

Performance Measure Summary

There are several inventory and performance measures listed in the pages of this Urban Area Report for the years from 1982 to 2005. There is no single performance measure that experts agree “says it all.” The best comparison of congestion levels and trends is done between regions of similar size, over several years, and with a few measures of congestion aspects. Examining a few measures over many years reduces the chance that data variations or the estimating procedures may have caused a “spike” in any single year. A few key points should be recognized by users of the Urban Mobility Report data.

Use the Trends – The multi-year performance measures are better indicators, in most cases, than any single year. (*5 years is 5 times better than 1 year*).

Use several measures – Each performance measure illustrates a different element of congestion. (*The view is more interesting from the top of a few measures*).

Compare to similar regions – Congestion analyses that compare areas with similar characteristics (for example population, growth rate, road and public transportation system design) are usually more insightful than comparisons of different regions. (*Los Angeles is not Peoria*).

Compare ranking changes and performance measure values – In some performance measures a small change in the value may cause a significant change in rank from one year to the next. This is the case when there are several regions with nearly the same value. (*15 hours is only 1 hour more than 14 hours*).

Consider the scope of improvement options – Any improvement project in a corridor within most of the regions will only have a modest effect on the regional congestion level. (*To have an effect on areawide congestion, there must be significant change in the system or service*).

Comparison of Several Key Mobility Performance Measures Medium Group – 500,000 to 1 million population urban areas

Urban Area	Delay per Traveler	Travel Time Index	Total Delay	1982 to 2005	
				Delay per Traveler	Total Delay
Jacksonville, FL	H+	H+	H+	F	F+
Nashville-Davidson, TN	H+	0	H+	0	F+
Salt Lake City, UT	0	H	H	0	F+
Raleigh-Durham, NC	H+	H	H+	F+	F+
Richmond, VA	L-	L-	0	S-	S
Louisville, KY-IN	H+	H+	H+	F+	F+
Hartford, CT	L-	L-	L	S	S-
Bridgeport-Stamford, CT-NY	H	H+	H+	F	F+
Charlotte, NC-SC	H+	H+	H+	F+	F+
Austin, TX	H+	H+	H+	F+	F+
Oklahoma City, OK	L-	L-	L	S	S-
Tulsa, OK	L-	L-	L	S-	S-
Tucson, AZ	H+	H+	H+	0	F+
Dayton, OH	L-	L-	L-	S-	S-
Honolulu, HI	L	H+	L	S-	S-
Birmingham, AL	H+	0	H	F+	F+
El Paso, TX-NM	L	0	L	F	S-
Rochester, NY	L-	L-	L-	S-	S-
Springfield, MA-CT	L-	L-	L-	S-	S-
Omaha, NE-IA	L	0	L	0	S-
Sarasota-Bradenton, FL	L	H	L	S-	S-
Allentown-Bethlehem, PA-NJ	L-	L	L-	S-	S-
Akron, OH	L-	L-	L-	S-	S-
Fresno, CA	L-	L	L-	S-	S-
Grand Rapids, MI	L	L-	L-	0	S-
Oxnard-Ventura, CA	H+	H+	0	F+	F+
Albuquerque, NM	H+	0	0	F	S
New Haven, CT	L-	L-	L-	S-	S-
Albany-Schenectady, NY	L-	L-	L-	S-	S-
Toledo, OH-MI	L-	L-	L-	S-	S-

0 – Average congestion levels or average congestion growth

H Higher congestion; H+ Much higher congestion; F Faster congestion growth; F+ Much faster growth

L Lower congestion; L- Much lower congestion; S Slower congestion growth; S- Much slower growth

Performance Measures and Definition of Terms

Travel Time Index – A measure of congestion that focuses on each trip and each mile of travel. The ratio of travel time in the peak period to travel time in free-flow. A value of 1.30 indicates a 20-minute free-flow trip takes 26 minutes in the peak.

Peak Travelers – Number of travelers (using any travel mode) who begin a trip during the morning or evening peak travel periods (6 to 9 a.m. and 4 to 7 p.m.).

Annual Delay per Traveler – A yearly sum of all the per-trip delays. This measure illustrates the effect of the per-mile congestion as well as the length of each trip. The extra time required to travel in the peak period is divided by the number of travelers who begin a trip during the peak period (6 to 9 a.m. and 4 to 7 p.m.).

Total Delay – The overall size of the congestion problem. Measured by the total travel time above that needed to complete a trip at free-flow speeds. The ranking of total delay usually follows the population ranking (larger regions usually have more delay).

Free-Flow Speeds (60 mph on freeways and 35 mph on arterials) – These values are used as the national comparison thresholds. Other speed values may be appropriate for urban areas or sub-regions.

Excess Fuel Consumed – Increased fuel consumption due to travel in congested conditions rather than free-flow conditions.

Public Transportation – Regular route service from all public transportation providers in an urban area.

Operations Treatments – Freeway incident management, freeway ramp metering, arterial street signal coordination and arterial street access management.

Congestion Cost – Value of travel delay for 2005 (estimated at \$14.60 per hour of person travel and \$77.10 per hour of truck time) and excess fuel consumption (estimated using state average cost per gallon).

Annual Increase Needed to Maintain Constant Congestion Level – Number of lane-miles that must be added to the road system each year – or – the number of new transit riders or carpoolers that must be added to keep congestion levels the same as the previous year.

Urban Area – The developed area (population density more than 1,000 persons per square mile) within a metropolitan region. The urban area boundaries change frequently (every year for most growing areas). The annual change in miles traveled, therefore, includes both new travel due to growth and travel that previously occurred in areas designated as rural.

Number of Rush Hours – Time when system might have congestion

Key Mobility Performance Measure Labels

Note: Designation of an urban area congestion problem as “Much higher”, “Much faster growth”, etc. is determined using a general indicator of the accuracy of the congestion estimates. For regions with the same indicator label, there may be no difference in congestion levels. Different values are used for the indicators in regions over 1 million population and below 1 million population.

Measures	Differences Within These Values May Not Indicate a Difference in Congestion Level	
	Above 1M Population	Below 1M Population
2005 Values Delay per Traveler - Travel Time Index - Total Delay -	5 Hours 5 Index Points 5 Hours x Average Population	3 Hours 3 Index Points 3 Hours x Average Population
1982 to 2005 Trends Delay per Traveler - Total Delay -	5 Hours 5 Hours x Average Population	3 Hours 3 Hours x Average Population

The Mobility Data for Tucson, AZ

Inventory Measures	2005	2004	2003	2002	2001	2000
Urban Area Information						
Population (1000s)	750	730	720	710	705	680
Rank	52	53	53	53	53	54
Urban Area (square miles)	505	500	460	430	400	375
Popn Density (persons/sq mile)	1,485	1,460	1,565	1,651	1,763	1,813
Peak Travelers (1000s)	407	394	387	377	369	352
Freeway						
Daily Vehicle-Miles of Travel (1000s)	3,540	3,425	3,285	3,000	2,750	2,420
Lane Miles	260	250	245	235	225	210
Arterial Streets						
Daily Vehicle-Miles of Travel (1000s)	11,100	10,320	10,105	9,620	9,610	9,355
Lane Miles	1,660	1,640	1,635	1,630	1,630	1,625
Public Transportation						
Annual Psgr-Miles of Travel (millions)	62	63	62	58	68	66
Annual Unlinked Psgr Trips (millions)	17	17	17	16	16	16
Cost Components						
Value of Time (\$/hour)	14.60	14.10	13.75	13.45	13.25	12.85
Commercial Cost (\$/hour)	77.10	74.60	72.65	71.05	69.95	68.00
Fuel Cost (\$/gallon)	2.42	2.04	1.59	1.47	1.62	1.52
System Performance						
Congested Travel (% of peak VMT)	57	56	55	54	52	50
Congested System (% of lane-miles)	53	53	53	49	49	49
Congested Time (number of "Rush Hours")	7.4	7.2	7.2	6.6	6.6	6.2
Annual Increase Needed To Maintain Constant Congestion Level:						
Lane-Miles	86	74	72	61	83	81
Transit Riders or Carpoolers (millions)	23	19	18	14	19	18
Annual Excess Fuel Consumed						
Total Fuel (1000 gallons)	10,483	9,541	9,468	8,076	7,393	6,737
Rank	41	45	44	46	46	47
Fuel per Peak Traveler (gallons)	26	24	24	21	20	19
Rank	31	33	30	38	37	36
Annual Delay						
Total Delay (1000s of person-hours)	17,011	15,501	15,340	12,986	12,075	11,026
Rank	40	42	41	45	46	46
Delay per Peak Traveler (person-hrs)	42	39	40	34	33	31
Rank	25	29	22	33	31	33
Delay due to Incidents (percent)	53	53	54	53	53	53
Travel Time Index						
Rank	1.23	1.22	1.23	1.20	1.19	1.18
Rank	28	31	29	32	32	35
Congestion Cost						
Total Cost (\$ millions)	338	292	279	231	214	189
Rank	39	39	38	44	45	46
Cost per Peak Traveler (\$)	830	742	722	613	579	537
Rank	23	25	22	26	27	32

Note: System Performance statistics for 2000 through 2005 data reflect the effects of operational treatments.

Note: Zeroes in the table reflect values less than 0.5.

The Mobility Data for Tucson, AZ, Continued

Inventory Measures	1999	1998	1997	1996	1995	1994
Urban Area Information						
Population (1000s)	670	660	650	640	620	605
Rank	53	53	53	53	54	54
Urban Area (square miles)	350	320	295	280	270	260
Popn Density (persons/sq mile)	1,914	2,063	2,203	2,286	2,296	2,327
Peak Travelers (1000s)	342	333	324	315	301	290
Freeway						
Daily Vehicle-Miles of Travel (1000s)	2,100	1,955	1,775	1,670	1,475	1,365
Lane Miles	195	185	175	160	145	135
Arterial Streets						
Daily Vehicle-Miles of Travel (1000s)	9,265	9,135	8,985	8,250	8,000	7,725
Lane Miles	1,615	1,615	1,610	1,605	1,595	1,550
Public Transportation						
Annual Psgr-Miles of Travel (millions)	64	59	62	64	60	62
Annual Unlinked Psgr Trips (millions)	18	16	18	18	16	18
Cost Components						
Value of Time (\$/hour)	12.40	12.15	12.00	11.70	11.40	11.05
Commercial Cost (\$/hour)	65.80	64.35	63.40	61.95	60.20	58.50
Fuel Cost (\$/gallon)	1.38	1.19	1.32	1.26	1.20	1.19
System Performance						
Congested Travel (% of peak VMT)	46	45	44	38	37	38
Congested System (% of lane-miles)	44	44	44	40	40	40
Congested Time (number of "Rush Hours")	6.2	6.0	5.8	5.4	5.2	5.2
Annual Increase Needed To Maintain Constant Congestion Level:						
Lane-Miles	83	77	74	53	39	30
Transit Riders or Carpoolers (millions)	18	16	16	10	8	6
Annual Excess Fuel Consumed						
Total Fuel (1000 gallons)	6,321	6,134	5,747	4,400	4,075	3,876
Rank	49	49	47	52	51	47
Fuel per Peak Traveler (gallons)	18	18	18	14	14	13
Rank	42	40	40	49	48	43
Annual Delay						
Total Delay (1000s of person-hours)	10,558	10,347	9,765	7,467	6,951	6,583
Rank	47	46	44	49	49	47
Delay per Peak Traveler (person-hrs)	31	31	30	24	23	23
Rank	36	35	36	44	42	42
Delay due to Incidents (percent)	53	53	53	53	53	53
Travel Time Index						
Rank	40	40	40	45	44	43
Congestion Cost						
Total Cost (\$ millions)	174	166	155	115	104	96
Rank	46	43	43	48	47	47
Cost per Peak Traveler (\$)	508	497	478	366	346	330
Rank	34	32	31	42	41	38

Note: System Performance statistics for 2000 through 2005 data reflect the effects of operational treatments.

Note: Zeroes in the table reflect values less than 0.5.

The Mobility Data for Tucson, AZ, Continued

Inventory Measures	1993	1992	1991	1990	1989	1988
Urban Area Information						
Population (1000s)	590	560	550	530	510	500
Rank	54	56	56	56	58	58
Urban Area (square miles)	250	240	230	220	210	200
Popn Density (persons/sq mile)	2,360	2,333	2,391	2,409	2,429	2,500
Peak Travelers (1000s)	280	262	254	242	231	225
Freeway						
Daily Vehicle-Miles of Travel (1000s)	1,330	1,280	1,250	1,275	1,200	1,070
Lane Miles	120	110	105	105	105	105
Arterial Streets						
Daily Vehicle-Miles of Travel (1000s)	7,675	7,500	7,320	7,190	7,110	7,050
Lane Miles	1,535	1,520	1,505	1,490	1,485	1,475
Public Transportation						
Annual Psgr-Miles of Travel (millions)	60	51	63	44	44	41
Annual Unlinked Psgr Trips (millions)	18	17	19	13	13	11
Cost Components						
Value of Time (\$/hour)	10.75	10.50	10.25	10.00	9.25	8.80
Commercial Cost (\$/hour)	57.05	55.40	53.80	51.60	48.95	46.70
Fuel Cost (\$/gallon)	1.18	1.22	1.06	1.07	1.11	1.02
System Performance						
Congested Travel (% of peak VMT)	39	39	39	39	35	30
Congested System (% of lane-miles)	40	40	40	40	35	30
Congested Time (number of "Rush Hours")	5.4	5.4	5.4	5.4	5.2	5.0
Annual Increase Needed To Maintain Constant Congestion Level:						
Lane-Miles	35	26	24	23	19	20
Transit Riders or Carpoolers (millions)	7	5	4	4	3	4
Annual Excess Fuel Consumed						
Total Fuel (1000 gallons)	4,049	3,892	3,748	3,782	3,277	2,705
Rank	46	44	43	42	42	41
Fuel per Peak Traveler (gallons)	14	15	15	16	14	12
Rank	40	34	32	25	27	31
Annual Delay						
Total Delay (1000s of person-hours)	6,867	6,487	6,327	6,354	5,632	4,659
Rank	43	43	41	38	38	40
Delay per Peak Traveler (person-hrs)	25	25	25	26	24	21
Rank	36	31	27	22	24	28
Delay due to Incidents (percent)	53	53	53	53	53	53
Travel Time Index						
Rank	35	34	31	28	30	37
Congestion Cost						
Total Cost (\$ millions)	97	90	85	83	69	54
Rank	42	40	40	38	36	38
Cost per Peak Traveler (\$)	349	343	334	342	297	240
Rank	28	28	25	20	22	26

Note: System Performance statistics for 2000 through 2005 data reflect the effects of operational treatments.

Note: Zeroes in the table reflect values less than 0.5.

The Mobility Data for Tucson, AZ, Continued

Inventory Measures	1987	1986	1985	1984	1983	1982
Urban Area Information						
Population (1000s)	490	480	470	455	450	450
Rank	57	57	58	58	58	57
Urban Area (square miles)	190	180	170	160	155	150
Popn Density (persons/sq mile)	2,579	2,667	2,765	2,844	2,903	3,000
Peak Travelers (1000s)	218	212	206	198	194	192
Freeway						
Daily Vehicle-Miles of Travel (1000s)	1,130	1,040	970	950	810	750
Lane Miles	105	100	95	95	90	90
Arterial Streets						
Daily Vehicle-Miles of Travel (1000s)	6,980	6,940	6,910	6,885	6,800	6,750
Lane Miles	1,460	1,455	1,410	1,395	1,390	1,380
Public Transportation						
Annual Psgr-Miles of Travel (millions)	41	43	41	41	41	41
Annual Unlinked Psgr Trips (millions)	10	11	10	10	10	10
Cost Components						
Value of Time (\$/hour)	8.50	8.20	8.00	7.75	7.45	7.20
Commercial Cost (\$/hour)	44.85	43.30	42.50	41.05	39.35	38.10
Fuel Cost (\$/gallon)	1.03	1.00	1.31	1.33	1.36	1.42
System Performance						
Congested Travel (% of peak VMT)	30	29	33	29	29	29
Congested System (% of lane-miles)	30	29	34	29	29	29
Congested Time (number of "Rush Hours")	5.0	5.0	5.2	5.2	5.0	5.0
Annual Increase Needed To Maintain Constant Congestion Level:						
Lane-Miles	25	--	--	--	--	--
Transit Riders or Carpoolers (millions)	4	--	--	--	--	--
Annual Excess Fuel Consumed						
Total Fuel (1000 gallons)	2,656	2,661	3,015	2,747	2,616	2,557
Rank	38	38	34	32	32	31
Fuel per Peak Traveler (gallons)	12	13	15	14	13	13
Rank	28	22	11	12	9	9
Annual Delay						
Total Delay (1000s of person-hours)	4,522	4,676	5,273	4,898	4,688	4,588
Rank	37	36	33	31	31	28
Delay per Peak Traveler (person-hrs)	21	22	26	25	24	24
Rank	24	18	11	10	9	8
Delay due to Incidents (percent)	53	53	53	52	52	52
Travel Time Index						
Rank	33	33	19	21	17	17
Congestion Cost						
Total Cost (\$ millions)	50	50	56	51	47	44
Rank	37	36	31	31	31	27
Cost per Peak Traveler (\$)	231	237	273	256	241	231
Rank	23	14	10	8	8	6

Note: System Performance statistics for 2000 through 2005 data reflect the effects of operational treatments.

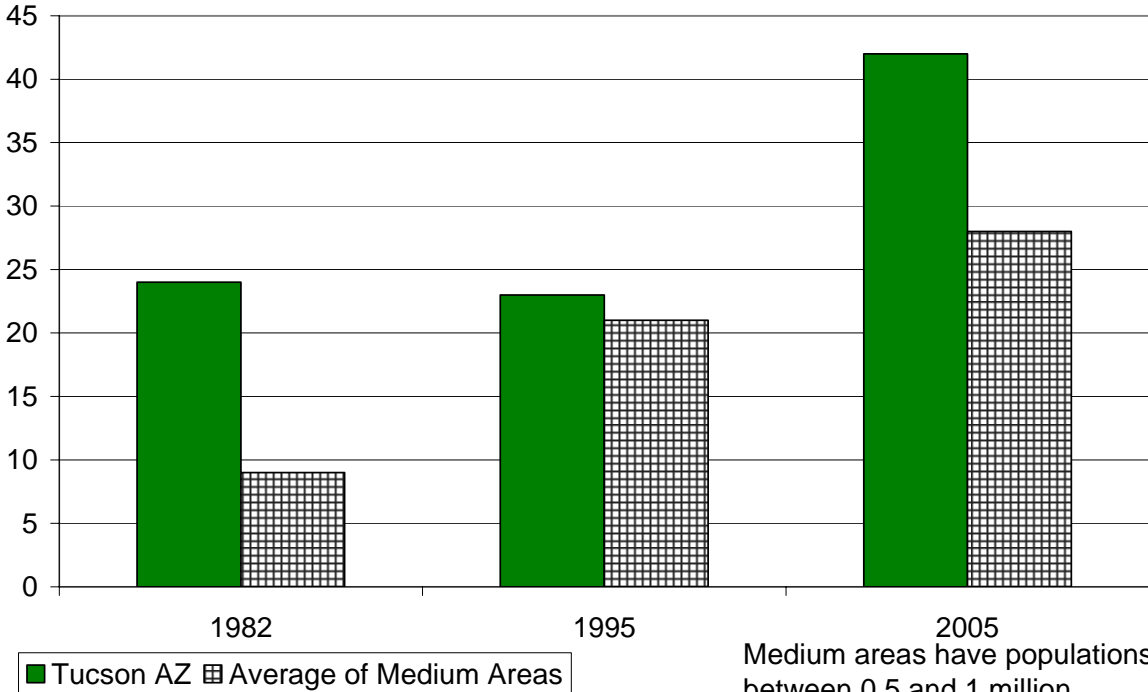
Note: Zeroes in the table reflect values less than 0.5.

Benefits From Public Transportation Service and Operations Strategies for Tucson, AZ

Operations Strategies	2005	2004	2003	2002	2001	2000
Freeway Ramp Metering						
Percent of Roadway Miles	--	--	--	--	--	--
Annual Delay Reduction (1000 hours)	--	--	--	--	--	--
Freeway Incident Management						
Cameras						
Percent of Roadway Miles	29	27	28	36	26	17
Service Patrols						
Percent of Roadway Miles	10	10	9	10	--	--
Annual Delay Reduction (1000 hours)	37	32	32	24	4	2
Arterial Signal Coordination						
Percent of Roadway Miles	68	68	64	64	64	64
Annual Delay Reduction (1000 hours)	104	105	87	86	88	75
Arterial Access Management						
Percent of Roadway Miles	45	45	45	45	46	46
Annual Delay Reduction (1000 hours)	755	718	678	547	569	500
HOV Lanes						
Daily Passenger-miles of Travel (1000s)	--	--	--	--	--	--
HOV User Delay Savings	--	--	--	--	--	--
Total Effect of Operations Treatments						
Annual Delay Reduction (1000 hours)	896	855	796	657	661	576
Annual Delay Saved per Peak Traveler (hours)	2	2	2	2	2	2
Annual Congestion Cost Savings (\$million)	17.6	15.9	14.3	11.6	11.6	9.8
Travel Time Index with Strategies	1.228	1.221	1.225	1.202	1.188	1.178
Travel Time Index (Base)	1.238	1.231	1.235	1.210	1.196	1.186
Public Transportation Service						
Existing Service						
Annual Passenger-miles of Travel (million)	62	63	62	58	68	66
Unlinked Passenger Trips (million)	17	17	17	16	16	16
Travel Time Index (combined road and transit)	1.224	1.216	1.220	1.198	1.183	1.174
Condition if Public Transportation Service were Discontinued						
Travel Time Index	1.243	1.235	1.240	1.217	1.203	1.193
Annual Delay Increase (1000 hours)	567	560	612	654	666	598
Annual Delay Increase per Peak Traveler (hours)	1	1	2	2	2	2
Annual Congestion Cost Increase (\$million)	11.3	10.6	11.2	11.7	11.8	10.3

Growth in Delay per Peak Traveler

Hours of Delay



Annual Hours of Delay (million)

Growth in Total Delay

