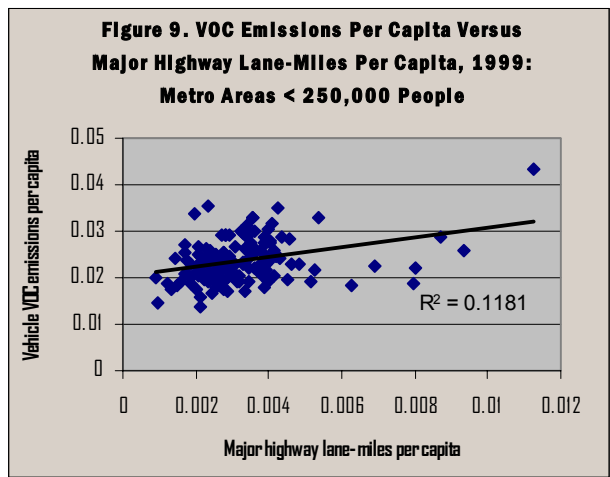
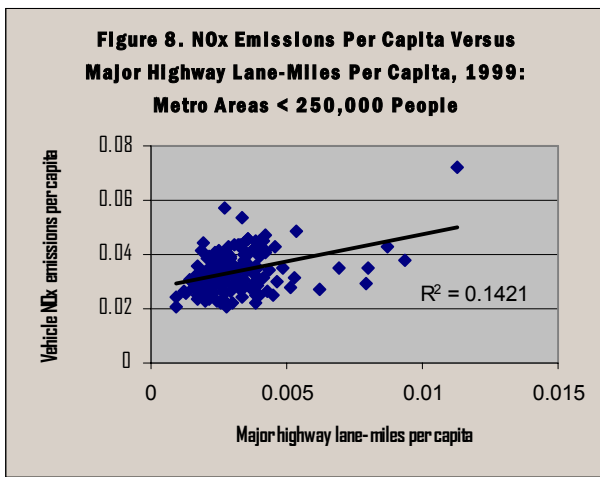
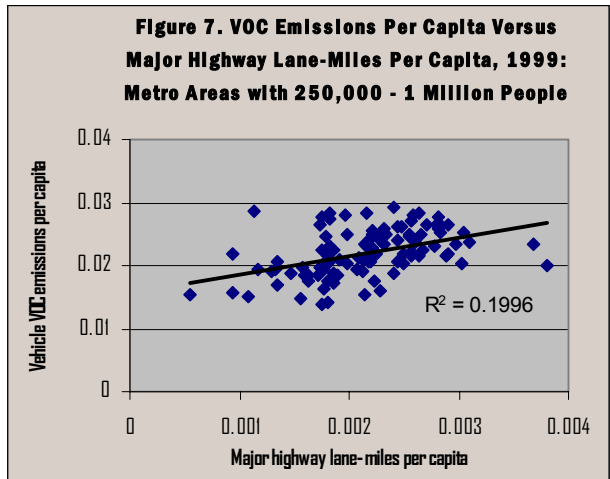
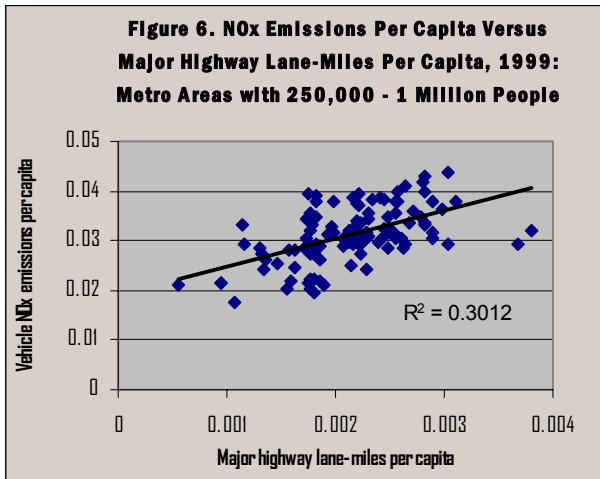
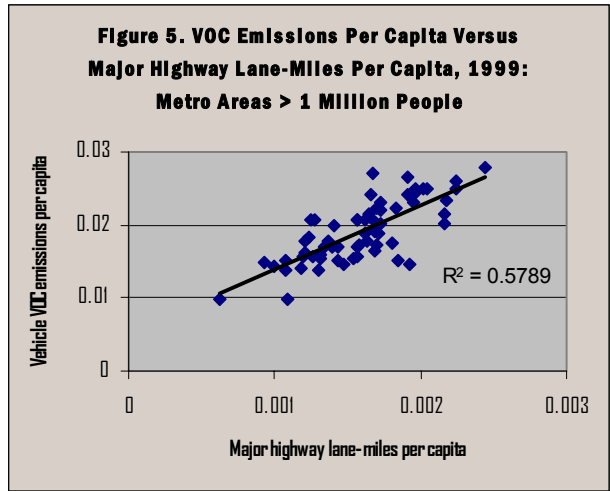
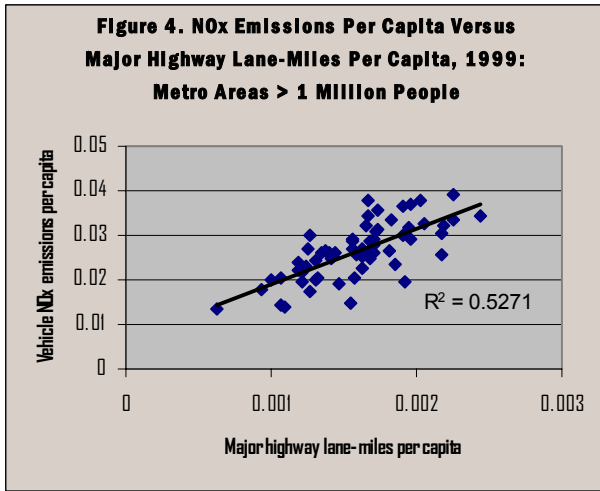
The 314 metropolitan areas examined in this report vary in population from 60,000 to 9 million and in size from the sprawl of the Los Angeles

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%.<sup>29</sup>



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



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.<sup>30</sup> 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

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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

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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](http://eire.census.gov/popest/archives/county/co_99_8.php), September 26, 2003.

## **Calculations of potential increases in NO<sub>x</sub> and VOC emissions from 14.6 percent increase in lane miles**

In order to estimate the increase in NO<sub>x</sub> 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 NO<sub>x</sub> 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
LAKE LAND-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

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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

Rank (VMT Per Capita)	Urbanized Area*	State	Total Daily VMT Per Capita	Population (1000)	Daily Vehicle-Miles Traveled (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

Rank (VMT Per Capita)	Urbanized Area*	State	Total Daily VMT Per Capita	Population (1000)	Daily Vehicle-Miles Traveled (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

Rank (VMT Per Capita)	Urbanized Area*	State	Total Daily VMT Per Capita	Population (1000)	Daily Vehicle-Miles Traveled (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

Rank (VMT Per Capita)	Urbanized Area*	State	Total Daily VMT Per Capita	Population (1000)	Daily Vehicle-Miles Traveled (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

Rank (VMT Per Capita)	Urbanized Area*	State	Total Daily VMT Per Capita	Population (1000)	Daily Vehicle-Miles Traveled (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

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- <sup>1</sup> American Lung Association (ALA), *State of the Air 2003*, May 2003.
- <sup>2</sup> U.S. PIRG Education Fund, *Danger in the Air: Unhealthy Levels of Smog in 2002*, August 2003.
- <sup>3</sup> U.S. EPA, Office of Transportation and Air Quality, <http://www.epa.gov/otaq/invtory/overview/pollutants/hydrocarbons.htm>. Accessed December 8, 2003.
- <sup>4</sup> U.S. EPA, Office of Transportation and Air Quality, <http://www.epa.gov/otaq/invtory/overview/pollutants/nox.htm>. Accessed December 8, 2003.
- <sup>5</sup> U.S. EPA, Office of Transportation and Air Quality, <http://www.epa.gov/otaq/invtory/overview/pollutants/pm.htm>. Accessed December 8, 2003.
- <sup>6</sup> 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>.
- <sup>7</sup> U.S. EPA, Office of Air & Radiation, <http://www.epa.gov/air/toxicair/newtoxics.html#what>. Accessed December 8, 2003.
- <sup>8</sup> 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.
- <sup>9</sup> California Air Resources Board, *Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles*, October 2000.
- <sup>10</sup> U.S. EPA, Office of Transportation and Air Quality, <http://www.epa.gov/otaq/invtory/overview/pollutants/carbonmon.htm#>. Accessed December 8, 2003.
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- <sup>12</sup> 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.
- <sup>13</sup> 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>.
- <sup>14</sup> 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>.
- <sup>15</sup> 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.
- <sup>16</sup> Federal Highway Administration, *CMAQ: Advancing Mobility and Air Quality*, May 2003.
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- <sup>18</sup> 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>.
- <sup>19</sup> 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>.
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- <sup>23</sup> 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.
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- <sup>25</sup> 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.
- <sup>26</sup> Brad Heavner, MaryPIRG Foundation, *Paving the Way*, November 2000.

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<sup>27</sup> 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.

<sup>28</sup> American Highway Users Alliance, *Unclogging America's Arteries: Prescriptions for Healthier Highways*. November 1999. Available at [www.highways.org](http://www.highways.org).

<sup>29</sup> 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.

<sup>30</sup> 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](http://www.bts.gov/publications/national_transportation_statistics/2002/html/table_01_06.html).