✪ GOVERNOR'S BUSINESS COUNCIL ✪

Texas' Roadways – Texas' Future

A Look at the Next 25 Years of Roadway Supply, Demand, Cost and Benefits

The Governor's Business Council Transportation Task Force

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EXECUTIVE SUMMARY

The Key Findings

1. Traffic congestion has a negative effect on economic growth. Investment in new roadways will generate economic, safety and environmental benefits as well as reduce congestion. The largest transportation problem now and well into the foreseeable future is the movement of people, goods and services from point to point within the urban areas. Failure to solve these problems will likely have significant economic consequences to the State.

2. Texas' population will increase from 20.8 million in 2000 to 29.6 million in 2025. Ninety percent of the growth, or almost 8 million more people, will live in Texas' metropolitan areas, where 15 million people lived in the year 2000.

3. Traffic congestion is getting worse. From 1990 to 2000, Texas' population grew 23 percent, the number of vehicles increased 23 percent, the number of workers grew by 23 percent, vehicle miles traveled increased by 41 percent, and TxDOT spending increased by 45 percent. The number of lane-miles increased by only 3 percent, causing congestion to rise by 126 percent.

4. From 1990 to 2000 traffic congestion has cost Texas 2.6 billion hours of delay (costing $40 billion) and 4.5 billion gallons of wasted fuel (costing $5.6 billion), bringing the total cost of delay to $45.6 billion. During this same period TxDOT spent only $37.4 billion on maintenance and new construction. While the number of workers during the 1990s increased by 19 percent, the number of workers commuting by more than 45 minutes grew by more than 50 percent.

5. Based on current highway construction and maintenance spending trends, $140 billion will be spent over the next 25 years. Under this scenario, delay time caused by congestion will increase over 350 percent by 2025.

6. The State has lost 15 years of purchasing power in terms of its ability to fund roadway improvements from the gasoline tax.

7. To maintain existing congestion levels would require the annual addition of almost 900 lane-miles to the State system in the metropolitan areas included in this report. To meet the 1.15 Travel Time Index scenario would require 1,500 lane-miles to be added to the system annually.

8. Over the next 25 years, the cost to reduce traffic congestion in the State from the current 1.30 to a 1.15 Travel Time Index is $78 billion more than is expected to be spent assuming current trends. These additional expenditures would reduce delay time by 20 billion hours (saving $311 billion), save 31 billion gallons of fuel (worth $43 billion) for a total of $354 billion in savings over 25 years. Additional benefits include 120,000 additional permanent jobs, reducing emissions by 775,000 tons of hydrocarbon pollutants, improved safety and increases in productivity that total an estimated $157 billion. The aggregate value of these benefits totals $511 billion versus a cost of $78 billion to achieve them.

9. The improvement costs included in this report are average estimates from across the State and may not be representative of any particular project. They do however provide a reasonable estimate of mobility improvement costs. The analysis indicates that achieving the 1.15 Travel Time Index goal would cost $335 more per year per household in 2025 than current trends. To simply maintain the present level of congestion will require $167 more per year per household. These costs are more than offset by travel time delay reductions and lower fuel consumption benefits of $2,118 per year per household at the 1.15 Travel Time Index standard.

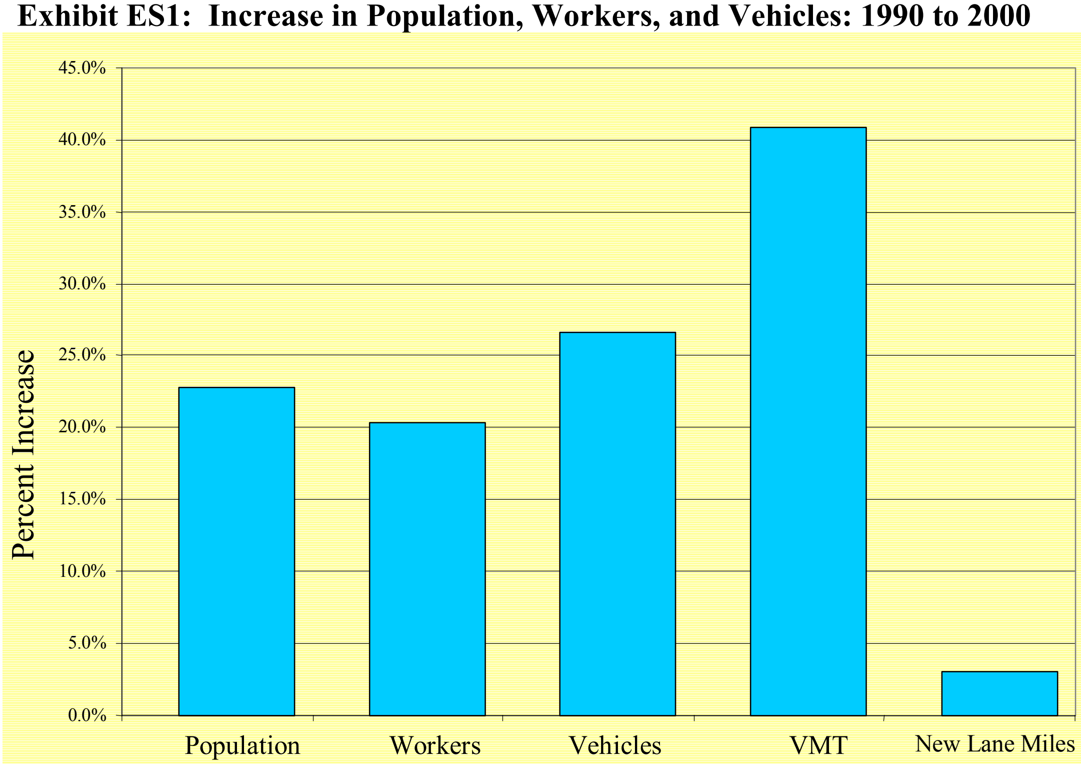
10. The goal of maintaining current congestion levels costs less than 1 cent per mile more for every mile driven than current expenditures. Further reducing the travel time penalty to only 15 percent more travel time than free-flow trips (a Travel Time Index of 1.15) will require less than 2 additional cents per mile. Seen as a toll, this would amount to 16 cents more than current trends to make a 10-mile work trip.

11. The principal strategies for reducing congestion must respond to increased demand by improving the flow of personal and commercial traffic on roadways where virtually all trip volume occurs. The potential solutions are many and varied, but their common, shared purpose must be to improve mobility and reduce congestion. Solutions must include new roadways, roadway expansions, improved traffic management and computer-based technological advances.

12. No other form of public investment that is both economically and socially feasible can do as much to reduce air pollution.

13. It will cost significantly less to solve these problems than do nothing and suffer the consequences.

Exhibit ES1: Increase in Population, Workers, and Vehicles: 1990 to 2000



Recommendations

This report is intended to establish a process whereby vision and needs drive the process of transportation improvement. Toward that end, specific performance objectives are proposed. It becomes critical then that improvement toward whatever objectives are adopted be measured on a regular and consistent basis. With respect to roadway performance and management it is recommended that:

1. Reducing congestion and improving urban mobility in Texas require strategies that improve the flow of roadway traffic. This will include new roadways and roadway expansions, but it will also mean improved traffic management, computer-based technological advances, public transportation, and other strategies.

2. The State should adopt a 25-year goal of reducing the Travel Time Index in all areas to 1.15. A trip taken during peak periods should take no more than 15 percent longer than during non-peak periods. As of 2000, these indexes in Houston, Dallas/Fort Worth, San Antonio and Austin ranged from 1.38 to 1.23. To accomplish this, urban mobility must be a major focal point of transportation planning at the State level. The State highway system represents an estimated two-thirds of urban transportation volume in the State's metropolitan areas where 90 percent of all population growth in the State is projected to occur. As a result, the major transportation challenge will be maintaining mobility within the urban areas.

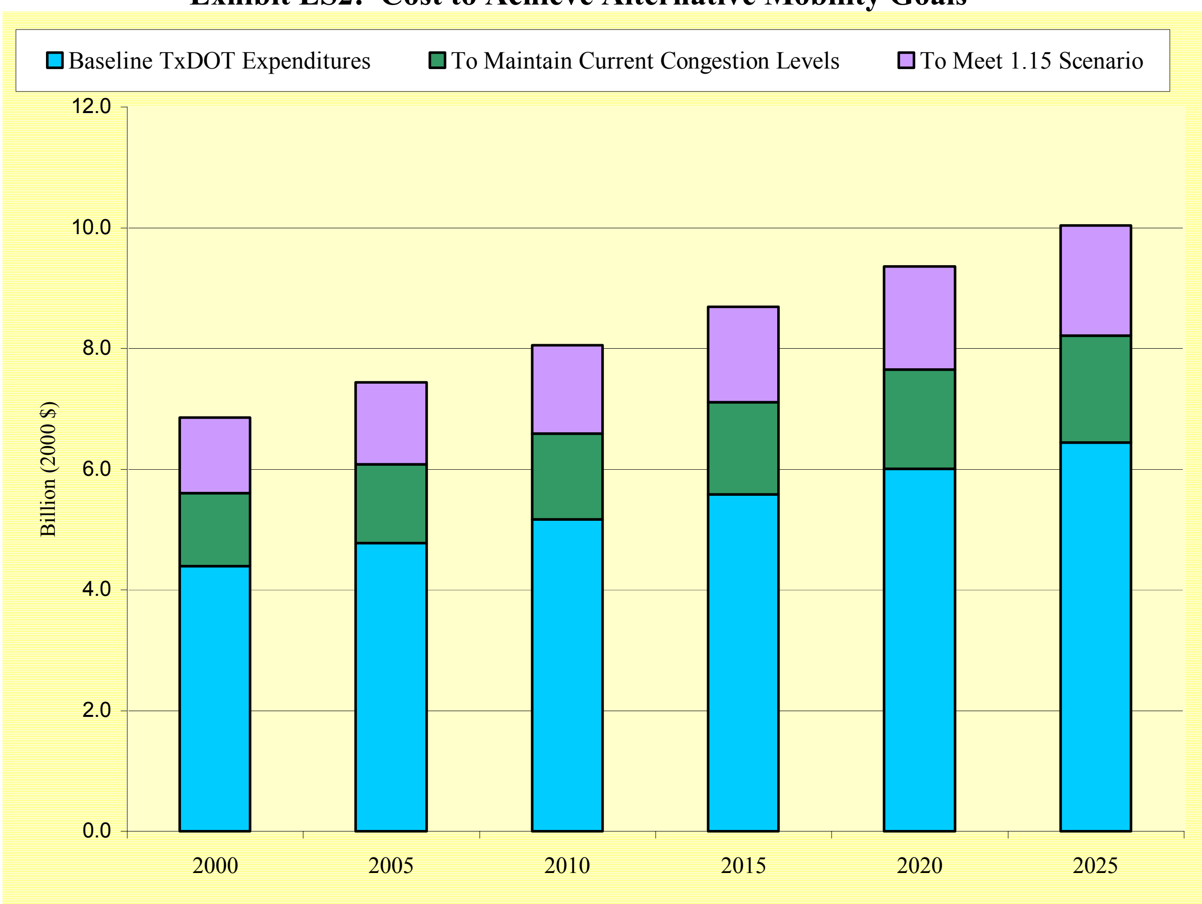
3. A detailed plan to accomplish this goal in the most effective, efficient and expeditious manner should be created by the Texas Department of Transportation (TxDOT) in conjunction with local and regional planning authorities throughout the State. These plans should not be constrained to spending based on the currently available revenue streams.

4. A long-term plan to finance and construct the necessary improvements should be developed by State and local agencies taking into consideration the fact that the cost of doing nothing is substantially more than the additional $78 billion it will cost over the next 25 years to expand and improve the transportation system. The financing plan should consider myriad methods including the use of local option taxes or fees, local and State borrowing programs, etc., based on the specific needs of each area.

5. State, TxDOT and Federal policies should be modified to motivate and allow local areas to fund as much of the solution as possible and to achieve maximum efficiencies by coordinating projects and quickly embracing and adopting solutions that will help achieve the goal. Local areas that fund large or disproportionate amounts of their local solutions should be guaranteed that their ongoing TxDOT funding will not be reduced because they achieve lower congestion levels than other areas of the State.

6. Accountability will be a key to success. The selection of particular mechanisms for reducing congestion (adding general purpose lanes, bus rapid transit, carpooling, intelligent transportation systems, etc.) should be determined through a fair and unbiased evaluation of the congestion-reducing abilities vs. costs of each option. Projects should each be evaluated using a **Delay Reduction Index** to measure the amount of congestion per dollar each option will yield to determine their cost effectiveness in reaching the objective. TxDOT should continue to publish the annual District and County Statistics (DISCOS) book in its historical form, but should expand the data to include key measurements that will allow a clear picture of urban mobility and congestion, progress made toward accomplishing the adopted goals, and will delineate local and state funding of projects and other pertinent performance measures. An independent third party should complete an annual evaluation and report card to measure progress, compare action and results to the long-term plan, and to ensure all participants are accountable toward achieving the goal. This plan should be delivered to the Governor, TxDOT, local and regional planning authorities and others.

Exhibit ES2: Cost to Achieve Alternative Mobility Goals



SUMMARY

Introduction

Transportation is crucial to the economy and standard of living in Texas. The most serious transportation threat to the State is the continuing delay in passenger and freight travel activity brought about by congested road facilities. Further, the problem is most critical in the State's major metropolitan areas. This challenge threatens to increase to dramatic levels in the future unless timely, substantial responses are undertaken. As a result, the Governor's Business Council has prepared this study of the future metropolitan transportation needs as well as the costs and benefits of meeting those needs.

The purpose of the Governor's Business Council study is:

> *to establish a process whereby vision, needs and accountability drive the process of transportation improvement, rather than currently or traditionally available resources. This is to start a "how we can fulfill our vision" process instead of a "what does the status quo allow" process.*

This focus on a defined vision and needs represents an important addition to current practice; from a financially constrained process to one based upon defining minimum performance standards and then seeking the resources to accomplish the objectives.

The future economic performance in Texas will be enhanced by a program that reduces travel delay hours in the State's largest urban areas and assures that other areas across the State maintain their current mobility. A key finding is that it costs significantly less to solve the problem than to do nothing and suffer with increased congestion.

The Importance of Reducing Metropolitan Traffic Congestion

The central issue in regard to road conditions in Texas today is highway congestion. This study takes as its goal addressing the needs of reducing highway congestion in the State. Urban traffic conditions have deteriorated substantially in urban areas, where two-thirds of Texans live, as traffic volumes have increased significantly more than roadway capacity improvements. Now, travel demand exceeds roadway capacity for several hours of a typical day in the larger urban areas. The size of the road system must increase to respond to dramatic population and business growth. Its quality of service must improve to meet the needs of an increasingly affluent society with high values of time for both people and goods and to assure a vigorous business climate and quality of life.

This study has as its dominant focus the needs for highways now and in the future in Texas. Highway-oriented travel, to meet the social and economic needs of both passengers and freight activities, are the centerpiece of transportation in Texas – as in the rest of the nation and world. While the consideration of alternatives to highways is very appropriate in almost every context, it is recognized that the prospects for serious contributions to travel needs in the future by non-highway alternatives are limited to a few travel "markets." Issues in the future will almost certainly center on the nature of the technologies in road vehicles, perhaps alternative fuels, and the nature of construction, finance or even ownership of roads. Most of the principal options are considered briefly here, but specific considerations of alternatives will be a part of the detailed studies in each metropolitan area as the broad statements of need are refined and turned into specific projects. Those alternatives may include a range of treatments including public transportation, travel demand management, access management, telecommuting, shifting work hours, carpool/parking priority, all of which can contribute to increasing the efficiency of existing roadways.

There are other highway needs to be sure. Among these are: adequate highway system maintenance, enhanced safety, system reliability and air quality concerns. All of these are addressed, completely or in part, by improving traffic flows.

I. Transportation and Demographics

Texas is now the nation's second most populous state and is growing rapidly. It is expected that the population will increase from 20.9 million in 2000 to 29.6 million in 2025. Nearly 90 percent of this increase will be in the largest metropolitan areas (Austin, Dallas-Fort Worth, Houston, and San Antonio) and the Border (Brownsville, El Paso, and Laredo) that are the focus of this report. At the same time, employment is projected to grow even faster than population. Moreover, incomes are rising in Texas, and as affluence increases, travel patterns change.

At the same time, Texas, like all other states, is almost fully dependent on roadways and personal vehicles. The number of workers in Texas increased by approximately 1.5 million from 1990 to 2000 – 1.3 million of them drove alone to work and 200,000 traveled in carpools. Thus, the road system absorbed the growth in travel demand in the last ten years. Only working at home made a significant additional contribution to meeting the needs of new workers. The latest U.S. Census indicates that more than 92 percent of work trip travel is by personal vehicle. This includes 77.7 percent driving alone and 14.5 percent in carpools. Area-wide transit use is small at 1.8 percent and is exceeded by both walking to work and by working at home. Transit carries over 15 percent of trips to downtowns in the major Texas cities however, and peak period travel in buses and carpools are equal to or greater than two freeway lanes in several corridors with high-occupancy vehicle lanes. The traditional downtown, however, includes less than 10 percent of the area-wide jobs, an indication of the many strategies needed to address the mobility challenges.

During the 1990s, average work trip travel time in Texas increased 3.2 minutes, from 22.2 minutes to 25.4 minutes, mirroring the national trend. Work trips are important because their concentration at peak hours causes much of the recurring traffic delay in urban areas. **However, non-work trip travel is increasing at an even greater rate than work trips, and this travel is even more dependent upon personal vehicles than work trip travel.**

II. Transportation and the Texas Economy

The Texas economy has also grown strongly and is projected to grow even more rapidly in the future. Presently, Texas represents approximately eight percent of the U.S. gross domestic product. It is expected that this will rise to 10 percent by 2025. Further, employment is projected to grow at a faster rate than the population.

And, while the national and state economies are expected to experience strong growth, international trade can be expected to grow even faster. Already, the North American Free Trade Agreement has resulted in strong trade increases, especially with Mexico. Most international commerce with Mexico crosses the international border in Texas. The U.S. Department of Transportation projects a near doubling of freight traffic, largely by truck, over the next 20 years. Given its extraordinary growth and strategic geographical position, the Texas figure could be substantially higher.

It is clear, based upon the continuing population increase, increasing affluence, increasing employment and economic trends that travel demand will continue to increase strongly in Texas. How well the State can respond to these challenges will in no small measure be a function of its ability to develop and maintain a competitive transportation infrastructure.

III. The Costs and Benefits of Reducing Urban Traffic Congestion

The urban areas included in this study represent 68 percent of the population, 56 percent of vehicle travel, 68 percent of registered vehicles, but over 95 percent of the travel delay. To further exacerbate the problem, these same areas are expected to absorb 80 percent of the population growth over the next 25 years. Congestion already costs Texas residents, travelers, and businesses lost time, wasted fuel and dollars. Addressing the mobility needs will require additional resources; this report outlines the cost but also estimates the substantial returns that can be derived from this investment.

As can be seen in the graph below, the rapid growth of Texas' metropolitan areas in the last decades has outpaced the growth in lane-miles of roadway. Such growth challenges all public services. The provision of other public services such as schools, hospitals, police, fire, and social services must also keep pace with growth. Highways that advance the ability of other services to meet their challenges must similarly keep pace.

Exhibit S1: Increase in Population, Workers, and Vehicles: 1990 to 2000

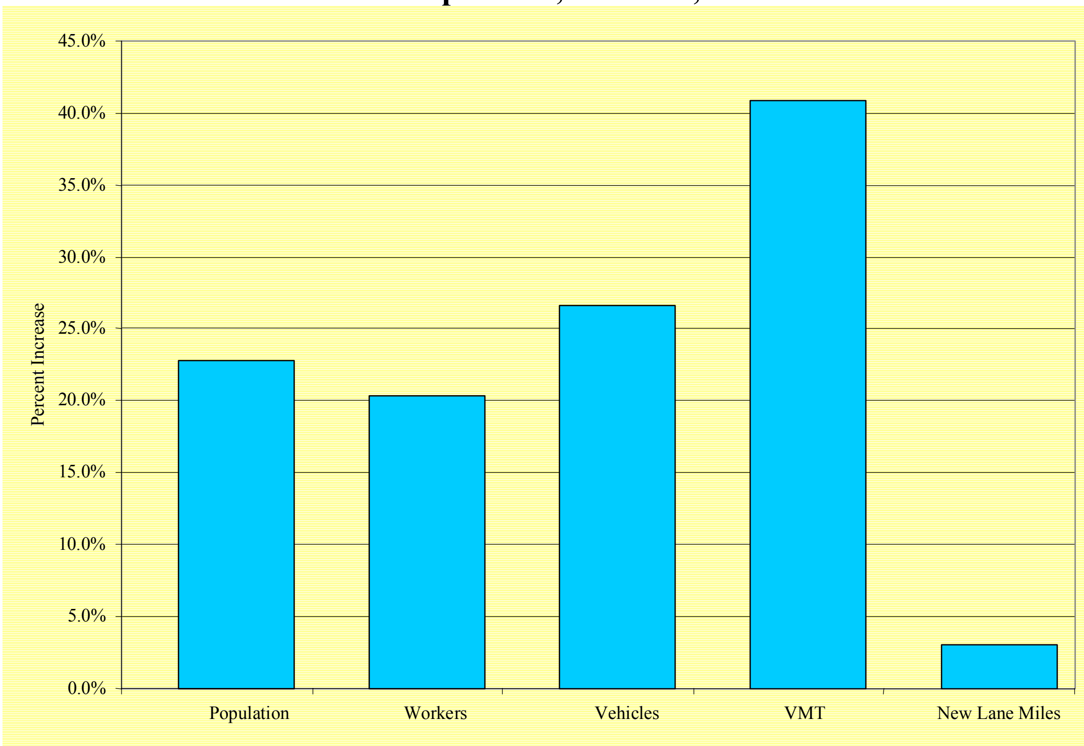
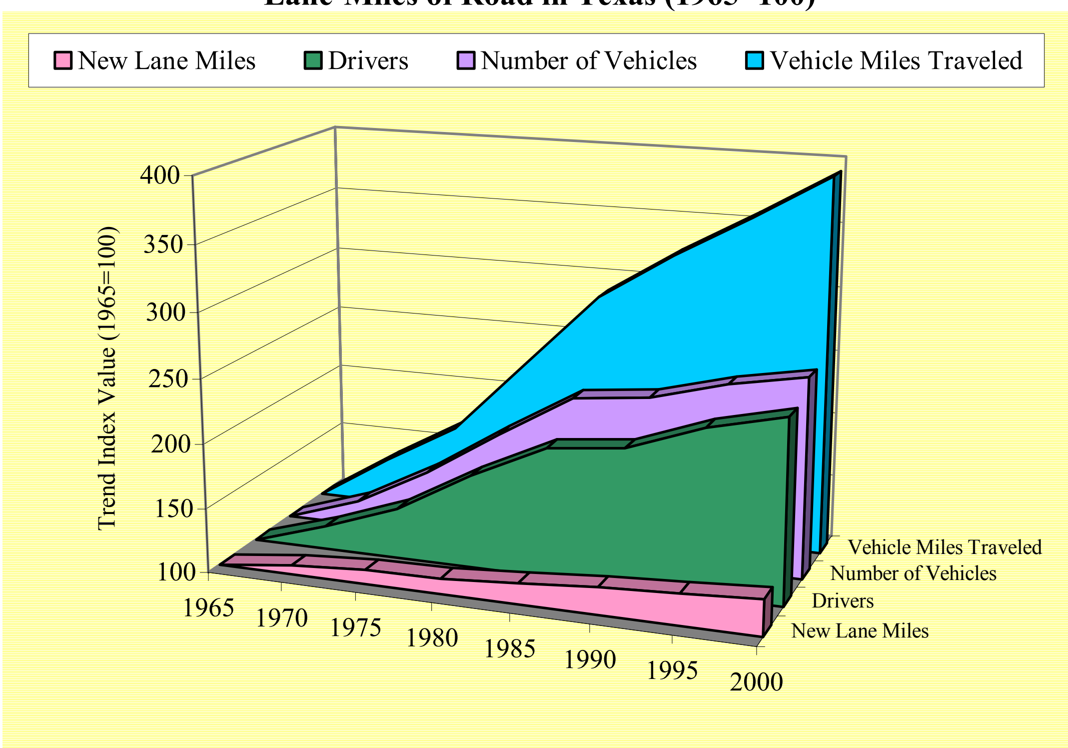


Exhibit S2: Index of Vehicle Miles Traveled, Number of Vehicles, Driver and Lane-Miles of Road in Texas (1965=100)



As a part of its annual national *Urban Mobility Report,* the Texas Transportation Institute uses the Travel Time Index, which estimates the extent to which peak period travel times are retarded by traffic congestion. A Travel Time Index of 1.00 indicates that there is no congestion-related time penalty – that a 30-minute trip in uncongested conditions would take 30 minutes during the peak period. A Travel Time Index of 1.50 indicates that a 30-minute trip in uncongested conditions would take 50 percent longer, or 45 minutes during peak period.

The graphic below shows the long-term trend in congestion in Texas' largest metropolitan areas. That congestion growth trend, in almost all cases exceeded the national trend. In the metropolitan areas considered in this research, the cost of congestion over the last 10 years alone represents a value to Texas and Texans of:

- 2.6 billion hours of delay ($40 billion),
- 4.5 billion gallons of wasted fuel ($5.6 billion) and
- $46 billion total in increased travel time and fuel (almost $2,500 per person in constant 2000 $).

In sum, during the last decade, the cost of congestion on our State's highways was more than was spent by the State on our highways. A portion of the wasted money, if spent on roadways, would have helped substantially to reduce the lost time and wasted fuel and the consequent air pollution.

Exhibit S3: Congestion Levels for Large Urban Areas in Texas

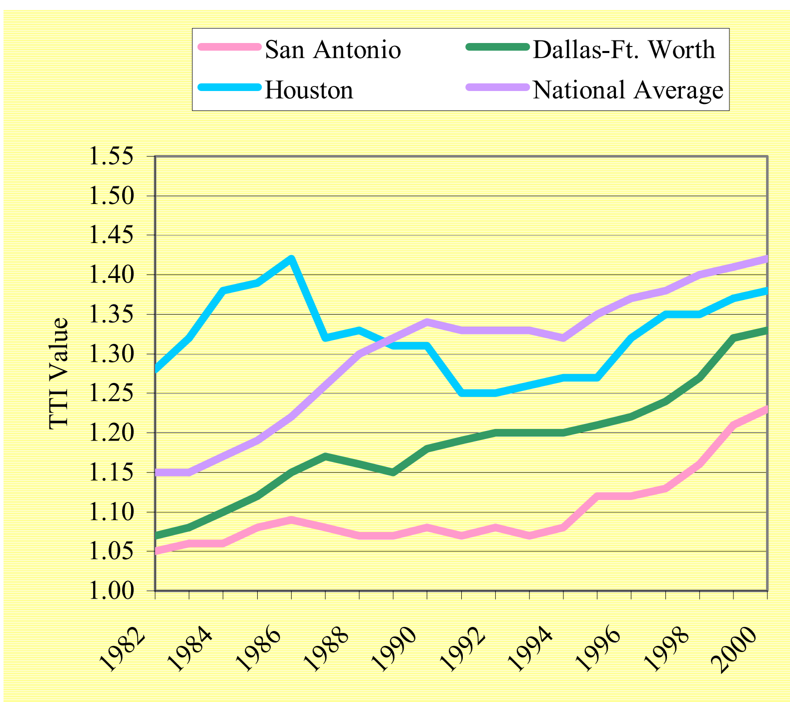
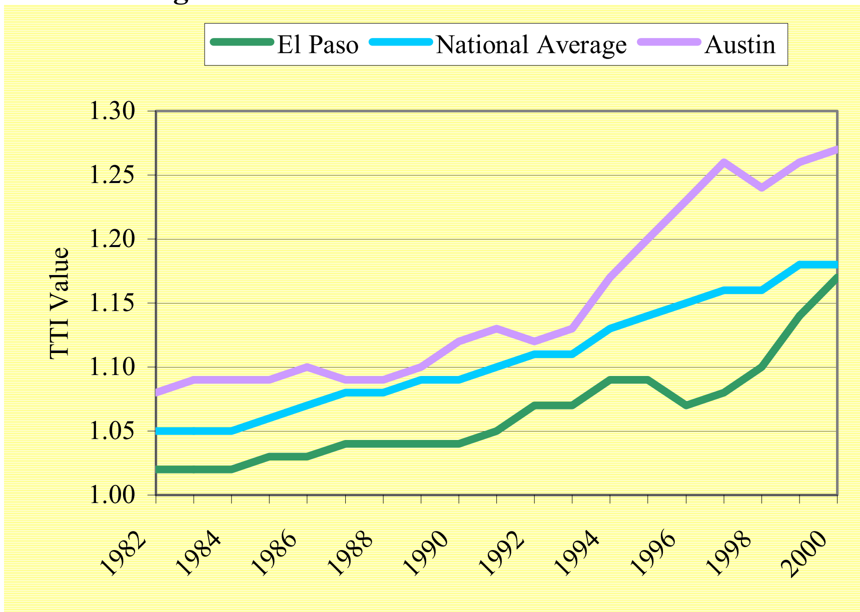


Exhibit S4: Congestion Levels for Medium-Sized Urban Areas in Texas



A 25-year analysis was performed comparing the costs of achieving particular congestion relief goals in five Texas areas – the Dallas-Fort Worth, Houston, San Antonio and Austin urban areas and the Border. The four scenarios included maintenance of the present Travel Time Index in each area and the rest of the State, and three improvement scenarios that consisted of reducing congestion to a particular Travel Time Index value (1.25, 1.20 and 1.15). In those areas where the existing Travel Time Index was already less than the target, the goal was to maintain the existing TTI.

Just to maintain present levels of congestion over the next 25 years would require $38.5 billion more than the $140.1 billion (Exhibits S5 and S6) that will be spent if present spending trends continue (the baseline). It will cost $218.3 billion to achieve a 1.15 Travel Time Index or an estimated $78.2 billion more than current trends indicate will be available. (*All costs in this report are in 2000 dollars unless otherwise noted.*)

These costs are a function of the lane-miles that would be added to the system in order to achieve and maintain the alternative congestion scenarios. The cost estimates were generated from general cost per lane-mile values for various types of roadway. The analysis did not consider specific project costs. For example, to maintain existing congestion levels would require the annual addition of almost 900 street and freeway lane-miles to the State system in the metropolitan areas included in this report at a cost of $38.5 billion more than is expected to be spent over the next 25 years. To meet the 1.15 TTI scenario would require 1,500 lane-miles to be added to the system annually in the metropolitan areas included in this report at a cost of $78.2 billion over 25 years.

While these numbers are daunting, they are relatively small when considered two different ways.

- On an annual cost per capita basis (see Exhibit S5), maintaining the current TTI will cost $60 more per capita in 2025 than the current trends (baseline).
- When compared to the baseline conditions, the benefits of doing something outweigh the costs of doing nothing. Maintaining the existing Travel Time Index in 2025, while costing $60 more per capita, will return $232 in benefits that year. Achieving the 1.15 Travel Time Index Goal will mean spending $121 more, but gaining a benefit of $764 in 2025.

Put in terms of cost to the average household (see Exhibit S6), to improve traffic flow to the 1.15 Travel Time Index standard would require $335 more per household in 2025 than what baseline expenditures are expected to be. It will cost $166 per household more to maintain the present level of traffic congestion than current spending trends indicate will be spent in 2025. These costs are more than offset by travel time delay reductions and lower fuel consumption benefits of $2,118 at the 1.15 Travel Time Index standard. By comparison, the average household spent $372 on alcoholic beverages in 2000, according to the U.S. Department of Labor Consumer Expenditure Survey.

When road construction, operations and maintenance costs are combined with the cost of additional travel time and fuel consumed in congested traffic, Exhibit S7 clearly shows that addressing the mobility challenge is a better value than suffering the problems of congestion. Peak period travelers across the entire State will spend $118 more annually to save $604 by meeting the 1.15 Travel Time Index Goal, an annual net savings of $486.

The plan is almost justified if one assumes that travelers place no value on their time (and anyone who observes driver behavior during the peak knows this is not true). Approximately $118 in additional cost to support the 1.15 TTI Goal would be offset by $73 of lower fuel costs due to more efficient operations. The travel time, air quality, health and other benefits are not included in this value.

Exhibit S5: Per Capita Costs and Savings from Achieving Alternative Travel Time Index Goals										
Year	Estimated Baseline (Current Trend) Expenditures ($Billion)	Additional Funds Required		Additional per Capita Cost		Estimated Savings per Capita		Estimated Net Benefit per Capita from Reduced Delay and Fuel Costs	
		to Maintain Existing Congestion Levels ($Billion)	to Achieve 1.15 TTI Goal ($Billion)	to Maintain Existing Congestion Levels	to Achieve 1.15 TTI Goal	to Maintain Existing Congestion Levels	to Achieve 1.15 TTI Goal	to Maintain Existing Congestion Levels	to Achieve 1.15 TTI Goal
2000	$4.4	$1.2	$2.5	$58	$118	$0	$217	($58)	$99
2005	$4.8	$1.3	$2.7	$59	$119	$94	$311	$35	$192
2010	$5.2	$1.4	$2.9	$59	$119	$126	$415	$67	$296
2015	$5.6	$1.5	$3.1	$59	$120	$160	$528	$101	$408
2020	$6.0	$1.7	$3.4	$60	$121	$194	$642	$134	$521
2025	$6.4	$1.8	$3.6	$60	$121	$232	$764	$172	$643
Net Increase									
from Current Trend									
Over 25 Years	$0	$38.5	$78.2						
25-Year Total	$140.1	$178.6	$218.3						

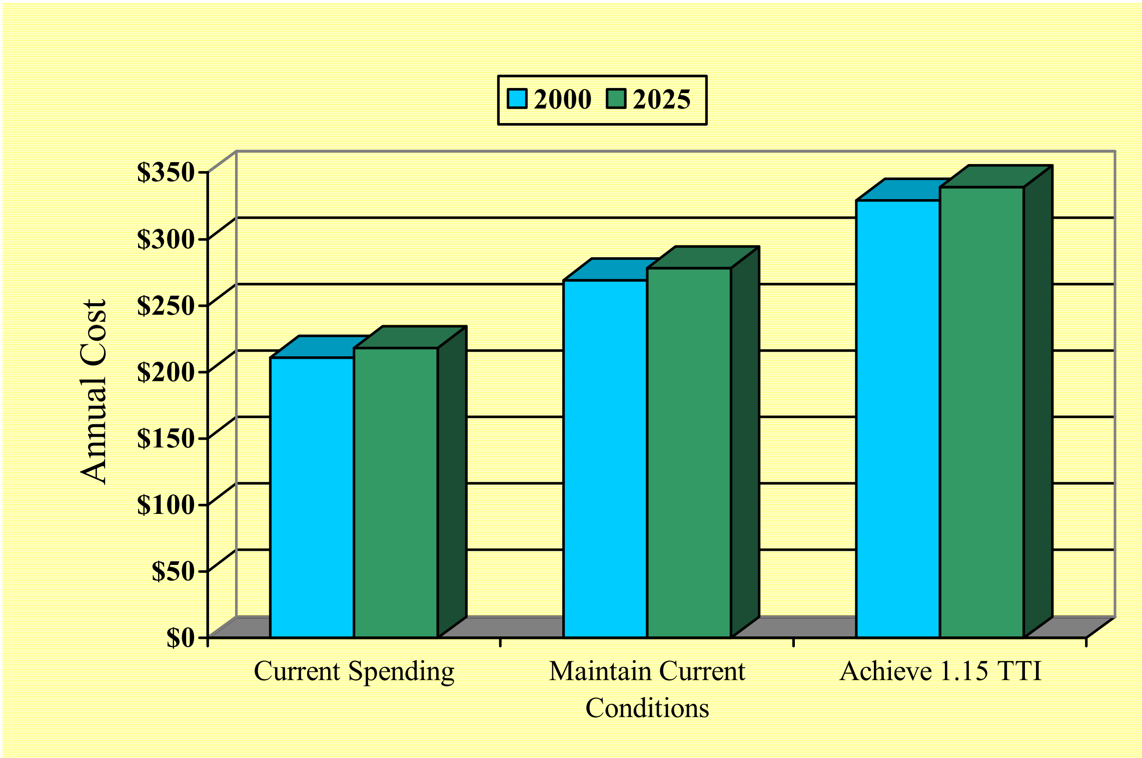
Note: The numbers presented in the table above are selected years only. The "Net Increase from Current Trend Expenditure" and "25-Year Total" lines in the table represent the net increase and total expenditures over the entire 25-year period.

Exhibit S6: Average per Household Costs and Savings from Achieving Alternative Travel Time Index Goals

Year	Estimated Baseline (Current Trend) Expenditures ($Billion)	Additional Funds Required		Additional Average per Household Cost		Estimated Savings per Household		Estimated Net Benefit per Household from Reduced Delay and Fuel Costs	
		to Maintain Existing Congestion Levels ($Billion)	to Achieve 1.15 TTI Goal ($Billion)	to Maintain Existing Congestion Levels	to Achieve 1.15 TTI Goal	to Maintain Existing Congestion Levels	to Achieve 1.15 TTI Goal	to Maintain Existing Congestion Levels	to Achieve 1.15 TTI Goal
2000	$4.4	$1.2	$2.5	$159	$324	$0	$596	($159)	$272
2005	$4.8	$1.3	$2.7	$162	$327	$259	$885	$97	$558
2010	$5.2	$1.4	$2.9	$163	$328	$347	$1,144	$184	$816
2015	$5.6	$1.5	$3.1	$163	$331	$442	$1,458	$279	$1,127
2020	$6.0	$1.7	$3.4	$166	$335	$537	$1,776	$371	$1,441
2025	$6.4	$1.8	$3.6	$166	$335	$643	$2,118	$477	$1,783
Net Increase									
from Current Trend									
Over 25 Years	$0	$38.5	$78.2						
25-Year Total	$140.1	$178.6	$218.3						

Note: The numbers presented in the table above are selected years only. The “Net Increase from Current Trend Expenditure” and “25-Year Total” lines in the table represent the net increase and total expenditures over the entire 25-year period.

Exhibit S7: Average Annual Cost per Texan to Achieve Mobility Goals



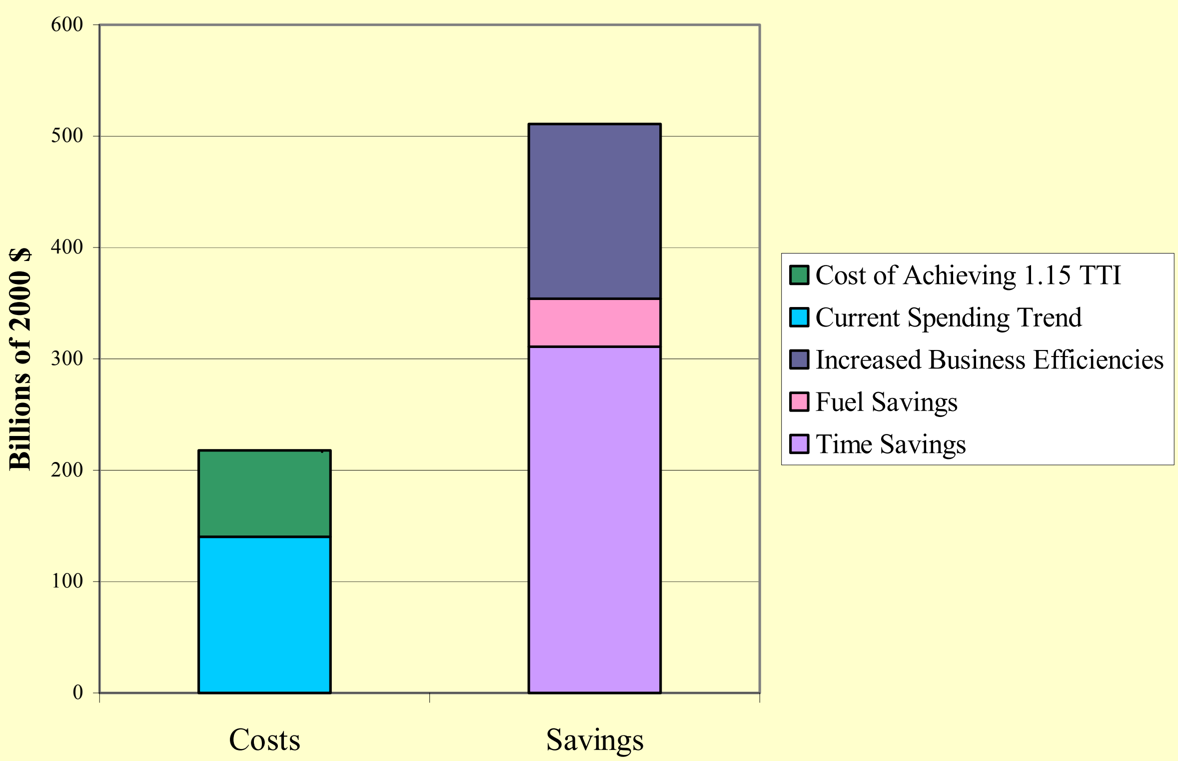
The benefits of providing this response to the State's needs are tremendous, and not all of the benefits can be quantified (e.g., air quality, reduced stress). However, as an example the following exhibit shows baseline expenditures, per capita and household costs, and per capita and household savings associated with both maintaining the current congestion level and achieving a 1.15 Travel Time Index goal.

Exhibit S8: The Annual Cost of "Doing Something" Compared to Current Trends						
Average Annual Peak Period Traveler[1] Cost Component	Current Trend		Cost to Achieve 1.15 Travel Time Index Goal		Savings	
Road Costs[2]		$211		$329		($118)
Congestion Costs:						
Delay	$737		$206		$531	
Fuel	$110		$37		$73	
Sub Total		$847		$243		$604
TOTAL		$1,058		$572		$486

[1] In this example, Peak Period Travelers include all those in the State, not just in urban areas.
[2] Road costs are the average annual per capita costs of constructing and maintaining the state highway system.

Exhibit S9 illustrates the aggregate 25-year cost of the current spending trend, the additional cost associated with achieving the 1.15 Travel Time Index goal, and the time, fuel and business efficiency savings. As can be seen in the chart, the net effect of spending $78 billion over 25 years to achieve a 1.15 TTI yields over $500 million in quantifiable benefits.

Exhibit S9: 25-Year Costs and Savings of Achieving the 1.15 TTI Goal



Other benefits from adequate funding that are not explored fully in this report total $157 billion over 25 years, a portion of which include:

- Greater safety from timely investment in road surfaces, bridges and appurtenances.
- Improved air quality due to reduced fuel consumption by stop-and-go traffic, including reducing emissions by 775,000 tons of hydrocarbon pollutants.
- Rapid response to maintenance problems would reduce overall construction and maintenance costs.
- Improved ride on the system from smoother pavements, fewer ruts and potholes.
- Greater ability to predict travel time and a reduced delay effect from collisions and vehicle breakdowns.
- Substantial job creation, on the order of 38,000 jobs per billion dollars of capital road spending. This amounts to an additional 120,000 permanent jobs associated with achieving the 1.15 TTI goal.

Thus, while travel demand is expected to increase rapidly, **the cost of the required roadway expansions is less than the cost to continue on the current trend**. Further, many of these issues can be addressed on a local option basis as opposed to a statewide tax increase. Of course, it is important to remember that cost is only one dimension to this issue – environmental considerations, public acceptance, as well as other issues, must be addressed.

IV. Consideration of Policy Options

The level of increase anticipated in metropolitan transportation demand dictate that roadways are the most viable comprehensive solution in addressing traffic congestion. Strategies other than roadway expansion can have a positive effect in some travel markets, but cannot produce universal improvements in traffic congestion throughout urban areas.

Transit can play an important role in providing an alternative to the automobile in some parts of large urban areas. However, attempting to expand automobile competitive transit service to all segments of an urban area in order to attract a significant number of automobile drivers to a much broader range of destinations would be prohibitively expensive and likely provide only limited response. For the purposes of this analysis, the proposals include the assumption of maintaining the current share of travel by transit at current levels (approximately 2 percent of commute trips).

While metropolitan planning organizations in Texas currently estimate that virtually all new transportation demand will be personal vehicle travel, each urban area and agency will identify approaches to meeting the congestion challenge. The mix of projects, programs, and strategies will likely be different for each. All improvement options should be evaluated with an analysis comparing the share of the resources consumed to the share of the problem solved. (This is a subject area recommended for further research.) The performance measures used should connect the projects and programs being evaluated with the goals expressed in the area-wide and sub-regional land use and transportation plan.

Clearly, preserving and improving urban mobility and access in Texas requires strategies that improve the flow of roadway traffic. This will include new roadways and roadway expansions, but it will also mean improved traffic management, computer-based technological advances and other strategies. Among them are:

- Improved Operations - Texas must lead the Nation in the effective operation of its road system. New capacity construction should be coupled with achieving the greatest throughput on existing facilities. New information-technology-based operations capabilities should be implemented wherever they can contribute cost-effective enhancements including greater user information, more rapid response to accident scenes, more effective operation of work-zones, etc. Attention should be given to improving the interactions between pedestrians and automobiles, especially to improve safety.

- Texas has a higher share than the national average of commuters who carpool. While the *share* of commuters who carpool dropped slightly from 1990 to 2000, the *number* of Texans who carpooled to work increased by almost 200,000. This is one of the State's key strengths in work travel. Every opportunity to encourage the natural market tendencies in the population to use carpooling should be employed.

- Toll roads or toll lanes may be very effective improvements and funding strategies in some corridors. This type of improvement focuses costs on those who use the specific facilities when they choose to use it rather than sharing costs among all residents. Toll roads also can be built rapidly by leveraging innovative finance mechanisms.

- Working at home opportunities are significant in Texas. It is the only other work "travel mode" to show significant growth in the last decade (in addition to auto-based work travel). More people work at home or walk to work than use transit. Both the private sector and government should consider opportunities to support the expansion of working at home. This may be as simple as reducing existing impediments to working at home options.

Texas' Roadways – Texas' Future:

A Look at State Roadway Supply, Demand, Costs and Benefits

Introduction

The purpose of the Governor's Business Council Plan is:

> *to establish a process whereby vision and needs drive the process of transportation improvement, rather than currently or traditionally available resources. This is to start a "how we can fulfill our vision" process instead of a "what does the status quo allow" process.*

A focus on vision would represent an important change in policy, from a financially constrained process to one based upon defining minimum performance standards and then seeking the resources to accomplish the objectives. It is a central thesis of this report that a program that reduces traffic delay hours in the State's largest metropolitan areas will enhance future economic performance and quality of life in Texas.

It is recognized that:

> *The most serious transportation threat to the State [and its metropolitan areas] is the continuing delay in passenger and freight travel activity brought about by congested road facilities. This challenge threatens to increase to dramatic levels in the future unless timely, substantial responses are undertaken.*

There has been a serious deterioration of mobility in Texas metropolitan areas in recent years. The Texas Transportation Institute's Travel Time Index indicates the amount of extra time required to make a trip in the peak period. In 2000, roadways in the four largest urban areas had a Travel Time Index value above 1.20, meaning a 20 percent travel time penalty for a peak trip (Exhibit 1). A trip that might take 30 minutes in the middle of the day would take 36 minutes during the peak. In 1990, only Houston topped this level. And these are just the average trips; congestion levels on some roads in all these areas are well in excess of the 20 percent travel time penalty value. A similar trend was identified in the 2000 US Census, with average journey-to-work travel times increasing from 22.2 minutes to 25.4 minutes in 2000.

Exhibit 1: Urban Mobility in Selected Texas Areas: 1990 to 2000			
Urban Area	Travel Time Index		Percent Increase in Travel Time Penalty
	1990	2000	
Austin	1.12	1.27	13.4
Dallas-Ft. Worth	1.18	1.33	12.7
Houston	1.31	1.38	5.3
San Antonio	1.08	1.23	13.9
El Paso	1.04	1.17	12.5
Brownsville	1.04	1.08	3.8
Laredo	1.03	1.06	2.9

These alarming trends threaten the social and economic well being of Texas. Mobility is central to the essence of the life-styles of a society with a large, affluent population, based in a large area, clustered in mega-cities, integrated in a modern, technologically-defined environment. In this sense Texas is a microcosm of America, reflecting almost all of the nation's patterns.

As future growth prospects in both population and economy indicate a continuation of past dramatic trends, far beyond the rates expected in the nation at large, Texas must respond to its mobility needs to serve present and future populations. This document lays out an approach to meeting the mobility needs of the State's great metropolitan areas at a cost far less than what is typically assumed.

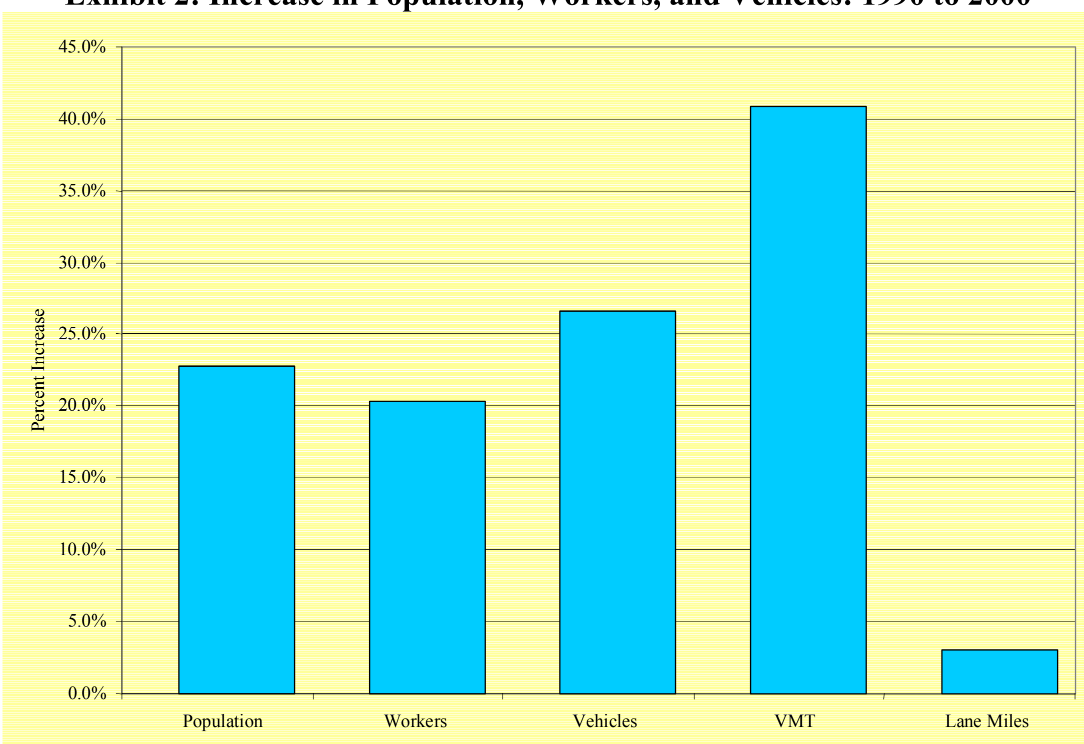
I. Transportation and Demographics

Demographic Trends and the Sources of Travel Demand

Population

Texas saw dramatic growth in the 1990s, adding almost 4 million people to reach a total population of 20.85 million by 2000, representing 12 percent of all national growth, and only slightly fewer residents than that added by California. In percentage terms this increase was far greater than national rates, with the State registering a 23 percent increase contrasted to 13 percent growth nationally. This was despite the fact that national growth far exceeded expectations, which had been closer to 10 percent. In fact, it was Texas' growth due to in-migration that added dramatically to both its growth rate and that of the nation. Population growth was paralleled by substantial growth in workers and vehicles, the other key ingredients in the travel mix (Exhibit 2). Vehicle-miles traveled, however, increased substantially faster while the increase in the number of lane miles was substantially slower.

Exhibit 2: Increase in Population, Workers, and Vehicles: 1990 to 2000

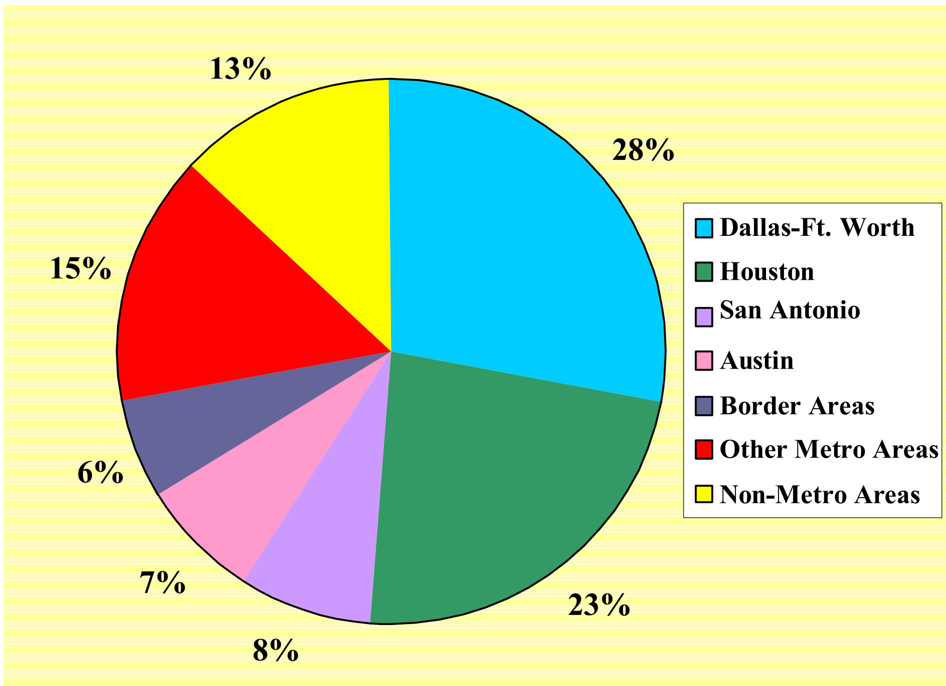


Texas at the millennium further paralleled America in that the State's population density of 80 persons per square mile is identical to the nation's average density. It also parallels the nation in having a broad distribution of population densities ranging from a few true mega-metropolitan areas, a large set of major cities, substantial rural population and vast areas with limited population. The dramatically greater growth rates in Texas in recent decades and projected into the future makes it distinct from the nation and will accelerate many of the distinctions. The concept of Texas having a higher population density than the nation in general is really a landmark in the State's evolution.

Workers, Households, and Auto Ownership

More than 9 million Texans were working in 2000, approximately 1.24 workers per household. Over half of the State's workers live in the Houston and Dallas-Ft. Worth metropolitan areas, with all Texas metropolitan areas accounting for 87 percent of workers in the State (Exhibit 3).

Exhibit 3: Where Texas' 9.2 Million Workers Live



An important facet of this worker population is their distribution within families. Approximately 75 percent of all workers in Texas live in households with other workers. In about 58 percent of the approximately 4 million married-couple families in Texas in 2000 the husband and wife both worked. This dimension of household composition affects incomes, car ownership and choices of mode to work.

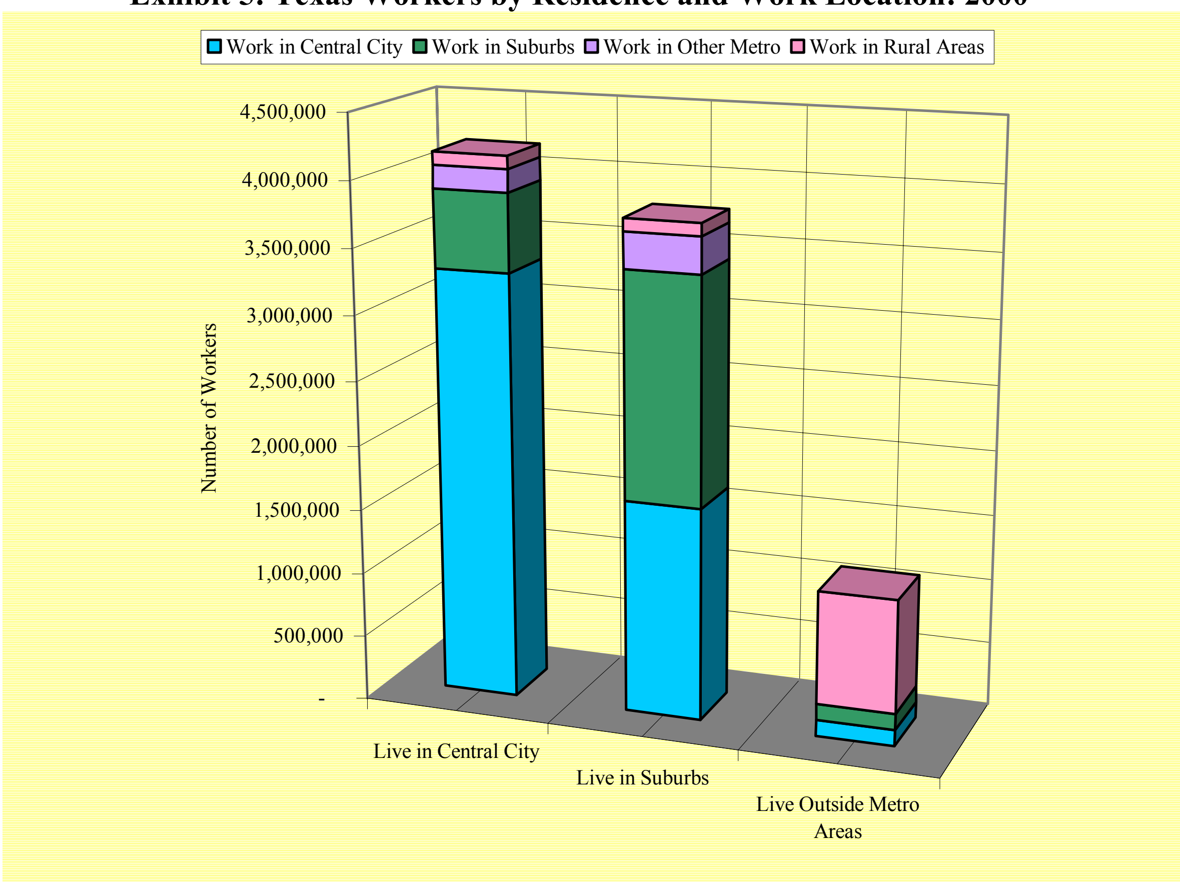
Further, the formation of populations into households and the stage in the life cycle of those households has immense bearing on the amount and scope of travel in which persons engage. It is households that give rise to many of the trips people make, for example, shopping and other services, and it is the stage in life that defines many trips such as school, recreation and personal business activities.

Another key barometer of commuting patterns is the percentage of workers that had jobs outside their county of residence (Exhibits 4 and 5). Of the roughly 1.5 million workers added in Texas between 1990 and 2000, about 900,000 worked in their county of residence. About 600,000 Texans worked outside their county of residence, representing a greater than 50 percent increase over 1990. This represented a dramatic increase from 16 percent of all workers commuting beyond their residence county in 1990 to over 20 percent in 2000.

Of those who live outside metropolitan areas, about 18 percent of the 1.2 million commute to metropolitan areas each day with the majority of those commuting into the center cities.

Exhibit 4: Texas Workers by Residence and Work Location			
Residence of Texas Worker	1990	2000	Percent Change
Total Workers	7,677,916	9,157,875	19.3%
Worked in Texas	7,610,487	9,067,659	19.1%
Worked in County of Residence	6,312,264	7,202,239	14.1%
Worked Outside County of Residence	1,230,794	1,865,420	51.6%
Worked Outside Texas	67,429	90,216	33.8%

Exhibit 5: Texas Workers by Residence and Work Location: 2000



Texas auto ownership varies from the national pattern in that the State has more one- and two-car households and fewer three-car households than the nation as a whole. Overall, the share of households without vehicles is significantly lower in Texas than in the nation. Nationally, about 10 percent of all households are without access to vehicles, while Texas, at about 8 percent in 1990 is now down to 7.4 percent. Texas, at about eight percent in 1990, is now down to 7.4 percent. These households without vehicles, numbering about 550,000, represent an important segment of the population whose transportation service needs must be recognized. What do we know about these households without access to vehicles?

- They are predominantly renters;
- Lack of vehicles is significantly higher among minorities;
- About a third of vehicle-less households are headed by a person over 65;
- Most households without vehicles are in the major cities; and,
- Households without vehicles represent a small share of the population.

Who and where they are is very important to transportation needs and plans.

Work Trip Behavior

The number of commuters increased by more than 1.5 million workers from 1990 to 2000, a greater than 20 percent increase, causing a serious strain on the transportation system that would be expected from such growth. The additional load was absorbed by the highway system as 1.3 million solo drivers and approximately 200,000 carpoolers were added to the traffic stream. The only other growth in share, in addition to driving alone, occurred among those working at home. (Transit users did increase by 2,100 commuters).

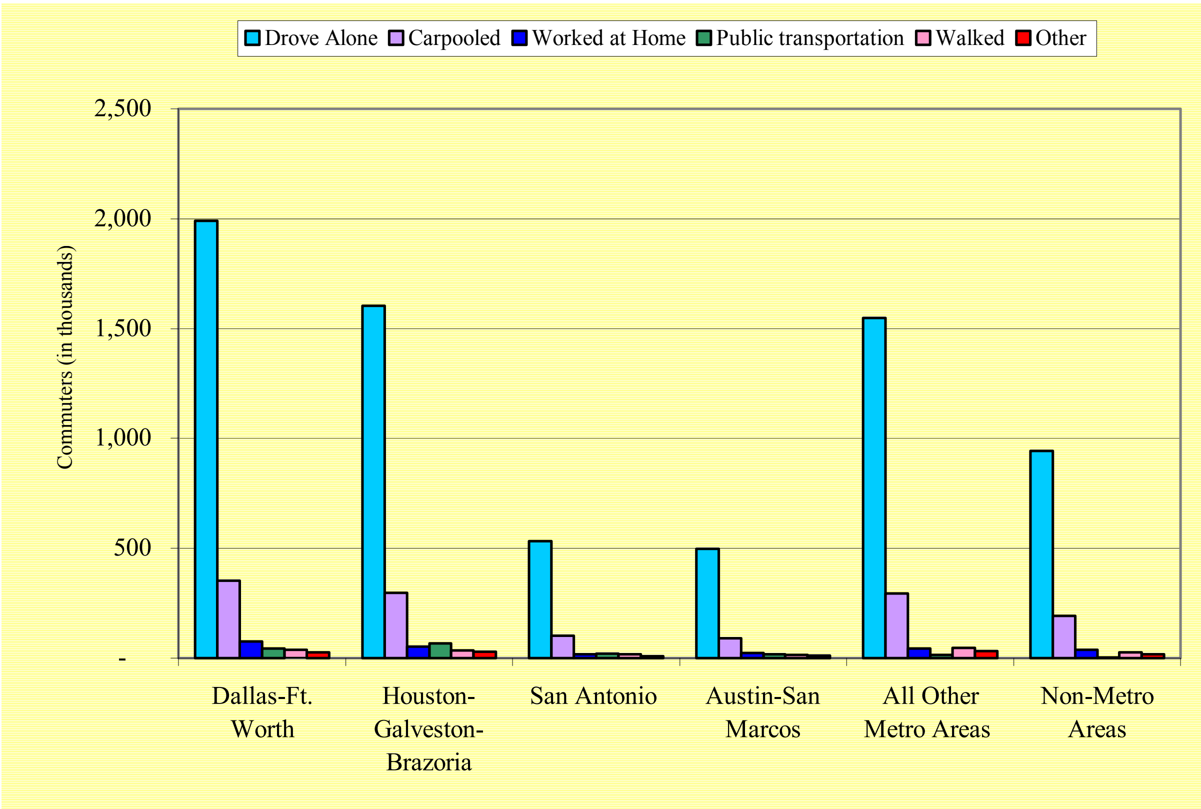
<u>At 78 percent, the percentage of people in Texas commuting by driving alone is only two percentage points higher than the national average</u> (Exhibit 6). More than 20 states exceed 80 percent in "drive alone." The significant differences in Texas and national patterns are in Texas being lower than average in transit use but higher in carpooling. <u>Texas exceeds the national average in ridesharing (the combination of carpooling plus transit)</u>. Carpooling is perhaps the great strength of the Texas system.

Exhibit 6: Commuting Mode Choice

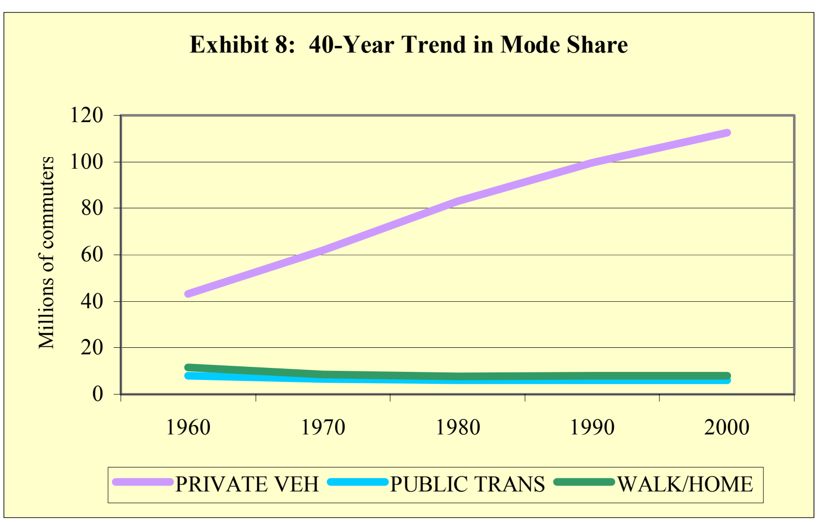
Mode	2000	1990	2000 share	1990 share	Net Change
Drove alone	7,115,590	5,821,200	77.7 percent	76.5 percent	1,294,390
Carpooled	1,326,012	1,133,917	14.5 percent	14.9 percent	192,095
Work at home	252,024	185,380	2.8 percent	2.4 percent	66,644
Walk	173,670	202,494	1.9 percent	2.7 percent	-28,824
Public transit	164,166	162,029	1.8 percent	2.1 percent	2,137
Other	126,413	105,467	1.4 percent	1.4 percent	20,946
All	9,157,875	7,610,487	100.0 percent	100.0 percent	1,547,388

The general consistency in modal usage for work travel in the major metropolitan areas is depicted in the following bar chart (Exhibit 7).

Exhibit 7: Mode Choice By Metropolitan Area



As indicated in the following chart (Exhibit 8), over the past 40 years, the national trend with regard to commuting patterns is not substantially different from that seen in Texas. In both instances, in the aggregate, the use of private vehicles has absorbed virtually the entire increase in the number of commuters.

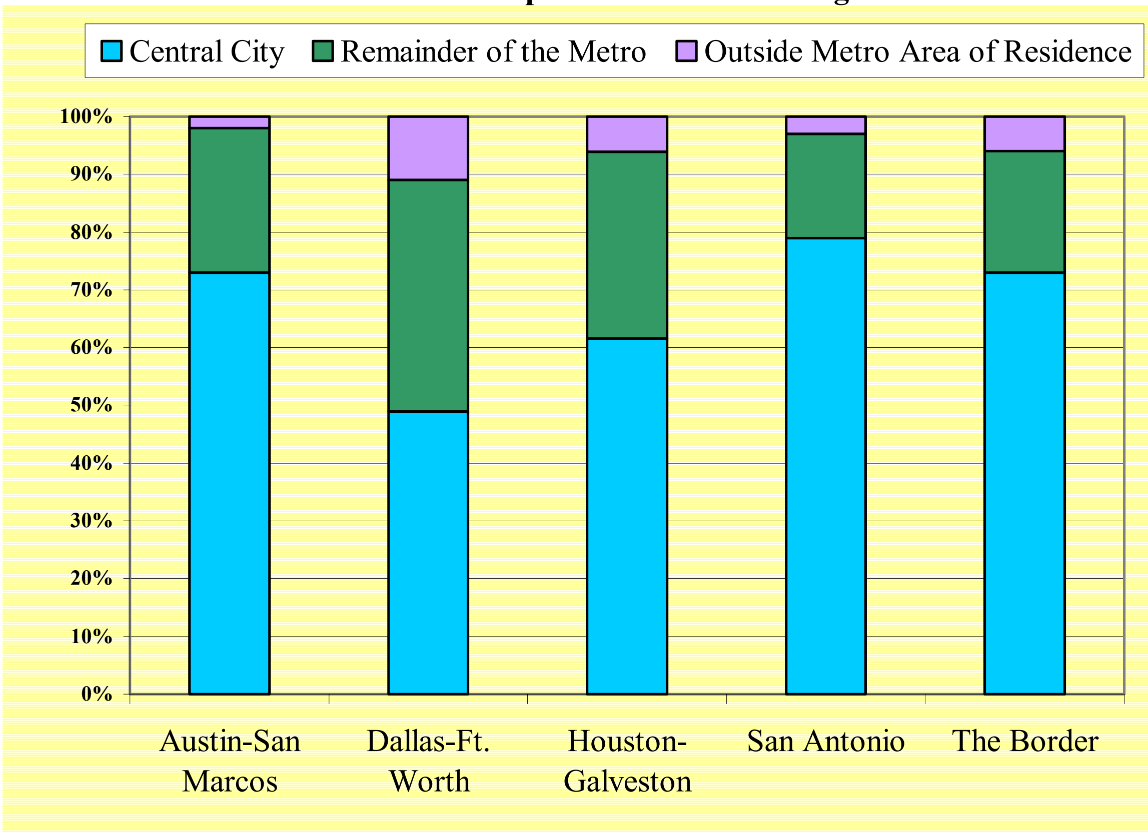


The Texas Commuting Markets

In terms of the relationship between where Texans live versus where they work, the data indicate the following:

- About 4.2 million workers live in central cities where about 3.3 million also work. Another 600,000 commute outward to suburbs, 300,000 completely leave their area each day to work, 100,000 going to rural areas, and 200,000 destined to other metropolitan areas.
- About 3.8 million workers live in suburbs with 1.8 million remaining in the suburbs to work while about 1.6 million commute into center cities. In addition, about 100,000 commute outward to rural areas and 300,000 actually travel to a different metropolitan area.
- About 1.2 million workers live outside metropolitan areas of which 1 million also work in rural areas. About 17 percent commute to metropolitan areas each day (roughly 100,000 to central cities and 100,000 to their suburbs.)

Exhibit 9: Where do Metropolitan Area Workers go to Work?



Recognizing these travel flows as markets to be served helps focus thinking. These data suggest a greater self-sufficiency among areas than in most states in that there seems to be a greater tendency for workers to live and work in their own areas than observed elsewhere. The geography of Texas, with the large metropolitan areas separated by long distances, affects this trend.

In general, Texas commuters make limited use of transit services for work travel. Overall work trip transit use in the State's metropolitan areas stands at two percent and only Houston exceeds three percent. However, taken together, Houston and Dallas account for two-thirds of the State's work trip transit use. And transit use is higher in congested corridors or into large activity centers where there is a travel time or reliability advantage to using transit.

The detailed work mode percentages for each area are displayed in the following table (Exhibit 10). The key point in the table is to confirm how similar all areas are.

Exhibit 10: Detailed Work Travel Mode Percentages						
Metropolitan Area	Drove Alone	Carpooled	Public Transportation	Walked	Other	Worked At Home
Dallas-Ft. Worth	78.8	14.0	1.7	1.5	1.1	3.0
Houston-Galveston-Brazoria	77.0	14.2	3.2	1.6	1.4	2.5
San Antonio	76.2	14.7	2.8	2.4	1.3	2.6
Austin-San Marcos	76.5	13.7	2.5	2.1	1.6	3.6
Borders Areas	74.3	18.0	1.4	2.1	2.0	2.3
All Other Metropolitan Areas	79.9	13.6	0.5	2.4	1.4	2.3
Non-Metropolitan Areas	77.3	15.6	0.2	2.2	1.5	3.2
Texas Overall	77.7	14.5	1.8	1.9	1.4	2.8

Also of interest is that roughly a quarter of a million residents worked at home in 2000, up from approximately 185,000 in 1990, representing an increase of about 36 percent. Working at home accounted for 2.75 percent of all workers, a greater share than those who walk to work or those who take transit to work.

Travel Time Trends

According to the 2000 Decennial Census, work travel times in Texas rose from 22.2 minutes in 1990 to 25.4 minutes in 2000 – almost identical to the average for the nation. *While total workers grew by about 19 percent, workers traveling more than 45 minutes grew by more than 50 percent.* These census data confirm an acceleration in work trip travel times in major Texas metropolitan areas (Exhibit 11). Statewide, average work trip travel time increased 1.3 minutes from 1980 to 1990, but more than doubled to a 3.2 minute increase from 1990 to 2000.

Exhibit 11: Average Journey to Work Travel Time For Selected Texas Metropolitan Areas (in minutes)					
Metropolitan Area	Year			Change	
	1980	1990	2000	1980-1990	1990-2000
Austin-San Marcos	19.0	21.3	25.5	2.3	4.2
Dallas-Ft. Worth	22.4	24.1	27.5	1.7	3.4
Houston-Galveston-Brazoria	25.9	26.1	28.8	0.2	2.7
Rio Grande Valley (see note)	16.8	17.6	20.8	0.8	3.2
San Antonio	20.2	21.9	24.5	1.7	2.6
Average	20.9	22.2	25.4	1.3	3.2
Note: Includes Brownsville-Harlingen-San Benito MSA and McAllen-Edinburg-Mission MSA					

There are two key measures of one-way work trip travel times that can provide insight regarding the trends:

- Those with a commute time of less than 20 minutes represent one-half of commuters and can be considered to have a convenient trip. When half of workers have that travel time, commuting can be said to be relatively easy.

That group suffered a sharp drop in share from about 49 percent of the population in 1990 down to 44 percent in 2000.

- Those with a commute time of over 45 minutes can be considered to have a more onerous trip. That group reached more than 14.5 percent of commuters in 2000 contrasted to 11.5 percent in 1990, considerably exceeding national patterns. Those traveling more than one hour reached 7 percent.

All Texas metropolitan areas listed below are ranked by the 20 minute and 60 minute criteria. Note that only five areas fall below the 50 percent level for less than 20 minute commutes.

Exhibit 12: One-Way Work Trip Travel Times

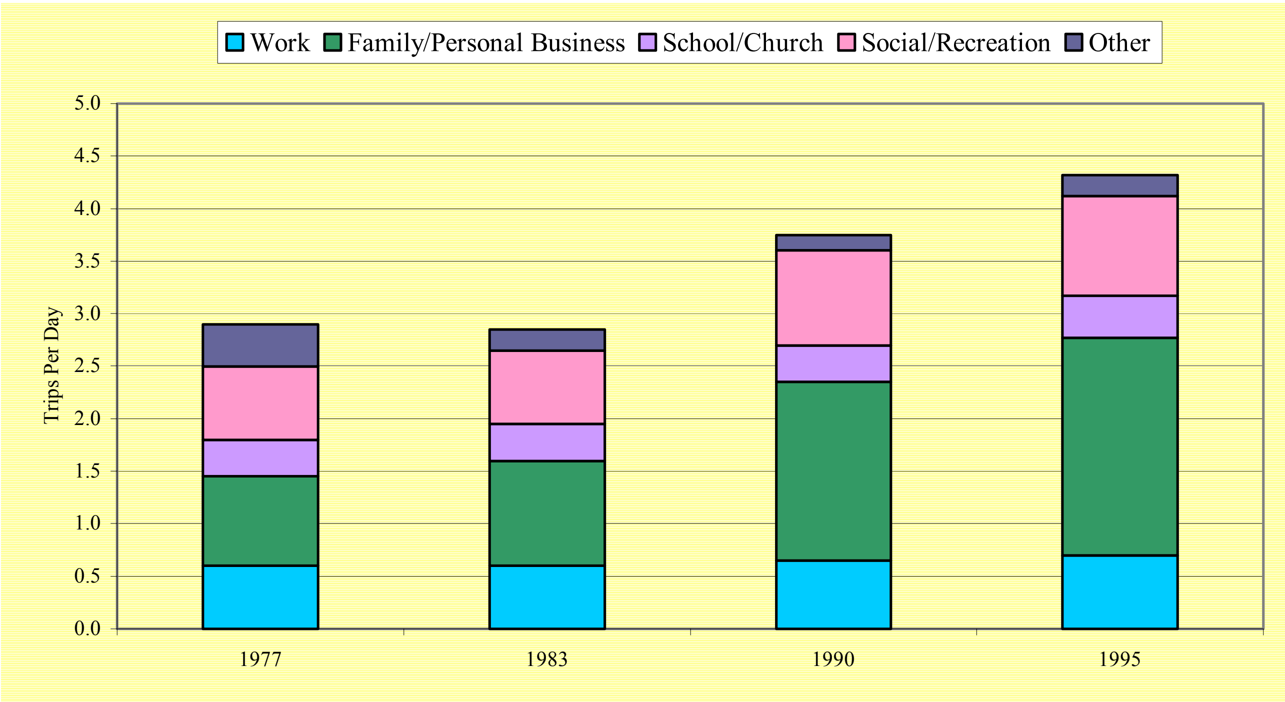
Percent Less Than 20 Minutes	Percent		Percent More Than 60 Minutes	Percent
Abilene	76%		Lubbock	3%
Bryan--College Station	75%		Abilene	3%
San Angelo	73%		Wichita Falls	3%
Lubbock	71%		Amarillo	3%
Odessa--Midland	70%		Bryan--College Station	3%
Wichita Falls	69%		El Paso	3%
Amarillo	67%		McAllen--Edinburg--Mission	4%
Texarkana, TX	63%		San Angelo	4%
Killeen--Temple	62%		Brownsville--Harlingen--San Benito	4%
Victoria	61%		Waco	4%
Waco	61%		Corpus Christi	4%
Brownsville--Harlingen--San Benito	59%		Texarkana, TX--Texarkana	4%
Corpus Christi	59%		Odessa--Midland	4%
Longview--Marshall	58%		Laredo	4%
Sherman--Denison	56%		Beaumont--Port Arthur	5%
Laredo	56%		Tyler, TX MSA	5%
McAllen--Edinburg--Mission	55%		Longview--Marshall	5%
Beaumont--Port Arthur	55%		San Antonio	5%
Tyler	54%		Victoria	5%
El Paso	46%		Killeen--Temple	6%
San Antonio	43%		Austin--San Marcos	6%
Austin--San Marcos	43%		Dallas--Fort Worth	8%
Dallas--Fort Worth	39%		Houston--Galveston--Brazoria	9%
Houston--Galveston--Brazoria	37%		Sherman--Denison	10%

Non-Work Travel Trends

<u>It is notable that work travel, so often the focus of transportation planning and policy, constitutes only about a 20 percent share of local travel trip-making.</u> Beyond local travel, long distance travel has been estimated at upwards of 20 to 25 percent of all passenger travel. (This increase does not include freight flows, which are discussed elsewhere in this review.) Further, while work travel per capita grew by 33 percent in the period, personal business travel doubled and social-recreational travel increased by more than 50 percent. The trend illustrated in Exhibit 13 demonstrates that point. It also demonstrates

that total trip making has grown substantially in the period. As will be discussed extensively in a following section, income per capita is the great determining factor in total trip-making. Taken together, all of this suggests that while the concentration of work trips during peak hours is the cause of most congestion, simply focusing on serving commuting trips will be increasingly inappropriate.

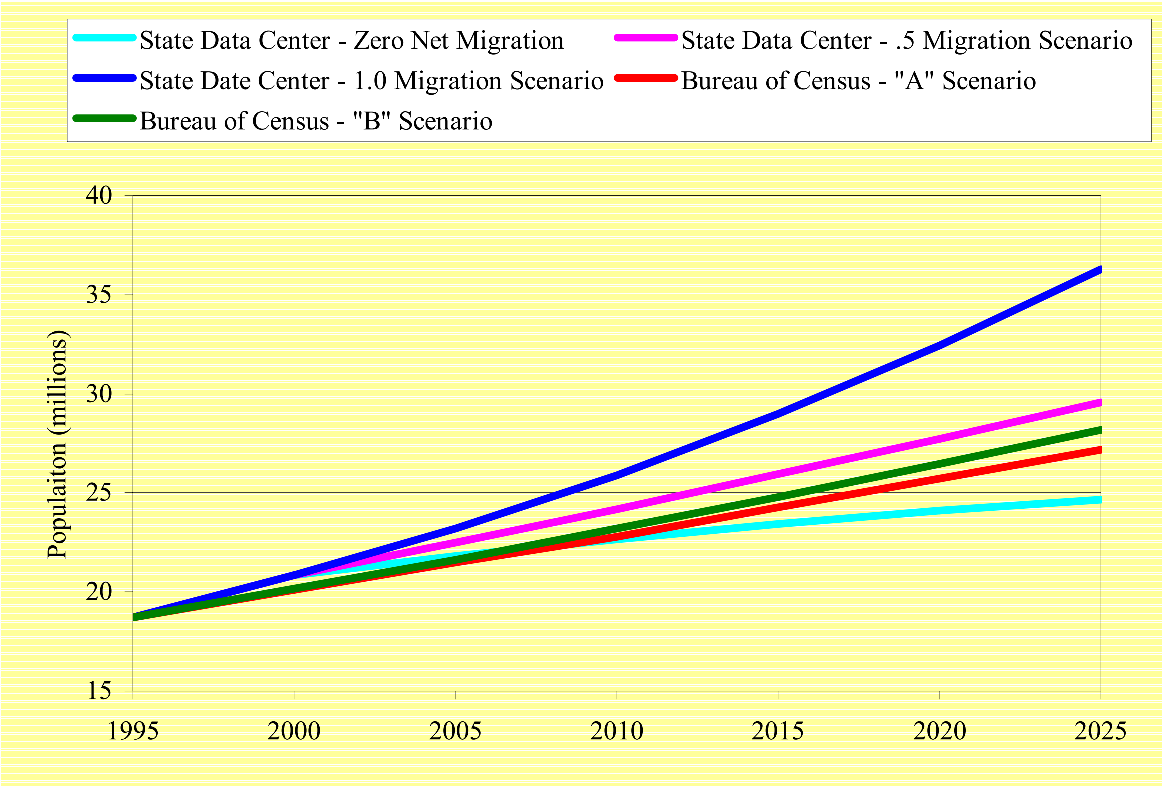
Exhibit 13: Person Trip Rates by Purpose



Future Population Patterns and Trends

Projections of future Texas population are sharply affected by immigration, both domestic and foreign. It is very likely that Texas will continue to be a very attractive destination for in-migrants in the future. The Texas State Data Center has prepared post-2000 census population projections that help understand these patterns further (Exhibit 14). Their projections distinguish between natural increase from births and that due to arrivals of outsiders into the State. They also distinguish, wisely, between projections based on continuation of the 1990 trends and a trend based on half that rate, which in fact is closer to nationally prepared projections for Texas, as shown in the figure below. It is our view that the projection based on continuation of the nineties trend should be seen only as the high-end scenario. While it is not clear that a rate half that is appropriate, it seems an effective working approximation to guide thinking about the future. Two years into the decade population growth is slightly ahead of the "half-90s" projection. (It is critical to recognize that while most demographic trends are close to being inexorable forces, foreign immigration is subject to congressional action and can literally change at the stroke of a pen.)

Exhibit 14: Texas Population Projection Scenarios



It is noteworthy that both of the U.S. Bureau of the Census projections shown in the figure are between the lower projections of the Texas State Data Center. It is further notable that the 0.5 projection is, by 2025, responsible for 5 million more residents contrasted to less than 4 million from natural increase (the zero net migration line). The 0.5 projection places the State at just about 30 million residents by 2025 while the 1.0 projection, based on continuation of 1990 trends, would add almost 7 million.

Population Distribution

The Texas State Data Center also has projected where the future population will locate. Overall those projections indicate that metropolitan areas will grow by 52 percent out to 2025, while non-metropolitan areas will only grow by about 15 percent. Metropolitan areas will absorb over 90 percent of the growth in the 25-year period (Exhibit 15). As a result, the metropolitan share of population rises from 73 percent to 78 percent in the 25-year period. Despite this dramatic metropolitan growth, Texas will still be a more rural state than the nation is today; even the high end scenario would only place Texas at a level roughly equivalent to 80 percent of the national metropolitan share in 2000. However, as rural counties increase in population and become assimilated into metropolitan regions, the metropolitan scenarios presented here, which seem almost extreme, may not fully represent the State's metropolitan future.

Exhibit 15: Metropolitan vs. Non-Metropolitan Population					
Area Type	2000 Population (thousands)	2025 Population (thousands)	Change (thousands)	Percent Growth	Growth Share
All Metropolitan Areas	15,213	23,086	7,873	52%	90%
Non-Metropolitan Areas	5,639	6,479	840	15%	10%
Texas Total	20,852	29,565	8,713	42%	100%

These projections indicate there will be two mega-metropolitan areas in 2025, Dallas-Ft. Worth and Houston, with more than 57 percent of the State's population, both in the above-five million level. There will also be additions and expansions of metropolitan areas into the over-one million group. As a result, metropolitan areas over one million in population will exceed the present state population and will account for almost three-quarters of the State's total population.

The detailed metropolitan area projections for the major areas focused on in this study are provided in Exhibit 16.

Exhibit 1: Metropolitan Area Population Projections				
Area	2000	2025	Change	Percent Change
Austin	1,159,836	1,673,791	513,955	44
Dallas-Fort Worth	5,030,828	7,700,175	2,669,347	53
Houston	4,643,540	6,803,126	2,159,586	47
San Antonio	1,559,975	2,073,672	513,697	33
The Border	1,777,429	2,962,971	1,185,542	67
Total of Large Metropolitan Areas	14,171,608	21,213,735	7,042,127	50
Balance of State	6,680,212	8,351,396	1,369,561	21
Texas Total	20,851,820	29,565,131	8,713,311	42
Percent Large Metropolitan	68%	72%	81%	

Some of the travel implications of the population growth and demographic characteristic trends are as follows:

- The increasing share of those over 65 will have broad travel and safety implications for both longer distance and local travel.

- Fourth among states in population over 65, Texas' problems with an aging population will not be as severe as many other states.

- The decline in share of the younger age groups should be positive for highway safety.
- For householders there will be a shift in travel activity from childcare to elder care.

- The decline in share of working age population will put pressure on hiring giving eligible workers more freedom of when and where they work.

- Pressures will exist to keep workers in the labor force after 65 and to attract more women into the labor force.

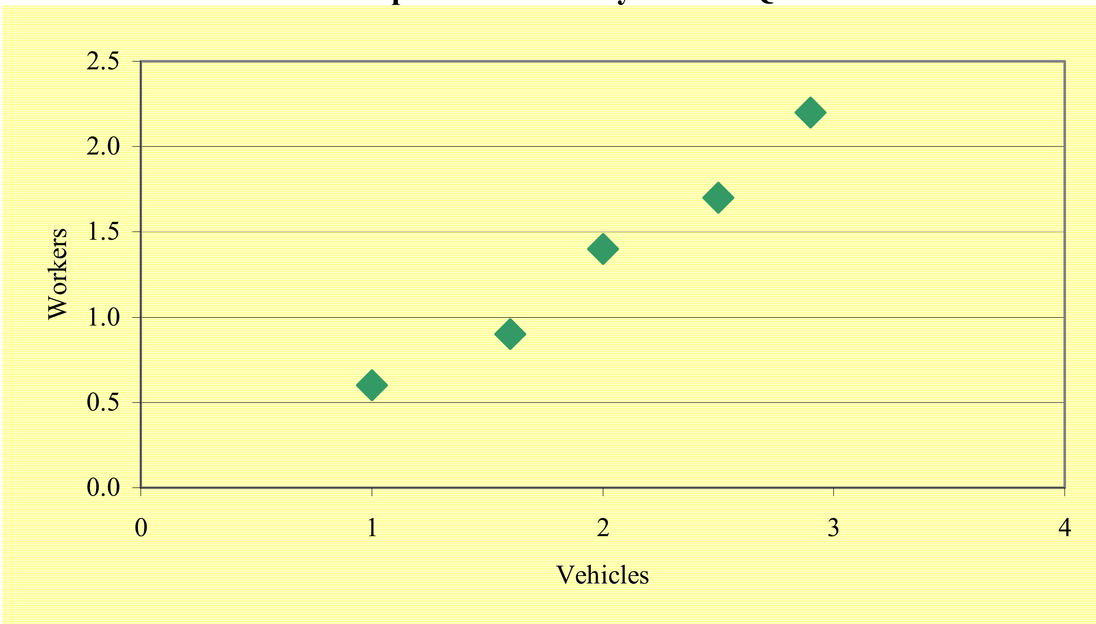
Affluence and Trip-Making

Many of the "problems" of transportation in America, mirrored in Texas, are the product of an affluent society. Both freight movement and passenger travel are affected by the wealth of the society in terms of the goods consumed per capita, the high value of goods produced and consumed, and the extraordinary need for, and discretionary preferences for, both local and long distance travel. In this area, Texas does not fully mirror the nation, with per-capita incomes in the State on the order of 95 percent of the national average, but still very affluent by world standards. However, in a transportation sense, Texas may be wealthier than the nation, in that a smaller percentage of Texas households are car-less than in the nation. The income differences between Texas and the nation is an area where Texas can be expected to move toward closer alignment with the national average over the coming years.

There are many factors to consider when evaluating prospective trip-making rates for the future. The number, size, structure, and age of households can be very significant. But household incomes will likely be the factor with the greatest influence over the nature and scale of travel in the future, and also the most difficult to predict.

Perhaps the key point about American (and world) affluence is that it is typically a product of the larger number of workers in a household rather than a single person earning a very high income. In Exhibit 17, drawn from the year 2000 Consumer Expenditure Survey of the US Bureau of Labor Statistics, households have been separated into five equal groups from lowest to highest income. Note that the number of workers (and vehicles owned) rises with increasing incomes. The highest income households average above two workers per household. This chart summarizes a great deal of the reality of American commuting and travel behavior today.

Exhibit 17: Relationship Between Workers and Vehicles per Household by Income Quintile



The same survey shows that transportation spending rises with income such that the highest income groups spend four times more on transportation than the lowest group. Detailed spending data such as this are not available for Texas, but are measured in selected metropolitan areas including Dallas-Ft. Worth and Houston (Exhibit 18).

Exhibit 18: Household Vehicle Ownership and Transportation Spending

Factor	United States	South	Dallas-Ft. Worth	Houston
Earners/Household	1.4	1.3	1.5	1.5
Vehicles/Household	1.9	1.9	2.0	2.0
Total Household Spending	38,045	34,102	46,600	48,299
Household Transportation Spending	7,417	7,038	8,948	9,722
Transportation Share of Spending	19.5%	20.6%	19.2%	20.1%

The table shows that shares of spending going to transportation in Dallas-Ft. Worth and Houston are not inconsistent with national and regional patterns. Note the consistency of spending shares going to transportation although total household spending varies significantly (from $34,000 to $48,000).

Exhibits 19, 20 and 21 demonstrate the role of household income on the scale and character of travel demand – affecting the number of trips made, their length and the choices of mode. This recognizes that many of our transportation congestion problems are products of affluence.

Exhibit 19: Annual Trips Per Household by Household Income - 1995

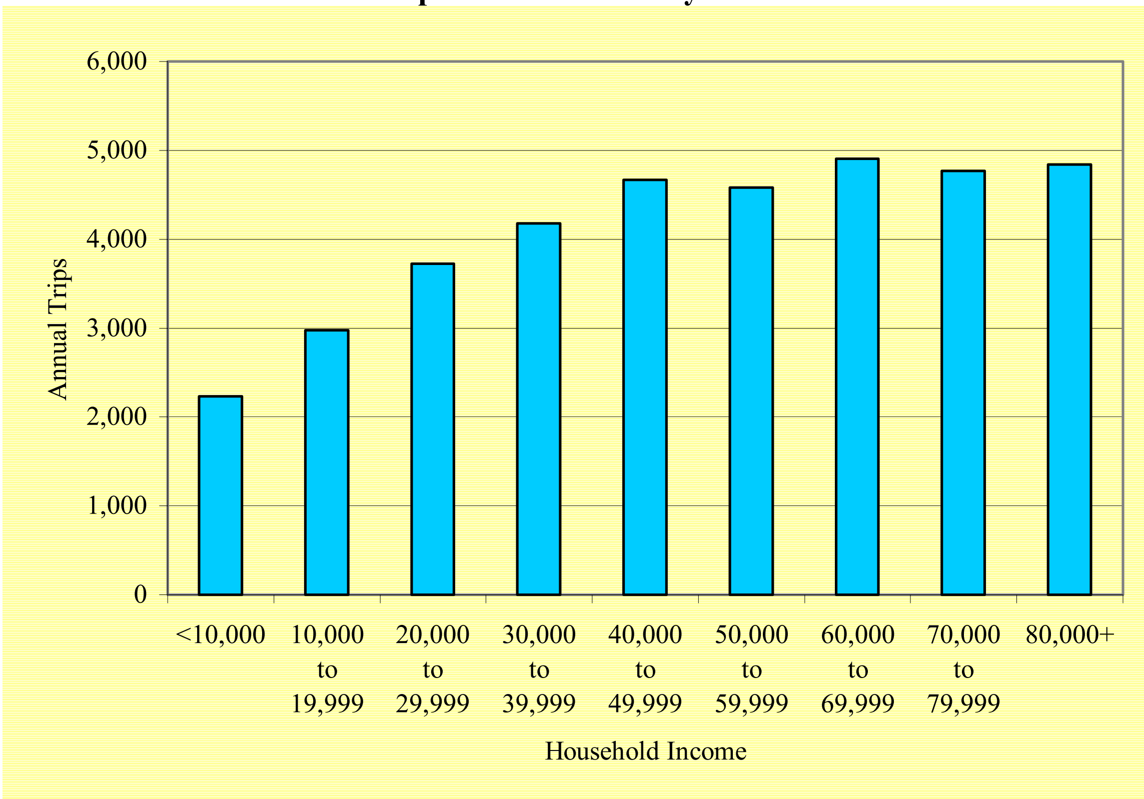


Exhibit 20: Work Trip Length by Household Income - 1995

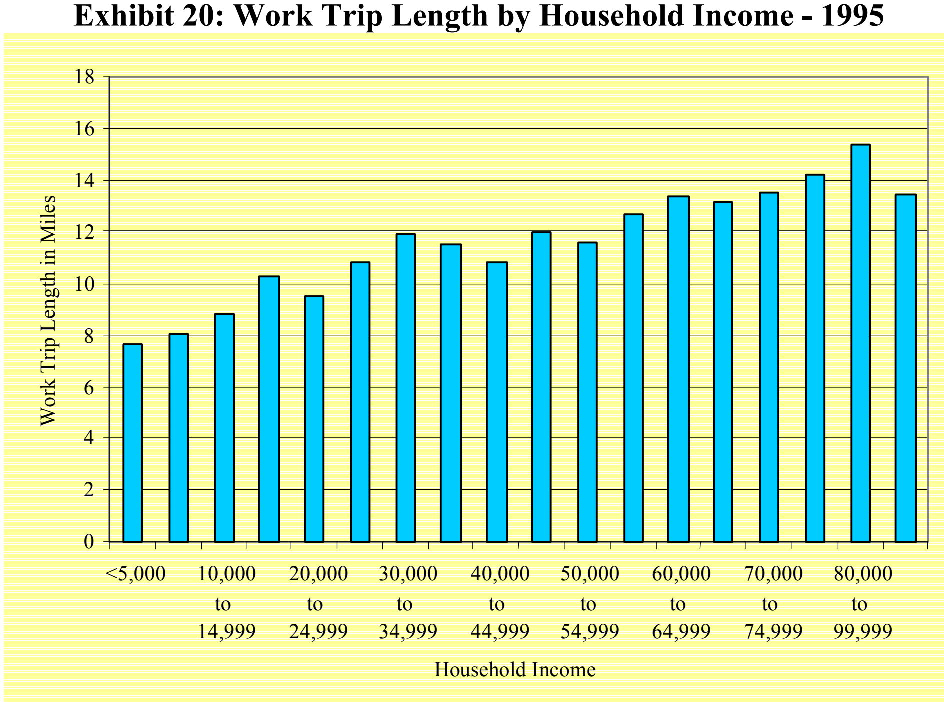
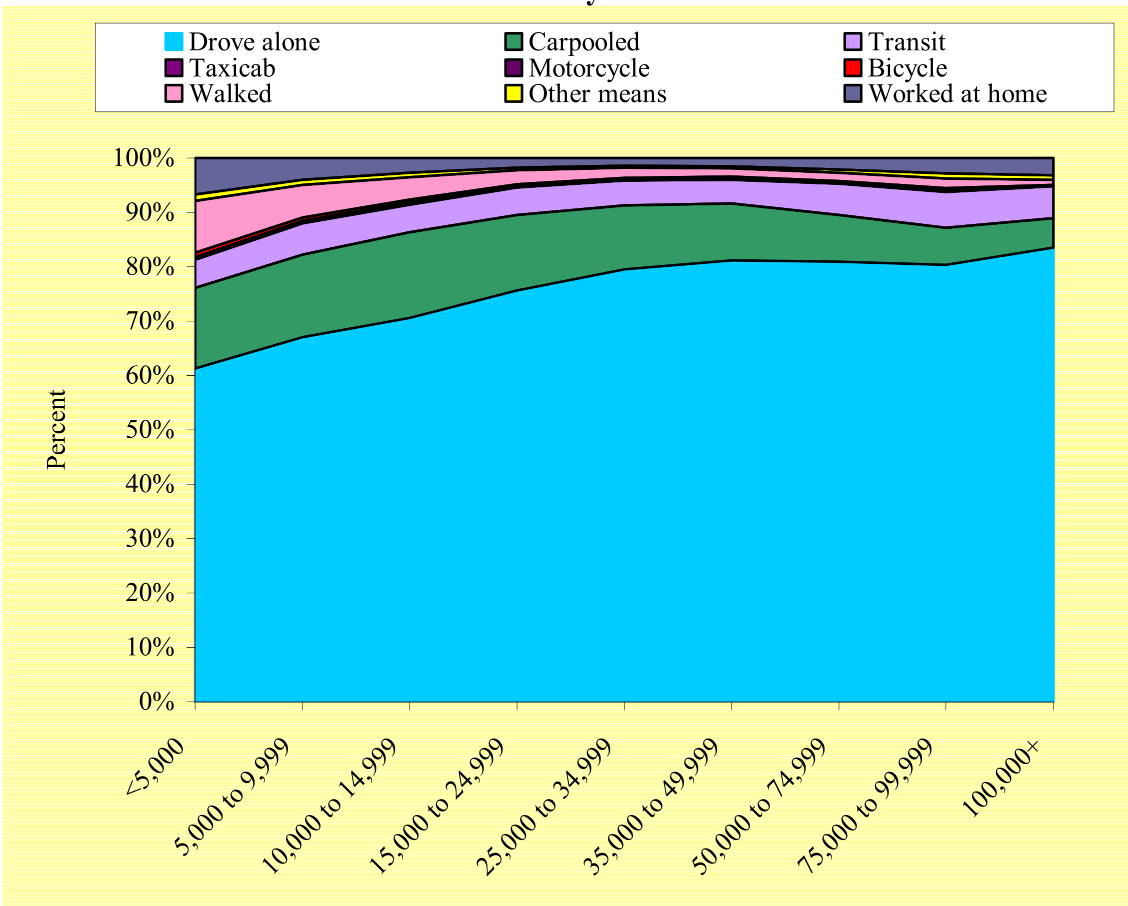


Exhibit 21: Mode Choice by 1995 Household Income



In summary, the foregoing points demonstrate that understanding the scope and character of travel today is a complex matter, in many ways quite distinct from traditional patterns. It is important to recognize that there are emerging factors that will modify historical commuting patterns and that will add to traditional commuting concerns. Key among these will be the size, nature, and location of future travel populations. Even with the adoption of a more conservative assumption about growth, there will be five million new adults arriving via in-migration, more than the four million increase by births. The scale of this increase and its concentration in a few metropolitan areas adds to the difficulties in addressing needs. This will be strongly affected by the prospects for greater travel growth in non-work travel than in work travel, a product of the affluence of the population. Other aspects affected by affluence are increasing auto ownership and use, and longer trip lengths. Increases in the non-traditional workforce, such as older workers, could shift the hours of work and affect the general safety of overall travel. All of these forces, as complex as they are, must be incorporated in the planning to assure effective response to future needs.

II. Transportation and the Texas Economy

The Texas economy, with a gross state product of $742 billion in 2000, is a major and growing part of the national economy – rising from seven to eight percent of national GDP from 1980 to 2000. There should be interest not only in Texas but also nationally in the prospective health of the Texas economy. Examination of that economy shows the key role played by transportation. It will require an effective, broadly capable transportation system to assure the appropriate contribution of the Texas economy to the well being of Texans and the nation.

Labor Force and Employment Trends

There has been a downturn in overall employment in Texas, as in the national economy, as a result of the recent economic slow-down. But the trend over the last ten years has been quite positive as shown in Exhibit 22. The overall labor force grew by 16.5 percent while the employed labor force rose almost 21 percent, reaching more than 10 million by the end of 2001. As of September 2002, total employment in Texas stood at almost exactly 10 million.

One of the keys to growth is the relationship between workers and the population they support. Historically, the ratio of workers to the total population has ranged closely around 40 percent, but this has been sharply affected by changes in the age distribution of the population and the increased participation of women in the labor force. Beginning in 1995, the ratio rose to 43 percent for the first time and reached 46 percent in 2001. In order to generate the levels of employment defined in Exhibit 23, the ratio of employment to population will reach extraordinary levels of 49 to 50 percent by 2020.

Exhibit 22: Texas Labor Force and Employment Trends

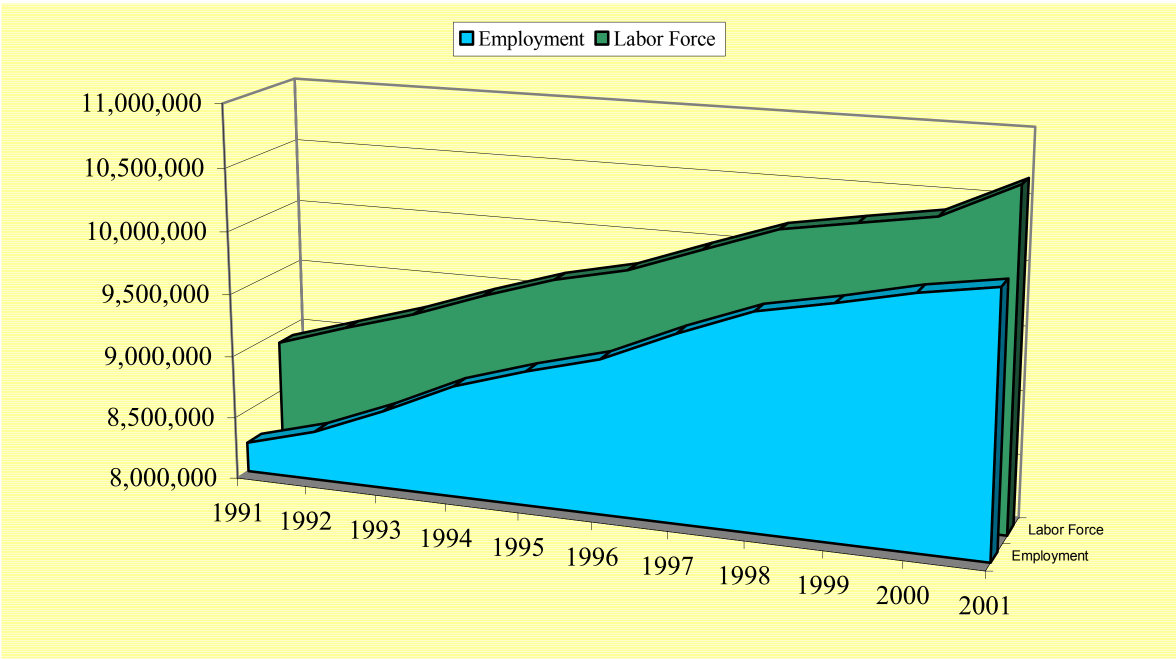
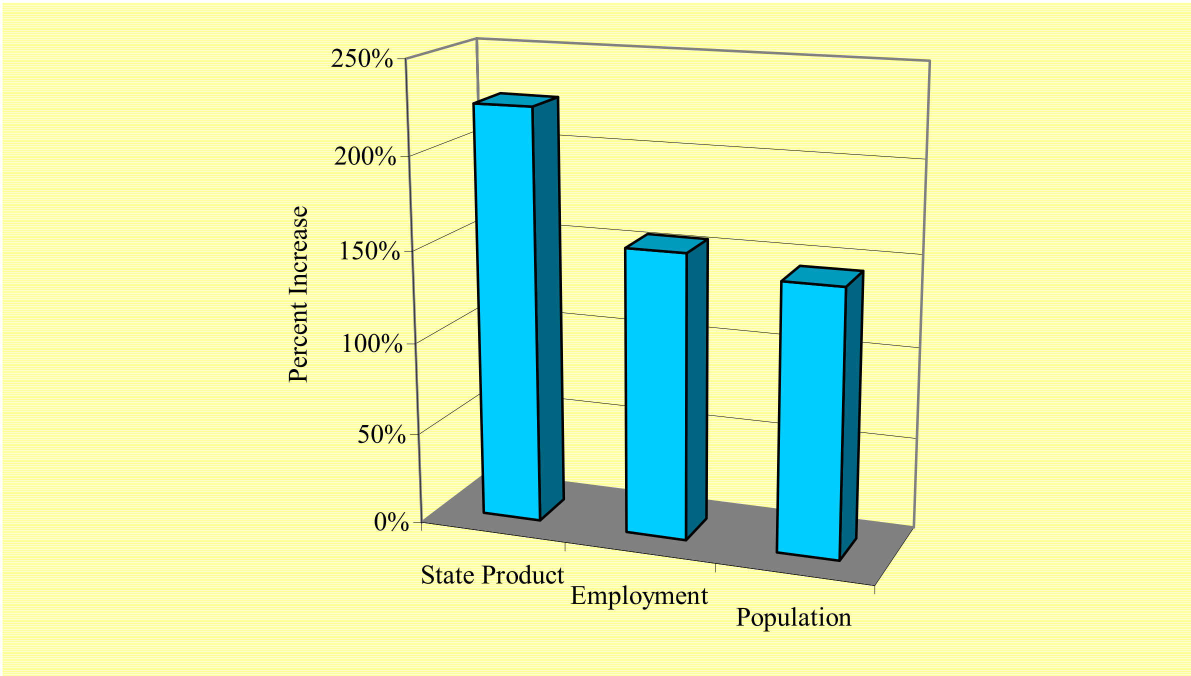


Exhibit 23: Growth in Key Indicators: 2001-2025



Projections of the Economy and Freight Impacts

Population growth will be substantial in the period from 2000 to 2025, but employment growth will be an equally significant factor. The wealth per capita resulting from economic growth, however, is the most significant factor of all in defining both the scale and scope of passenger and freight movements.

When considering freight flows within Texas, at least four levels of analysis are needed:

1. Local movements, typically within metropolitan areas. Usually pick up and delivery activities serving businesses and households are almost exclusively a truck-based component of movements.
2. Inter-city movements between major areas of the State or between the State and other states. This freight flow is handled by trucks, rail and waterborne vessels.
3. Through movements passing through Texas between other states. Trucks are responsible for a significant share of this freight market, with rail, water and air also playing a role.
4. The special case in Texas of movements to and from or through Texas on the way to and from Mexico. Mexico movements, while not a distinctly different class, have some unique characteristics.

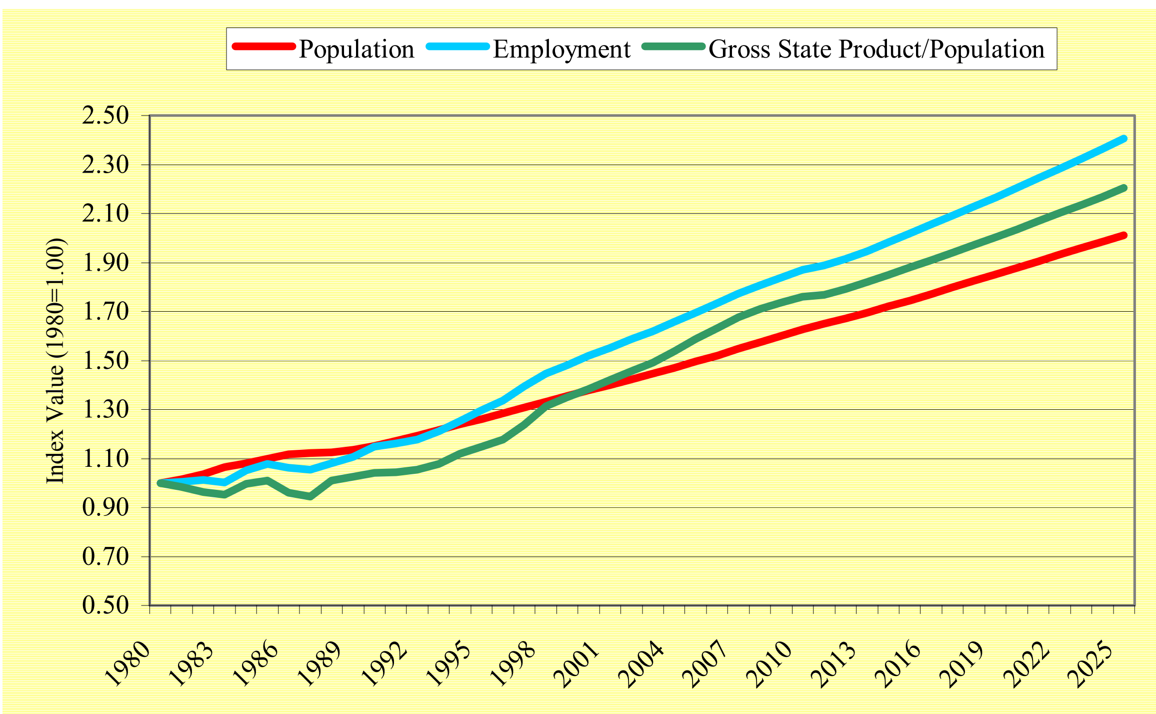
All of these movements must be addressed in any comprehensive understanding of the roles the Texas transportation system is expected to play in the Texas and national economies.

Most of the freight tonnage, amounting to 1.1 billion tons and more than $800 billion, generated by the over 470,000 establishments in Texas stays in Texas, but the tonnage shipped beyond the borders represents a major share of the value shipped. About 80 percent of the freight value moves by truck (Exhibit 24).

Exhibit 24: Shipments by Truck			
Truck Shipment Share	Value (Billions)	Tons Shipped (millions)	Ton-Miles (billions)
Shipped within Texas	$336	765	52
Shipped to other States	$231	148	154
Received from States	$262	203	184

As the population and wealth of Texas grows, its share of US economic activity will also grow. It was noted earlier that the Texas share of the economy grew from 7 percent to 8 percent of the US economy in the last 20 years. In the next 20 years it is projected to reach 10 percent of the national economy (Exhibit 25). The challenges of moving people and goods within and through Texas will be substantial. Failure to respond to those challenges may disrupt that growth potential.

Exhibit 25: Key Economic Trends



From purely a trade perspective, the U.S. Department of Transportation's Freight Analysis Framework (FAF) has developed expected growth trends for freight movement in the US. The key is that international trade will strongly influence total freight flows. Texas will be at the center of many of those flows. The growth rates projected will generate overall increases for the period on the order of 87 percent for domestic traffic and over 100 percent for International traffic, the strongest of which will be the US/Mexico trade. Comparison of projected truck freight flows within and through the State for 1998 and 2020 shows the strong growth in routes with more than 10,000 trucks per day in both East-West and North-South flows. Recognizing that trucks have the impact of three or four passenger vehicles on the road system, their future growth will severely impact congestion especially in metropolitan areas. Traffic flows through Texas, amounting to 20 percent of all truck shipments in the state, whether North-South or East-West, will be a product of the growth in surrounding states and the nation at large, as well as within Texas. Texas will be challenged to serve these cross-national flows and there is little it can do to change them.

Concluding Statement

Texas will face significant growth in population in the years to come. How well the State can fully translate population growth into economic growth, in the form of jobs, income, productivity, trade, and wealth will in no small measure be a function of its ability to develop and maintain a competitive transportation infrastructure.

III. Transportation and Mobility

Introduction

Traffic congestion already costs Texas residents, travelers, and businesses lost time, wasted fuel and dollars. It is clear that addressing the State's mobility needs will require additional financial resources. This report outlines the cost of those improvements, but also estimates the substantial returns that can be derived from this investment.

The rapid growth of Texas' largest metropolitan areas in the last decades has outpaced the expansion of the roadway network and their rapid growth is expected to continue. Such growth challenges all public services. The provision of other public services such as schools, hospitals, police, fire, and social services must keep pace with growth. Highways that advance the ability of other services to meet their challenges must similarly keep pace.

The increases in vehicle miles traveled, the number of vehicles and the number of drivers far outpaced growth in roadways since 1965 (Exhibit 26). The result of this imbalance can be seen in the follow historical congestion levels as measured by the Travel Time Index shown in Exhibits 27 and 28.

The Travel Time Index is used by the Texas Transportation Institute in their annual Urban Mobility Report as an area-wide mobility measure. The index is the ratio of peak period travel to free-flow travel time. The Travel Time Index expresses the average amount of extra time it takes to travel in the peak relative to free-flow travel. A Travel Time Index of 1.30, for example, indicates a 20-minute off-peak trip will take 26 minutes during the peak travel periods (20 x 1.30 = 26).

Exhibit 26: Index of Vehicle Miles Traveled, Number of Vehicles, Driver and Lane-Miles of Road in Texas (1965=100)

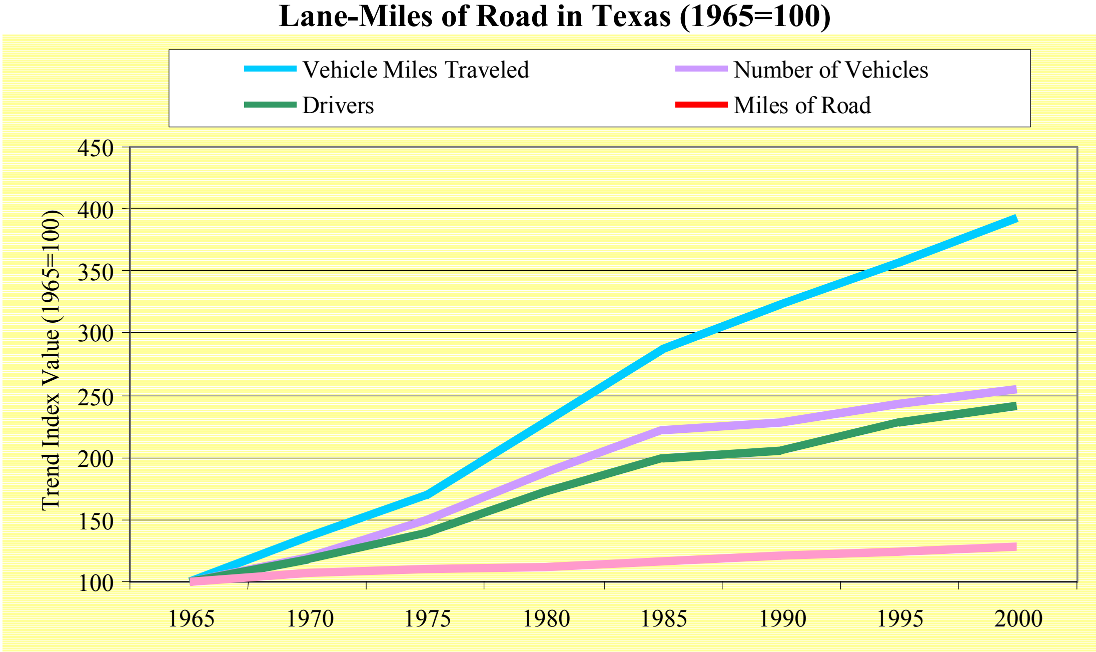


Exhibit 27: Congestion Levels for Large Urban Areas in Texas

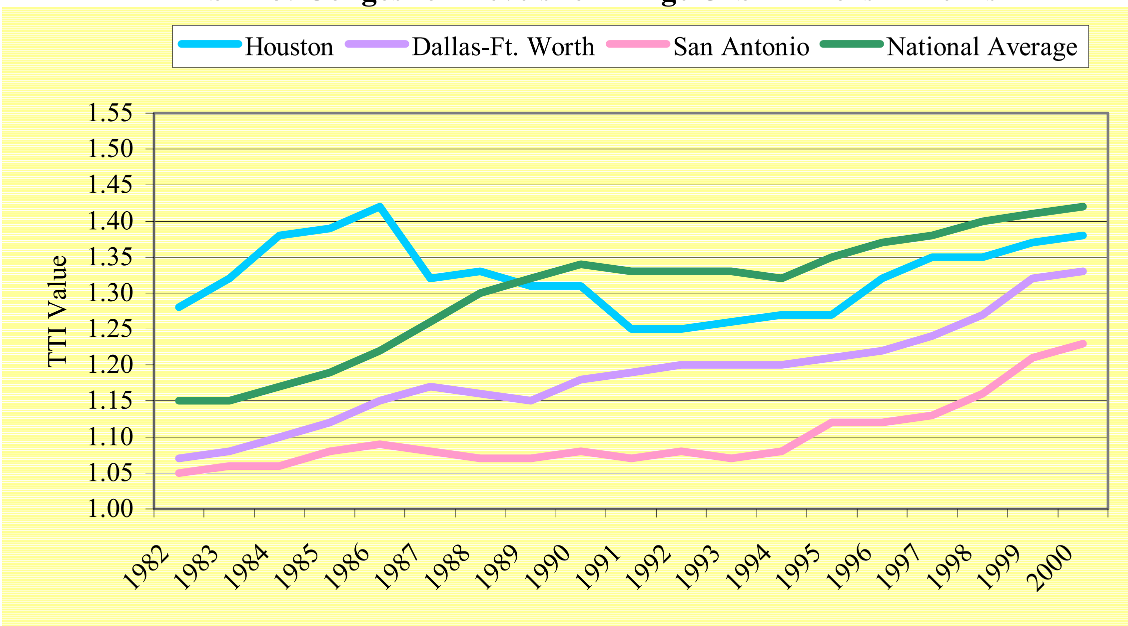
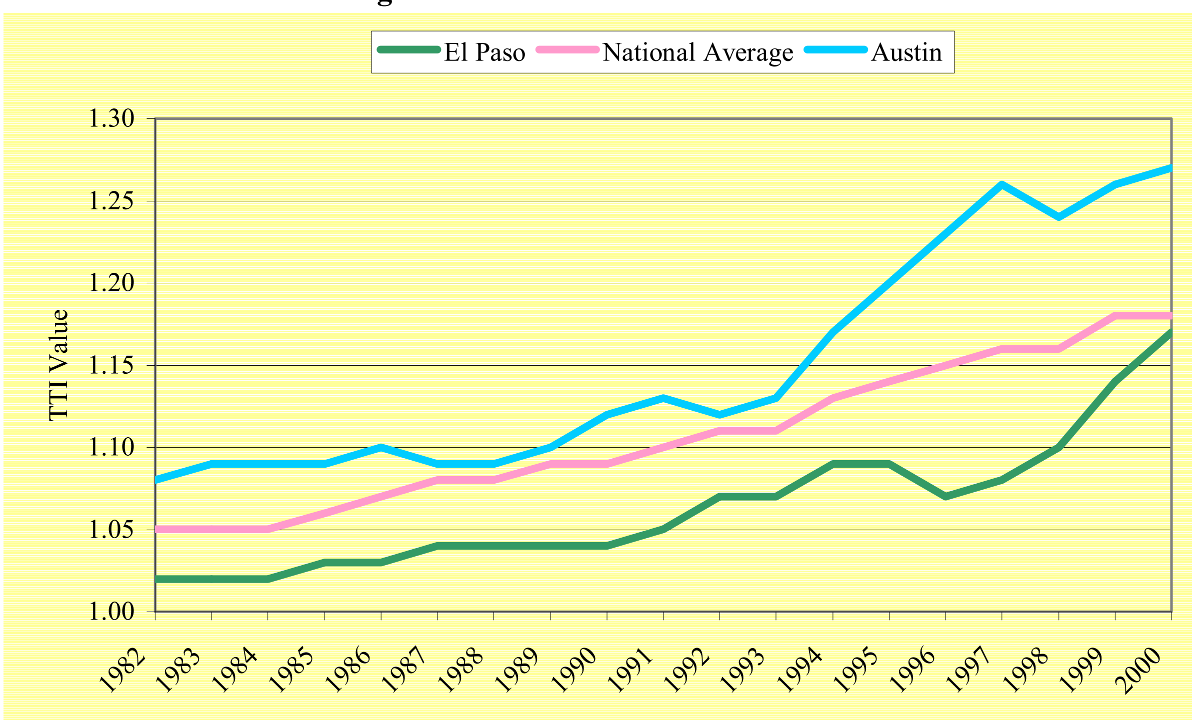


Exhibit 28: Congestion Levels for Medium Urban Areas in Texas



This portion of the research sought to answer the following major questions:

- In order to ensure adequate transportation infrastructure, how many lane-miles of roadway, of what type, in what metropolitan areas must the lane-miles be added in order to achieve certain mobility goals?
- What will it cost to achieve these goals?
- What is the economic return on the alternative investment levels made by the State to achieve these mobility goals?

A model was constructed to estimate funding levels needed to meet alternative roadway mobility scenarios. For the purposes of this study, four Travel Time Index goals were established – maintaining the current Travel Time Index in each urban area, and achieving Travel Time Index indices of 1.25, 1.20 and 1.15 alternatively in each urban area. Travel demand was estimated from the projected population and employment levels. Public transportation ridership was assumed to grow at the same rate as travel demand, so that "market share" remained constant. Consequently, the transportation investment required to meet each goal is in addition to the investment required by various public transportation strategies.

Areas of Analysis

For the purpose of this analysis, Austin, Dallas, Ft. Worth, Houston, San Antonio, the Border, and the remainder of the State were chosen for analysis. The table below (Exhibit 29) defines the counties included in each urban area. In total, the counties contained in these areas represent 68 percent of the State's population and 57 percent of the State's daily vehicle miles traveled (DVMT). All other counties, whether urban or rural, were grouped into the "Balance of State" category.

Exhibit 29: Metropolitan Areas and Counties

Austin	Houston	Ft. Worth	Dallas	San Antonio	The Border
Travis	Harris	Tarrant	Dallas	Bexar	Cameron
Williamson	Galveston	Parker	Collin	Guadalupe	Hidalgo
Hays	Montgomery	Johnson	Denton	Comal	Webb
	Ft. Bend		Rockwall		El Paso
	Brazoria		Ellis		
	Liberty		Kaufman		
	Waller				

Model Attributes

The model constructed to perform this analysis is driven by three major factors: population, DVMT, and lane-miles. Population and DVMT are demand variables. Lane-miles of various road classifications is a major variable for supply.

The population projection used in this analysis was the mid-line migration scenario produced by the Texas State Data Center. That projection is believed to most closely represent the future population growth pattern in the State and is widely used by numerous public and private entities as a basis for population driven projections.

Projections of DVMT were developed from historical data published in the Texas Department of Transportation's annual District and County Statistics report (DISCOS).

The model addresses supply/demand issues at a macro level. It is recognized that specific solutions to specific supply/demand issues will be made at the individual project level. This model, like any other, is a representation of reality – not reality itself. It assumes for example, that the population is evenly distributed across an area, and that the space for new lane-miles exists.

Despite these limitations, the model does provide significant benefit. First, it quantifies how many lane-miles must be constructed to reach and maintain specific levels of mobility. Second, it provides an estimate of how much each scenario would cost to attain if the solution were to be achieved only by adding lane-miles. Third, it recognizes that investments in roadways provide a significant benefit to the economy on both a local and regional basis in terms of increased efficiencies and reduced costs and provides an estimate for those returns. Finally, the model provides a tool to evaluate alternative scenarios and assess mobility and spending issues on an ongoing basis.

A more detailed explanation of the model used to estimate cost, supply and demand functions is included in Appendix III.

Analysis Process

Four key elements comprise the analytical procedures. Additional information is provided in the Appendix.

- Spending – Current TxDOT spending for construction, rehabilitation and maintenance amounts to almost $4.4 billion annually. Approximately $3.4 billion is spent for construction of new roads, adding lanes to existing roads and rebuilding worn-out roads. Of the $3.4 billion, between $700 million and $1 billion is spent on new capacity. The other $1 billion is spent on maintenance activities.

- Demand – Current daily travel is presented in Exhibit 30. Future travel is estimated from population and daily travel per capita forecasts. Per capita travel is estimated to increase slightly over time as urban area size and average annual earnings increase. The growth rate in daily vehicle-miles of travel shown in Exhibit 30 is the combination of increasing population and growing miles per capita.
- System – The road system supply in each urban area is presented in Exhibit 30. These are used as baseline values in the analysis of expansion needs.
- Mobility Levels – Congestion is essentially a condition resulting from more demand than supply. The mobility measure, Travel Time Index, can be affected by either lowering demand or by increasing the capacity of the operations efficiency of the roadway.

Exhibit 30: Key Analysis Input Statistics

Urban Area	Daily Demand (million vehicle-miles)	System Length (lane-miles)	Travel Time Index
Austin	21.3	3,755	1.27
Dallas	54.1	8,767	1.33
Ft. Worth	30.0	4,840	1.33
Houston	69.3	10,502	1.38
San Antonio	27.6	4,553	1.23
The Border	22.5	6,128	1.13
Remainder of State	176.5	149,226	1.05

Note: The Travel Time Index value for the remainder of the State is estimated from a relatively limited dataset. The potential lack of precision does not affect the results, however. The improvement scenarios include sufficient system additions to maintain current congestion levels in these areas. These investments are controlled by populations and travel growth, rather than the initial congestion level.

<u>The Results</u>

The analysis was performed to estimate the amount of new roadway lane-miles and the cost of roadway construction and maintenance. The goal scenario tables indicate the cost of the lane-miles necessary to achieve the Travel Time Index goals in each area. Enough lane-miles are added to offset the demand *growth* and maintain or achieve the Travel Time Index goals in each urban area and in the remainder of the State. In those areas where the existing mobility levels are better than the Travel Time Index goal, the cost shown is that necessary to maintain the existing mobility levels. The following discussion briefly outlines the major elements of the analysis.

Productivity

The estimate of the return to the State's economy on the investment made is based on research by Nadiri and Mamureas for Federal Highway Administration (see www.fhwa.dot.gov//policy/naridi.htm). That work indicates a return of 16 percent annually for current roadway investments. For the purposes of this study, the annual rate of return is conservatively estimated at 12 percent on the amount spent for new capacity. For each $100 million spent on new roads, for example, the return to the economy will be $12 million annually as long as the roadway is maintained and rebuilt as needed. (Note: Over the last 30 plus years, the annual rate of return on expenditures for new roadways has been slowly declining as the roadway network has matured. However, recent research indicates that the rate of return has begun to rise again. This study, to be conservative in its estimates of benefit, assumes a continued slow decline even though the most recent research may indicate otherwise.)

Travel Delay Savings

Travel delay (the extra travel time above that required to travel at free-flow speeds) is estimated for roadway systems based on research used by the Texas Transportation Institute in the Annual Urban Mobility Report. More information can be found at: http://mobility.tamu.edu/ums. The methodology estimates the travel speed from the amount of travel on the road system and the amount of roadway available for that travel – a relatively simple density relationship. As travel volume grows, speeds decline and delay is estimated as the difference between free-flow speed and the congested speed. The calculation is performed for both streets and freeways.

The value of travel delay for the purposes of this study is $13 per person hour, or $16.50 per vehicle hour. The rate is representative of the value of time, rather than a wage based value.

Fuel Consumption and Cost

Fuel consumption is also based on the Texas Transportation Institute methodology. As speeds decline, fuel consumption grows due to less efficient operation on congested facilities. The speed estimates are used as the basis for this calculation. Fuel is valued at the state average fuel cost in 2000, $1.39 per gallon.

Return on Investment

The return on investment shown in each table is calculated through 2050 so that all road investments will be provided the opportunity for at least 25 years of return. The construction, maintenance and reconstruction costs for this 50-year period are also subtracted from the net benefits for this time period. The actual return on the amount invested in new construction continues into the future as long as the roadway is properly maintained. Finally, the return on investment on new capacity is in addition to other return associated with time and fuel savings as a result of reducing congestion.

The budget shortfalls shown for each alternative are the difference between current trends and the amount needed for the improvement to the target values. There are two budget shortfall figures.

- Shortfall without inflation – This value presents the additional funding needs in current (2000) dollars. This amount illustrates the difference between expected revenue and the needs for achieving the target.
- Shortfall with inflation – The second value estimates the additional amount that would be needed to actually purchase the improvements at the forecasted levels of inflation. The primary funding sources for highway construction – the fuel tax and vehicle registration fees – are unit-based taxes (per gallon or per vehicle). They do not increase in relation to inflation or construction cost increases. The net effect has been, and will continue to be a decline in purchasing power. (See Revenues on page 40 for further explanation.)

All other dollar amounts are constant value 2000 dollars except where otherwise noted.

Mobility Goal Description

The congestion reduction goals are expressed in terms of achieving areawide average travel time index values. The additional roadway needed to achieve the goal, or to maintain an existing travel time index value, is determined by the rate of travel growth in each area. Population growth and increasing affluence both have the effect of increasing travel demand in each area. The goal scenarios are described below. More information about the costs and benefits of each scenario are included in Appendix III.

- Maintain Existing Travel Time Index -- This alternative estimates the roadway needs to continue the current mobility levels. No improvement is modeled, but additional lane-miles are added to offset the demand growth.

- Improve Travel Time Index Values to a Maximum of 1.25 -- This alternative estimates the roadway needed to improve mobility levels in Houston, Austin and Dallas-Fort Worth to 1.25 and continue the existing levels in the other areas.

- Improve Travel Time Index Values to a Maximum of 1.20 -- This alternative estimates the roadway needed to improve mobility levels in Houston, Austin, San Antonio and Dallas-Fort Worth to 1.20 and continue the existing levels in the Border and other areas.

- Improve Travel Time Index Values to a Maximum of 1.15 -- This alternative estimates the roadway needed to improve mobility levels in Houston, Austin, San Antonio and Dallas-Fort Worth to 1.15 and continue the existing levels in the Border and other areas.

Exhibit 31 illustrates the total costs to achieve mobility goals in each urban area, as well as the budget shortfall and economic return from improved productivity for the mobility improvement scenarios. While the costs for progress are substantial, the additional increment of cost for progress beyond the "maintain" scenario is relatively modest. There is a relatively substantial cost to keep the travel time index for the larger systems in Houston and Dallas-Fort Worth from increasing; it is relatively inexpensive to produce further reductions.

Exhibit 31: 25-Year Program to Achieve Mobility Goals

Urban Area	Total 25-Year Cost for Mobility Goal (billions 2000 $)			
	Maintain Existing Travel Time Index	1.25 Travel Time Index Goal	1.20 Travel Time Index Goal	1.15 Travel Time Index Goal
Austin	$6.8	$7.3	$8.5	$9.8
Border	10.4	10.4	10.4	10.4
Dallas-Ft. Worth	31.9	39.8	45.1	50.8
Houston	23.7	31.6	35.0	38.5
San Antonio	9.5	9.9	11.0	12.7
Balance of State	96.3	96.3	96.3	96.3
Total Cost	178.6	195.3	206.3	218.3
Total Shortfall	38.5	55.2	66.2	78.3
Total Return	$333.0	$393.0	$432.0	$477.0

Total costs for the scenarios range from $179 to $218 billion, with shortfalls up to $78 billion relative to the current trend of $140 billion. The return on investment from the additional roadway spending and consequent mobility gains range from $333 billion to $477 billion. These benefits are in excess of the delay and fuel savings per peak period traveler, which are presented in Exhibit 32.

Exhibit 33 presents the delay and fuel cost per peak period traveler. Peak period travelers are estimated from the Census survey data indicating the time of departure for trips.

The cost components for new capacity and maintenance and reconstruction spending are presented for each scenario in Exhibit 34. New capacity costs range from 41 percent to 49 percent of the total.

Finally, the costs shown in Exhibit 31 are a function of the lane-miles that would be added to the system in order to achieve and maintain the alternative congestion scenarios. For example, to maintain existing congestion levels would require the annual addition of almost 900 lane-miles to the State system in the metropolitan areas included in this report. To meet the 1.15 TTI scenario would require 1,500 lane-miles be added to the system annually. Detailed tables showing lane-mile requirements by TTI scenario are contained in Appendix III.

Exhibit 32: Congestion Cost Savings for Mobility Goals			
	Total Congestion Cost Savings per Peak Period Traveler Relative to Existing Travel Time Index Levels		
Urban Area	1.25 Travel Time Index Goal	1.20 Travel Time Index Goal	1.15 Travel Time Index Goal
Austin	$88	$374	$737
Border	---	---	---
Dallas-Ft. Worth	$337	$752	$1,100
Houston	$482	$922	$1,217
San Antonio	---	$106	$351
Balance of State	---	---	---
Average	$192	$415	$604

Exhibit 33: Total Congestion Cost for Mobility Goal Scenarios				
	Average Fuel and Delay Cost Per Peak Period Traveler			
Urban Area	Maintain Existing Travel Time Index	1.25 Travel Time Index Goal	1.20 Travel Time Index Goal	1.15 Travel Time Index Goal
Austin	$1,190	$1,102	$816	$453
Border	$160	$160	$160	$160
Dallas-Ft. Worth	$1,390	$1,053	$638	$290
Houston	$1,410	$928	$488	$193
San Antonio	$810	$810	$704	$459
Balance of State	$150	$150	$150	$150
Average	$838	$644	$423	$234

Exhibit 34: 25-Year Cost Components for Mobility Goals			
Goal Scenario	New Capacity Cost (billions)	Maintenance and Reconstruction Costs (billions)	Total Costs (billions)
Maintain Current Travel Time Index	$73.5	$105.0	$178.6
1.25 TTI Goal	$87.7	$107.6	$195.3
1.20 TTI Goal	$96.9	$109.4	$206.3
1.15 TTI Goal	$107.1	$111.2	$218.3

Funding Requirements

Exhibit 35 illustrates the progression of the estimated annual cost to reach the various goals. The second column, "Estimated Current Baseline TxDOT Expenditures" was calculated based on vehicle-miles of travel per capita, population growth, and historical expenditures. This was deemed reasonable because, to a great degree, revenue is derived from user fees and, as a result, revenues will rise with increased population and daily travel per capita rates. The columns to the right show the various annual costs (in constant 2000 dollars) associated with each Travel Time Index goal.

Exhibit 35: Estimated Travel Time Index Scenario Cost (in billions $, non-inflation adjusted)

Year	Estimated Current Baseline TxDOT Expenditures	Estimated Needs to Maintain Current Travel Time Index	Estimated Needs to Meet		
			1.25 Travel Time Index Goal	1.20 Travel Time Index Goal	1.15 Travel Time Index Goal
2000	4.396	5.604	6.128	6.473	6.852
2005	4.772	6.085	6.654	7.027	7.439
2010	5.165	6.585	7.200	7.605	8.050
2015	5.576	7.110	7.775	8.212	8.692
2020	6.003	7.653	8.369	8.839	9.357
2025	6.439	8.210	8.978	9.482	10.037
TOTAL	140.075	178.592	195.292	206.266	218.344

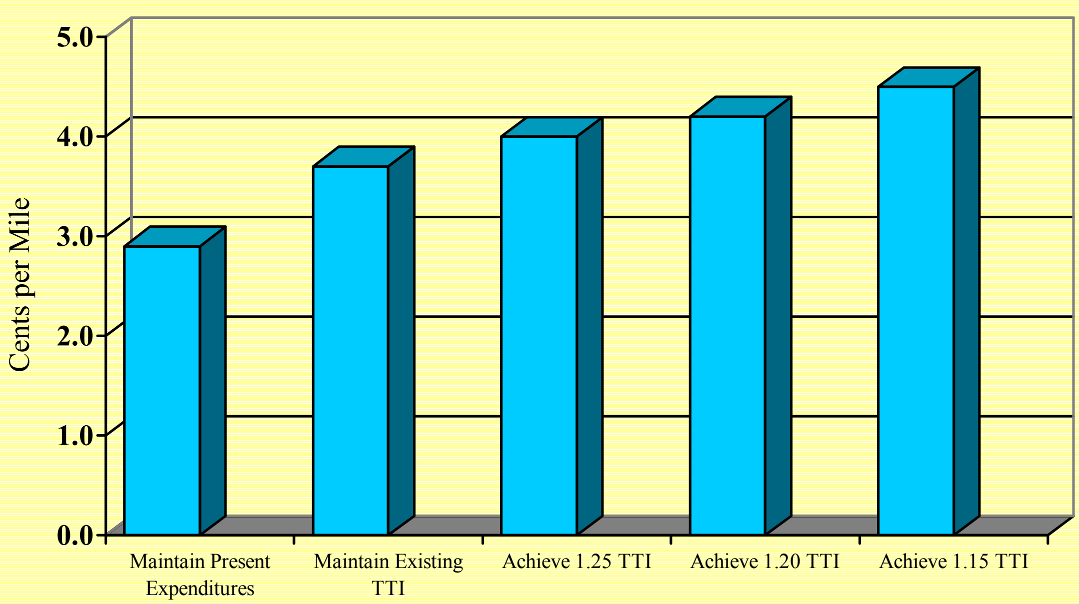
Exhibit 36 illustrates the change in "deficit" under each scenario over 25 years. In this table, the numbers in parentheses indicate the amount by which expenditures for new capacity and maintenance associated with each goal are expected to exceed expenditures based on current trends (in constant 2000 dollars). The "Total" line is the total "deficit" over 25 years. The "deficit" can, of course, be made up in a number of ways – increased fuel taxes, vehicle registration fees, tolls or other use fees, other taxes, public/private partnerships, bonds, or other means.

Exhibit 36 also illustrates that the annual funding gap to maintain current congestion levels grows from $1.2 billion to almost $1.8 billion as the State's population grows. A similar annual amount is required to move congestion levels down to a maximum Travel Time Index of 1.15 across the state.

Exhibit 36: Estimated Spending "Deficit" to Meet Travel Time Index Scenarios (in billions $, 2000 constant $)				
		Estimated Needs to Meet		
Year	Estimated Needs to Maintain Current Travel Time Index	1.25 Travel Time Index Goal	for 1.20 Travel Time Index	for 1.15 Travel Time Index
2000	$(1.209)	$(1.733)	$(2.077)	$(2.456)
2005	(1.312)	(1.881)	(2.255)	(2.667)
2010	(1.420)	(2.036)	(2.440)	(2.886)
2015	(1.533)	(2.198)	(2.635)	(3.116)
2020	(1.651)	(2.366)	(2.836)	(3.354)
2025	(1.771)	(2.538)	(3.043)	(3.598)
TOTAL	($38.518)	($55.218)	($66.191)	($78.270)

While these apparent deficit values may seem daunting, it must be recognized that Texas is a very large state with a very large population and economy, and as a result generates large numbers in almost any area of public concern. Spread across the 22 million people, the 10 million workers, the 8 million households, or the million or so businesses in the State they appear far more reasonable. When expressed in cost per mile, as in Exhibit 37, the goal of maintaining current congestion levels is less than 1 cent per mile more than current expenditures. Achieving a goal of average peak period trips requiring only 15 percent more travel time than free-flow trips (Travel Time Index of 1.15) will require less than 2 additional cents per mile. Seen as a toll, this would amount to an additional 16 cents to make a 10-mile work trip. This would provide travel times similar to conditions in El Paso in the late-1990s, Austin and San Antonio in the early-1990s, Dallas-Fort Worth in the late-1980s and Houston in the late-1970s.

Exhibit 37: Cost per Vehicle-Mile Traveled by Mobility Goal Scenario



The annual cost of the various goal scenarios does not significantly increase during the period of analysis. Exhibit 38 shows the cost to achieve a 1.15 Travel Time Index is approximately $100 per person more than current spending trends. Exhibit 39 shows that household expenditures for any of the alternatives change less than $40 over the 25 years. Total household spending would range from $605 in 2025 if current spending trends continued, compared to $940 to achieve the 1.15 Travel Time Index target, a $335 increase to fund a significant improvement in travel conditions. By comparison, the average household spent $372 on alcoholic beverages in 2000, according to the U.S. Department of Labor Consumer Expenditure Survey.

As another example, a person annually driving 20,000 miles currently pays $580 per year to help fund a transportation system that sees congestion levels increasing every year. To expand the roadway system so that congestion remains at present levels into the future, serving new needs and new users, that same person would have to pay $740. To expand the system to reduce the Travel Time Index level to 1.15, the cost would rise to $900.

Exhibit 38: Average Annual Cost per Texan to Achieve Mobility Goals

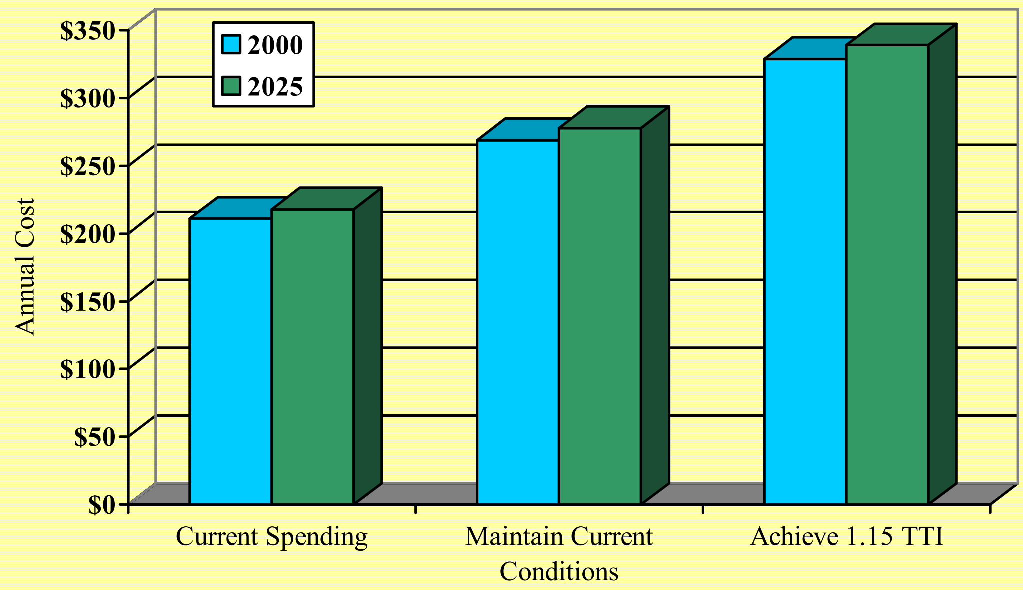
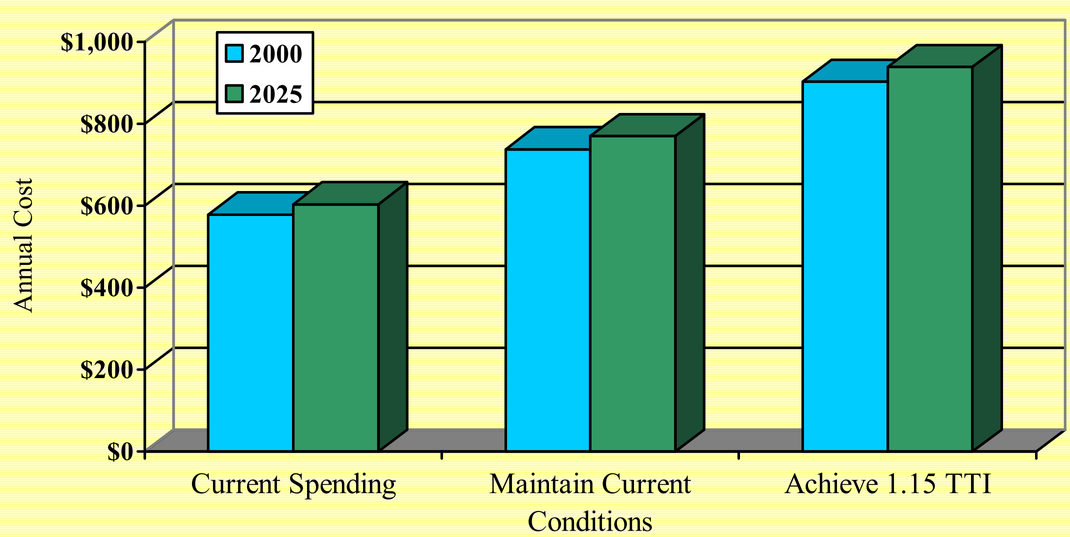


Exhibit 39: Average Annual Cost per Texas Household to Achieve Mobility Goals



The benefits from these increased expenditures are significant no matter how they are compared. Using a very conservative set of benefits – only travel time savings and fuel consumption reductions – the benefits of the "Maintain Current Conditions" scenario grow to $172 more per person than the costs by 2025. Improving conditions so that no traveler or freight shipment suffers a trip time penalty of more than 15 percent will provide benefits of $764 per person more than current trends. For all state residents this would equal a benefit/cost ratio of 6 to 1 from just the two categories of benefits. If the $333 billion to $477 billion in productivity benefits to society (from Exhibit 31) were included, the benefit/cost ratios would be much larger.

Exhibit 40: Comparison to Current Trends

Year	Estimated Additional Cost per Capita		Estimated Benefits per Capita Due to Improved Conditions	
	to Maintain Current Travel Time Index	to Meet a 1.15 Travel Time Index Goal	to Maintain Current Travel Time Index	to Meet a 1.15 Travel Time Index Goal
2000	$58	$118	$0	$217
2005	$59	$119	$94	$311
2010	$59	$119	$126	$415
2015	$59	$120	$160	$528
2020	$60	$121	$194	$642
2025	$60	$121	$232	$764

Urban Area Analysis

Mobility improvements are within reach of Texas' urban areas, and with the projected congestion levels seen in this report, it is important that the improvements be pursued. Current congestion levels cause over 315 million person-hours of delay and 516 million gallons of excess fuel to be consumed (Exhibit 41). These represent a total cost of almost $6 billion in 2000. And that cost will continue to rise if the State continues its present funding course. Increases in the direct costs of congestion each year for the next 25 years will average:

- 388 million hours of delay per year
- 634 million gallons of fuel wasted per year
- $7.3 billion of additional operating costs each year

not to mention the economic and social potential of the society that would never be realized.

Exhibit 41: Congestion Costs by Metropolitan Area in 2000			
Urban Area	Annual Person-Hours of Delay (millions)	Annual Gallons of Fuel Wasted (millions)	Annual Cost Due to Congestion (millions)
Austin	21	35	$400
Dallas-Ft. Worth	141	228	$2,640
Houston	121	199	$2,285
San Antonio	26	42	$475
The Border	7	12	$130
TOTAL	316	516	$5,930

Exhibit 42 illustrates the regional cost for various mobility goals. Current trends indicate the State will spend an average of $5.6 billion over the 25 years on new capacity, maintenance and reconstruction of roadways. If that amount were increased by 28 percent to $7.1 billion, congestion would get no worse than it is today. Improving conditions to a travel time penalty of no more than 15 percent would require an additional $1.6 billion (a 56 percent increase over expected expenditures).

Exhibit 42: Roadway Spending Amounts for Mobility Levels				
	Average Annual Capacity and Maintenance Cost to: (all costs in billions of constant $)			
Urban Area	Maintain Existing Travel Time Index	Achieve 1.25 Travel Time Index Goal	Achieve 1.20 Travel Time Index Goal	Achieve 1.15 Travel Time Index Goal
Austin	0.273	0.291	0.339	0.390
Dallas[1]	0.871	1.096	1.249	1.413
Ft. Worth[1]	0.405	0.495	0.555	0.619
Houston	0.948	1.265	1.398	1.538
San Antonio	0.381	0.398	0.442	0.507
The Border[2]	0.416	0.416	0.416	0.416
Balance of State[2]	3.851	3.851	3.851	3.851
State Total	7.144	7.812	8.251	8.734

[1]These areas are separate Districts of the Texas DOT and have their own budgets.
[2]Investment in the Border Area and Balance of State remains constant over the 25-year period under each scenario because their current Travel Time Index levels are below the 1.15 level. To do otherwise would imply that congestion levels would be allowed to degrade to the alternative Travel Time Index goals.

Benefits and Other Impacts

For the spending increases, the State's major urban areas will see significant benefits compared to the current trend of declining operating quality. The return in time and fuel savings as a result of reducing congestion levels is, in almost all cases, significant (Exhibit 43).

Exhibit 43: Cost and Benefits Per Peak Period Traveler by Metropolitan Area for 1.15 Travel Time Index Scenario				
	Cost of Improvement	Cost Savings from Improvement	Economic Return from Improvement	Net Benefit
Austin	$714	$737	$86	$109
Dallas-Ft. Worth	$711	$1,100	$85	$474
Houston	$617	$1,217	$74	$674
San Antonio	$476	$351	$57	($68)

In the case of San Antonio, the net benefit under these calculations is a negative $68 per year. The reason this is the case is that, in 2000, the year for which the latest Travel Time Index data is available, the San Antonio Travel Time Index was 1.23 and, as such, the cost savings from delay was not sufficient to offset the cost. However, it is certain that congestion has increased since 2000 (and will certainly go higher still if no action is taken). As such, the cost saving is now very likely more than enough to cover the costs of the improvements or will certainly reach that threshold in the very near future.

Air Quality Issues

More than 500 million gallons of fuel are wasted due to congestion on Texas highways every year. This produces on the order of 36,000 tons of hydrocarbon pollutants. Fuel savings from improved roadway operations in the future can be up to 400 million gallons of fuel annually with consequent benefits in pollution generation. No other form of public investment that is both economically and socially feasible can do as much to reduce air pollution.

Other benefits from adequate funding that are not explored fully in this report include:

- Greater safety from timely investment in road surfaces, bridges and appurtenances.
- Improved air quality due to reduced fuel consumption by stop-and-go traffic.
- Greater ability to predict travel time and a reduced delay effect from collisions and vehicle breakdowns.
- Substantial job creation, on the order of 38,000 jobs per billion dollars of capital road spending. This amounts to an additional 120,000 jobs for the 1.15 Travel Time Index Goal.
- Rapid response to maintenance problems would reduce overall construction and maintenance costs by keeping small problems from getting worse.
- Improved ride on the system from smoother pavements, fewer ruts and potholes.

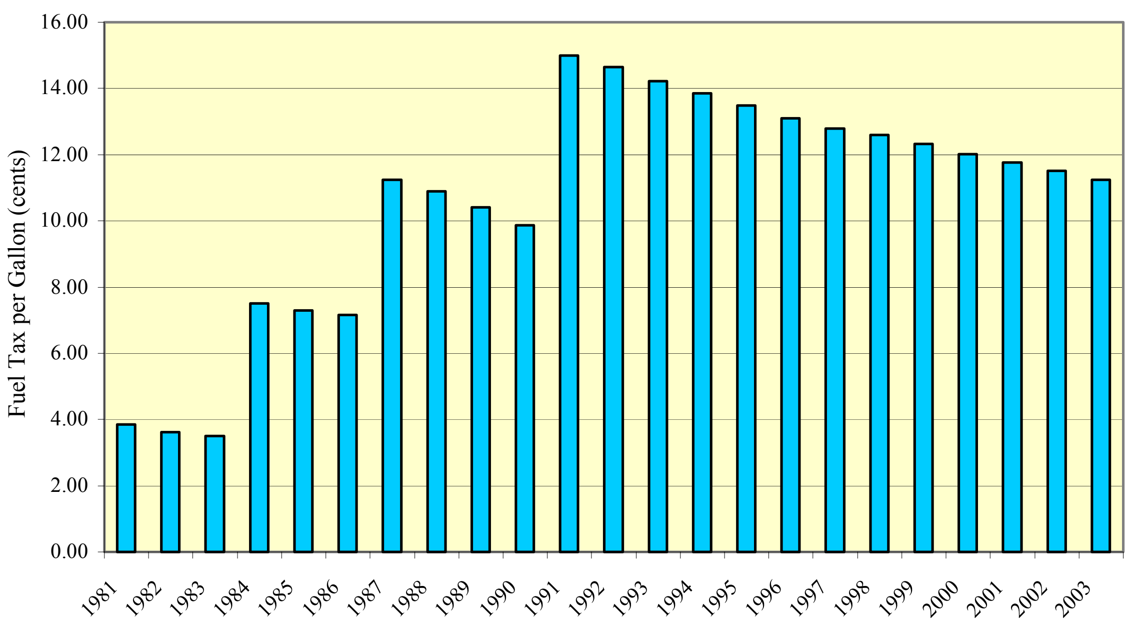
Revenues

While not the focus of this report, the revenue side of the roadway improvement question must receive adequate attention if the mobility issues are to be addressed.

There are three major sources of revenue that fund highway construction and maintenance in Texas – fuel taxes, vehicle registration fees, and federal transfers (federal transfers are primarily refunds to the State of federal fuel taxes collected in the State). All three major revenue streams have one significant trait in common – they are all unit-based taxes. Vehicle registration fees are applied to a vehicle (a unit) with variation in the assessed fee contingent on the weight of the vehicles. The fuel tax is applied on a gallon of fuel (a unit) without regard to price. In contrast, the sales tax – a major source of revenue for the State's general fund – is a tax applied to the price of goods and services. As the price of goods and services rise, presumably reflecting a rise in the cost of items that need to be purchased by the State, tax revenue also rises.

Over the last 20 or more years, the rate has been raised three times – from 5 cents to 10 cents per gallon in 1984, to 15 cents in 1987, and to its current rate of 20 cents in 1991. The effects of inflation, however, have eroded the "real" tax rate down to 14.9 cents per gallon, essentially what it was when it was raised to 15 cents per gallon in 1987. Said another way, as a result of inflation, the State has lost 15 years of purchasing power in terms of its ability to fund roadway improvements from the gasoline tax. The following table shows the real value of that portion of the gasoline tax that is dedicated to highway use. (Currently, the Texas Constitution dedicates ¾ of motor fuel tax revenues for highways and ¼ to public education.)

Exhibit 44: Highway Portion of "Real" State Gasoline Tax Rates: 1981 to Present



In order to achieve any of the congestion scenarios outlined in this report, it will be necessary to raise additional revenue. Texans have already taken steps toward that end with the passage of a constitutional amendment in 2001 that created the Texas Mobility Fund allowing the issuance of bonds to fund highway improvements. But that is only a start. If we want to achieve mobility goals, new funds will be needed. It is likely that not only will existing tax and fees need to be raised, but new sources of revenues will have to be found as well.

Given the extent of the mobility problems and the magnitude and scope of the solutions that must be found, the State should set a course that, within one year provides a comprehensive roadway funding and mobility solution set that meets the needs of the State for the next 25 years.

Summary

Clearly, the cost of building and maintaining a roadway network sufficient to support the world's 10th largest economy requires a significant investment. Costs for the scenarios outlined in this report are estimated to be from $38 billion to $178 billion more than is currently projected to be spent over the next 25 years. Further, these costs reflect only those borne by the State, and do not include additional expansion by county, municipal, and special purpose entities or costs associated with public transportation programs. But while the costs are large, so are the returns for improving mobility. In many instances, the savings resulting from reduced congestion costs alone covers the costs associated with the improvements. In addition, there are significant added benefits resulting from improved economic efficiencies, air quality and safety.

IV. Consideration of Policy Options

<u>Alternatives to Capacity Enhancement</u>

While roadway additions and operational improvements are the primary improvements analyzed in this report, there are other sets of improvement strategies that can have a positive effect in some travel markets. This section summarizes two general approaches that do not involve roadway widening.

Transferring demand to walking, bicycling and transit and providing different land use patterns are strategies that differ from traditional congestion relief projects and are, therefore, somewhat difficult to analyze. These projects seek to create more close destinations so that walk, bike and transit trips have travel times close to those of private vehicles.

Altering the Urban Form

This strategy would seek to improve coordination between transport and land use and to limit urban sprawl. There are two related approaches:

The Compact City. "Smart growth" policies seek to increase population densities and make urban areas more compact, which it is presumed would move travel demand from the roadway system to transit. The goal is to make walk, bike and transit trips more competitive because there are more nearby destinations. While it is true that Western European and Japanese urban areas have much higher densities than in the US and that they also have much higher transit market shares, they also have more intense traffic congestion and slower roadway travel speeds. The highest density US urban areas have far lower public transit market shares than Canadian, Western European and Japanese urban areas with similar densities. Finally, there is no recent precedent for significantly increasing either urban densities or transit market shares. Even in Western Europe and Japan, urban densities and transit market shares have been dropping for decades. (See working paper #1.)

Improving the geographical balance of jobs and residences (walkability). Making jobs closer to homes, it is presumed, would also reduce auto traffic volume by making bicycling, walking and transit more attractive. At the most localized level, the concept is that jobs and housing should be close enough for "walkability." Areas such as Manhattan, San Francisco, Paris and the core areas of other international urban areas are often cited as walkable because of the proximity of jobs and housing. However, the walkability of these locations results from a jobs-housing imbalance – the *excess* of jobs over resident workers. In fact, at the sub-regional level outside the central business districts, there is a stronger balance of jobs and housing in US urban areas than at the local level. This balance exists because of the geographical mobility that the automobile provides. Historical trends show that at the county level job-worker balance is increasing; with center city job-worker ratios declining and suburban ratios increasing. In fact it is this increasing balance of jobs and workers that has diminished the effectiveness of transit.

Urban planning will have difficulty changing demand by coordinating employment and housing locations, because people make their employment decisions independent of such planning. The average US commuter in an urban area has a choice of virtually hundreds of thousands of jobs that are closer than the job that has actually been taken.

Transportation Choice

This strategy attempts to expand transit service to provide travel choices to more urban residents (transportation choice). One method to achieve transportation choice is to build or expand urban rail systems, but this has not been achieved in built-up urban areas in the last 50 years. Outside of the three largest urban areas in Japan, there is virtually no major high-income urban area (Western Europe, North America, Australia and New Zealand) in which transit provides automobile competitive service except within the core or to the core from suburban locations. There is little, if any, automobile competitive transit service between suburban locations in Paris, London, Toronto or New York, much less Portland, Phoenix, Houston or Dallas. The cost to develop a transit system that could provide a competitive alternative to the automobile would be far beyond the capacity of any urban area to afford. (The Japanese systems [Tokyo-Yokohama, Osaka-Kobe-Kyoto and Nagoya] that are able to provide automobile competitive service throughout much of their metropolitan areas were built *with* the city, not after it had been developed.) (See working paper #2.)

Strategies such as a more compact city, walkability and transit choice can have micro-level benefits – at the individual level or even at a small neighborhood level. However, these strategies have virtually no potential to reduce area-wide roadway travel demand.

<u>Accommodating Increased Traffic Demand</u>

The metropolitan planning organizations in all of the four largest Texas metropolitan areas and large urban areas along the Texas-Mexico border anticipate that most of the future increase in metropolitan travel demand will be for personal vehicles. As a result, moving the higher levels of traffic requires strategies that minimize traffic delay – that focus on accommodating traffic demand – as components of future plans. This could include a variety of road-based strategies, such as:

- New roadways
- Expanded roadways
- Improved traffic management
- Improved traffic signal coordination
- Improved incident management (Data in the Texas Transportation Institute *2002 Urban Mobility Report* indicates that approximately 54 percent of delay in the four largest Texas urban areas is incident related.)

- Improved driver information (navigation and internet applications)
- Other technological advances (intelligent transportation systems)
- Encouragement of telecommuting
- Development of expanded high-occupancy vehicle lanes and high-occupancy toll lanes.

Improved Operations

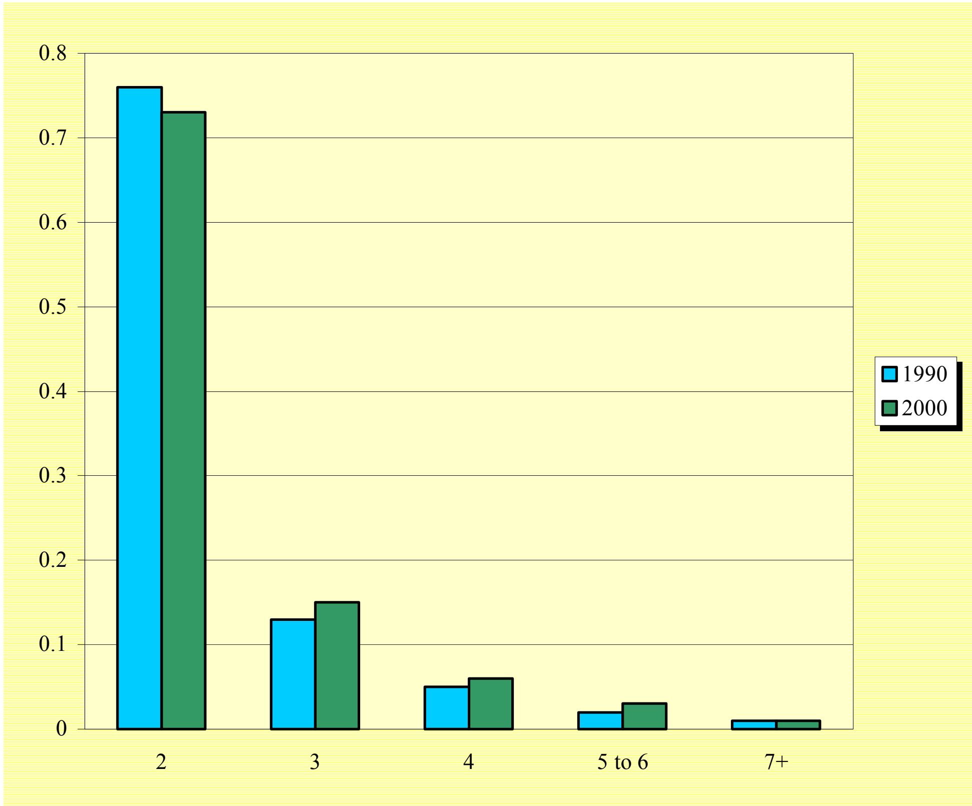
Texas must lead the nation in the effective operation of its road system. New capacity construction should be premised on having achieved the greatest throughput on existing facilities. New information-technology-based operations capabilities should be implemented wherever they can contribute cost-effective enhancements including greater user information, more rapid response to accident scenes, more effective operation of work-zones, and other similar strategies.

In some situations, future transportation systems will also rely on pedestrian treatments. Attention should be given to improving the pedestrian interface with automobiles, especially to improve safety.

Carpooling Opportunities

As discussed earlier in this review, carpooling is perhaps Texas' greatest strength in work travel. Carpooling is at exceptional levels at 14.5 percent, contrasted to the national average of 12.2 percent and to almost all other states. This is all the more significant given that Texas has such a low percentage of households without vehicles. In fact, Texas had the greatest increase among states in carpooling from 1990 to 2000 (almost 200,000 commuters) at a time when about half of the states were losing carpool riders. An even more significant factor is that Texas saw gains in share in the largest carpool groups – those greater than just two people, which are typically "fam-pools" of workers from the same household. The following chart shows that Texas gained in all larger pools except the very largest, those with more than seven people (Exhibit 45).

Exhibit 45: Carpool Share by Persons in Carpool



The table below demonstrates that this focus on carpooling is statewide in character.

Exhibit 46: Carpool Share by Persons in Carpool	
Area	Major Metropolitan Carpool Shares in 2000
Dallas-Ft. Worth	14.0%
Houston	14.2%
San Antonio	14.7%
Austin-San Marcos	13.7%
All Other Metropolitan Area	14.9%
Non-Metropolitan	15.6%
TEXAS	14.5%

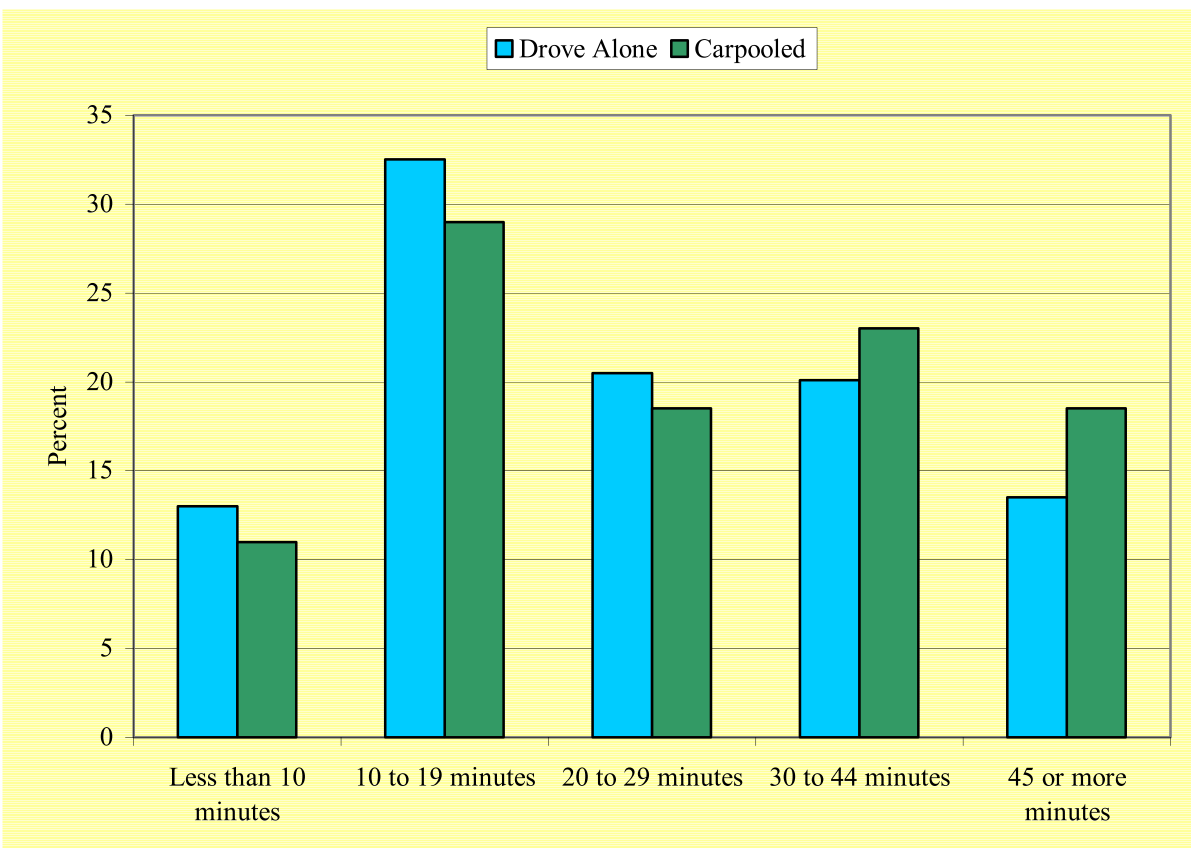
Much of the Texas advantage in carpooling is attributable to very high usage of carpools among the Hispanic population (Exhibit 47). This is also observed in the high levels of carpooling in adjacent states with substantial Hispanic populations such as Nevada, Arizona and New Mexico.

Exhibit 47: Carpool Share by Race/Ethnicity	
	Carpool Share in 2000
Anglo	10.3%
African-American	15.6%
Hispanic	23.3%
Nationwide Share	12.2%

The emphasis on carpooling should be seen as an important opportunity to be capitalized on. It should be built upon as part of a comprehensive statewide strategy. In many instances, the use of carpools and transit are substitutes. In Texas, often the combination of carpool plus public transportation shares exceeds that of many other states.

More carpool lanes, special treatment of toll lanes, or high-occupancy toll lanes, should be considered. For example, according to past experience carpool commuters tend to travel longer distances to work. Picking up riders for the carpool also adds about a five-minute penalty for each person added in a work trip. In Texas carpool work trips average 28.2 minutes contrasted to about 22.5 minutes for single occupant vehicles. This is shown strongly in the figure below in which carpools are heavily distributed in the 30 minute and above travel time groups. Special carpool lanes and special parking areas are ways to help get back some of that time to reward the carpooling activity. They also work well for longer trips that, as seen below, are more likely to be carpool trips.

Exhibit 48: Carpool vs. Single Occupant Travel Times



Working at Home

Working at home opportunities are significant in Texas. It is the only area to show significant growth in the last decade in addition to auto-based work travel. More people work at home (and walk to work) than use transit. Opportunities to support the expansion of working at home, working with the private sector and governments, should be evaluated as part of an overall strategy of response to delay. This may be as simple as reducing existing regulatory impediments to working at home options.

In many cases, while workers cannot work at home full time, the opportunity to work at home on an occasional basis, perhaps a few times a month can make for significant reductions in peak hour travel demand with effectively zero public costs and enhanced productivity.

Toll Roads as an Alternative to Traditional Finance

For decades, the gasoline tax, both at the federal and state level succeeded in providing the funding for the required roadway capacity. But as metropolitan areas have become larger, it has become much more expensive to build the additional roadway capacity required to meet rising travel demand. This problem is exacerbated by the fact that Texas metropolitan areas are among the fastest growing in the nation. The expensive requirements for more capacity are not likely to be met by a federal gasoline tax program that is designed to address the much more modest needs of slower growing areas around the nation.

A very high proportion of traffic congestion and population growth in Texas is in the largest metropolitan areas. Moreover, the costs of construction and maintenance are higher in the major metropolitan areas and it may not be possible for the fast growing, more congested and higher cost areas to receive statewide funding that is consistent with their needs. As a result, despite the effectiveness of the gas tax program in the past, the intensifying mobility needs of the State's major metropolitan areas are unlikely to be effectively met by gasoline tax increases. There is an equity consideration as well. Toll roads permit the specific charging for a road as it is used. Thus, those who do not use the road are not charged in their fuel taxes for that facility unless they specifically choose to use it.

Provision of roadways through more commercial mechanisms, such as special purpose toll authorities or private companies makes it possible to create more roadway funding options. County Toll Road Authorities or Regional Mobility Authorities can construct and operate toll roads that produce revenue for maintenance, as well as construction and operation. Private toll road operators can provide another funding source. Another advantage to private infrastructure development is that investors, rather than Texas' taxpayers, take the commercial risk.

As a result, it seems likely that toll financing will continue to be an important component of any program to address the mobility problems in the major metropolitan areas of

Texas. And there are expanding opportunities for development. Major international companies are now involved in building and operating new toll roads in a number of nations. For example, one private consortium has proposed building a toll road in the middle of the Washington Capitol Beltway. The French intercity systems have been so successful that they are in the process of being sold by government agencies to the private sector. The United Kingdom is considering programs to expand its motorway system using private toll builders and operators.

Toll financing could be used for a wide variety of projects that could improve the flow of traffic in Texas metropolitan areas, such as:

- Expanding the high occupancy vehicle lanes into high-occupancy toll lanes that provide high-speed and reliable service to buses, carpools and users who are willing to pay for premium service.

- Roadway expansions above or below (tunnels) current freeways. Various European urban areas have or will expand their roadway systems through the use of tollway tunnels.

- New roadways, both in urban cores and expanding peripheries.

V. Establishing an Ongoing Evaluation System

This section establishes transportation objectives for Texas metropolitan areas and lays down a proposed continuing process for ongoing annual consideration of metropolitan transportation needs based on system performance reporting.

Establishing Objectives

The purpose of the Governor's Business Council Plan, as stated at the outset, is to:

> *Establish a process whereby vision and needs drive the process of transportation improvement, rather than currently or traditionally available resources.*
> This is to start a *"how can we fulfill our vision"* process instead of a *"what does the status quo allow"* process.

It is recognized that:

> *The most serious transportation threat to the state and its metropolitan areas is the continuing delay in passenger and freight travel activity brought about by congested road facilities. This challenge threatens to increase to dramatic levels in the future unless timely substantial responses are undertaken.*

Urban Roadways: Performance and Management

Given that the primary goal is to minimize travel delay, the urban transportation planning process will need to give priority to the most cost effective improvements. It will be important to establish a focused performance and management system to accomplish this objective.

Measuring Roadway Performance

A number of performance indicators can be used to measure travel delay and traffic congestion in Texas metropolitan areas. The important concern is not which measure or measures are used, but rather that the set of measures focus improvement activities on the roadway performance goals. The following list includes several measures that might be used. In most applications, it is appropriate to focus principally on peak period travel, because the volumes during the morning and evening "rush hours" are sufficiently higher than average to tax the capacity of the roadway system much more than during off-peak periods.

- Travel Time Index: The Travel Time Index was developed by the Texas Transportation Institute, which produces an annual *Urban Mobility Report* analyzing traffic congestion in urban areas throughout the nation. The Travel Time Index estimates the amount of time it takes to travel during peak travel periods (morning and evening "rush" hours) compared to non-congested periods. A Travel Time Index of 1.30 means that it takes 30 percent more time to travel during peak hours compared to non-congested periods -- a 20 minute trip during an uncongested period would take 26 minutes during the peak travel period.

- Travel speed: The new automated regional highway monitoring systems, such as TranStar in Houston and Transguide in San Antonio, are capable of reporting speed data for roadway segments and are already providing much improved roadway performance monitoring information to administering agencies.

- Mobility and employment access: Research has been conducted to estimate the extent of access between locations in an urban area, especially for the work trip. Access can be stated in terms such as "50 percent of the jobs in the urban area are accessible to the average resident within a period of 20 minutes." Access can also be measured by mode, such as automobile, transit or walking. Access indicators have been used only to a limited degree in transportation planning.

- Commercial operating costs: Slower urban travel times directly translate into higher commercial operating costs for long distance trucks and local delivery vehicles.

- Buffer Index: The Buffer Index is a Texas Transportation Institute measure of system reliability. It provides an estimate of the additional travel time (compared to the average) necessary to complete a trip 19 out of 20 times (95^{th} percentile).

- Misery Index: The Misery Index is a Texas Transportation Institute measure of the speed of the slowest 20 percent of traffic compared to the average speed of all traffic. While the Misery Index may be an effective measure of travel reliability, it is not easy to communicate and was not used in the *2002 Urban Mobility Report*.

- Travel delay time: The Texas Transportation Institute also produces estimates of peak period travel time delay as a part of its annual *Urban Mobility Report*. In addition, new project evaluation reports often quantify changes in total delay hours that are anticipated from implementation. Delay can also be expressed in per capita terms to indicate the individual effects of congestion.

- Journey to work travel time: The decennial US Census collects journey to work travel times that are available at the detailed metropolitan area levels, though historically this data has been updated only every 10 years. There are plans to shift the journey to work data system from the decennial census to the annual American Community Survey over the next decade, which will provide more frequent information updates on mode choice, travel times and work trip origins and destinations.

- Level of Service Indicators: Departments of Transportation have long used "level of service" (LOS) indicators to measure the flow of traffic on roadways. The indicators have a range of from A to F, with "F" indicating a breakdown in the flow of traffic.

All of these indicators make a contribution to better understanding of the transportation congestion issue. But among these indicators, it would appear that the Travel Time Index would be the best single overall indicator of metropolitan roadway system performance. This readily understandable indicator provides an effective index of travel delay, the minimization of which must be the principal objective of any future urban mobility program in the state's largest urban areas. It can be estimated from a variety of data sources and modeling efforts, and can be communicated to a variety of audiences relatively easily. The Travel Time Index has become the principal measure used in the annual *Urban Mobility Report* and is simple in concept so that it can be readily understood by the press, the public and elected officials.

<u>An Urban Roadway Supply Management System</u>

It is proposed that the state adopt a set of urban mobility objectives together with local agencies and supportive planning processes. This would be accomplished through the Urban Roadway Supply Management System (URSMS), which would involve:

- A set of urban roadway system objectives and reporting systems for the largest metropolitan areas in the state developed as a consensus of agencies at all government levels. These would be identified for individual project analyses as well as system evaluations.

- Commitment of all state funding that is available for new construction, system expansion and system management in a planning process intended to achieve the urban roadway system objectives.

Both the objectives and reporting requirements would apply to freeways, tollways and primary arterial roadways administered by both TxDOT and local agencies. Locally administered roadways would be included because of their importance in achieving the traffic flows necessary to support the longer term economic growth in the urban areas of the state. Developing a consensus plan would provide a method to coordinate investments so that the greatest benefits are achieved and the economic efficiency of public sector spending is maximized.

<u>Performance Indicators and Objectives</u>

Four performance indicators would be adopted:

- Urban Mobility Objectives

- Delay Reduction Index

- Travel Speed Objectives
- Financial Performance

Urban Mobility Objectives

The Travel Time Index appears to be the most effective and readily understood overall measure of mobility for urban areas. It is proposed that the state, in cooperation with local agencies establish Urban Mobility Objectives (UMO), using the Travel Time Index, for each of the largest urban areas and a target date by which the UMO is to be achieved. This report uses several example Travel Time Index objectives for the major Texas metropolitan areas to estimate funding and project needs.

Delay Reduction Index

In support of the Urban Mobility Objectives, it is proposed that projects be evaluated based upon the cost effectiveness of their contribution to the objective. As a result, a measure of the reduction in delay hours is proposed for evaluating projects for funding. Local roadway administrating agencies would be encouraged to adopt similar planning criteria. TxDOT project evaluations currently use cost data and overall travel delay reduction, giving credit for local contributions and user fee payments. By focusing on TxDOT costs per delay hour, it is possible for projects to score higher on cost effectiveness through the use of toll revenues or local government contributions in some funding categories. (It would be important to establish mechanisms to ensure that funding developed from local sources would not lower the allocations of TxDOT funding). The goal would be to maximize the provision of the most critical new roadway space within the TxDOT financial constraints. The Delay Reduction Index evaluation process might be incorporated into local project prioritization schemes, or its use expanded where similar methods are already in place. (Examples of project evaluation formats are in Appendix IV.)

Travel Speed Objectives

TxDOT and local roadway planning, administering and operating authorities would identify target conditions for each major roadway segment and for sections of major travel corridors. The targets would incorporate desirable travel conditions, as well as recognized local constraints and development plans. Improvement programs can be developed with an understanding of the community goals for particular sections and with simultaneous consideration of several mode, operating and land use options. The benefits, costs and characteristics can be compared to the community targets in a way that combines performance and finance needs in a relatively easily understood format.

Currently, the transportation measurement indicators in Houston, San Antonio and Austin, as well as some cities and transit agencies, have the capability to produce detailed information to support the Travel Speed Objective for some of their networks. For the near future, however, most of this activity will be based on estimates and models. In addition, summarized Travel Speed Objective data would be included in the annual report to the Legislature and Governor.

Financial Performance Indicator

To support the Urban Mobility Objective, a financial performance indicator would be produced -- the cost per reduced Travel Time Index point. This indicator would be calculated and reported in both the long-term planning process and the annual report to the Legislature and the Governor.

Access Indicators

It would also be appropriate to identify "access" indicators to evaluate the performance of the urban transportation system and its relationship to land use development patterns. Because of their relatively infrequent use, specific standards are not recommended, but it would be appropriate to begin examining the development of such standards. This could build on research efforts and practices in Texas, other states and other countries.

- Work trip access indicators could be calculated from existing transportation planning models, both for highway and transit modes. It could, for example, be determined what percentage of jobs in a metropolitan area are within a 30-minute commute for 90 percent of workers using auto or transit modes.

- Other access indicators could be developed, such as the percentage of people within 30 minutes of major medical facilities, within 30 minutes of major airports, etc.

Based upon this research, specific access standards could be proposed and integrated into the URSMS.

The Long-Term Planning Process

TxDOT, in consultation with metropolitan planning organizations and local transportation agencies, would develop a long-term plan for each included metropolitan area, to cover a 25-year horizon. This plan would be coordinated with other long-term regional land use and transportation plans. The purpose of the long-term plan would be to develop a program of proposed projects and strategies to meet the Urban Mobility Objective. The proposed projects would be evaluated using the Delay Reduction Index and other key performance measures. The plan could be updated every three to five years.

As a part of the planning process, proposals would be solicited from developers of private highway infrastructure, in a manner similar to the process being developed for the Governor's Trans Texas Corridor program.

Each long-term plan would include at least the following information:

- Proposed program of projects (state and local), including the Delay Reduction Index.

- Financial plan (sources and uses of funds)

- Projected Urban Mobility Objective values for each of years one through five, and years 10, 15, 20 and 25.

As a part of each long-term plan, detailed analysis and recommendations would be made for project implementation during the next five-year period.

Annual Report

TxDOT would submit an Annual Report on URSMS to the Legislature and Governor detailing the progress toward the Urban Mobility Objective in each of the covered metropolitan areas (see Appendix IV for sample forms). In preparing the report, TxDOT could also draw upon information from local agencies that administer and operate the transportation systems.

As currently envisioned, the Annual Report would include several elements that would be taken from existing long-range plans and other sections that provide more operational or financial details.

- Summary information comparing objectives, results and financial performance between the urban areas.

- Summary demographic and traffic information for each urban area.

- Performance information on the overall Urban Mobility Objective for each urban area.

- Performance information on the Urban Mobility Objective for the TxDOT administered roadways in each urban area.

- Overall performance information on the Urban Mobility Objective for the locally administered roadways in the urban area by jurisdiction.

- Performance information on the Urban Mobility Objective for the each of the local roadway administering agencies in the urban area by jurisdiction.

- Performance information for other modal operations in the urban area.

In addition, the Annual Report would include Roadway Segment Speed Objective information:

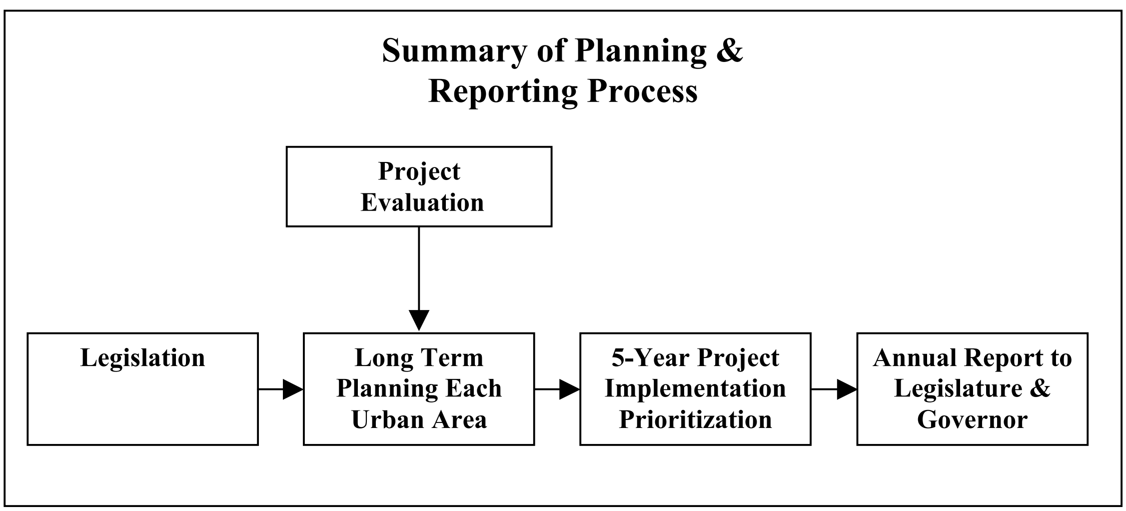
- Overall urban area summary.
- For TxDOT-administered roadways.
- For locally administered roadways, one form for each agency.

<u>Legislation</u>

The URSMS might be implemented by enacting legislation that establishes:

- Urban Mobility Objectives
- Delay Reduction Index
- Financial Performance Indicator
- Planning Process
- Annual Report Requirement

The overall planning and reporting process is depicted below. Alternatively, elements of the existing metropolitan planning organization or other local agencies with a cooperative process that provides a forum for state and local agencies and the private sector to discuss transportation needs and state and local goals could be enacted.



Consistency with Governor's Trans Texas Corridor Plan

The *Governor's Business Council Urban Mobility Plan* (GBC Plan) is consistent with and supplements the Governor's "Trans Texas Corridor Plan." The Trans Texas Corridor Plan seeks to provide new intercity corridors that would bypass the major metropolitan areas. The GBC Plan would seek similar objectives *within* the major metropolitan areas of the state, where daily traffic congestion is threatening to reduce both the quality of life and economic growth. The Trans Texas Corridor Plan and the GBC Plan can be seen as parts of a comprehensive approach to improving transportation throughout the state.

Moreover, the two plans incorporate similar strategies. The Governor's Trans Texas Corridor Plan will seek proposals from private infrastructure firms to build and operate transportation improvements that would be directly paid for by users (drivers, trucking companies and rail operators). The GBC Plan would also include the potential for seeking private infrastructure proposals to improve mobility on roadways within the major urban areas, which would be similarly financed by user fees.

The Governor's Trans Texas Corridor Plan offers a potential model for seeking private proposals to build needed additions to roadway systems in urban areas around the state.

VI. Conclusion

There are four key points that must be recognized with respect to mobility issues faced by Texans and our potential to address those issues:

First, traffic congestion has a significant detrimental effect on economic growth – not just locally, but over entire economy and for all Texans.

Second, during the past 10 years, among those who drive, traffic congestion has cost Texans 2.6 billion hours of delay, 4.5 billion gallons of wasted fuel, and $45.6 billion in increased travel time and fuel.

Third, traffic congestion is getting worse. The number of people, vehicles, and miles traveled has increased significantly faster than the increase in lane-miles of roadway. There is absolutely no reason to believe that, given the present course, the situation will improve.

Fourth, the cost to significantly reduce traffic congestion in Texas' four largest metropolitan areas is less than the cost of doing nothing.

Fifth, the principal strategies for reducing congestion must respond to increased demand by improving the flow of personal and commercial traffic on roadways.

If these four points are accepted as a point of departure, the issue then dissolves into six separate questions:

- *What level of mobility to we wish to achieve?* This report has recommended establishing a goal of a Travel Time Index of 1.15 across all modes.

- *How are we going to achieve it?* There are a number of different strategies that can be employed including demand management, improved operations, toll facilities, and public transportation, but building additional lane-miles of roadway will, by far, provide the largest portion of the solution.

- *What does it cost?* This report provides estimated costs to achieve and maintain four different mobility scenarios.

- *What are the returns?* This report provides estimated returns, both in reduced fuel and delay times, as well as general returns to the economy. In the aggregate, the returns are greater than the costs.

- *How do we finance it?* This report started from the premise of solving the problem rather than doing as much as can be done with the funds that are available. As a result, it does not address revenue issues in detail. It is recommended that a comprehensive solution set, designed to meet the funding requirement of the mobility goal, be adopted within one year.

- *How will we know if we're doing the right thing?* This report proposes a series of monitoring, reporting and management steps that should be adopted to insure the mobility goals are met.

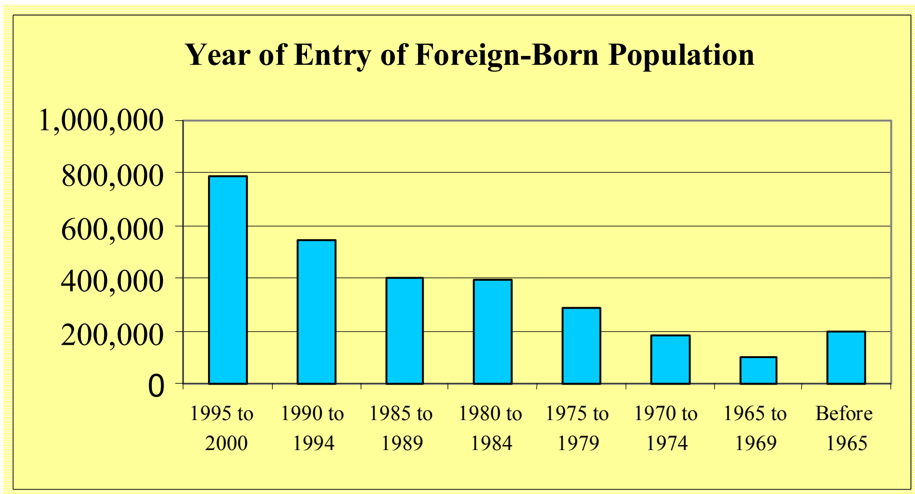
The challenge before the State is to achieve and then maintain a satisfactory level of mobility for its citizens and their shared future. The cost of meeting that challenge is significant – but the cost of failure is greater.

APPENDICES

APPENDIX I

Immigration

Texas now has almost 3 million foreign-born residents out of a population of roughly 21 million, a little less than half of who have arrived in the nineties, accounting for about a third of all of the population change in the period.

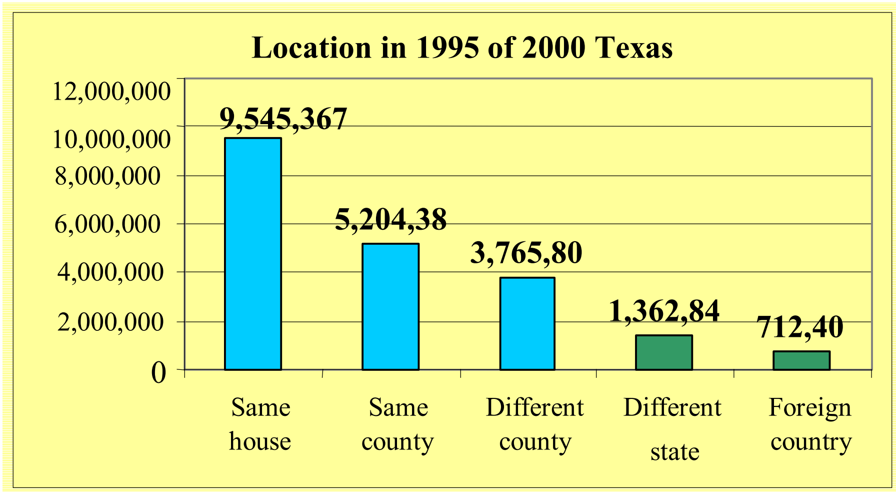


It is this immigrant population that is likely to be responsible, in major part, for defining many of the other of Texas' demographic attributes, including those below:

Characteristics in 2000	Texas	U.S.A.	ratio
% under 18	28.2%	25.7%	1.10
% over 65	9.9%	12.4%	.80
Median Income	$39, 100	$41,350	.95
Average Household size	2.74	2.59	1.06
% Home Ownership	63.8%	66.2%	.96
% households with no vehicle	6.3%	9.3%	.68

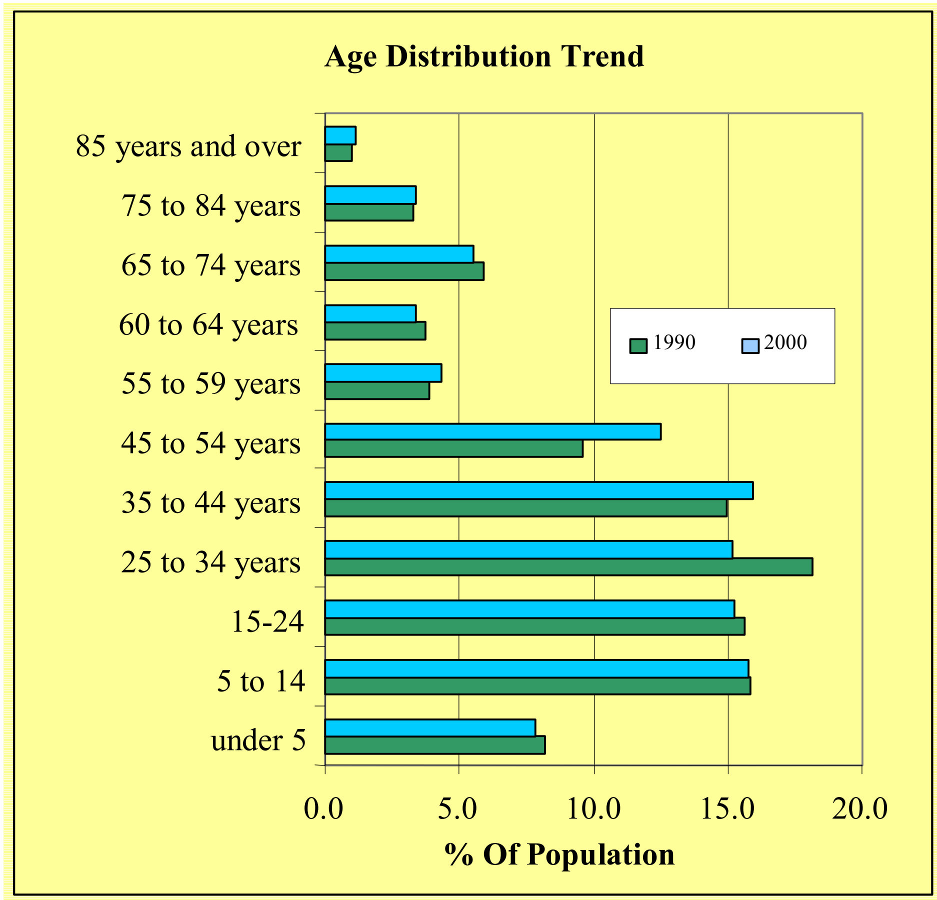
These attributes are all of a set of characteristics associated with a somewhat less affluent group of households that are larger with more young members. One transportation attribute that stands out in contrast to this pattern is that there is a far lower share of households in Texas without a vehicle than in the nation on average. In fact the share of Texas' households without vehicles in 1990 was about two-thirds of the nation's 2000 average. The income effect seems to assert itself in that Texans have fewer households with three or more vehicles than the national average despite its larger family sizes, as shown in the trend chart from the census later in this text.

The arrival of outsiders needs to be seen in context; the following chart describing the location of persons five and older in 1995 helps considerably in confirming that a high level of stability is the typical situation. In 2000 about half of Texans were living in the same house as in 1995, another quarter had moved but were still living in the same county and about a 15 percent share were from other counties within the state. Only about 10 percent of residents in 2000 were from other states or from outside the country.



An Aging Population

Changes in the age distribution of the population of Texas are exhibited in the figure below for the period between 1990 and 2000: It has the classical characteristic of our age; the younger age workers shifting into the older worker age groups. Note the sharp drop in younger workers and the rise in the share of population in the 45 to 54 year age groups. These will be the people hitting retirement after 2010. Also observable is the decline in the younger over-65 population as the depression generation moves into older age.



Texas' aging problem is significant but not as acute as most others, largely due to the balancing of the younger immigrant age groups. Fourth among states in aged population, Texas had the greatest increase in percentage terms, 20.7 percent, between 1990 and 2000, adding about 350,000 over-65 residents. The percentage of the Texas population over 65 is almost exactly 10 percent, which is relatively minor given that the US is over 12 percent on average and Florida, for example, is over 18 percent. There will be many states over 20 percent within a decade or so. These characteristics of the population will have strong bearing on the scale and character of transportation demand in Texas in the coming years.

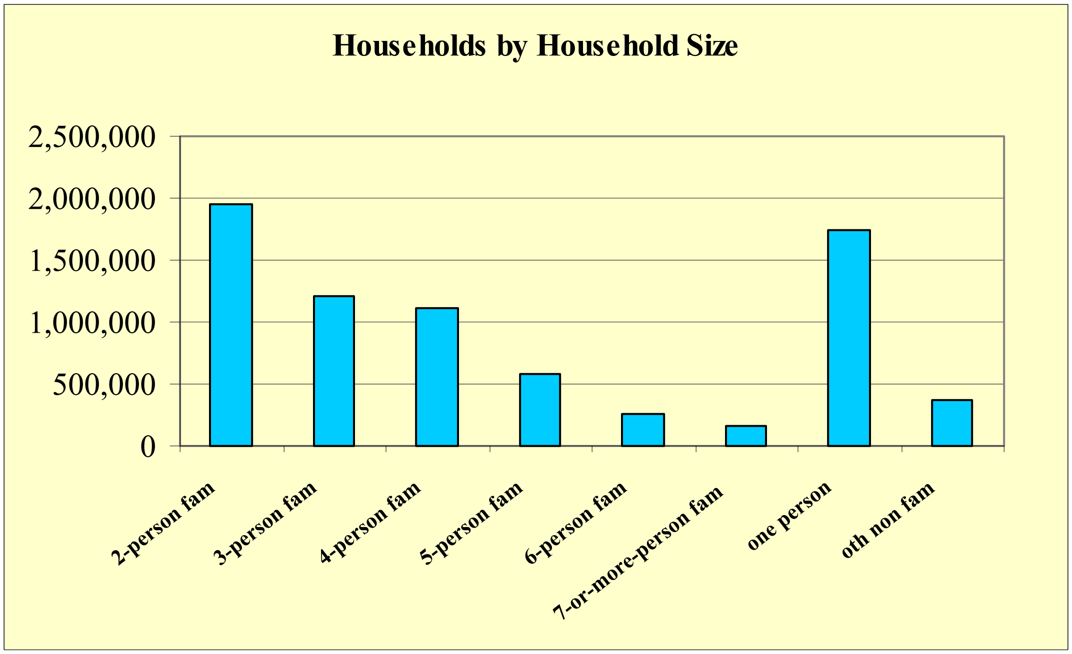
Rank	Area	2000		1990		Change, 1990 to 2000	
		Population 65 years and over		Population 65 years and over			
		Number	Percent	Number	Percent	Number	Percent
(X)	United States	34,991,753	12.4	31,241,831	12.6	3,749,922	12.0
1	California	3,595,658	10.6	3,135,552	10.5	460,106	14.7
2	Florida	2,807,597	17.6	2,369,431	18.3	438,166	18.5
3	New York	2,448,352	12.9	2,363,722	13.1	84,630	3.6
4	Texas	2,072,532	9.9	1,716,576	10.1	355,956	20.7
5	Pennsylvania	1,919,165	15.6	1,829,106	15.4	90,059	4.9
6	Ohio	1,507,757	13.3	1,406,961	13.0	100,796	7.2
7	Illinois	1,500,025	12.1	1,436,545	12.6	63,480	4.4
8	Michigan	1,219,018	12.3	1,108,461	11.9	110,557	10.0
9	New Jersey	1,113,136	13.2	1,032,025	13.4	81,111	7.9
10	North Carolina	969,048	12.0	804,341	12.1	164,707	20.5

A key attribute of the present and future population will be its workers, particularly in terms of transportation needs. The 2000 census surveys showed about 10 million Texans to be in the labor force, roughly 7.2 percent of the nation's labor force, about the same share as its population. Over the 30-year period 2000-2030 an estimate of the state's labor force-age population rises at a substantial, but somewhat slower pace than the general population's increase, rising from 13 million people between the ages of 18 and 64 to almost 19 million. A key attribute of this change is that the prospective commuting population declines as a share of the population from 61.9 percent in 2000 to 60.4 percent in 2030.

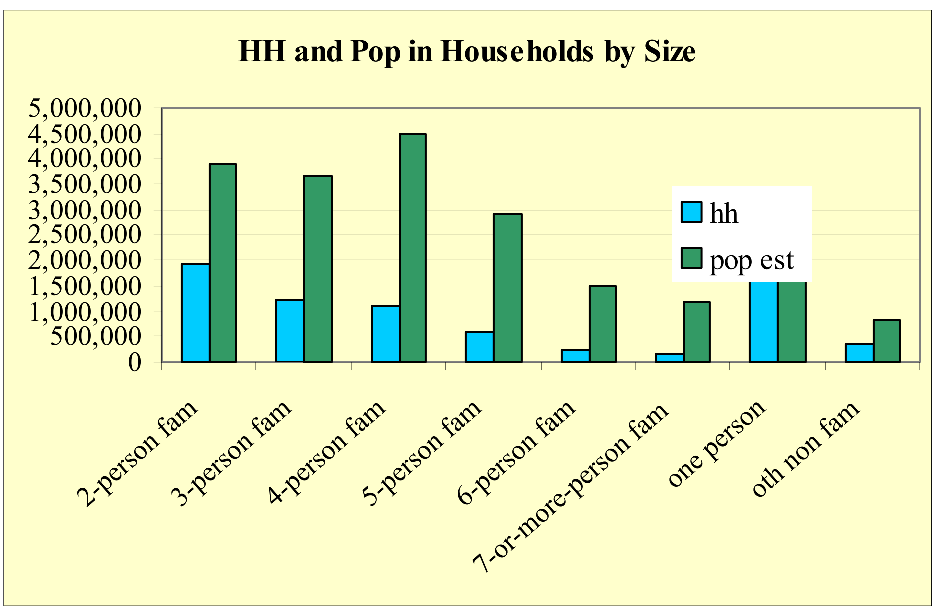
This means that the dependent population, those not yet at or those already beyond the working years, will rise as a share of population, going from 38.1 percent to 39.6 percent of the population. Contrasted to the nation in general these are relatively small changes. Overall the median age of the population rises from 32.3 in 2000 to 38.5 in 2030. The growth of the Hispanic immigrant population significantly slows the aging of the population. Hispanics average 13 years younger than the Anglo population – by 2030 they are at a median of 31.9 years whereas Anglos are at 44.3.

Household Characteristics

Of the approximately 20 million persons in Texas not living in institutions in 2000, about 17.7 million (85 percent) lived in more than 5 million family households. The remainder consisted of almost one million women and 800,000 men living alone with the balance unrelated persons living together. In addition to the typical situation of parents and children within the family household, more than 10 percent of household members consisted of grandparents, grandchildren, brothers and sisters of the householder or unrelated individuals. While all households averaged 2.74 in size; family-based households were far larger, as expected, at 3.35 persons. The distribution of households by size of household is shown below.



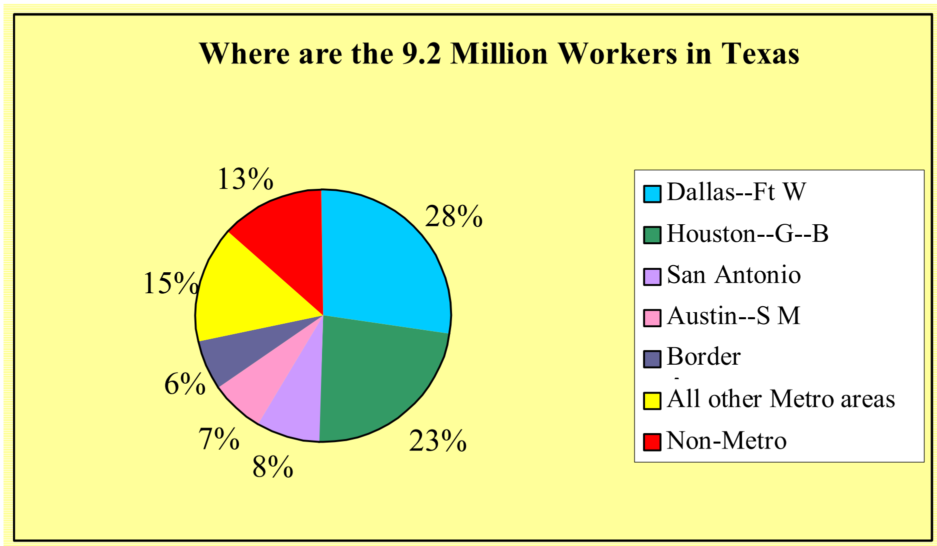
These households represent very different shares of the population as shown in the chart below. Note, for instance that the largest group of persons live in 4-person households and there are more people in 6-or-more-person households than living alone.



The formation of populations into households and the stage in the life cycle of those households has immense bearing on the amount and scope of travel that persons engage in. It is households that give rise to many of the trips people make: shopping and other services; and it is the stage in life that defines many trips to school, recreation and personal business activities. The larger family sizes in Texas would tend to have the effect of reducing overall travel demand contrasted to that same population in more households.

The Work Trip Market

The pie chart below identifies in more detail the location of the workers in Texas. Half of the workers in the state are in Dallas-Ft. Worth and Houston.



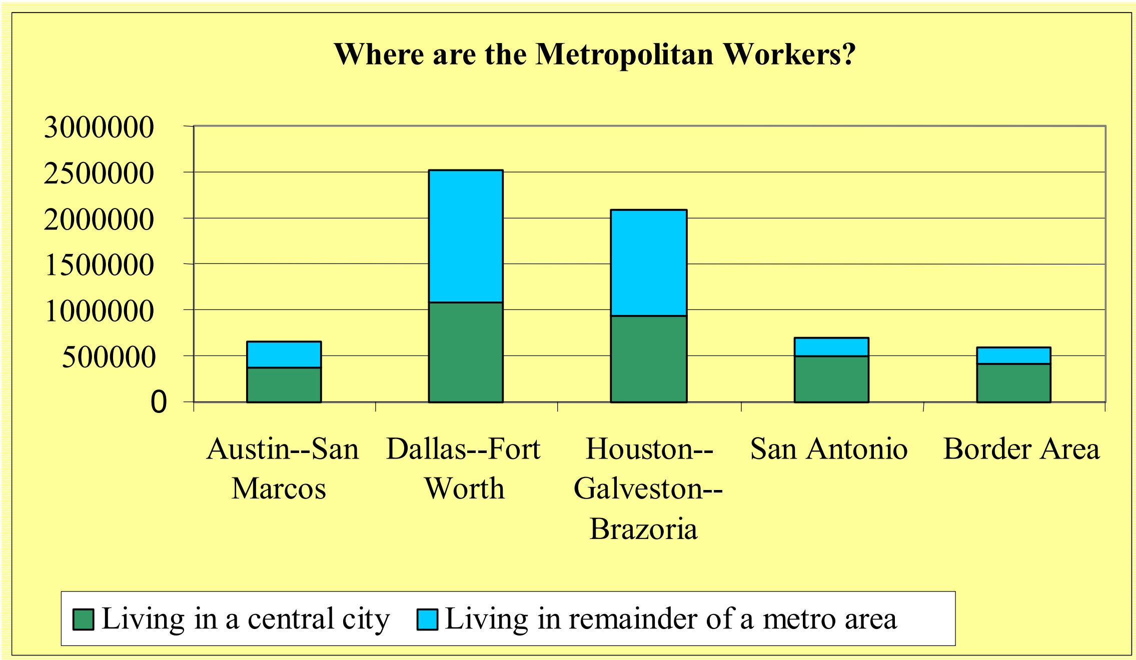
SUMMARY: TEXAS COMMUTING MARKETS BY SIZE

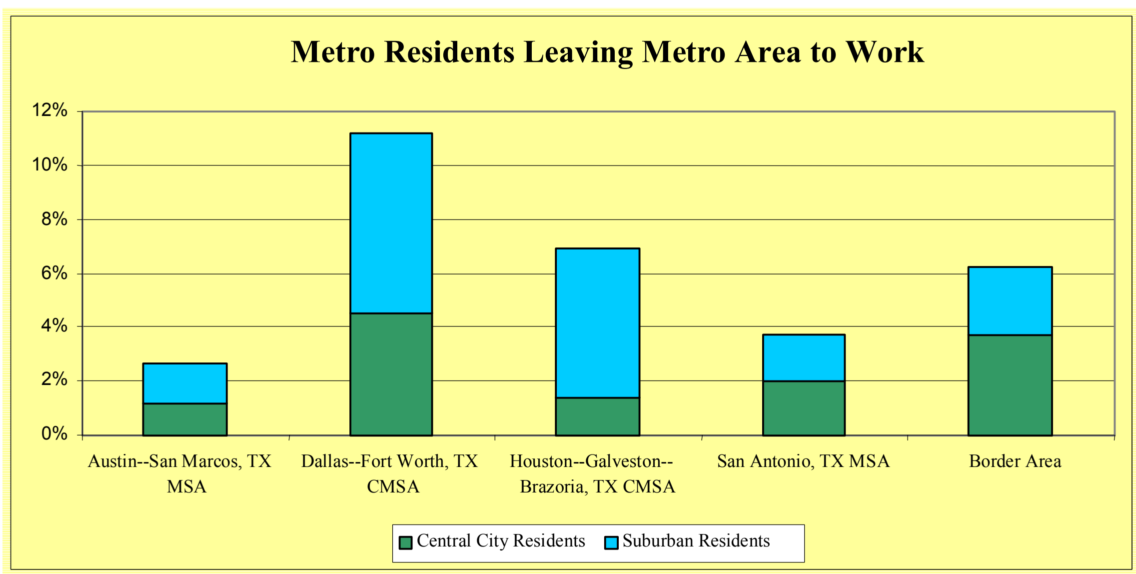
1. Central City to Central City – 3.3 million
2. Suburbs to Suburbs – 1.8 million
3. Suburbs to Central City – 1.6 million
4. Rural to Rural – 1 million
5. Suburbs to other Metropolitan– 300,000
6. Central City to other Metropolitan – 200,000
7. All others; 4 at about 100,000

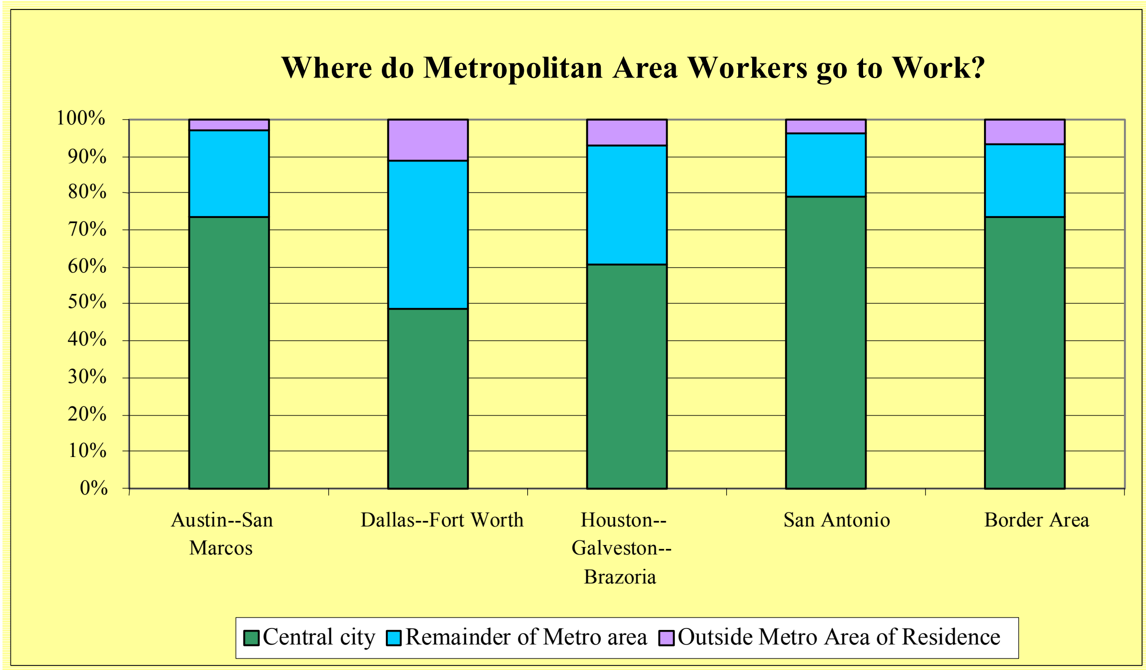
The following three charts describe the work flows of the almost 6.5 million workers in the five major metropolitan areas studied:

- The first shows that, unlike the rest of the country, most workers reside in central cities rather than suburbs in Texas, largely attributable to annexation policies in Texas. (note: A metropolitan area can have more than one central city)
- The second identifies the flow of workers to areas beyond their home metropolitan area. (This could include for example, flows from Dallas to Fort Worth.)
- The third provides a more detailed depiction of the flows within and between the five areas.

These data suggest a greater self-sufficiency among areas than in most states. There seems to be a greater tendency for workers to live and work in their own areas than observed elsewhere.

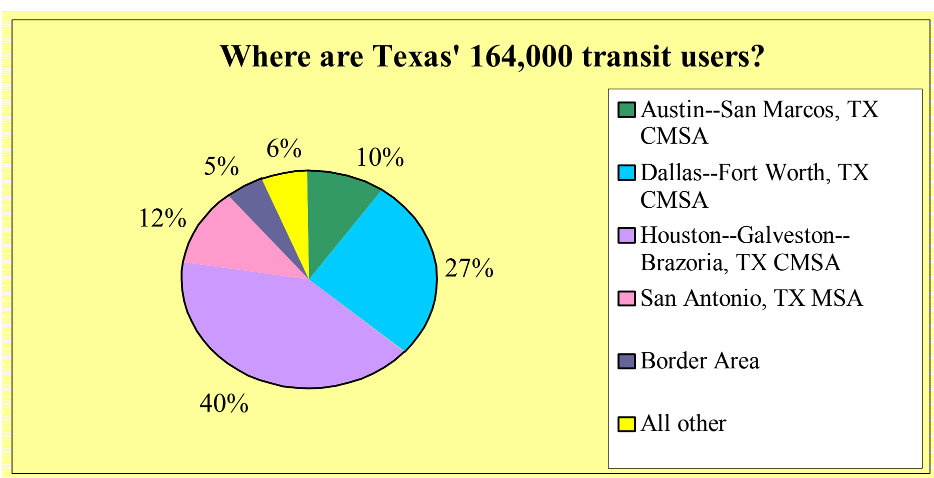




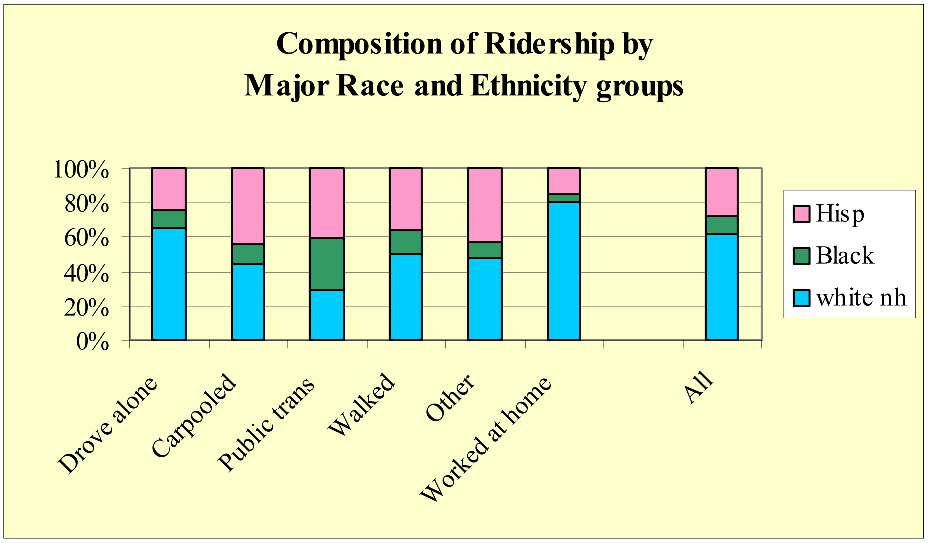


Roughly a quarter of a million residents worked at home in 2000, up from approximately 185,000 in 1990, about a 36 percent increase. Working at home accounted for 2.75 percent of all workers, a greater share than those who walk to work or those who use transit to work.

The state makes limited use of transit services for work travel. Overall transit use in the state's metropolitan areas stands at 2 percent and only Houston exceeds 3 percent. While transit use is fifth ranked among modes for the overall state, among metropolitan areas it surpasses walking but still is below working at home.



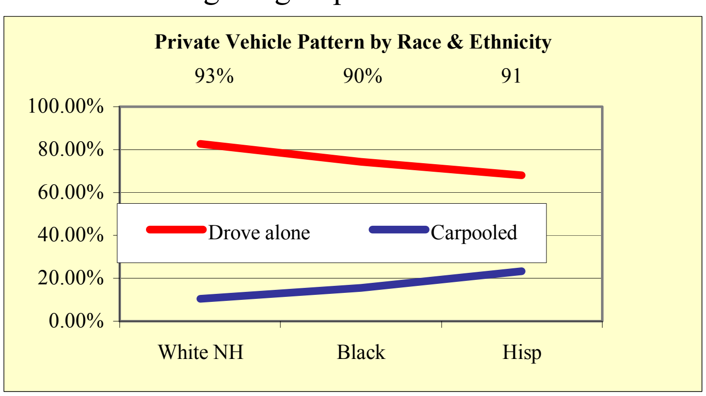
When mode choice results are stratified by the major racial and ethnic groups in Texas significant patterns emerge. The mode of transportation with a distribution most similar to the distribution of workers themselves is driving alone. Among the significant variations are: working at home with 80 percent Anglo composition; car-pooling with a strong Hispanic composition; and transit use with a strong Black composition.



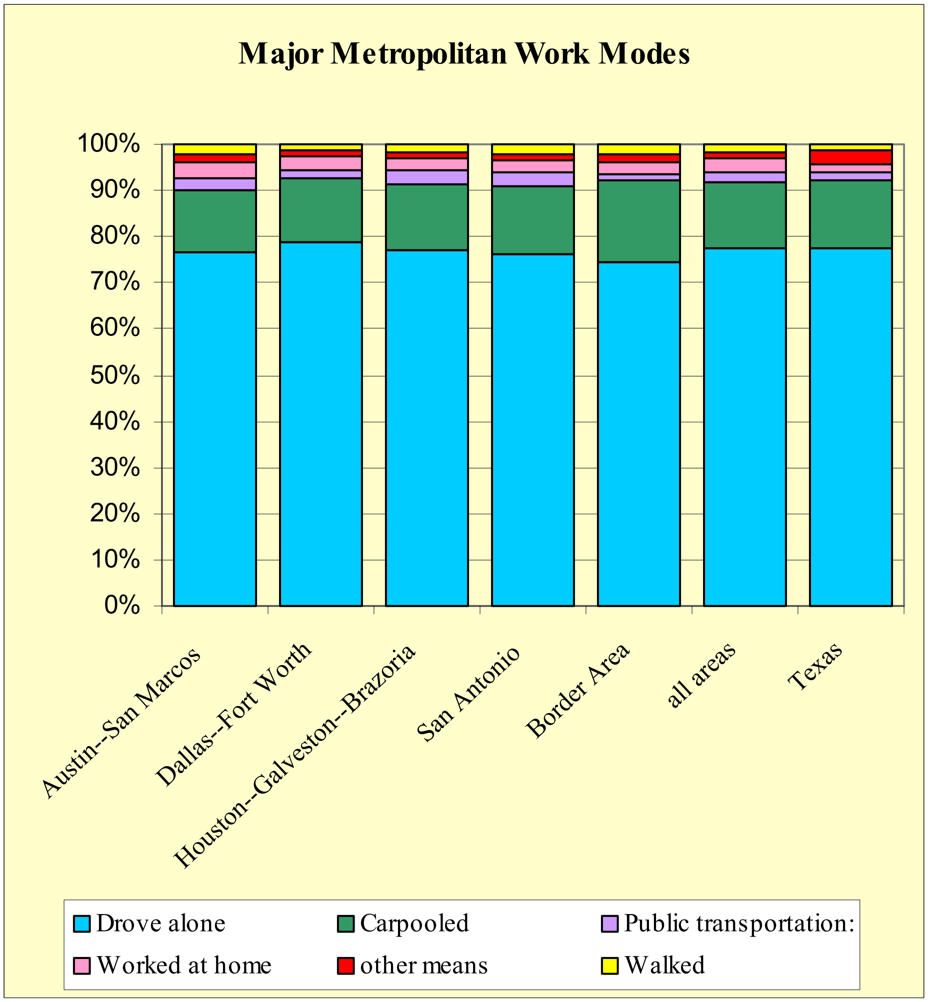
When the mode shares by race and ethnicity are examined, as below, the Black group is most similar to the overall national pattern. An extraordinary difference is notable in the strong orientation to carpooling on the part of Hispanics.

	Anglo	Black	Hisp	US
Drove alone	82.69%	74.46%	67.96%	75.7%
Carpooled	10.31%	15.55%	23.31%	12.2%
Public trans	0.84%	5.10%	2.64%	4.6%
Walked	1.52%	2.34%	2.44%	2.9%
Other	1.06%	1.31%	2.12%	1.3%
Worked at home	3.57%	1.24%	1.53%	3.3%
	100%	100%	100%	100%

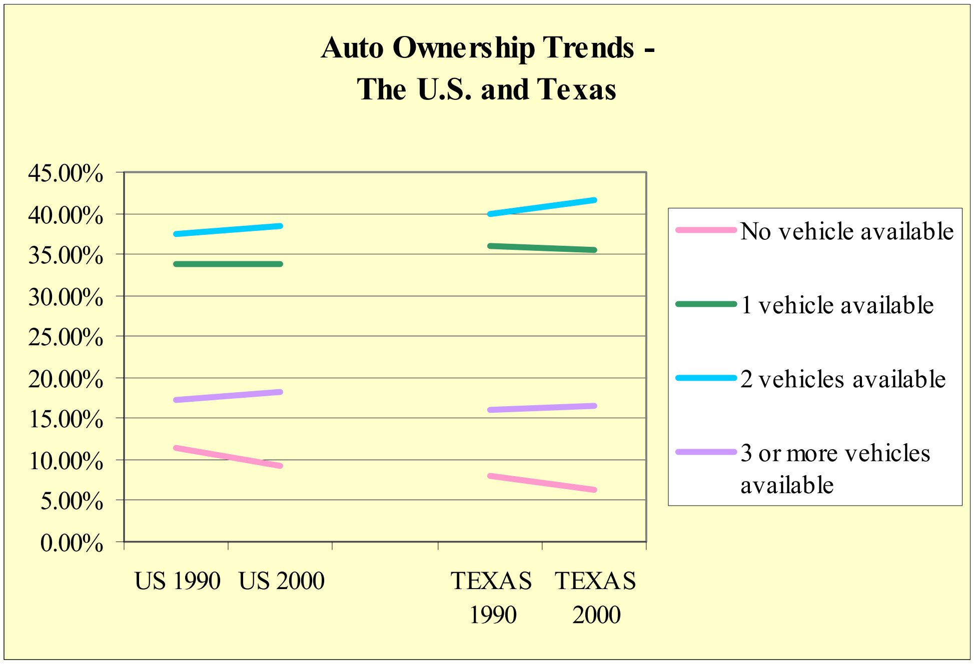
The chart below shows how the combination of driving alone and carpooling comes out to a very similar value for all groups in Texas. Similarly, if working at home and walking are combined their total share is very similar among all groups. Transit use is the truly distinct difference among the groups.



The modal usage for work travel in the detailed study areas selected is depicted in the bar chart below; its key characteristic is the similarity in mode choice despite large variations in the scale of commuting. The detailed work mode percentages for each area are displayed in the table following; perhaps the key point in the table is to confirm how similar all areas are.



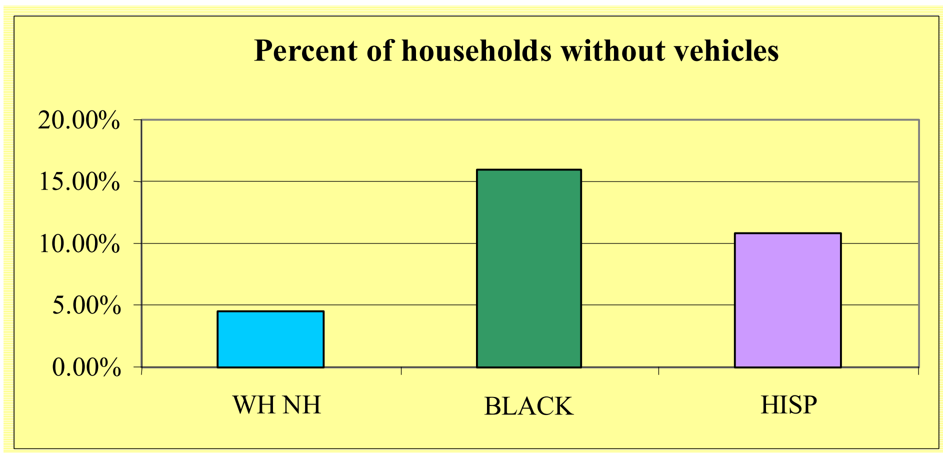
Household Auto Ownership

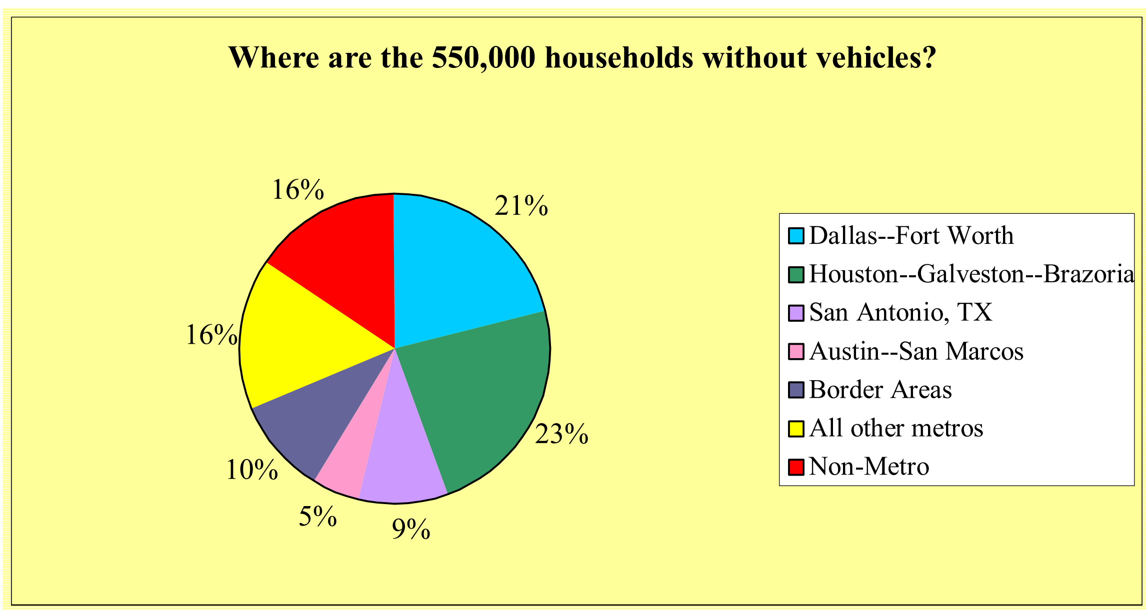


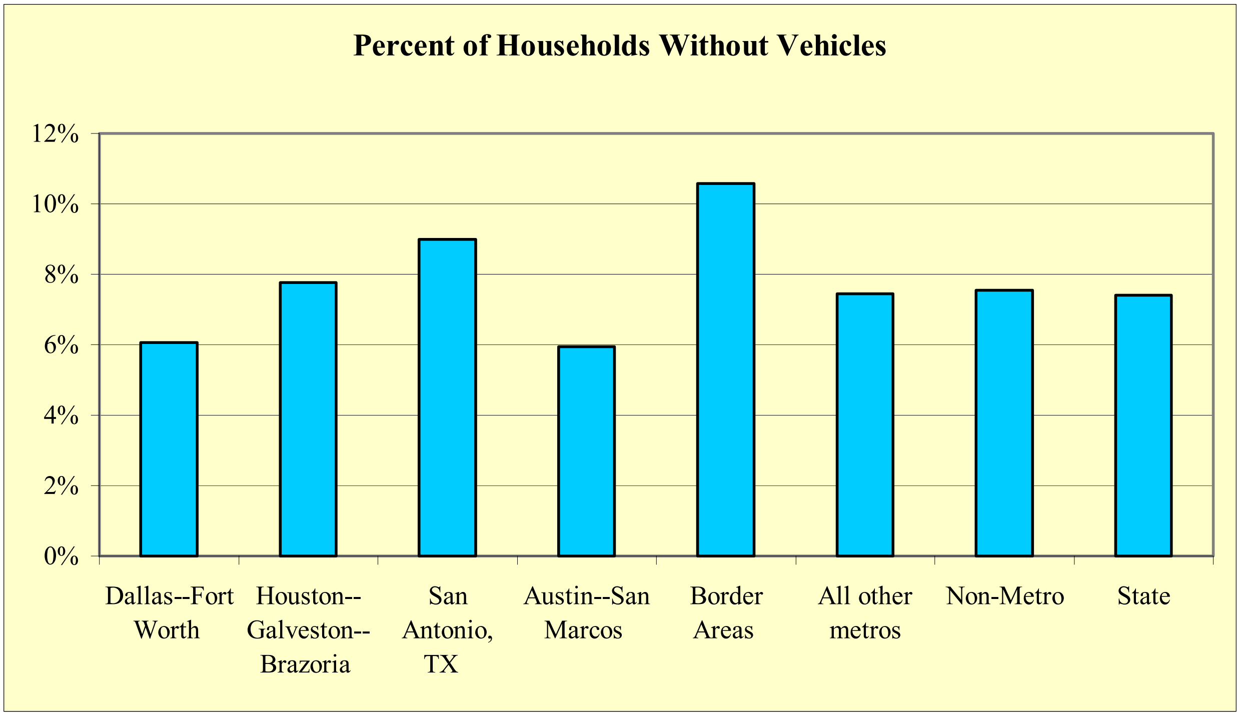
The ways in which Texas auto ownership varies from the national pattern was to be expected—more one and two car households and fewer three-car households. What is unexpected is that the share of households without vehicles is significantly lower in Texas than in the nation. In fact Texas was below the nation's 2000 average in 1990. The nation today hovers at 10 percent of all households without access to vehicles, while Texas, at about 8 percent in 1990 is now down to 7.4 percent. These households without vehicles numbering about 550,000 represent an important component of the community whose transportation service needs must be recognized. Who and where they are is very important to transportation needs and plans. What do we know about these households?

- They are predominantly renters: two-thirds of the vehicle-less households are renters. Only about 4 percent of home owning households are without a vehicle whereas 14 percent of renting households are vehicle-less.
- Lack of vehicles is predominantly among minorities: the figure below shows the pattern; 5 percent of Anglo (White non-Hispanic) households are without vehicles contrasted to 15 percent of Black households, with Hispanic households roughly in between.
- The Anglo population predominates among no-vehicle households: almost 40 percent of households without a vehicle are Anglo with about 36 percent in the Hispanic population, and 25 percent in the Black population.
- About a third of vehicle-less households are headed by a person over 65: Noted earlier was the fact that those over 65 constituted only 10 percent of the population. More than half of the home-owning households without vehicles were over 65. Lack of vehicles is more evenly spread among renters where about 20 percent are over 65.

- Most households without vehicles are in the major cities: The figure below shows that distribution with Houston and Dallas-Ft. W. the major locations. But it is to be noted that 16 percent of vehicle-less households reside in rural (non-metropolitan) areas. Only Houston, Dallas-Ft. W, San Antonio, Austin and El Paso have more than 20,000 households without vehicles.
- Households without vehicles represent a small share of the population. Most households without vehicles are small households; almost half are one-person households, another 20 percent are two-person households.







Non-Work Travel Trends

There are no data for local travel purposes explicitly for Texas; however national patterns make a case that is wholly appropriate for Texas. First, the following list shows the eight major elements of travel of concern in this review. It is notable that work travel, so often the focus of transportation planning and policy concern only constitutes about a 20 percent share of local travel trip-making activity; but a slightly greater share of travel volume. Beyond local travel, long distance travel has been estimated at upwards of 20-25 percent of all passenger travel. None of this includes all of the freight flows treated elsewhere in this review.

•	**COMMUTING**
•	**OTHER RESIDENT TRAVEL**
	• **School**
	• **Work Connected Business**
	• **Personal Business**
	• **Shopping**
	• **Visit Friends And Relatives**
	• **Social/Recreational**
	• **Medical Dental**
	• **Other**
•	**TOURISM**
	• **Overnight Visitors**
	• **Same Day Visitors**
	• **Business Travel**
•	**SERVICES**
	• **Telephone**
	• **Gas**
	• **Electric**
	• **Cable TV**
•	**PUBLIC VEHICLES**
	• **Government/Military**
	• **Police**
	• **Fire**
	• **Ambulance**
	• **Refuse**
	• **Road Construction/Maint.**
•	**URBAN GOODS MOVEMENT**
	• **Couriers**
	• **Store Delivery**
	• **Home Delivery**
	• **Office Delivery**
	• **Services/Repair**
•	**THRU PASSENGER TRAVEL**
	• **Business**
	• **Social Recreational**
	• **Visit Friends/Relatives**
•	**THRU FREIGHT TRAVEL**
	• **Agriculture**
	• **Construction/Manufacturing**
	• **Wholesale/Retail**
	• **Import/Export**

Despite the dramatic growth of work travel in recent years, trips for other purposes have grown even faster, largely trips for family and personal business or for social and recreational purposes. While work travel per capita grew by 33 percent in the period, personal business travel doubled and social-recreational travel increased by more than 50 percent. Income per capita is the great factor in total trip making. This suggests that simply focusing on serving commuting trips will be increasingly inappropriate.

Intercity Passenger Travel

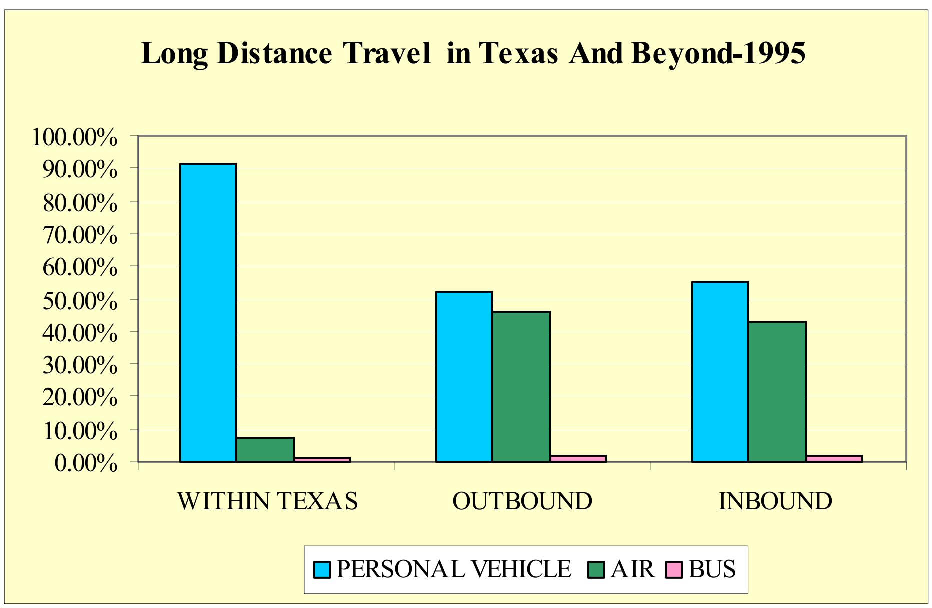
The 1995 American Travel Survey while relatively old still provides meaningful insight into long distance travel in Texas. The survey addresses all trips by households of more than 100 miles in length. A quick overview of the survey findings to gain a sense of scale of the activity is shown in the table below:

In thousands	TO		
FROM	Texas	Outside	All
Texas	56,800	23,500	80,300
Outside	19,200		
Total	76,000		

It shows that Texans made over 56 million trips of over 100 miles within Texas in 1995. Those trips averaged over 450 miles in length, roundtrip, but two million of them averaged between one thousand and two thousand miles round-trip wholly within the state. Another 23 million trips went beyond Texas, principally to adjacent states, Florida and California. Visitors to the state numbered just above 19 million. They also came principally from adjacent states, but also from Illinois and New York.

This travel by Texans amounts to a rate of travel of roughly 4.3 trips per year per capita total, 3 of which are within state. This is higher than the national average of 4 trips per person. Just the intra-state trips by Texans alone constitute 25 billion person miles of travel and the trips outside the state average 1500 miles round-trip, significant parts of which were in the state.

The highway mode was the dominant mode for all long distance travel within the state and a substantial majority for trips into and out of the state as shown below.

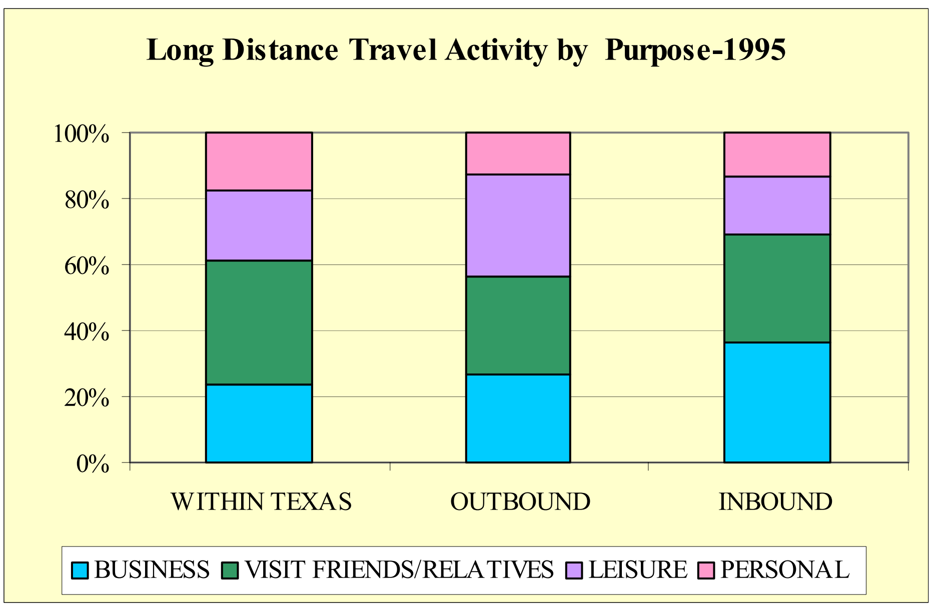


As expected, pleasure travel dominates the within-state travel activity including leisure and visiting activities and a significant portion of inbound and outbound travel is business oriented. Business travel will often be more oriented to air travel. Travel within Texas for business purposes is roughly 80 percent by personal vehicle and 20 percent by air. Over 200,000 of the air trips within state were made in personal aircraft. Non-business within-state travel was almost exclusively in private vehicles; for example, trips for visiting friends and relatives was more than 95 percent by personal vehicle.

At the national level long-distance trips by racial and ethnic minorities averaged only about half the trips per year of the general population, although their trip-making growth rates have been equivalent to or greater than the general population. It can be expected that overtime their annual trip-making rates will coincide with general population rates as their incomes rise. This will be a major source of long-distance travel growth for Texas.

One of the key concerns of Texas now and in the future is cross-border passenger flows with Mexico. The levels of traffic are prodigious; overnight visits to the US from Mexico grew by 50 percent from 1990 to 2000 and exceed 10 million visits per year; while US visitors to Mexico were closer to 20 million visits per year with growth of 20 percent for the period.

Same day travel at the border has grown dramatically, US Customs records for 2000 show almost 300 million border crossings from Mexico to the US for the year and over 90 million vehicle crossings. Of these, El Paso and San Ysidro California, both had levels above 40,000 vehicles per day, together accounting for more than 25 percent of all the crossings. In Texas, in addition to El Paso, Hidalgo, Brownsville and Laredo exceeded 20,000 vehicles per day. These four Texas ports accounted for 43 percent of all border crossings with Mexico.



This all makes the point that most trips, particularly longer ones, have economic or social transactions at their destination of value to the traveler and to the society.

APPENDIX II

Texas Establishments

There are over 470,000 establishments in Texas employing over 8 million people of the 10 million employed in Texas. More than half of these establishments are in smaller units of 1 to 4 employees. As a general scale statement about half of the employment comes from establishments employing under one hundred employees and half from larger firms, including more than 500 establishments with over a thousand employees.

Among Texas non-farm sector establishments employment is divided by industry as in the accompanying table. This structuring of the economy is misleading regarding the role of transportation in the state economy. The transportation component shown consists of only the for-hire aspects of transportation – trucking, airlines, taxis, etc. Public employees engaged in providing transportation, either services or infrastructure would appear in government; similarly, private transportation, particularly trucking, would appear in the industry of which it is a part. For example, super markets, which have immense truck fleets, would be counted under food services. All auto related activities – sales, servicing, and fueling appear as retail services or trade.

Industry	Share of Employment
Services	29%
Trade	24%
Govt	17%
Mfg	11%
Trans/Util	6%
Construction	6%
FIRE	5%
Mining	2%

Source: Bur. of Census
FIRE: Finance, Insurance, Real Estate

Texas Freight Patterns

An economy of the scale of the U.S. and of Texas generates immense amounts of ton-miles of travel to support the population and their economic activities. As a rough guide:

- each person in America generates about 13,500 ton-miles of travel per capita. This number will vary from state to state given the industrial mix, etc.
- the ton-miles per capita roughly equate to about $2,000 per capita in freight costs.
- each dollar of national GDP generates about .4 ton-miles of freight movement. This has been declining over time as the US economy has become more oriented to services.

When considering freight flows within Texas at least three levels of consideration are needed:

- o local movements, typically within metropolitan areas. Usually pick up and delivery activities serving businesses and households and almost exclusively a truck-based component of movements.
- o Inter-city movements between major areas of the state or between the state and other states.
- o Through movements passing through Texas between other states.
- o The special case in Texas of movements to and from or through Texas on the way to and from Mexico.

All of these movements must be addressed in any comprehensive understanding of the roles the Texas transportation system is expected to play in the Texas and national economies. There are weaknesses in current data that make examination of all of these freight patterns a sketchy exercise. Recent improvements have expanded our knowledge, but gaps continue.

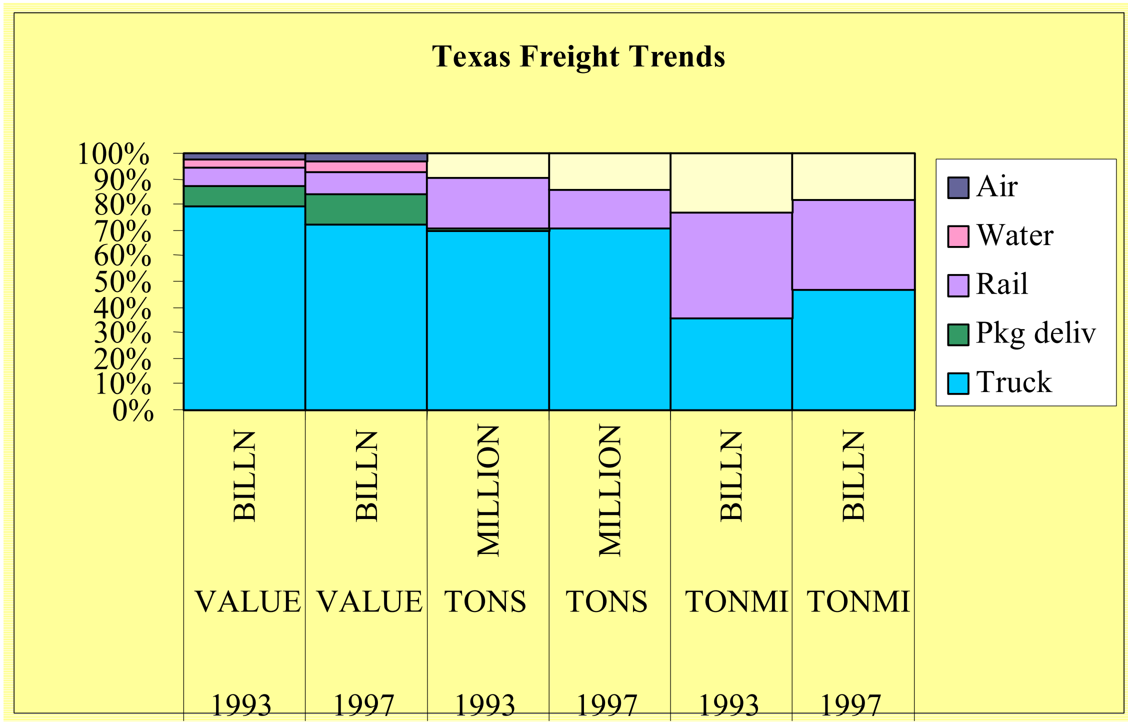
In 1997 the Texas economy shipped over 900 million tons of product, valued at over $550 billion, more than 200 billion miles. The bar chart below describes some of the patterns in the three key measures of freight flow:

- value of freight moved;
- tons of freight moved;
- and ton-miles of freight moved.

Each of these measures has utility when considering differing aspects of freight movement.

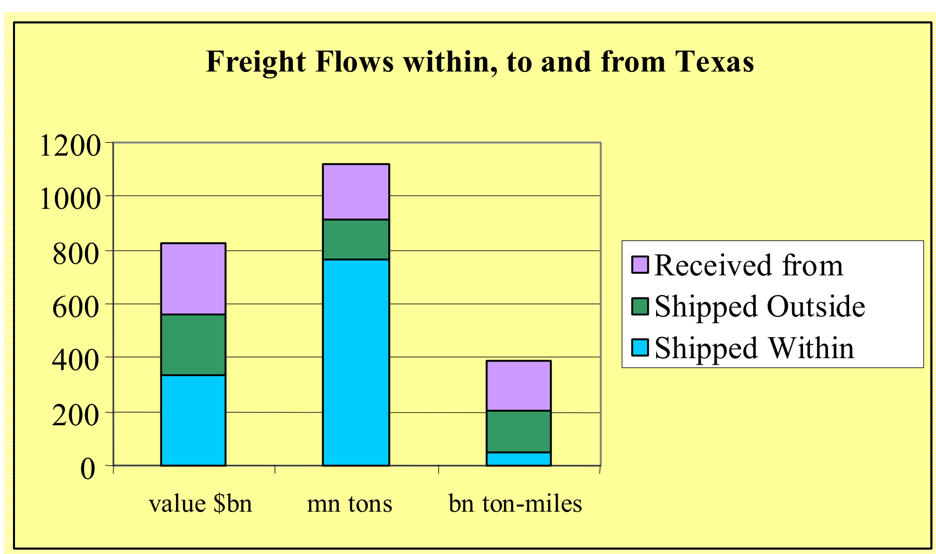
As can be seen from the chart, trucking dominates the activity levels, particularly in terms of tons and value. When ton-miles are considered, water and rail become more significant. Both air and package delivery are significant factors in the value of freight moved, but effectively disappear when tons and ton-miles moved are addressed. [1]

[1] It will be obvious, certainly in Texas, that pipelines are not represented here. National data on pipelines are limited, moreover pipelines are often treated as a separable activity that only rarely interacts with the other freight modes. The 1997 CFS showed 180 million tons of fuels and other petroleum products worth $33 billion dollars shipped by pipelines in Texas.



source: CFS

It is critical to note that these data represent freight flows originating in the state based on the great majority but not all of the industries shipping in the state. That which is not represented is very likely to be a small share and also heavily oriented to trucking. But more importantly, this addresses freight originating within Texas only – not freight destined to Texas from elsewhere (addressed below) and not freight moving thru Texas. These have immense impacts on the Texas transportation system.



source: CFS 1997

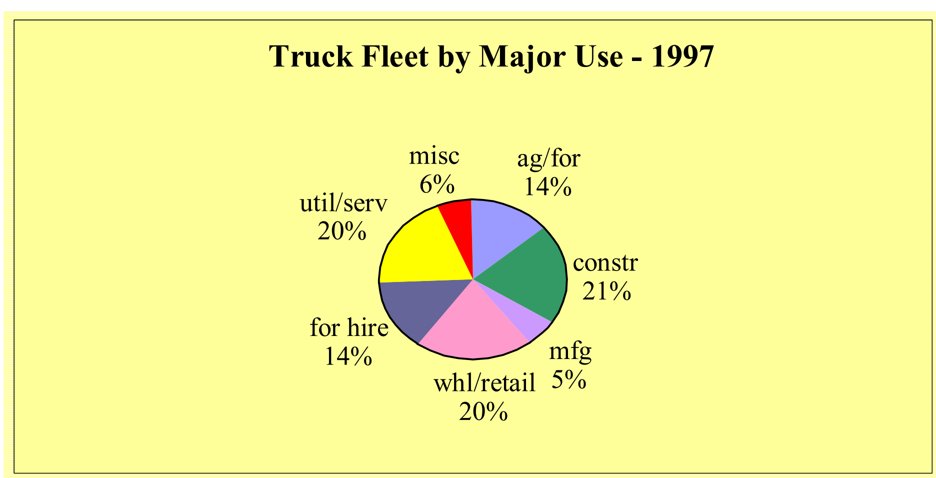
As can be seen from the graphic above most of the tonnage generated in Texas stays in Texas but the tonnages shipped beyond the borders have a major share of the value shipped. It is also noteworthy that the goods shipped into Texas from other states are similar in levels to that shipped outbound. The small differences can be seen in the table below:

	value $bn	mn tons	bn ton-miles
Shipped Within Texas	336	765	52
Shipped to other States	231	148	154
Received from States	262	203	184

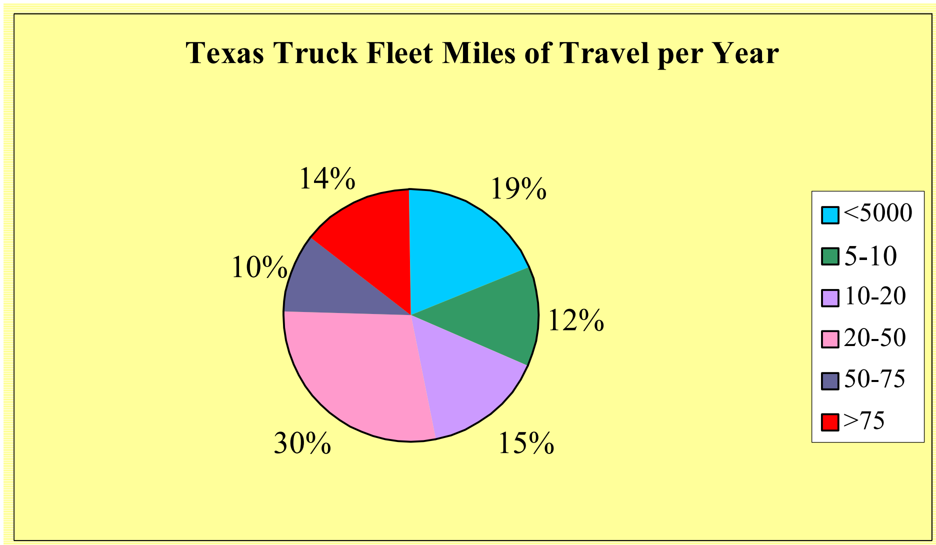
As can be seen the amounts received from other states exceed slightly the amounts shipped to other states in all categories. All of this tonnage, amounting to 1.1 billion tons, at some point moves within the state. Broadly speaking, the trade flows with other states seem symmetric in that the same states seem both to receive and ship actively with Texas. These states include the adjacent states, and the major trade centers of the nation – California, Florida, Illinois, Indiana, Ohio and Michigan. The flow map depicts these patterns. Total national flows related to Texas are shown in the following map.

The Texas Commercial Vehicle Fleet

Another approach to understanding freight flows in Texas is to examine the state's truck fleet. The truck fleet was measured at 4.4 million vehicles in 1997 by the Census Vehicle Inventory and Use Survey (VIUS). Most of those vehicles, of course, consist of pickups, vans and wagons, more than 3 million of which are for personal use. Beyond those there are about another million such vehicles used for business purposes – florists, plumbers, construction, etc. Beyond those there were only about 260,000 commercial large vehicles. The ways in which this fleet is used is shown below in the pie chart.

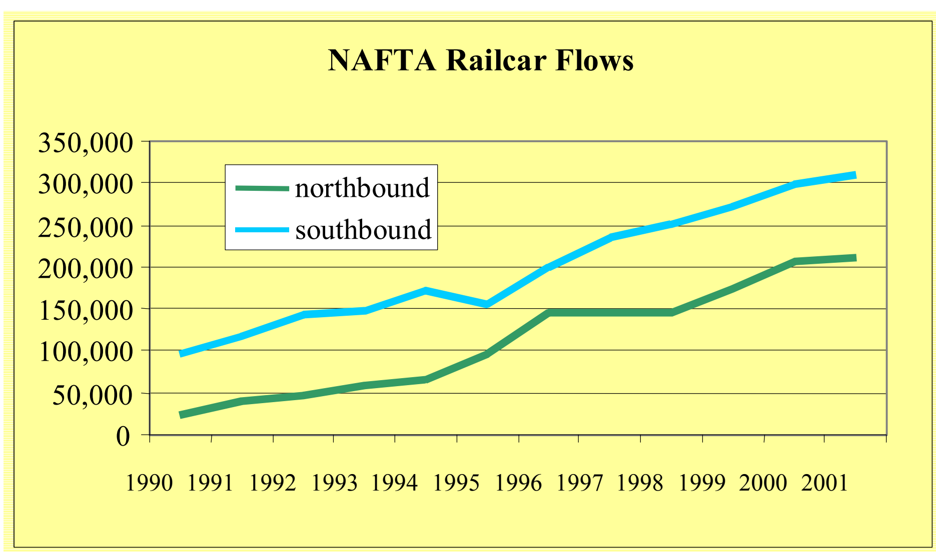


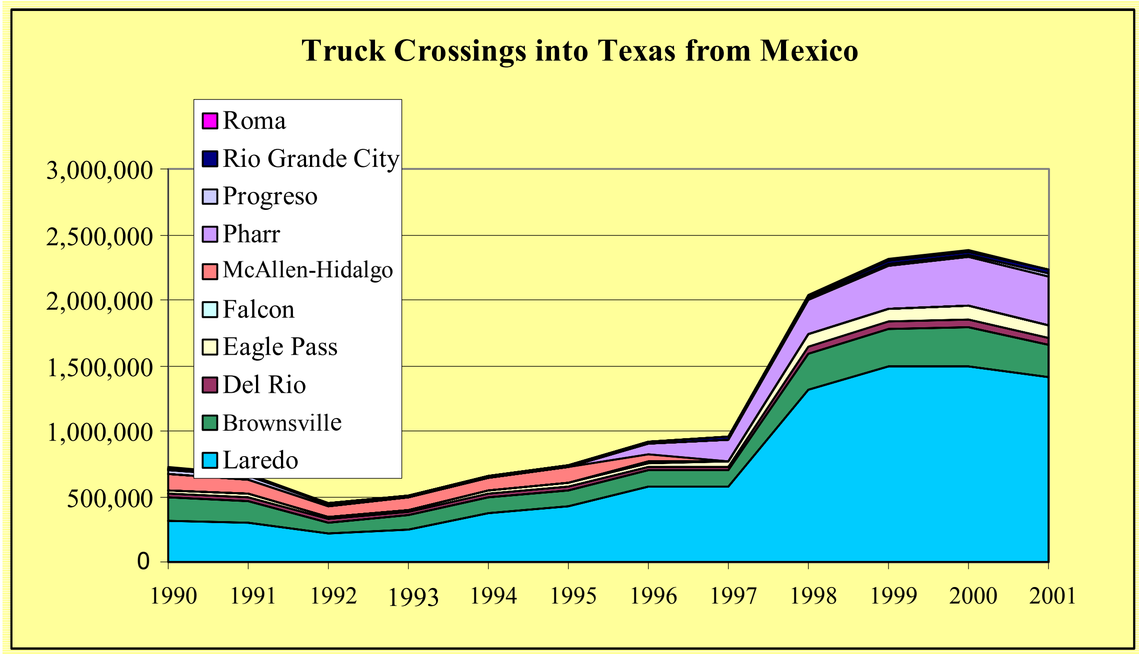
The majority of this fleet has a local or short range of operation, with fewer than 25 percent defined as long-range vehicles. Similarly about 70 percent of the fleet estimated that less than 25 percent of their mileage occurred outside the State. Even so miles operated were substantial, with about 25 percent of the fleet running more than 50,000 miles per year as shown below.

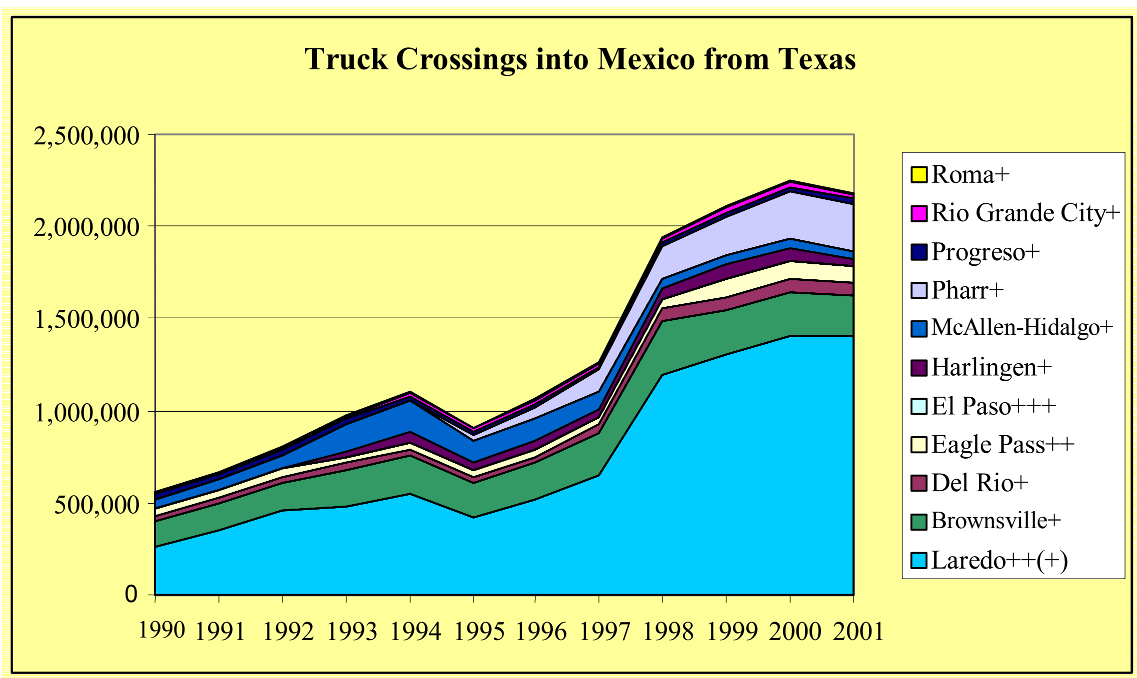


NAFTA and Interstate Flows

In January 1994, the world's largest free trade area was formed by the United States, Canada, and Mexico – the North American Free Trade Agreement (NAFTA). The graphics below show the explosion in freight flows engendered by NAFTA after 1994, particularly in trucking. Rail car flows in both directions have roughly doubled since initiation of the compact. Truck flows, especially in the northbound direction have grown even more dramatically, approaching five times 1994 levels, with the great bulk of the moves through Laredo.



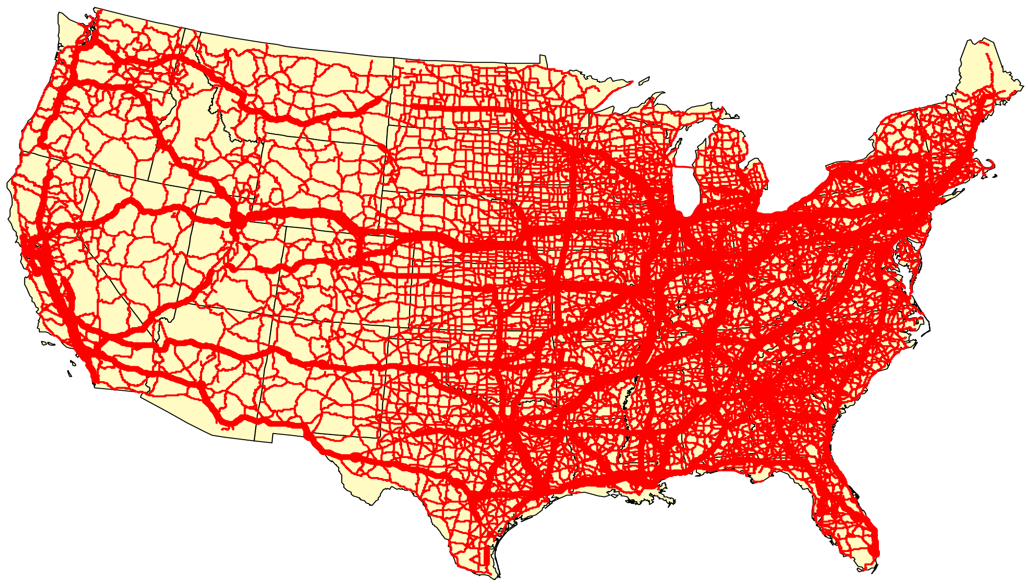




source: compiled by TAMIU from U.S. Customs

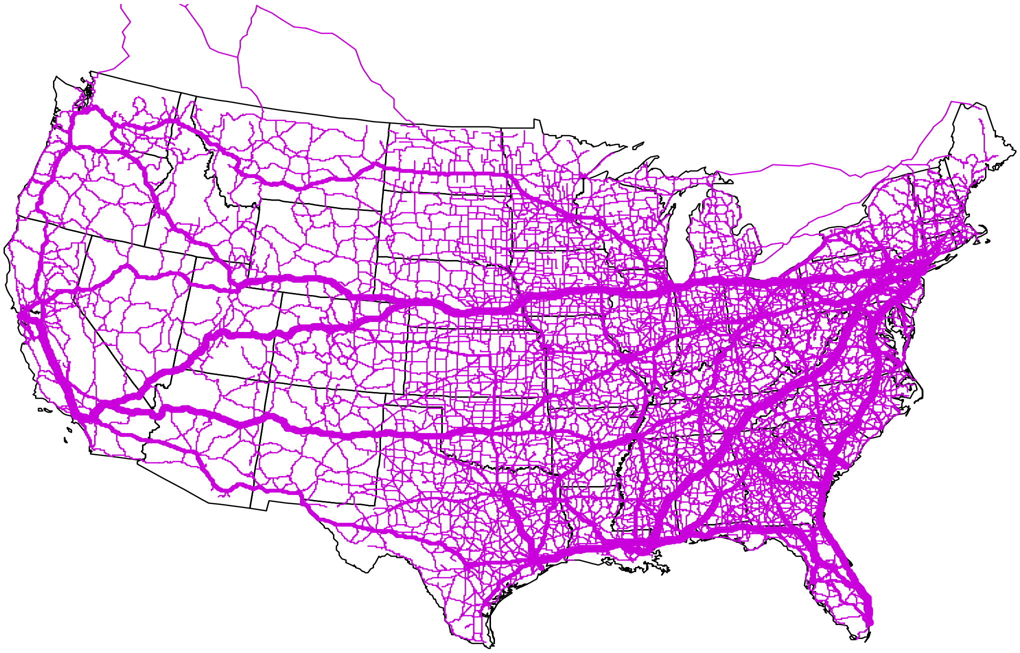
Interstate Flows

It is difficult to characterize those flows moving across the state of Texas. There are two major flow patterns – the first is an East-West flow corresponding to the dominant Interstate routes and the second is North-South flows engendered by NAFTA all of which is best portrayed in map form as below: It is estimated by the US DOT that truck traffic moving on the high level network of the state accounts for 20 percent of daily traffic volumes.

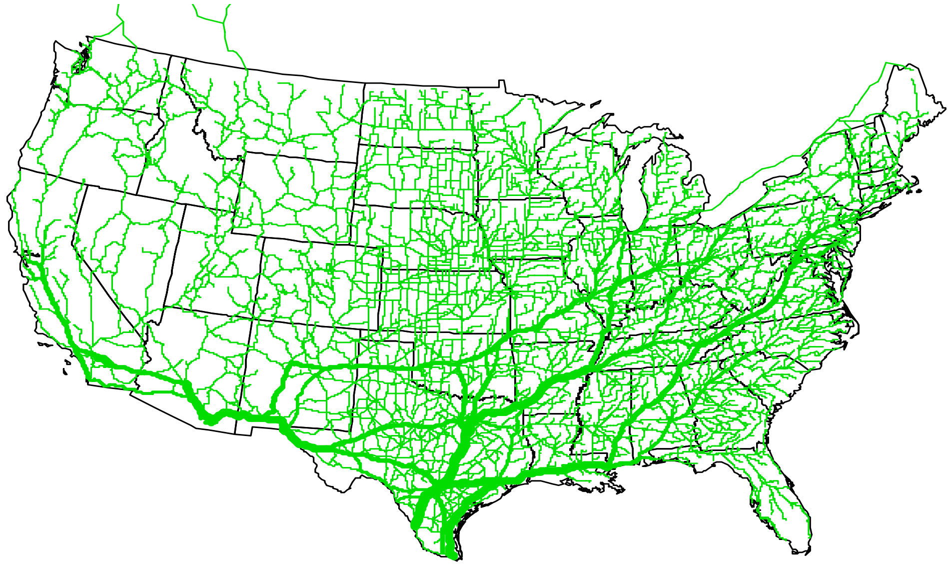


Major parts of these flows are generated by foreign trade as the following graphic displays. The chart shows the flows of the inland movements of goods moving in foreign trade.

INLAND FLOWS OF GOODS IN FOREIGN TRADE



NAFTA FLOWS



Comparison between these maps provides a sense of the nature and composition of the flows affecting Texas.

As the economy of Texas and the nation grows the challenges of moving people and goods within and through Texas will be substantial. Not responding to those challenges will be the way to disrupt that growth potential.

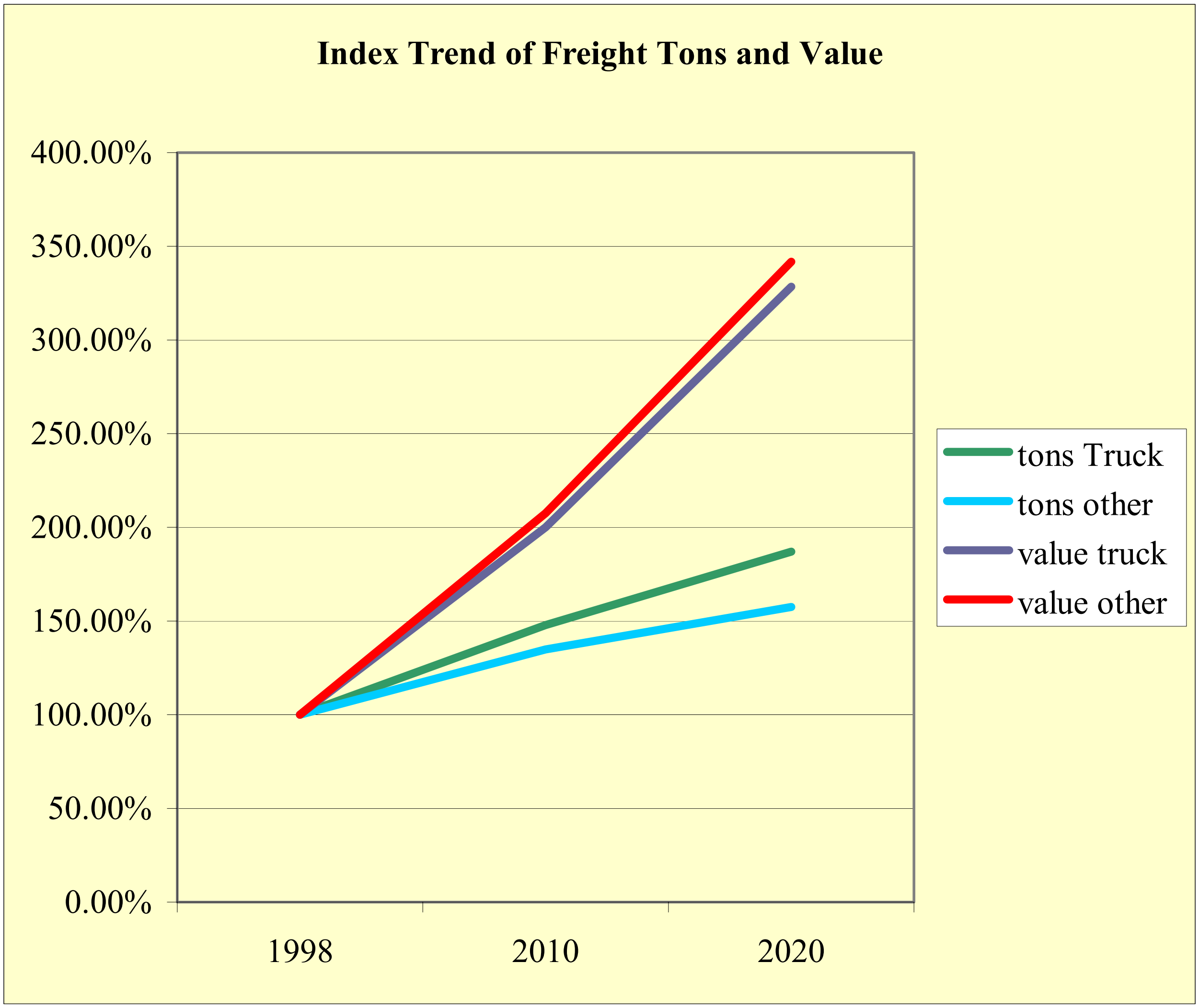
The US DOT's Freight Analysis Framework (FAF), the source of the maps shown here has developed expected growth trends for freight movement in the US. The key is that international trade will strongly influence total freight flows. Texas will be at the center of many of those flows. The growth rates shown will generate overall increases for the period on the order of 87 percent for domestic traffic and over 100 percent for International traffic, the strongest of which will be the US/Mexico trade.

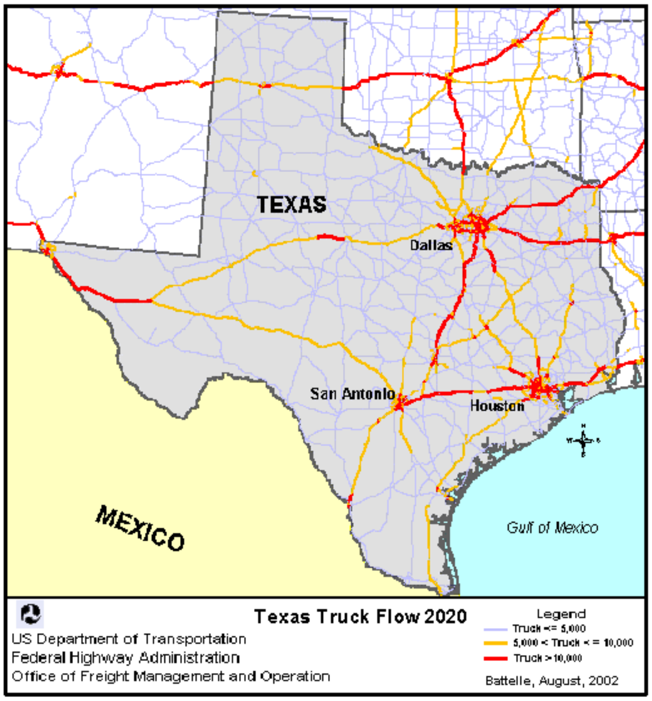
Traffic flows through Texas, whether North-South or East-West, will be a product of the growth in surrounding states and the nation at large. Texas will be challenged to serve these cross-national flows and there is little it can do to change them.

1998-2020	Growth Rates
US Domestic	2.90%
US International	3.40%
International Sectors	
US/Can	3.10%
US/Mexico	3.50%
US/Rest of World	3.40%

In greater detail these truck forecasts of tons and value are shown in the graphic below indexed to present levels of freight movement. It is clear that all freight sectors will show growth, but truck activity growth will be extraordinary. In tonnage non-truck modes are expected to see a 60 percent increase in the period while truck tonnages will jump almost 90 percent. The major increases in airfreight value, more than quadrupling in the period, exceeded the major increases in trucking estimated at more than a tripling in value. This is of course an index measure the actual value of truck freight will be about six times that of air freight. But even the value of rail movements is expected to triple in the period.

Despite the tripling in overall value of domestic freight moved in the period the share of freight in international trade will increase from 19 percent to 24 percent as a result of a quadrupling in the value of international trade.


Index Trend of Freight Tons and Value
400.00%
350.00%
300.00%
250.00%
200.00%
150.00%
100.00%
50.00%
0.00%
1998
2010
2020
tons Truck
tons other
value truck
value other



TEXAS
Dallas
San Antonio
Houston
MEXICO
Gulf of Mexico
Texas Truck Flow 2020
US Department of Transportation
Federal Highway Administration
Office of Freight Management and Operation
Legend
Truck <= 5,000
5,000 < Truck < = 10,000
Truck > 10,000
Battelle, August, 2002

APPENDIX III

The Model's Calculations

The operation of the roadway needs model is based on a series of three calculations.

- Roadway mileage need – These calculations allow the analyst to use the projected demand levels and the system inventory to estimate roadway needs for a variety of purposes. These range from meeting mobility targets or maintaining existing mobility levels to estimating the effect of identifying roadway additions.

- Cost of build and maintain roadway – Unit costs for construction are applied to any roadway added in an alternative, and maintenance cost are estimated for the entire system.

- Comparisons of costs and benefits – Results of the expenditure analysis are compared and benefits to the economy are estimated in this step. Measures such as cents-per-mile are used to compare the alternatives in ways that are easier to understand. Benefits to the economy from transportation investments are also estimated in this section of the model.

The first series of calculations is used to determine the number of new lanes miles that must be added to the system to accommodate projected growth and maintain existing Travel Time Index levels (i.e., existing levels of delay). Briefly, those steps are as follows:

1. The population projection is recorded for each county within each urban area.

2. The daily vehicle miles traveled for 2000 is entered for each county.

3. The initial daily vehicle miles traveled per capita for each county for base year 2000 is calculated and the rate of annual growth in daily vehicle miles traveled per capita is applied for future years.

4. A five-year rate of increase in daily vehicle miles traveled is calculated as a function of the growth in population and the growth in per capita daily vehicle miles traveled.

5. Daily vehicle miles traveled for each county for future years is determined by multiplying the projected population by projected daily vehicle miles traveled per capita.

6. Lane-miles existing in base year 2000 are entered for each county in each urban area.

7. The cost of construction per lane mile for various roadway classifications is entered.

8. The rate of increase in daily vehicle miles traveled for each five-year increment is multiplied by the number of lane-miles in each roadway classification to determine the number of lane-miles that must be constructed to achieve the target mobility level.

9. The average cost of construction per lane mile of each roadway classification is multiplied by the new lane-miles that must be added to determine the cost of new construction necessary achieve the mobility target.

If the target goal is a mobility improvement, the differential between the existing Travel Time Index and the target is used to determine the number of lane-miles necessary to achieve the Travel Time Index goal. In most analyses, where an area has an existing Travel Time Index less than the goal Travel Time Index, the Travel Time Index is allowed to remain at the lower level. For example, the San Antonio urban area has a Travel Time Index of 1.23. It is allowed to remain at 1.23 under the "1.25 Goal" scenario instead of being allowed to degrade to 1.25 by withholding funds for new capacity until such time as congestion did worsen to a 1.25 level. The same is the case with the Border area with a Travel Time Index of 1.13 and the remainder of the State with an estimated Travel Time Index of 1.05. The Travel Time Indices for those areas are maintained at their present levels by adding new roadway capacity at levels sufficient to offset demand growth.

The second series of calculations involved the cost to maintain the existing roadway network and the additional lane-miles that would be added under the various scenarios.

1. Texas Department of Transportation expenditures by county on maintenance, contract preventative maintenance, and construction costs were obtained from District and County Statistics (DISCOS) publications.

2. The average cost per lane mile for maintenance and contract preventative maintenance over a period of 10 years were obtained. These costs were divided by the sum of lane-miles over the period in each county to obtain a 10-year average cost per lane mile for maintenance.

3. The dollar amounts were converted to year 2000 constant value dollars using inflation rate data obtained from the U. S. Bureau of Labor Statistics.

4. Construction costs reported in the DISCOS publication include costs for both new construction as well as the cost of reconstructing existing roadways. To produce an estimate of each category of expenditure, the number of new lane-miles added in each urban area county for a 10-year period was obtained. A weighted average cost of construction per lane mile for each county was obtained using the number of lanes miles in each roadway classification and the cost of constructing a lane mile of each roadway classification.

5. The new lane-miles added each year in each county was multiplied by the weighted average of construction cost per lane mile to determine an estimate of new construction cost. This cost was deducted from the construction figure reported in the DISCOS publication to obtain the estimated amount spent on reconstruction.

6. The estimate of reconstruction cost in each county was then divided by the number of lane-miles in the county to determine the cost per lane mile of reconstruction.

7. The lane mile costs for maintenance and reconstruction were then applied to the number of miles in the system in each year of the analysis to determine the maintenance/reconstruction costs. For new lane-miles added under each scenario, the maintenance/reconstruction costs were calculated beginning the second year the lane mile was in service and each year thereafter. As such, in this model, maintenance/reconstruction costs are more analogous to depreciation costs than true "out-of-pocket" costs, but nevertheless account for costs that eventually must be paid.

8. Costs of future construction and maintenance were calculated using both 2000 constant dollars and projected inflation rates. Costs with inflation were based on inflation projections from the Office of Management and Budget. This was done because the major sources of revenue to fund transportation construction are fixed, unit-based revenues as opposed to rate/value revenues (e.g., the fuel tax is a fixed rate applied to a gallon on fuel and vehicle registration fees are based on weight and vehicle type.

The final series of calculations in the model involves comparing the costs of the four scenarios, determining cost on a cents-per-VMT basis, the costs compared to "present-trend" spending on roadways, and calculating an estimated rate of return.

1. The annual expenditures required by the Travel Time Index scenario is divided by the number of vehicle miles traveled to produce an estimate of cost to road users.

2. Total expenditures for the past 10 years by the Texas Department of Transportation were obtained from DISCOS. Total expenditures over the period were then divided by VMT over the same period to obtain a weighted average of expenditures per VMT. This rate of spending was then multiplied by VMT projections to estimate future levels of TxDOT spending. Levels of spending necessary to expand and maintain the system to reach the various Travel Time Index goals were then subtracted from the estimates of future TxDOT spending to determine the "deficit" in spending that must be overcome in order to meet each Travel Time Index goal.

3. A rate of return of 12 percent per year is applied to the cost of new construction that adds roadway capacity. Based on prior published research from the Federal Highway Administration, the rate of return is assumed to be constant and continue for as long as the roadway is maintained. This rate of return represents not only part of the "payback" on the investment itself, but also represents the "cost" of doing nothing when compared to the alternative of continuing the present rate of roadway expansion.

The following tables show the effect of inflation on the TxDOT's purchasing power with respect to highway construction and maintenance. As indicated in Exhibit 34, the estimated 25-year cost to achieve the 1.15 Travel Time Index Goal is $218 billion. The effect of inflation over the time period is expected to drive the cost up to an estimated $311 billion. This becomes important because, as explained on pages 40 and 41, revenues do not rise with inflation.

Cost to Achieve Travel Time Index Goals Including 2.55 Percent Annual Inflation

Year	Estimated Current Baseline TxDOT Expenditures	Estimated Needs to Maintain Current TTI	Estimated Needs to Meet 1.25 TTI Goal	Estimated Needs to Meet for 1.20 TTI	Estimated Needs to Meet for 1.15 TTI
2000	4,395,644,654	5,604,377,650	6,128,431,437	6,472,786,121	6,851,824,221
2001	4,584,603,044	5,862,141,588	6,410,298,348	6,770,491,048	7,166,962,368
2002	4,661,660,412	6,065,008,642	6,632,135,082	7,004,792,720	7,414,984,447
2003	4,738,905,697	6,326,317,463	6,917,878,352	7,306,591,817	7,734,456,514
2004	4,816,338,898	6,600,080,768	7,217,240,698	7,622,775,241	8,069,155,237
2005	4,893,960,450	6,883,121,122	7,526,747,572	7,949,673,211	8,415,195,936
2006	4,974,034,128	7,175,303,057	7,846,250,836	8,287,129,266	8,772,412,986
2007	5,054,301,686	7,480,851,367	8,180,370,338	8,640,022,841	9,145,971,559
2008	5,134,763,125	7,792,721,032	8,521,402,292	9,000,217,275	9,527,258,520
2009	5,215,418,444	8,114,699,410	8,873,488,204	9,372,086,787	9,920,904,236
2010	5,296,267,643	8,450,807,352	9,241,024,906	9,760,275,263	10,331,824,534
2011	5,380,338,211	8,818,027,273	9,642,582,803	10,184,396,576	10,780,781,850
2012	5,464,610,579	9,240,215,785	10,104,249,291	10,672,003,962	11,296,942,903
2013	5,549,084,748	9,619,434,055	10,518,927,479	11,109,982,790	11,760,569,213
2014	5,633,760,718	10,010,275,152	10,946,315,321	11,561,385,424	12,238,405,409
2015	5,718,638,049	10,412,947,908	11,386,641,175	12,026,453,053	12,730,706,805
2016	5,805,624,853	10,835,414,280	11,848,611,505	12,514,381,354	13,247,207,565
2017	5,892,818,416	11,274,698,491	12,328,972,276	13,021,733,450	13,784,269,552
2018	5,980,218,737	11,726,889,666	12,823,446,915	13,543,992,467	14,337,111,391
2019	6,067,825,817	12,196,587,629	13,337,065,365	14,086,470,981	14,911,356,755
2020	6,155,639,211	12,684,201,432	13,870,274,929	14,649,641,426	15,507,505,744
2021	6,244,780,608	13,188,003,683	14,421,186,688	15,231,508,748	16,123,446,474
2022	6,334,131,657	13,710,545,003	14,992,589,768	15,835,018,793	16,762,297,297
2023	6,423,692,359	14,252,245,610	15,584,943,681	16,460,656,890	17,424,571,964
2024	6,513,462,713	14,813,527,539	16,198,709,924	17,108,910,470	18,110,786,447
2025	6,603,442,274	15,394,813,597	16,834,350,842	17,780,267,857	18,821,457,665
TOTAL	143,533,967,133	254,533,256,554	278,334,136,028	293,973,645,831	311,188,367,592

The following table compares the inflated versus non-inflated costs.

Amount Lost Due to Estimated Inflation

Year	Estimated Needs to Maintain Current TTI	Estimated Needs to Meet 1.25 TTI Goal	Estimated Needs to Meet for 1.20 TTI	Estimated Needs to Meet for 1.15 TTI
2000	(1,208,732,996)	(1,732,786,783)	(2,077,141,467)	(2,456,179,567)
2001	(1,277,538,543)	(1,825,695,304)	(2,185,888,003)	(2,582,359,324)
2002	(1,403,348,229)	(1,970,474,670)	(2,343,132,307)	(2,753,324,035)
2003	(1,587,411,767)	(2,178,972,655)	(2,567,686,120)	(2,995,550,818)
2004	(1,783,741,870)	(2,400,901,801)	(2,806,436,344)	(3,252,816,340)
2005	(1,989,160,672)	(2,632,787,122)	(3,055,712,762)	(3,521,235,486)
2006	(2,201,268,928)	(2,872,216,708)	(3,313,095,138)	(3,798,378,858)
2007	(2,426,549,681)	(3,126,068,652)	(3,585,721,154)	(4,091,669,872)
2008	(2,657,957,907)	(3,386,639,167)	(3,865,454,150)	(4,392,495,395)
2009	(2,899,280,966)	(3,658,069,760)	(4,156,668,343)	(4,705,485,792)
2010	(3,154,539,709)	(3,944,757,263)	(4,464,007,620)	(5,035,556,891)
2011	(3,437,689,063)	(4,262,244,593)	(4,804,058,365)	(5,400,443,640)
2012	(3,775,605,206)	(4,639,638,712)	(5,207,393,383)	(5,832,332,324)
2013	(4,070,349,307)	(4,969,842,731)	(5,560,898,042)	(6,211,484,465)
2014	(4,376,514,434)	(5,312,554,603)	(5,927,624,706)	(6,604,644,691)
2015	(4,694,309,859)	(5,668,003,126)	(6,307,815,004)	(7,012,068,756)
2016	(5,029,789,426)	(6,042,986,652)	(6,708,756,501)	(7,441,582,712)
2017	(5,381,880,074)	(6,436,153,860)	(7,128,915,033)	(7,891,451,136)
2018	(5,746,670,928)	(6,843,228,177)	(7,563,773,729)	(8,356,892,654)
2019	(6,128,761,812)	(7,269,239,548)	(8,018,645,164)	(8,843,530,938)
2020	(6,528,562,221)	(7,714,635,717)	(8,494,002,215)	(9,351,866,532)
2021	(6,943,223,075)	(8,176,406,080)	(8,986,728,141)	(9,878,665,866)
2022	(7,376,413,346)	(8,658,458,111)	(9,500,887,136)	(10,428,165,640)
2023	(7,828,553,252)	(9,161,251,323)	(10,036,964,532)	(11,000,879,605)
2024	(8,300,064,825)	(9,685,247,211)	(10,595,447,757)	(11,597,323,733)
2025	(8,791,371,323)	(10,230,908,568)	(11,176,825,582)	(12,218,015,391)
TOTAL	(110,999,289,421)	(134,800,168,895)	(150,439,678,698)	(167,654,400,459)

The following tables show the estimated miles of road by classification that would have to be added to the system to meet the indicated mobility goals. In the report, only those roads that are state-maintained are included in the cost figures.

AUSTIN

PROJECTED LANE MILES NEEDED
CONGESTION SCENARIO: Maintain Existing TTI (1.27)

Functional Classification	Existing Miles	Lane Miles Added by 2005	Lane Miles Added 2006 to 2010	Lane Miles Added 2011 to 2015	Lane Miles Added 2016 to 2020	Lane Miles Added 2021 to 2025	Total Lane Miles Added 2000 to 2025
Muni Urban Principal Arterial	318.0	33.5	32.8	33.3	33.4	33.6	166.6
Muni Urban Freeway	-	-	-	-	-	-	-
Cty Urban Principal Arterial	8.0	0.8	0.8	0.8	0.8	0.8	4.2
Other Local Principal Arterial	-	-	-	-	-	-	-
Other Local Urban Freeway	-	-	-	-	-	-	-
State Rural Local	-	-	-	-	-	-	-
State Rural Minor Collector	67.0	7.0	6.9	7.0	7.0	7.1	35.1
State Rural Major Collector	1,135.0	119.4	116.9	118.9	119.2	120.1	594.5
State Rural Minor Arterial	416.0	43.8	42.8	43.6	43.7	44.0	217.9
State Rural Principal Arterial - IH	110.0	11.6	11.3	11.5	11.5	11.6	57.6
State Rural Principal Arterial - Other	349.0	36.7	35.9	36.6	36.6	36.9	182.8
State Urban Local	11.0	1.2	1.1	1.2	1.2	1.2	5.8
State Urban Collector	326.0	34.3	33.6	34.2	34.2	34.5	170.7
State Urban Minor Arterial	149.0	15.7	15.3	15.6	15.6	15.8	78.0
State Urban Principal Arterial - IH	303.0	31.9	31.2	31.7	31.8	32.0	158.7
State Urban Principal Arterial - Other	505.0	53.1	52.0	52.9	53.0	53.4	264.5
State Urban Principal Arterial - Freeway	384.0	40.4	39.6	40.2	40.3	40.6	201.1
TOTAL LANE MILES	4,081.0	429.4	420.3	427.6	428.4	431.7	2,137.4

AUSTIN

PROJECT LANE MILES NEEDED
CONGESTION SCENARIO: 1.25 TTI

Functional Classification	Existing Miles	Lane Miles Added by 2005	Lane Miles Added 2006 to 2010	Lane Miles Added 2011 to 2015	Lane Miles Added 2016 to 2020	Lane Miles Added 2021 to 2025	Total Lane Miles Added 2000 to 2025
Muni Urban Principal Arterial	318.0	36.5	36.0	37.0	37.3	37.8	184.6
Muni Urban Freeway	-	-	-	-	-	-	-
Cty Urban Principal Arterial	8.0	0.9	0.9	0.9	0.9	1.0	4.6
Other Local Principal Arterial	-	-	-	-	-	-	-
Other Local Urban Freeway	-	-	-	-	-	-	-
State Rural Local	-	-	-	-	-	-	-
State Rural Minor Collector	67.0	7.7	7.6	7.8	7.9	8.0	38.9
State Rural Major Collector	1,135.0	130.3	128.7	131.9	133.1	135.0	659.0
State Rural Minor Arterial	416.0	47.8	47.2	48.3	48.8	49.5	241.5
State Rural Principal Arterial - IH	110.0	12.6	12.5	12.8	12.9	13.1	63.9
State Rural Principal Arterial - Other	349.0	40.1	39.6	40.6	40.9	41.5	202.6
State Urban Local	11.0	1.3	1.2	1.3	1.3	1.3	6.4
State Urban Collector	326.0	37.4	37.0	37.9	38.2	38.8	189.3
State Urban Minor Arterial	149.0	17.1	16.9	17.3	17.5	17.7	86.5
State Urban Principal Arterial - IH	303.0	34.8	34.3	35.2	35.5	36.0	175.9
State Urban Principal Arterial - Other	505.0	58.0	57.2	58.7	59.2	60.1	293.2
State Urban Principal Arterial - Freeway	384.0	44.1	43.5	44.6	45.0	45.7	223.0
TOTAL LANE MILES	4,081.0	468.6	462.6	474.3	478.7	485.5	2,369.6

AUSTIN

PROJECT LANE MILES NEEDED
CONGESTION SCENARIO: 1.20 TTI

Functional Classification	Existing Miles	Lane Miles Added by 2005	Lane Miles Added 2006 to 2010	Lane Miles Added 2011 to 2015	Lane Miles Added 2016 to 2020	Lane Miles Added 2021 to 2025	Total Lane Miles Added 2000 to 2025
Muni Urban Principal Arterial	318.0	44.1	44.5	46.5	47.8	49.3	232.3
Muni Urban Freeway	-	-	-	-	-	-	-
Cty Urban Principal Arterial	8.0	1.1	1.1	1.2	1.2	1.2	5.8
Other Local Principal Arterial	-	-	-	-	-	-	-
Other Local Urban Freeway	-	-	-	-	-	-	-
State Rural Local	-	-	-	-	-	-	-
State Rural Minor Collector	67.0	9.3	9.4	9.8	10.1	10.4	48.9
State Rural Major Collector	1,135.0	157.5	158.9	166.0	170.6	175.9	828.9
State Rural Minor Arterial	416.0	57.7	58.2	60.8	62.5	64.5	303.8
State Rural Principal Arterial - IH	110.0	15.3	15.4	16.1	16.5	17.1	80.3
State Rural Principal Arterial - Other	349.0	48.4	48.9	51.0	52.5	54.1	254.9
State Urban Local	11.0	1.5	1.5	1.6	1.7	1.7	8.0
State Urban Collector	326.0	45.2	45.6	47.7	49.0	50.5	238.1
State Urban Minor Arterial	149.0	20.7	20.9	21.8	22.4	23.1	108.8
State Urban Principal Arterial - IH	303.0	42.1	42.4	44.3	45.5	47.0	221.3
State Urban Principal Arterial - Other	505.0	70.1	70.7	73.9	75.9	78.3	368.8
State Urban Principal Arterial - Freeway	384.0	53.3	53.8	56.2	57.7	59.5	280.5
TOTAL LANE MILES	4,081.0	566.4	571.3	596.9	613.3	632.6	2,980.5

AUSTIN

PROJECT LANE MILES NEEDED
CONGESTION SCENARIO: 1.15 TTI

Functional Classification	Existing Miles	Lane Miles Added by 2005	Lane Miles Added 2006 to 2010	Lane Miles Added 2011 to 2015	Lane Miles Added 2016 to 2020	Lane Miles Added 2021 to 2025	Total Lane Miles Added 2000 to 2025
Muni Urban Principal Arterial	318.0	51.8	53.3	56.8	59.3	62.2	283.4
Muni Urban Freeway	-	-	-	-	-	-	-
Cty Urban Principal Arterial	8.0	1.3	1.3	1.4	1.5	1.6	7.1
Other Local Principal Arterial	-	-	-	-	-	-	-
Other Local Urban Freeway	-	-	-	-	-	-	-
State Rural Local	-	-	-	-	-	-	-
State Rural Minor Collector	67.0	10.9	11.2	12.0	12.5	13.1	59.7
State Rural Major Collector	1,135.0	184.7	190.3	202.6	211.8	222.1	1,011.4
State Rural Minor Arterial	416.0	67.7	69.7	74.2	77.6	81.4	370.7
State Rural Principal Arterial - IH	110.0	17.9	18.4	19.6	20.5	21.5	98.0
State Rural Principal Arterial - Other	349.0	56.8	58.5	62.3	65.1	68.3	311.0
State Urban Local	11.0	1.8	1.8	2.0	2.1	2.2	9.8
State Urban Collector	326.0	53.1	54.6	58.2	60.8	63.8	290.5
State Urban Minor Arterial	149.0	24.3	25.0	26.6	27.8	29.2	132.8
State Urban Principal Arterial - IH	303.0	49.3	50.8	54.1	56.5	59.3	270.0
State Urban Principal Arterial - Other	505.0	82.2	84.7	90.1	94.2	98.8	450.0
State Urban Principal Arterial - Freeway	384.0	62.5	64.4	68.5	71.7	75.1	342.2
TOTAL LANE MILES	4,081.0	664.3	684.1	728.3	761.6	798.4	3,636.7

DALLAS

PROJECT LANE MILES NEEDED
CONGESTION SCENARIO: Maintain Existing TTI (1.33)

Functional Classification	Existing Miles	Lane Miles Added by 2005	Lane Miles Added 2006 to 2010	Lane Miles Added 2011 to 2015	Lane Miles Added 2016 to 2020	Lane Miles Added 2021 to 2025	Total Lane Miles Added 2000 to 2025
Muni Urban Principal Arterial	1,359.0	157.3	165.5	176.8	190.7	206.4	896.8
Muni Urban Freeway	114.0	13.2	13.9	14.8	16.0	17.3	75.2
Cty Urban Principal Arterial	4.0	0.5	0.5	0.5	0.6	0.6	2.6
Other Local Principal Arterial	169.0	19.6	20.6	22.0	23.7	25.7	111.5
Other Local Urban Freeway	-	-	-	-	-	-	-
State Rural Local	6.0	0.7	0.7	0.8	0.8	0.9	4.0
State Rural Minor Collector	901.0	104.3	109.7	117.2	126.5	136.9	594.6
State Rural Major Collector	1,796.0	207.8	218.7	233.7	252.1	272.8	1,185.2
State Rural Minor Arterial	315.0	36.5	38.4	41.0	44.2	47.9	207.9
State Rural Principal Arterial - IH	390.0	45.1	47.5	50.7	54.7	59.2	257.4
State Rural Principal Arterial - Other	435.0	50.3	53.0	56.6	61.1	66.1	287.1
State Urban Local	10.0	1.2	1.2	1.3	1.4	1.5	6.6
State Urban Collector	1,095.0	126.7	133.4	142.5	153.7	166.3	722.6
State Urban Minor Arterial	440.0	50.9	53.6	57.3	61.8	66.8	290.3
State Urban Principal Arterial - IH	1,336.0	154.6	162.7	173.8	187.5	202.9	881.6
State Urban Principal Arterial - Other	1,252.0	144.9	152.5	162.9	175.7	190.2	826.2
State Urban Principal Arterial - Freeway	791.0	91.5	96.3	102.9	111.0	120.2	522.0
TOTAL LANE MILES	10,413.0	1,205.0	1,268.2	1,355.0	1,461.5	1,581.8	6,871.4

DALLAS

PROJECT LANE MILES NEEDED
CONGESTION SCENARIO: 1.25 TTI

Functional Classification	Existing Miles	Lane Miles Added by 2005	Lane Miles Added 2006 to 2010	Lane Miles Added 2011 to 2015	Lane Miles Added 2016 to 2020	Lane Miles Added 2021 to 2025	Total Lane Miles Added 2000 to 2025
Muni Urban Principal Arterial	1,359.0	204.2	221.5	243.6	270.3	300.6	1,240.2
Muni Urban Freeway	114.0	17.1	18.6	20.4	22.7	25.2	104.0
Cty Urban Principal Arterial	4.0	0.6	0.7	0.7	0.8	0.9	3.7
Other Local Principal Arterial	169.0	25.4	27.5	30.3	33.6	37.4	154.2
Other Local Urban Freeway	-	-	-	-	-	-	-
State Rural Local	6.0	0.9	1.0	1.1	1.2	1.3	5.5
State Rural Minor Collector	901.0	135.4	146.9	161.5	179.2	199.3	822.3
State Rural Major Collector	1,796.0	269.8	292.8	322.0	357.2	397.3	1,639.0
State Rural Minor Arterial	315.0	47.3	51.3	56.5	62.6	69.7	287.5
State Rural Principal Arterial - IH	390.0	58.6	63.6	69.9	77.6	86.3	355.9
State Rural Principal Arterial - Other	435.0	65.4	70.9	78.0	86.5	96.2	397.0
State Urban Local	10.0	1.5	1.6	1.8	2.0	2.2	9.1
State Urban Collector	1,095.0	164.5	178.5	196.3	217.8	242.2	999.3
State Urban Minor Arterial	440.0	66.1	71.7	78.9	87.5	97.3	401.5
State Urban Principal Arterial - IH	1,336.0	200.7	217.8	239.5	265.7	295.5	1,219.2
State Urban Principal Arterial - Other	1,252.0	188.1	204.1	224.5	249.0	277.0	1,142.6
State Urban Principal Arterial - Freeway	791.0	118.8	128.9	141.8	157.3	175.0	721.9
TOTAL LANE MILES	10,413.0	1,564.5	1,697.4	1,866.9	2,070.8	2,303.5	9,503.0

DALLAS

PROJECT LANE MILES NEEDED
CONGESTION SCENARIO: 1.20 TTI

Functional Classification	Existing Miles	Lane Miles Added by 2005	Lane Miles Added 2006 to 2010	Lane Miles Added 2011 to 2015	Lane Miles Added 2016 to 2020	Lane Miles Added 2021 to 2025	Total Lane Miles Added 2000 to 2025
Muni Urban Principal Arterial	1,359.0	233.5	258.1	288.9	326.0	368.8	1,475.3
Muni Urban Freeway	114.0	19.6	21.7	24.2	27.3	30.9	123.8
Cty Urban Principal Arterial	4.0	0.7	0.8	0.9	1.0	1.1	4.3
Other Local Principal Arterial	169.0	29.0	32.1	35.9	40.5	45.9	183.5
Other Local Urban Freeway	-	-	-	-	-	-	-
State Rural Local	6.0	1.0	1.1	1.3	1.4	1.6	6.5
State Rural Minor Collector	901.0	154.8	171.1	191.6	216.1	244.5	978.1
State Rural Major Collector	1,796.0	308.6	341.1	381.8	430.8	487.3	1,949.7
State Rural Minor Arterial	315.0	54.1	59.8	67.0	75.6	85.5	342.0
State Rural Principal Arterial - IH	390.0	67.0	74.1	82.9	93.6	105.8	423.4
State Rural Principal Arterial - Other	435.0	74.7	82.6	92.5	104.4	118.0	472.2
State Urban Local	10.0	1.7	1.9	2.1	2.4	2.7	10.9
State Urban Collector	1,095.0	188.1	208.0	232.8	262.7	297.1	1,188.7
State Urban Minor Arterial	440.0	75.6	83.6	93.5	105.6	119.4	477.7
State Urban Principal Arterial - IH	1,336.0	229.5	253.7	284.0	320.5	362.5	1,450.3
State Urban Principal Arterial - Other	1,252.0	215.1	237.8	266.2	300.3	339.7	1,359.1
State Urban Principal Arterial - Freeway	791.0	135.9	150.2	168.2	189.8	214.6	858.7
TOTAL LANE MILES	10,413.0	1,789.1	1,977.6	2,213.8	2,498.0	2,825.6	11,304.1

DALLAS

PROJECT LANE MILES NEEDED
CONGESTION SCENARIO: 1.15 TTI

Functional Classification	Existing Miles	Lane Miles Added by 2005	Lane Miles Added 2006 to 2010	Lane Miles Added 2011 to 2015	Lane Miles Added 2016 to 2020	Lane Miles Added 2021 to 2025	Total Lane Miles Added 2000 to 2025
Muni Urban Principal Arterial	1,359.0	262.8	295.9	337.0	386.7	444.7	1,727.0
Muni Urban Freeway	114.0	22.0	24.8	28.3	32.4	37.3	144.9
Cty Urban Principal Arterial	4.0	0.8	0.9	1.0	1.1	1.3	5.1
Other Local Principal Arterial	169.0	32.7	36.8	41.9	48.1	55.3	214.8
Other Local Urban Freeway	-	-	-	-	-	-	-
State Rural Local	6.0	1.2	1.3	1.5	1.7	2.0	7.6
State Rural Minor Collector	901.0	174.2	196.1	223.4	256.4	294.8	1,145.0
State Rural Major Collector	1,796.0	347.3	391.0	445.4	511.0	587.7	2,282.4
State Rural Minor Arterial	315.0	60.9	68.6	78.1	89.6	103.1	400.3
State Rural Principal Arterial - IH	390.0	75.4	84.9	96.7	111.0	127.6	495.6
State Rural Principal Arterial - Other	435.0	84.1	94.7	107.9	123.8	142.3	552.8
State Urban Local	10.0	1.9	2.2	2.5	2.8	3.3	12.7
State Urban Collector	1,095.0	211.8	238.4	271.5	311.6	358.3	1,391.6
State Urban Minor Arterial	440.0	85.1	95.8	109.1	125.2	144.0	559.2
State Urban Principal Arterial - IH	1,336.0	258.4	290.9	331.3	380.2	437.2	1,697.8
State Urban Principal Arterial - Other	1,252.0	242.1	272.6	310.5	356.3	409.7	1,591.1
State Urban Principal Arterial - Freeway	791.0	153.0	172.2	196.1	225.1	258.8	1,005.2
TOTAL LANE MILES	10,413.0	2,013.8	2,266.9	2,582.1	2,963.0	3,407.2	13,233.1

FT. WORTH

PROJECT LANE MILES NEEDED
CONGESTION SCENARIO: Maintain Existing TTI (1.33)

Functional Classification	Existing Miles	Lane Miles Added by 2005	Lane Miles Added 2006 to 2010	Lane Miles Added 2011 to 2015	Lane Miles Added 2016 to 2020	Lane Miles Added 2021 to 2025	Total Lane Miles Added 2000 to 2025
Muni Urban Principal Arterial	733.0	61.3	62.6	66.8	70.4	73.3	334.4
Muni Urban Freeway	70.0	5.9	6.0	6.4	6.7	7.0	31.9
Cty Urban Principal Arterial	6.0	0.5	0.5	0.5	0.6	0.6	2.7
Other Local Principal Arterial	-	-	-	-	-	-	-
Other Local Urban Freeway	-	-	-	-	-	-	-
State Rural Local	4.0	0.3	0.3	0.4	0.4	0.4	1.8
State Rural Minor Collector	175.0	14.6	14.9	16.0	16.8	17.5	79.8
State Rural Major Collector	919.0	76.8	78.4	83.8	88.3	91.9	419.2
State Rural Minor Arterial	95.0	7.9	8.1	8.7	9.1	9.5	43.3
State Rural Principal Arterial - IH	201.0	16.8	17.2	18.3	19.3	20.1	91.7
State Rural Principal Arterial - Other	227.0	19.0	19.4	20.7	21.8	22.7	103.6
State Urban Local	15.0	1.3	1.3	1.4	1.4	1.5	6.8
State Urban Collector	719.0	60.1	61.4	65.6	69.1	71.9	328.0
State Urban Minor Arterial	208.0	17.4	17.8	19.0	20.0	20.8	94.9
State Urban Principal Arterial - IH	812.0	67.9	69.3	74.0	78.0	81.2	370.4
State Urban Principal Arterial - Other	967.0	80.8	82.5	88.2	92.9	96.7	441.1
State Urban Principal Arterial - Freeway	498.0	41.6	42.5	45.4	47.9	49.8	227.2
TOTAL LANE MILES	5,649.0	472.2	482.1	515.0	542.8	564.8	2,576.9

FT. WORTH

PROJECT LANE MILES NEEDED
CONGESTION SCENARIO: 1.25 TTI

Functional Classification	Existing Miles	Lane Miles Added by 2005	Lane Miles Added 2006 to 2010	Lane Miles Added 2011 to 2015	Lane Miles Added 2016 to 2020	Lane Miles Added 2021 to 2025	Total Lane Miles Added 2000 to 2025
Muni Urban Principal Arterial	733.0	79.5	83.1	90.7	97.7	103.7	454.7
Muni Urban Freeway	70.0	7.6	7.9	8.7	9.3	9.9	43.4
Cty Urban Principal Arterial	6.0	0.7	0.7	0.7	0.8	0.8	3.7
Other Local Principal Arterial	-	-	-	-	-	-	-
Other Local Urban Freeway	-	-	-	-	-	-	-
State Rural Local	4.0	0.4	0.5	0.5	0.5	0.6	2.5
State Rural Minor Collector	175.0	19.0	19.8	21.7	23.3	24.8	108.6
State Rural Major Collector	919.0	99.7	104.2	113.7	122.4	130.1	570.1
State Rural Minor Arterial	95.0	10.3	10.8	11.8	12.7	13.4	58.9
State Rural Principal Arterial - IH	201.0	21.8	22.8	24.9	26.8	28.4	124.7
State Rural Principal Arterial - Other	227.0	24.6	25.7	28.1	30.2	32.1	140.8
State Urban Local	15.0	1.6	1.7	1.9	2.0	2.1	9.3
State Urban Collector	719.0	78.0	81.5	89.0	95.8	101.8	446.0
State Urban Minor Arterial	208.0	22.6	23.6	25.7	27.7	29.4	129.0
State Urban Principal Arterial - IH	812.0	88.1	92.0	100.5	108.2	114.9	503.7
State Urban Principal Arterial - Other	967.0	104.9	109.6	119.7	128.8	136.9	599.9
State Urban Principal Arterial - Freeway	498.0	54.0	56.5	61.6	66.3	70.5	308.9
TOTAL LANE MILES	5,649.0	613.0	640.3	699.0	752.6	799.5	3,504.5

FT. WORTH

PROJECT LANE MILES NEEDED
CONGESTION SCENARIO: 1.20 TTI

Functional Classification	Existing Miles	Lane Miles Added by 2005	Lane Miles Added 2006 to 2010	Lane Miles Added 2011 to 2015	Lane Miles Added 2016 to 2020	Lane Miles Added 2021 to 2025	Total Lane Miles Added 2000 to 2025
Muni Urban Principal Arterial	733.0	91.0	96.4	106.6	116.3	125.1	535.3
Muni Urban Freeway	70.0	8.7	9.2	10.2	11.1	11.9	51.1
Cty Urban Principal Arterial	6.0	0.7	0.8	0.9	1.0	1.0	4.4
Other Local Principal Arterial	-	-	-	-	-	-	-
Other Local Urban Freeway	-	-	-	-	-	-	-
State Rural Local	4.0	0.5	0.5	0.6	0.6	0.7	2.9
State Rural Minor Collector	175.0	21.7	23.0	25.4	27.8	29.9	127.8
State Rural Major Collector	919.0	114.1	120.8	133.6	145.8	156.9	671.1
State Rural Minor Arterial	95.0	11.8	12.5	13.8	15.1	16.2	69.4
State Rural Principal Arterial - IH	201.0	24.9	26.4	29.2	31.9	34.3	146.8
State Rural Principal Arterial - Other	227.0	28.2	29.8	33.0	36.0	38.7	165.8
State Urban Local	15.0	1.9	2.0	2.2	2.4	2.6	11.0
State Urban Collector	719.0	89.2	94.5	104.5	114.0	122.7	525.1
State Urban Minor Arterial	208.0	25.8	27.3	30.2	33.0	35.5	151.9
State Urban Principal Arterial - IH	812.0	100.8	106.7	118.1	128.8	138.6	593.0
State Urban Principal Arterial - Other	967.0	120.0	127.1	140.6	153.4	165.1	706.2
State Urban Principal Arterial - Freeway	498.0	61.8	65.5	72.4	79.0	85.0	363.7
TOTAL LANE MILES	5,649.0	701.1	742.6	821.4	896.1	964.3	4,125.5

FT. WORTH

PROJECT LANE MILES NEEDED
CONGESTION SCENARIO: 1.15 TTI

Functional Classification	Existing Miles	Lane Miles Added by 2005	Lane Miles Added 2006 to 2010	Lane Miles Added 2011 to 2015	Lane Miles Added 2016 to 2020	Lane Miles Added 2021 to 2025	Total Lane Miles Added 2000 to 2025
Muni Urban Principal Arterial	733.0	102.4	110.0	123.2	136.2	148.4	620.2
Muni Urban Freeway	70.0	9.8	10.5	11.8	13.0	14.2	59.2
Cty Urban Principal Arterial	6.0	0.8	0.9	1.0	1.1	1.2	5.1
Other Local Principal Arterial	-	-	-	-	-	-	-
Other Local Urban Freeway	-	-	-	-	-	-	-
State Rural Local	4.0	0.6	0.6	0.7	0.7	0.8	3.4
State Rural Minor Collector	175.0	24.4	26.3	29.4	32.5	35.4	148.1
State Rural Major Collector	919.0	128.4	137.9	154.5	170.7	186.1	777.6
State Rural Minor Arterial	95.0	13.3	14.3	16.0	17.6	19.2	80.4
State Rural Principal Arterial - IH	201.0	28.1	30.2	33.8	37.3	40.7	170.1
State Rural Principal Arterial - Other	227.0	31.7	34.1	38.2	42.2	46.0	192.1
State Urban Local	15.0	2.1	2.3	2.5	2.8	3.0	12.7
State Urban Collector	719.0	100.4	107.9	120.9	133.6	145.6	608.4
State Urban Minor Arterial	208.0	29.1	31.2	35.0	38.6	42.1	176.0
State Urban Principal Arterial - IH	812.0	113.4	121.8	136.5	150.9	164.4	687.0
State Urban Principal Arterial - Other	967.0	135.1	145.1	162.6	179.7	195.8	818.2
State Urban Principal Arterial - Freeway	498.0	69.6	74.7	83.7	92.5	100.8	421.4
TOTAL LANE MILES	5,649.0	789.1	847.4	949.7	1,049.5	1,143.9	4,779.7

HOUSTON

PROJECT LANE MILES NEEDED
CONGESTION SCENARIO: Maintain Existing TTI (1.38)

Functional Classification	Existing Miles	Lane Miles Added by 2005	Lane Miles Added 2006 to 2010	Lane Miles Added 2011 to 2015	Lane Miles Added 2016 to 2020	Lane Miles Added 2021 to 2025	Total Lane Miles Added 2000 to 2025
Muni Urban Principal Arterial	989.0	96.5	100.1	106.0	112.2	116.7	531.5
Muni Urban Freeway	32.0	3.1	3.2	3.4	3.6	3.8	17.2
Cty Urban Principal Arterial	257.0	25.1	26.0	27.5	29.2	30.3	138.1
Other Local Principal Arterial	120.0	11.7	12.1	12.9	13.6	14.2	64.5
Other Local Urban Freeway	302.0	29.5	30.6	32.4	34.3	35.6	162.3
State Rural Local	45.0	4.4	4.6	4.8	5.1	5.3	24.2
State Rural Minor Collector	428.0	41.7	43.3	45.9	48.6	50.5	230.0
State Rural Major Collector	1,781.0	173.7	180.3	190.8	202.1	210.1	957.1
State Rural Minor Arterial	836.0	81.5	84.6	89.6	94.9	98.6	449.2
State Rural Principal Arterial - IH	188.0	18.3	19.0	20.1	21.3	22.2	101.0
State Rural Principal Arterial - Other	1,003.0	97.8	101.5	107.5	113.8	118.3	539.0
State Urban Local	44.0	4.3	4.5	4.7	5.0	5.2	23.6
State Urban Collector	1,095.0	106.8	110.8	117.3	124.3	129.2	588.4
State Urban Minor Arterial	495.0	48.3	50.1	53.0	56.2	58.4	266.0
State Urban Principal Arterial - IH	1,209.0	117.9	122.4	129.5	137.2	142.7	649.7
State Urban Principal Arterial - Other	2,165.0	211.2	219.1	232.0	245.7	255.4	1,163.4
State Urban Principal Arterial - Freeway	1,213.0	118.3	122.8	130.0	137.7	143.1	651.8
TOTAL LANE MILES	12,202.0	1,190.2	1,235.0	1,307.3	1,384.9	1,439.7	6,557.1

HOUSTON

PROJECT LANE MILES NEEDED
CONGESTION SCENARIO: 1.25 TTI

Functional Classification	Existing Miles	Lane Miles Added by 2005	Lane Miles Added 2006 to 2010	Lane Miles Added 2011 to 2015	Lane Miles Added 2016 to 2020	Lane Miles Added 2021 to 2025	Total Lane Miles Added 2000 to 2025
Muni Urban Principal Arterial	989.0	137.1	147.6	161.8	177.3	190.5	814.2
Muni Urban Freeway	32.0	4.4	4.8	5.2	5.7	6.2	26.3
Cty Urban Principal Arterial	257.0	35.6	38.3	42.0	46.1	49.5	211.6
Other Local Principal Arterial	120.0	16.6	17.9	19.6	21.5	23.1	98.8
Other Local Urban Freeway	302.0	41.9	45.1	49.4	54.1	58.2	248.6
State Rural Local	45.0	6.2	6.7	7.4	8.1	8.7	37.0
State Rural Minor Collector	428.0	59.3	63.9	70.0	76.7	82.4	352.3
State Rural Major Collector	1,781.0	246.9	265.7	291.3	319.2	343.0	1,466.2
State Rural Minor Arterial	836.0	115.9	124.7	136.7	149.8	161.0	688.2
State Rural Principal Arterial - IH	188.0	26.1	28.1	30.7	33.7	36.2	154.8
State Rural Principal Arterial - Other	1,003.0	139.0	149.7	164.0	179.8	193.2	825.7
State Urban Local	44.0	6.1	6.6	7.2	7.9	8.5	36.2
State Urban Collector	1,095.0	151.8	163.4	179.1	196.3	210.9	901.4
State Urban Minor Arterial	495.0	68.6	73.9	81.0	88.7	95.3	407.5
State Urban Principal Arterial - IH	1,209.0	167.6	180.4	197.7	216.7	232.9	995.3
State Urban Principal Arterial - Other	2,165.0	300.1	323.0	354.1	388.1	417.0	1,782.3
State Urban Principal Arterial - Freeway	1,213.0	168.1	181.0	198.4	217.4	233.6	998.6
TOTAL LANE MILES	12,202.0	1,691.3	1,820.6	1,995.7	2,187.1	2,350.3	10,044.9

HOUSTON

PROJECT LANE MILES NEEDED
CONGESTION SCENARIO: 1.20 TTI

Functional Classification	Existing Miles	Lane Miles Added by 2005	Lane Miles Added 2006 to 2010	Lane Miles Added 2011 to 2015	Lane Miles Added 2016 to 2020	Lane Miles Added 2021 to 2025	Total Lane Miles Added 2000 to 2025
Muni Urban Principal Arterial	989.0	152.7	166.7	185.1	205.5	223.5	933.5
Muni Urban Freeway	32.0	4.9	5.4	6.0	6.6	7.2	30.2
Cty Urban Principal Arterial	257.0	39.7	43.3	48.1	53.4	58.1	242.6
Other Local Principal Arterial	120.0	18.5	20.2	22.5	24.9	27.1	113.3
Other Local Urban Freeway	302.0	46.6	50.9	56.5	62.7	68.3	285.0
State Rural Local	45.0	6.9	7.6	8.4	9.3	10.2	42.5
State Rural Minor Collector	428.0	66.1	72.1	80.1	88.9	96.7	404.0
State Rural Major Collector	1,781.0	275.0	300.1	333.3	370.0	402.6	1,681.0
State Rural Minor Arterial	836.0	129.1	140.9	156.5	173.7	189.0	789.1
State Rural Principal Arterial - IH	188.0	29.0	31.7	35.2	39.1	42.5	177.4
State Rural Principal Arterial - Other	1,003.0	154.9	169.0	187.7	208.4	226.7	946.7
State Urban Local	44.0	6.8	7.4	8.2	9.1	9.9	41.5
State Urban Collector	1,095.0	169.1	184.5	204.9	227.5	247.5	1,033.5
State Urban Minor Arterial	495.0	76.4	83.4	92.6	102.8	111.9	467.2
State Urban Principal Arterial - IH	1,209.0	186.7	203.7	226.3	251.2	273.3	1,141.1
State Urban Principal Arterial - Other	2,165.0	334.3	364.8	405.2	449.8	489.4	2,043.4
State Urban Principal Arterial - Freeway	1,213.0	187.3	204.4	227.0	252.0	274.2	1,144.9
TOTAL LANE MILES	12,202.0	1,884.0	2,056.2	2,283.7	2,534.9	2,758.1	11,516.8

HOUSTON

PROJECT LANE MILES NEEDED
CONGESTION SCENARIO: 1.15 TTI

Functional Classification	Existing Miles	Lane Miles Added by 2005	Lane Miles Added 2006 to 2010	Lane Miles Added 2011 to 2015	Lane Miles Added 2016 to 2020	Lane Miles Added 2021 to 2025	Total Lane Miles Added 2000 to 2025
Muni Urban Principal Arterial	989.0	168.3	186.2	209.5	235.5	259.4	1,059.0
Muni Urban Freeway	32.0	5.4	6.0	6.8	7.6	8.4	34.3
Cty Urban Principal Arterial	257.0	43.7	48.4	54.4	61.2	67.4	275.2
Other Local Principal Arterial	120.0	20.4	22.6	25.4	28.6	31.5	128.5
Other Local Urban Freeway	302.0	51.4	56.9	64.0	71.9	79.2	323.4
State Rural Local	45.0	7.7	8.5	9.5	10.7	11.8	48.2
State Rural Minor Collector	428.0	72.8	80.6	90.7	101.9	112.3	458.3
State Rural Major Collector	1,781.0	303.1	335.3	377.3	424.1	467.2	1,907.0
State Rural Minor Arterial	836.0	142.3	157.4	177.1	199.1	219.3	895.2
State Rural Principal Arterial - IH	188.0	32.0	35.4	39.8	44.8	49.3	201.3
State Rural Principal Arterial - Other	1,003.0	170.7	188.9	212.5	238.8	263.1	1,074.0
State Urban Local	44.0	7.5	8.3	9.3	10.5	11.5	47.1
State Urban Collector	1,095.0	186.4	206.2	232.0	260.8	287.2	1,172.5
State Urban Minor Arterial	495.0	84.2	93.2	104.9	117.9	129.8	530.0
State Urban Principal Arterial - IH	1,209.0	205.8	227.6	256.1	287.9	317.1	1,294.6
State Urban Principal Arterial - Other	2,165.0	368.5	407.6	458.7	515.6	567.9	2,318.2
State Urban Principal Arterial - Freeway	1,213.0	206.4	228.4	257.0	288.9	318.2	1,298.8
TOTAL LANE MILES	12,202.0	2,076.7	2,297.5	2,585.0	2,905.7	3,200.7	13,065.5

SAN ANTONIO

PROJECT LANE MILES NEEDED
CONGESTION SCENARIO: Maintain Existing TTI (1.23)

Functional Classification	Existing Miles	Lane Miles Added by 2005	Lane Miles Added 2006 to 2010	Lane Miles Added 2011 to 2015	Lane Miles Added 2016 to 2020	Lane Miles Added 2021 to 2025	Total Lane Miles Added 2000 to 2025
Muni Urban Principal Arterial	330.0	27.1	27.5	28.6	28.6	27.8	139.7
Muni Urban Freeway	-	-	-	-	-	-	-
Cty Urban Principal Arterial	4.0	0.3	0.3	0.3	0.3	0.3	1.7
Other Local Principal Arterial	-	-	-	-	-	-	-
Other Local Urban Freeway	-	-	-	-	-	-	-
State Rural Local	-	-	-	-	-	-	-
State Rural Minor Collector	165.1	13.6	13.8	14.3	14.3	13.9	69.9
State Rural Major Collector	938.2	77.0	78.3	81.3	81.4	79.2	397.2
State Rural Minor Arterial	298.0	24.5	24.9	25.8	25.9	25.1	126.2
State Rural Principal Arterial - IH	261.4	21.5	21.8	22.7	22.7	22.1	110.7
State Rural Principal Arterial - Other	78.5	6.4	6.6	6.8	6.8	6.6	33.2
State Urban Local	10.7	0.9	0.9	0.9	0.9	0.9	4.5
State Urban Collector	628.1	51.6	52.4	54.4	54.5	53.0	265.9
State Urban Minor Arterial	261.3	21.5	21.8	22.7	22.7	22.0	110.6
State Urban Principal Arterial - IH	800.8	65.8	66.8	69.4	69.5	67.6	339.1
State Urban Principal Arterial - Other	768.3	63.1	64.1	66.6	66.7	64.8	325.3
State Urban Principal Arterial - Freeway	342.7	28.1	28.6	29.7	29.7	28.9	145.1
TOTAL LANE MILES	4,887.1	401.3	407.9	423.7	424.0	412.4	2,069.2

SAN ANTONIO

PROJECT LANE MILES NEEDED
CONGESTION SCENARIO: 1.25 TTI

Functional Classification	Existing Miles	Lane Miles Added by 2005	Lane Miles Added 2006 to 2010	Lane Miles Added 2011 to 2015	Lane Miles Added 2016 to 2020	Lane Miles Added 2021 to 2025	Total Lane Miles Added 2000 to 2025
Muni Urban Principal Arterial	330.0	27.1	27.5	28.6	28.6	27.8	139.7
Muni Urban Freeway	-	-	-	-	-	-	-
Cty Urban Principal Arterial	4.0	0.3	0.3	0.3	0.3	0.3	1.7
Other Local Principal Arterial	-	-	-	-	-	-	-
Other Local Urban Freeway	-	-	-	-	-	-	-
State Rural Local	-	-	-	-	-	-	-
State Rural Minor Collector	165.1	13.6	13.8	14.3	14.3	13.9	69.9
State Rural Major Collector	938.2	77.0	78.3	81.3	81.4	79.2	397.2
State Rural Minor Arterial	298.0	24.5	24.9	25.8	25.9	25.1	126.2
State Rural Principal Arterial - IH	261.4	21.5	21.8	22.7	22.7	22.1	110.7
State Rural Principal Arterial - Other	78.5	6.4	6.6	6.8	6.8	6.6	33.2
State Urban Local	10.7	0.9	0.9	0.9	0.9	0.9	4.5
State Urban Collector	628.1	51.6	52.4	54.4	54.5	53.0	265.9
State Urban Minor Arterial	261.3	21.5	21.8	22.7	22.7	22.0	110.6
State Urban Principal Arterial - IH	800.8	65.8	66.8	69.4	69.5	67.6	339.1
State Urban Principal Arterial - Other	768.3	63.1	64.1	66.6	66.7	64.8	325.3
State Urban Principal Arterial - Freeway	342.7	28.1	28.6	29.7	29.7	28.9	145.1
TOTAL LANE MILES	4,887.1	401.3	407.9	423.7	424.0	412.4	2,069.2

SAN ANTONIO

PROJECT LANE MILES NEEDED
CONGESTION SCENARIO: 1.20 TTI

Functional Classification	Existing Miles	Lane Miles Added by 2005	Lane Miles Added 2006 to 2010	Lane Miles Added 2011 to 2015	Lane Miles Added 2016 to 2020	Lane Miles Added 2021 to 2025	Total Lane Miles Added 2000 to 2025
Muni Urban Principal Arterial	330.0	33.8	35.0	37.0	37.6	37.2	180.5
Muni Urban Freeway	-	-	-	-	-	-	-
Cty Urban Principal Arterial	4.0	0.4	0.4	0.4	0.5	0.5	2.2
Other Local Principal Arterial	-	-	-	-	-	-	-
Other Local Urban Freeway	-	-	-	-	-	-	-
State Rural Local	-	-	-	-	-	-	-
State Rural Minor Collector	165.1	16.9	17.5	18.5	18.8	18.6	90.3
State Rural Major Collector	938.2	96.0	99.4	105.1	106.9	105.7	513.1
State Rural Minor Arterial	298.0	30.5	31.6	33.4	34.0	33.6	163.0
State Rural Principal Arterial - IH	261.4	26.7	27.7	29.3	29.8	29.4	143.0
State Rural Principal Arterial - Other	78.5	8.0	8.3	8.8	8.9	8.8	42.9
State Urban Local	10.7	1.1	1.1	1.2	1.2	1.2	5.9
State Urban Collector	628.1	64.3	66.5	70.3	71.6	70.7	343.5
State Urban Minor Arterial	261.3	26.7	27.7	29.3	29.8	29.4	142.9
State Urban Principal Arterial - IH	800.8	81.9	84.8	89.7	91.3	90.2	437.9
State Urban Principal Arterial - Other	768.3	78.6	81.4	86.0	87.6	86.5	420.2
State Urban Principal Arterial - Freeway	342.7	35.1	36.3	38.4	39.1	38.6	187.4
TOTAL LANE MILES	4,887.1	500.0	517.8	547.3	557.1	550.4	2,672.6

SAN ANTONIO

PROJECT LANE MILES NEEDED
CONGESTION SCENARIO: 1.15 TTI

Functional Classification	Existing Miles	Lane Miles Added by 2005	Lane Miles Added 2006 to 2010	Lane Miles Added 2011 to 2015	Lane Miles Added 2016 to 2020	Lane Miles Added 2021 to 2025	Total Lane Miles Added 2000 to 2025
Muni Urban Principal Arterial	330.0	40.4	42.6	45.8	47.5	47.6	224.0
Muni Urban Freeway	-	-	-	-	-	-	-
Cty Urban Principal Arterial	4.0	0.5	0.5	0.6	0.6	0.6	2.7
Other Local Principal Arterial	-	-	-	-	-	-	-
Other Local Urban Freeway	-	-	-	-	-	-	-
State Rural Local	-	-	-	-	-	-	-
State Rural Minor Collector	165.1	20.2	21.3	22.9	23.7	23.8	112.1
State Rural Major Collector	938.2	115.0	121.2	130.3	134.9	135.4	636.8
State Rural Minor Arterial	298.0	36.5	38.5	41.4	42.8	43.0	202.3
State Rural Principal Arterial - IH	261.4	32.0	33.8	36.3	37.6	37.7	177.4
State Rural Principal Arterial - Other	78.5	9.6	10.1	10.9	11.3	11.3	53.3
State Urban Local	10.7	1.3	1.4	1.5	1.5	1.5	7.3
State Urban Collector	628.1	77.0	81.1	87.3	90.3	90.6	426.3
State Urban Minor Arterial	261.3	32.0	33.8	36.3	37.6	37.7	177.4
State Urban Principal Arterial - IH	800.8	98.1	103.5	111.2	115.1	115.6	543.5
State Urban Principal Arterial - Other	768.3	94.1	99.3	106.7	110.5	110.9	521.5
State Urban Principal Arterial - Freeway	342.7	42.0	44.3	47.6	49.3	49.4	232.6
TOTAL LANE MILES	4,887.1	598.8	631.4	678.9	702.7	705.2	3,317.0

THE BORDER

PROJECT LANE MILES NEEDED
CONGESTION SCENARIO: Maintain Existing TTI (1.13)

Functional Classification	Existing Miles	Lane Miles Added by 2005	Lane Miles Added 2006 to 2010	Lane Miles Added 2011 to 2015	Lane Miles Added 2016 to 2020	Lane Miles Added 2021 to 2025	Total Lane Miles Added 2000 to 2025
Muni Urban Principal Arterial	333.0	43.8	47.2	51.4	53.1	55.5	251.0
Muni Urban Freeway	-	-	-	-	-	-	-
Cty Urban Principal Arterial	-	-	-	-	-	-	-
Other Local Principal Arterial	6.0	0.8	0.9	0.9	1.0	1.0	4.5
Other Local Urban Freeway	2.0	0.3	0.3	0.3	0.3	0.3	1.5
State Rural Local	22.4	2.9	3.2	3.5	3.6	3.7	16.9
State Rural Minor Collector	427.2	56.1	60.6	65.9	68.1	71.2	322.0
State Rural Major Collector	1,582.3	207.9	224.5	244.2	252.3	263.6	1,192.6
State Rural Minor Arterial	272.7	35.8	38.7	42.1	43.5	45.4	205.5
State Rural Principal Arterial - IH	223.7	29.4	31.7	34.5	35.7	37.3	168.6
State Rural Principal Arterial - Other	766.3	100.7	108.7	118.3	122.2	127.7	577.5
State Urban Local	9.3	1.2	1.3	1.4	1.5	1.5	7.0
State Urban Collector	534.7	70.3	75.9	82.5	85.3	89.1	403.0
State Urban Minor Arterial	476.5	62.6	67.6	73.6	76.0	79.4	359.1
State Urban Principal Arterial - IH	259.7	34.1	36.8	40.1	41.4	43.3	195.7
State Urban Principal Arterial - Other	1,216.9	159.9	172.7	187.8	194.0	202.7	917.2
State Urban Principal Arterial - Freeway	335.8	44.1	47.6	51.8	53.5	55.9	253.1
TOTAL LANE MILES	6,468.5	849.9	917.8	998.5	1,031.4	1,077.6	4,875.2

Construction Costs Used in the Cost Estimation Model

Functional Classification	Cost Per Lane Mile in millions $
State Rural Local	.465
State Rural Minor Collector	.465
State Rural Major Collector	.465
State Rural Minor Arterial	.465
State Rural Principal Arterial - IH	.750
State Rural Principal Arterial - Other	.465
State Urban Local	.618
State Urban Collector	.618
State Urban Minor Arterial	.618
State Urban Principal Arterial - IH	5.697
State Urban Principal Arterial - Other	3.000
State Urban Principal Arterial - Freeway	5.697
State Other Principal Arterial	3.000

APPENDIX IV

Annual Report to the Legislature

URBAN ROADWAY SUPPLY MANAGEMENT SYSTEM ANNUAL REPORT TO THE LEGISLATURE				
Date				
Part 1 All Urban Area Summary				
	Urban Areas			
	Austin	Dallas-Fort Worth	Houston	San Antonio
Current Year Urban Mobility Objective (UMO)				
Target UMO				
Variance				
TxDOT System UMO				
Target UMO				
Variance				
Target UMO				
Variance				

Part 2: Individual Urban Area Summary			
Urban Area			
	Population	Urban Land Area	DVMT
Historic			
1985			
1990			
1995			
2000			
Report Year			
2003			
Projected			
2004			
2005			
2006			
2007			
2008			
2013			
2018			
2023			
2028			

Part 3 Overall System Urban Mobility Objective (TxDOT and Local)			
	Adopted Objective (TTI)	Actual (TTI)	Difference
Historic			
1985			
1990			
1995			
2000			
Report Year			
2003			
Projected			
2004			
2005			
2006			
2007			
2008			
2013			
2018			
2023			
2028			

Part 4 TxDOT System Urban Mobility Objective			
	Adopted Objective (TTI)	Actual (TTI)	Difference
Historic			
1985			
1990			
1995			
2000			
Report Year			
2003			
Projected			
2004			
2005			
2006			
2007			
2013			
2018			
2023			
2028			

Part 5 Local System Urban Mobility Objective (All Agencies Combined)			
	Adopted Objective (TTI)	Actual (TTI)	Difference
Historic			
1985			
1990			
1995			
Report Year			
2003			
Projected			
2004			
2005			
2006			
2007			
2008			
2013			
2018			
2023			
2028			

Part 6 Local System Urban Mobility Objective (One Form for each Individual Agency)			
	Adopted Objective (TTI)	Actual (TTI)	Difference
Historic			
1985			
1990			
1995			
Report Year			
2003			
Projected			
2004			
2005			
2006			
2007			
2008			
2013			
2018			
2023			
2028			

Part 7 ROADWAY SEGMENTS				
Administering Agency	Free Flow Standard	Volume Weighted Speed Objective	% Peak Period Time Meeting Objective	Variance
Urban Area				
TxDOT System				
Local Agency Systems (Aggregate)				
Local (List all administering agencies and data)				
Urban Area Average				

Part 8 TxDOT Roadway Segments						
Roadway	Segment	Lane Miles	Free Flow Standard	Volume Weighted Speed Objective	% Peak Period Time Meeting Objective	Variance
List All						
Summary						

Part 9 Locally Administered Roadway Segments (One Form for Each Agency)						
Local Agency						
Roadway	Segment	Lane Miles	Free Flow Standard	Volume Weighted Speed Objective	Period Time Meeting Objective	Variance
List All						
Summary						

PROJECT EVALUATION SHEET

PROJECT EVALUATION SHEET Part 1 Summary Information			
PROJECT			
DATE			
HORIZON YEAR			
Alternative (Data from Part 2)	Annualized State Resources Required	Annual Delay Hours Reduced	Cost per Reduced Delay Hour
A			
B			
C			
Etc.			

Part 2 Project Alternative Evaluation Sheet	
PROJECT	
ALTERNATIVE	
DATE	

Table 1
DELAY HOURS DATA; PLANNING HORIZON YEAR

	Base Year	Null Case	With Proposed Alternative	Change (Null to Proposed)
DVMT				
Delay Hours: Commercial				
Delay Hours: Other				
Total Delay Hours				

Table 2
COST PER DELAY HOUR REDUCED

Item		Annualized
1. Total Cost of Alternative (Constant $)		
2. Less Commercial Revenues (Such as Tolls)		
3. Less Local Financial Participation		
4. Net State Resources Required (#1-#2-#3)		
5. Annual Reduction in Delay Hours (From Table 1)		
6. Public Resource Cost per Delay Hour Reduced ((#2+#4)/#5)		
7. State Resources Cost per Delay Hour Reduced (#4/#5)		