WHY ARE THE ROADS SO CONGESTED?
A Companion Analysis of the Texas Transportation Institute's Data On Metropolitan Congestion

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SURFACE TRANSPORTATION POLICY PROJECT
1100 17th Street NW, 10th Floor
Washington, DC 20036 (202) 466-2636

For the last 16 years, the Texas Transportation Institute (TTI) has reported on traffic congestion in the country's major metropolitan areas. This year's TTI study reports that in 1997, congestion levels continued to increase in almost all of the 68 cities for which they reported data. In some areas, traffic congestion has become a daily topic as officials and citizens seek ways out of the jams. But in order to effectively fight congestion, we need to first know why it is occurring.

The Surface Transportation Policy Project (STPP) has produced the following companion analysis of TTI's data to begin to answer the question: "Why are the roads so congested?" Using TTI's new data, we performed several analyses to illuminate the true causes of congestion while dispelling some myths.

It is commonly felt that congestion is a natural and unavoidable consequence of 'growth.' But what kind of growth are we talking about? Our analysis centers on several growth factors measured by the Texas Transportation Institute.

The Role Of Population Growth

TTI's data show that population growth is only a minor factor in the recent rise in congestion. Population in the metro areas studied grew by 22% during the study years (1982-1997). By contrast, the delay experienced by drivers grew by 235% in the same period. This was in large part due to the increase in driving in these areas. Actual population growth in these areas totaled almost 22 million people over this period, but STPP calculates that the increase in driving by each resident makes it feel as if about 70 million more drivers have been added to the highways. This 'perceived population growth' experienced by motorists helps explain the widespread feeling that our metro areas are "growing too fast" or "bursting at the seams."

The Growth in Driving

Only 13% of the growth in driving between 1983 and 1990 is attributed to population growth. In other words, most of the growth in driving comes not from new drivers, but from more driving by the people already on the road. Why are Americans driving so much more each year? U.S. Department of Transportation data show that 69% of the growth in driving in this period was due to 3 factors: longer average trips, less carpooling, and a switch from biking, walking, or transit to driving. Each of these factors is at least partially related to changing development patterns. Americans are each driving more every year in large part because of the increasingly spread out nature of our metro areas. As growth sprawls outward, jobs, housing and services grow farther apart. Development patterns that require an automobile trip for every errand force us to drive more every year to accomplish the same things. This is confirmed in STPP's analysis of TTI's data, which found that the spread of our metro areas is directly contributing to the increase in driving.

The Role Of Roadbuilding

One commonly cited cause of congestion is a failure to provide more road space. Our analysis shows that on average, the highway networks in the cities studied by TTI have expanded faster than population. The amount of highway per person in these metro areas grew by 10% over the last 16 years. We are adding highways faster than we are adding people to drive on them.

In addition, our analysis found that road building seemed to have little impact on congestion. Between 1982 and 1997, metro areas that were aggressive in expanding the amount of road space per person fared no better in terms of rush-hour congestion than those that did the least to add new road space; in fact, they did slightly worse. This is due in part to what is known among transportation planners as 'induced travel,' a phenomenon in which newly available road space encourages additional car travel. Our analysis of TTI's data confirms previous research on induced travel; in the metro areas studied, a 10% increase in the size of the highway network is associated with a 5.3% increase in the amount of driving.

This analysis indicates that our current traffic congestion problems are not an inevitable consequence of the healthy growth of our metro areas. These problems appear to be more closely linked to the sprawling development patterns that require so much driving. In addition, our analysis shows that congestion is not easily alleviated through adding road space. These results indicate that the traditional, road-based approach to fighting congestion is not working very well, and transportation officials might have greater success if they focus their efforts on other, more innovative congestion-fighting techniques.

I. Population Growth and Congestion: Perception vs. Reality

As shown by the TexasTransportation Institute, drivers are experiencing increasingly congested road conditions. This crowding on the roads is often attributed to a region's growth. Yet TTI's data shows that population in the metro areas studied has grown by an average of 22% in the 16 years since 1982, while the average traffic delay experienced by individuals has increased 235% in the same period. Obviously, something else is going on.

That something else is the increase in driving, most of it necessitated by our sprawling pattern of development. According to TTI, the amount Americans drive every day has grown by about 70% since 1982. This makes it feel as if the roads are bursting at the seams with new drivers. In fact, the roads are mostly filled with the original residents, who are simply driving farther and more often.

The chart below shows how the increase in driving per person magnifies population growth and affects the crowding on the roads in the metro areas with the worst rush-hour congestion. For example, in Los Angeles, California, the population grew by 2.4 million since 1982. But the 56% increase in driving made it seem as if 5.5 million additional drivers were on the road. This 'perceived population growth' on the roads helps explain why our highways are so congested.

Table 1. Actual and Perceived Population Growth (1982 to 1997)

TRI Rank[1]	Metro Area[2]	Percent Change in Population	Percent Change in Driving	Actual Population Growth	Perceived Population Growth
1	Los Angeles CA	24.2%	56.0%	2,400,000	5,544,978
2	Seattle-Everett WA	36.1%	68.9%	520,000	992,230
3	San Francisco-Oakland CA	18.5%	43.1%	610,000	1,419,150
4	Washington DC-MD-VA	28.3%	77.4%	765,000	2,088,576
5	Chicago IL-Northwestern IN	12.7%	87.9%	900,000	6,220,291
6	Atlanta GA	60.2%	138.6%	970,000	2,231,840
6	Miami-Hialeah FL	19.7%	67.2%	340,000	1,163,042
8	Boston MA	5.8%	32.3%	165,000	919,836
9	Detroit MI	5.4%	46.0%	205,000	1,753,198
9	Las Vegas NV	155.6%	182.9%	700,000	823,256
9	San Diego CA	46.6%	84.1%	830,000	1,496,694

Overall since 1982, population in the 68 metro areas studied has grown by 22 million people. However, because of the huge increase in driving, it feels as though about 70 million more drivers are on the highways in these metro areas. This is more than three times the actual population growth. The next page shows the perceived population growth for the rest of the cities studied by the Texas Transportation Institute, as ranked by TTI's measure of rush-hour congestion, the Travel Rate Index.

1. The TRI Ranking is based on TTI's Travel Rate Index. Where numbers are repeated, those Metro Areas had identical Travel Rate Indices.

2. The term 'Metro Areas' refers to Urbanized Areas which the U.S. Census Bureau defines as developed land with a density of greater than 1,000 persons per square mile.

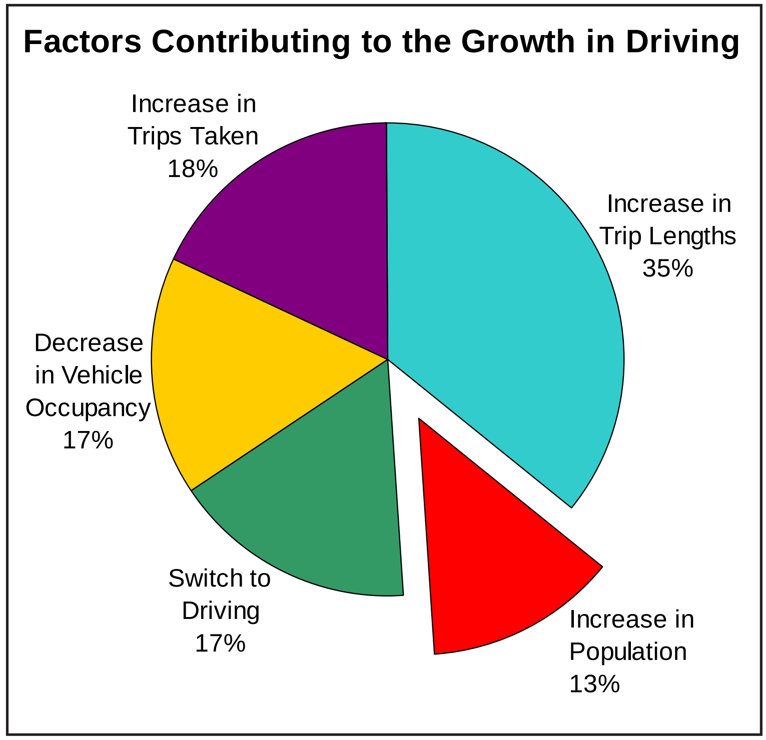
Table 1. Continued

TRI Rank	Metro Area[1]	Percent Change in Population	Percent Change in Driving	Actual Population Growth	Perceived Population Growth
12	Houston TX	29%	72%	700,000	1,721,493
12	New York NY-Northeastern NJ	3%	43%	500,000	7,106,903
12	Portland-Vancouver OR-WA	33%	108%	330,000	1,085,780
15	San Jose CA	35%	60%	420,000	719,081
16	Denver CO	33%	65%	450,000	872,117
16	Phoenix AZ	68%	131%	970,000	1,868,916
16	San Bernardino-Riverside CA	44%	78%	415,000	738,362
19	Minneapolis-St. Paul MN	31%	106%	540,000	1,849,919
19	Tacoma WA	40%	70%	170,000	293,002
21	Dallas TX	28%	82%	510,000	1,488,533
21	Ft. Lauderdale-Hollywood-Pompano Bch FL	41%	96%	435,000	1,022,901
21	Sacramento CA	49%	83%	405,000	686,090
21	St. Louis MO-IL	10%	73%	180,000	1,356,168
25	Austin TX	66%	174%	250,000	662,531
25	Baltimore MD	26%	68%	450,000	1,148,363
25	Charlotte NC	64%	161%	225,000	562,689
28	Cincinnati OH-KY	12%	67%	140,000	754,807
28	Honolulu HI	24%	56%	135,000	319,898
28	Indianapolis IN	17%	103%	150,000	889,524
28	Philadelphia PA-NJ	29%	46%	1,200,000	1,869,502
28	Salt Lake City UT	32%	101%	220,000	683,568
33	Columbus OH	22%	93%	180,000	775,729
33	Milwaukee WI	4%	55%	45,000	664,338
35	Orlando FL	75%	185%	460,000	1,125,589
36	Albuquerque NM	28%	101%	125,000	443,003
36	Louisville KY-IN	10%	106%	75,000	815,917
36	New Orleans LA	4%	54%	40,000	578,682
36	Tampa FL	54%	140%	290,000	754,898
36	Tucson AZ	44%	184%	200,000	826,550
41	Cleveland OH	7%	59%	120,000	1,031,649
41	Norfolk VA	32%	73%	250,000	561,863
43	Memphis TN-AR-MS	28%	92%	210,000	697,376
44	Fort Worth TX	20%	80%	215,000	868,177
44	Omaha NE-IA	12%	83%	60,000	416,021
46	San Antonio TX	29%	67%	280,000	634,044
47	Jacksonville FL	34%	73%	210,000	451,137
48	Fresno CA	57%	44%	195,000	150,612
48	Nashville TN	26%	130%	130,000	652,206
48	Providence-Pawtucket RI-MA	9%	62%	75,000	512,225
51	Colorado Springs CO	48%	65%	135,000	182,519
52	Hartford-Middletown CT	13%	47%	75,000	264,288
52	Kansas City MO-KS	24%	86%	265,000	935,290
52	Oklahoma City OK	58%	72%	370,000	458,411
55	El Paso TX-NM	36%	70%	160,000	315,680
55	Pittsburgh PA	4%	41%	65,000	740,998
55	Salem OR	16%	76%	25,000	121,905
58	Eugene-Springfield OR	13%	66%	25,000	125,043
58	Rochester NY	-3%	93%	-20,000	592,628
58	Spokane WA	20%	45%	55,000	123,311
61	Bakersfield CA	63%	96%	145,000	220,914
61	Beaumont TX	22%	46%	25,000	52,405
61	Boulder CO	38%	83%	30,000	66,182
61	Laredo TX	74%	206%	70,000	196,013
65	Brownsville TX	61%	88%	55,000	78,750
65	Buffalo-Niagara Falls NY	0%	33%	0	359,651
67	Albany-Schenectady-Troy NY	0%	77%	0	382,796
67	Corpus Christi TX	24%	60%	60,000	150,472
	All	**22%**	**69%**	**21,900,000**	**70,644,075**

1. The term 'Metro Areas' refers to Urbanized Areas which the U.S. Census Bureau defines as developed land with a density of greater than 1,000 persons per square mile.

II. Sprawl as a Primary Cause of Congestion

The Texas Transportation Institute's data indicates that the almost 70% increase in driving in the last 16 years is a primary cause of congestion. The factors that contribute the most to that increase are at least partially related to sprawling development patterns. According to the figure (right) published in a U.S. Department of Transportation study, as much as 69% of the growth in driving between 1983 and 1990 was caused by factors influenced by sprawl. These factors include the same people driving farther, as well as a decrease in carpooling and a switch from biking, walking, or transit to driving. These changes are in part necessitated by the spread of subdivisions and office parks isolated from stores and schools. Residents are often left with no real alternative to driving. One of the unintended consequences of this growth pattern has been a steadily growing number of vehicle trips that has served to clog local streets and freeways with traffic and increasingly frustrate residents and workers. At the same time, the chart shows that population growth accounted for only 13% of the growth in driving.



Source: *Travel Behavior Issues in the 90's*. U.S. Department of Transportation, Federal Highway Administration. Washington, DC, July 1992: p. 14.

STPP conducted a rigorous analysis[1] of more recent data (1992-1997) to examine the relationships between the growth in driving and other factors measured by TTI. STPP analyzed the growth of vehicle miles traveled (VMT) versus the growth of population, growth in the size of the urbanized area, increase in the number of highway lane miles, and initial density of the urban area[2]. This analysis demonstrates how the spreading out of the metropolitan area has contributed to an increase in driving. TTI's data reveals that every 10% growth in the size of an urbanized area generally has resulted in a 2.5% increase in miles driven, over and above the increase in driving that comes from population growth or other factors. The influence of additional road capacity, another outgrowth of sprawl, is discussed later in this paper.

This analysis indicates that our current traffic congestion problems are not an inevitable result of the normal, healthy growth of our metro areas. These problems are more closely linked to the sprawling development patterns that require so much driving.

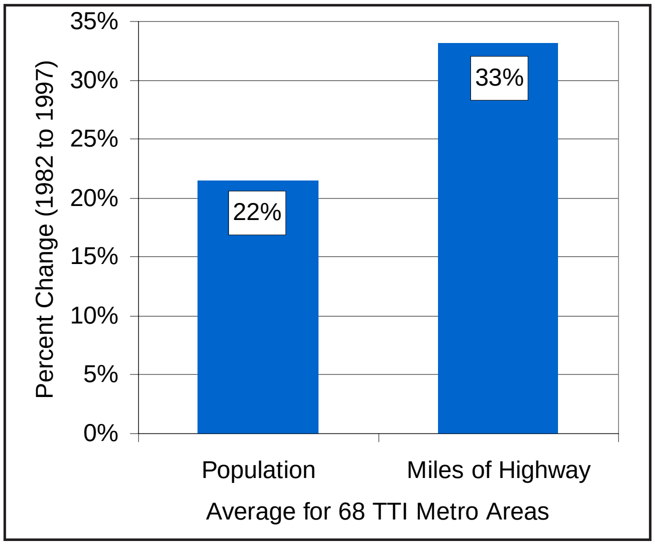
1. This analysis estimated a system of equations simultaneously; the results reported were generated with full-information maximum likelihood estimation. Contact STPP for detailed methodology.

2. With one exception, all data came straight out of the TTI database. The one exception was initial (1992) urban area density, which was developed by Professor Rolf Pendall of Cornell University and represents the average density of all urban development in the metropolitan area.

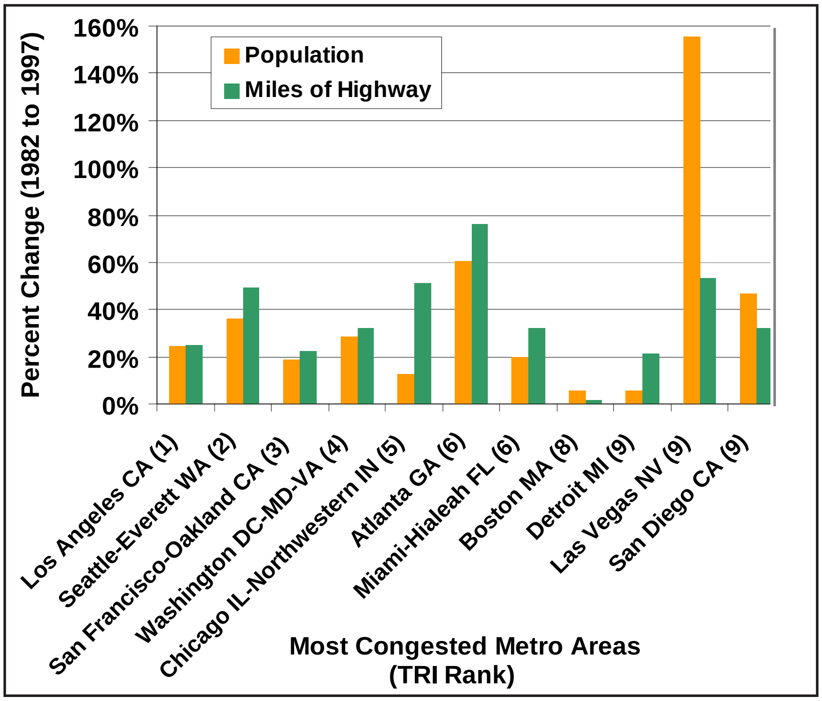
III. Roads: Keeping Pace with Growth

While we often hear that road building is not keeping up, the graphs below show that this is not the case. We used TTI data to compare the growth in population and the growth in miles of roadway since 1982, and found that road building is more than keeping pace with the real growth in our metro areas, the growth in population.

Forty-three of the 68 metro areas included in TTI's study added highway capacity at a greater rate than population growth; four others came very close to keeping pace. The average amount of roadway per person has grown 10% in the last 16 years, meaning that on average we are adding highways faster than we are adding people to drive on them. (see graph, right)



As shown below, eight of the metro areas with the worst rush hour congestion as measured by TTI built enough roads to keep up with the pace of population growth. (Graphs are available for all metro areas included in TTI's study; the ranking is by TTI's Travel Rate Index.) Our analysis shows that building highways to keep pace with population may not even be necessary. According to TTI's data, those metro areas which experienced a decline in the amount of roadway per person actually had slightly *lower* congestion levels than those metro areas showing an increase of roadway capacity per person.



Some would argue that metro areas should try to keep pace with the growth in driving. According to our analysis of TTI's data, the amount of driving per person has grown an average of 3% per year in metro areas since 1982. If all the metro areas in TTI's study were to attempt to build roads at this rate, it would require adding a total of 5,016 lane miles of highway per year at a prohibitive cost. Using a conservative estimate of the cost to add lanes to existing freeways[1], we found that the existing gas tax would have to be raised an average of 17 cents per gallon in the metro areas studied.

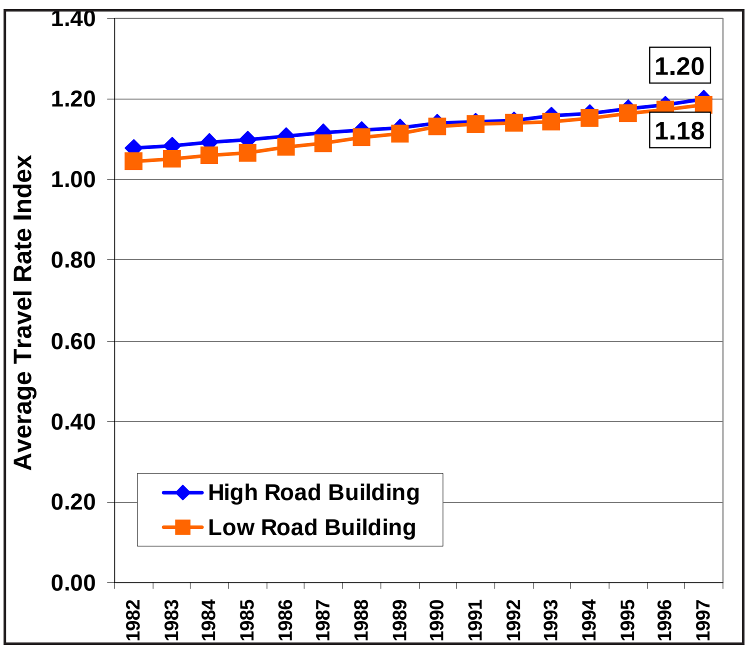
1. Costs were calculated at $1.45 million per lane mile added, which was derived from a study by the Federal Transit Administration (Cambridge Systematics, Inc. et al. *Characteristics of Urban Transportation Systems* prepared for FTA. USDOT, Publication Number DOT-T-93-07. September 1992.)

IV. Road Building Has Little Effect on Congestion

Our analysis of TTI's data shows that building new and wider roads has had little long-term impact on road congestion, and that such roads appear to actually generate additional traffic. In order to control for population growth, we looked at the amount of highway space per resident each metro area has added since 1982. We split the 68 metro areas included in TTI's study into three groups and compared the congestion rates for the high and low group. The high road-building areas increased road capacity per person by 28%, while the low-road building areas actually decreased road capacity per person by 11%. Despite this wide discrepancy, the rush-hour congestion profiles as measured by the Travel Rate Index for each group are almost identical. Interestingly, the high road building areas show slightly *higher* congestion levels than the low road-building areas throughout the period.

One explanation for this outcome is that new and wider roads tend to generate new traffic. This phenomenon, known as 'induced travel', occurs when road capacity is expanded and drivers flock to the new facility hoping to save time. The new roadways also tend to draw people who would otherwise avoid congested conditions or take alternative modes to their destinations. In the long run, this encourages additional development nearby, and that leads to even more traffic.

Our rigorous analysis of TTI's data[1] confirms this relationship. In the metro areas studied, a 10% increase in the size of the highway network has been associated with a 5.3% increase in the amount of driving. In other words, half of the new highway capacity has been filled with driving that would not have occurred if the road space had not been added. This is consistent with previous research on induced travel, including an FHWA sponsored study which found that when additional road capacity provides a 10% improvement in travel time, driving increases by 5%[2].



1. See Section II for a full description.

2. Patrick DeCorla-Souza and Henry Cohen. *Accounting for Induced Travel in Evaluation of Urban Highway Expansion.* Washington, DC: FHWA, 1997.

Methodology

The data for this analysis comes from the Texas Transportation Institute's annual report, *Urban Roadway Congestion*. To read that report, visit TTI's website at http://mobility.tamu.edu. We are very grateful to TTI, particularly Tim Lomax and David Schrank, for giving us access to their data and permitting us to perform our own, independent analysis. Our analysis covers the entire 16 years of data collected by TTI, and used TTI's Travel Rate Index for ranking comparisons. See TTI's study for an explanation of their data source and rankings.

Perceived Population Growth

The perceived population growth was calculated by multiplying each metro area's population in 1982 by the percentage increase in vehicle miles traveled in each of those metro areas. For example, Los Angeles, California had a population of 9.9 million people in 1982. Multiplying this by the growth in vehicle miles traveled (56%) gives us the perceived growth in population of 5.5 million people.

Comparison of Congestion Indices

In order to compare the congestion indices of metro areas which built many roads between 1982 and 1997 and those that didn't, we divided TTI's 68 metro areas into three groups. The group which built many roads during the period increased their road capacity by an average of 28 percent per person. The group which build the fewest roads during the period actually experienced a decline in road capacity per person of 11 percent. We then averaged the Travel Rate Index for each of the groups, for all years from 1982 to 1997, and plotted the metro areas with high road-building rates against metro areas with low road-building rates.

Metro Areas Which Built Many Roads (averaged 28% increase in lane miles per capita)		Metro Areas Which Built Few Roads (averaged 11% decrease in lane miles per capita)	
Albuquerque NM	Milwaukee WI	Bakersfield CA	Hartford-Middletown CT
Austin TX	Nashville TN	Baltimore MD	Las Vegas NV
Charlotte NC	New Orleans LA	Beaumont TX	Norfolk VA
Chicago IL-Northwestern IN	New York NY-Northeastern NJ	Boston MA	Oklahoma City OK
Dallas TX	Pittsburgh PA	Boulder CO	Phoenix AZ
Detroit NM	Portland-Vancouver OR-WA	Brownsville TX	Sacramento CA
Fort Worth TX	Providence-Pawtucket RI-MA	Colorado Springs CO	San Antonio TX
Houston TX	Rochester NY	Columbus OH	San Bernardino-Riverside CA
Jacksonville FL	St. Louis MO-IL	Denver CO	San Diego CA
Laredo TX	Tampa FL	Eugene-Springfield OR	San Jose CA
Louisville KY-IN	Tucson AZ	Fresno CA	Tacoma WA
Memphis TN-AR-MS		Ft. Lauderdale-Hollywood-Pompano Beach FL	

Increase in Gas Tax

Finally, to calculate the additional average gas tax required to keep congestion rates steady, we used TTI's estimates of highway capacity deficiencies, and multiplied those numbers by $1.45 million per lane mile (a conservative estimate of the cost of road construction; from USDOT). Dividing this figure by the number of gallons of gasoline consumed per year (in the affected metro areas) gives the average gas tax increase required, over and above what would be needed to continue normal building practices.

It should also be noted that wherever we use the terms 'miles of highway' or 'miles of roadway,' this has a specific definition and refers to lane miles of Interstates, freeways, expressways and principal arterials.