Performance Indicators in Urban Transport Planning

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INTRODUCTION

Throughout the world, increasing traffic congestion threatens economic growth. In the high income world, a view has emerged to the extent that urban areas cannot "build their way" out of traffic congestion.[1] This view has led further to a de-emphasis of roadway capacity enhancement in urban areas. At the same time, urban containment policies ("anti-sprawl" policies) are being adopted at least partially in the hope that more compact urban areas will be materially less dependent upon automobiles, as people walk, cycle and use public transport to a much greater degree. In the United States, planning principles of this sort have dominated public policy for up to two decades. These strategies, which might be labeled the "conventional wisdom," have not, however, resulted in higher public transport market shares, and automobile use has continued to grow as more households have gained access to cars.

Texas Governor Rick Perry and his Governor's Business Council were not content to accept the economic losses in urban areas that would result from the continued traffic growth that is projected by regional planning agencies.[2] As a result, a study was commissioned to establish a long-term mobility improvement objective, and to estimate the infrastructure and financial resources that would be required.

This paper proposes the method used in the Governor's Business Council (GBC) report[3] as a model for urban transport planning in other urban areas. The basic thesis is that transport and urban planning must become more objective in approach and less focused on particular projects. It must also be more based upon long-term transport improvement objectives. While the GBC report was limited to roadway improvements, the same process could be applied to all modes of

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[1] That "building out of congestion" is impossible has been more of an article of faith than an objectively determined truth. Few, it any urban areas have seriously reviewed what would be required to control or reduce traffic congestion.

[2] Generally, traffic growth is expected to continue at least at the rate of population gain in virtually all major U.S. urban areas.

[3] The Governor's Business Council Report, "Texas' Roadways – Texas' Future: A Look at the Next 25 Years of Roadway Supply, Demand, Cost and Benefits," was overseen by Transportation Task Force Chairman Michael Stevens and was authored by Alan E. Pisarksi (independent consultant), Tim Lomax (Texas Transportation Institute), David Ellis (Texas Transportation Institute) and Wendell Cox (Wendell Cox Consultancy), www.texasgbc.org/reports.html.

urban transport, allowing public resources to be allocated to those strategies that most effectively contribute to the achievement of adopted long term transport objectives.

THE URBAN TRANSPORT PLANNING PROBLEM

In many high-income world urban areas, urban transport planning is based upon various principles that may be generally characterized as seeking to encourage public transport use, walking and cycling as an alternative to the automobile. Success, then, it could be said should be measured by the extent to which public transport, walking and cycling market shares increase, while automobile market shares decline.

The potential of walking is limited by land use patterns that make it impractical for many desired longer trips. Cycling has greater potential for longer trips, which can sometimes be automobile competitive especially for short trips within the most dense urban cores. However, there are barriers to cycling, such as greater potential (at least perceived) for injury or death, exposure to uncomfortable weather and capacity limitations (such as for carrying children and goods)

Among the favored alternatives, public transport would seem to have the greatest potential for attracting drivers. The reality, however, is that public transport is, at best, barely retaining its market share relative to the automobile, and in most areas is declining. One international data sample indicates that, since 1980, public transport market share has been declining at an average rate of 14.0 percent per decade (Table 1).

Table 1
Change in Public Transport Market Share:
Urban Area Average

Area	Change in Public Transport Market Share	Lose	Gains
United States	-11.6%	11	2
Canada	-17.4%	4	2
Western Europe	-14.7%	9	2
Asia	-22.0%	7	0
Australia	-4.4%	4	2
Average/Total	-14.0%	35	8

Calculated from data in Kenworthy-Laube and *Millenium Cities Database.* [4]

Theory and Reality in Planning: The reality is, further, that the urban transport plans that have given priority to non-automobile modes of travel have simply failed to make a material difference. There seems to be no reason to expect matters to change in the future, without government interventions to limit personal freedom that are also seem unlikely. As a result, considerable amounts continue to be spent on public transport, while virtually all of the travel

[4] Jeffrey R. Kenworthy and Felix B. Laube, *An International Sourcebook of Automobile Dependence in Cities 1960-1990,* University of Colorado Press, 1999 and *Millennium Cities Database,* International Union of Public Transport, 2001.

growth is in automobiles, which rely on a roadway system receiving a far smaller amount of funding than its share would justify.

This is illustrated by a sample of US urban areas, where regional transportation plans (25 year plans) call for spending 20 times as much on public transport as its market share represents (Table 2).

- In Dallas-Fort Worth, Minneapolis-St. Paul and St. Louis, public transport's share of spending will be more than 60 times its market share.

- Public transport's share of spending less than 10 times its market share only in the New York metropolitan area (New York and Northern New Jersey), where its market share is by far the highest in the nation.

Table 2
Public Transport Market Share and Forecast Spending

Metropolitan Area	Share of Spending on Public Transport to 2025	Public Transport Market Share	Ratio of Public Transport Share to Spending
Atlanta	56%	1.5%	37
Boston	72%	2.9%	25
Chicago	41%	3.7%	11
Cleveland	48%	0.9%	53
Dallas- Fort Worth	47%	0.7%	67
Denver	57%	1.3%	44
Detroit	23%	0.5%	46
Houston	34%	1.0%	34
Miami	66%	1.2%	55
Minneapolis/St. Paul	61%	0.9%	68
New York	75%	9.2%*	8
Northern New Jersey	42%	9.2%*	5
Philadelphia	48%	2.5%	19
Phoenix	19%	0.4%	48
San Diego	41%	1.4%	29
San Francisco	77%	3.3%	23
Seattle	43%	1.7%	25
St. Louis	50%	0.8%	63
Washington, D.C.	52%	3.7%	14
Average	50%	2.5%	20

*New York metropolitan area share (includes Northern New Jersey
Source: Federal Highway Administration and
www.publicpurpose.com/ut-2001urbansharer.htm.

- In San Francisco, which will spend 77 percent of its financial resources on public transport, the regional planning agency projects a 42 percent increase in automobile use from 2000 to 2025. Even if public transport use were to double (a highly unlikely prospect[5]), its market share would rise barely a percentage point.

Transport planning of this sort will lead to more time spent in traffic and air pollution becomes worse than it would otherwise be due to the heightened congestion. This must lead to a quality of life deterioration.

Often these transport policies are accompanied by "anti-sprawl" land use policies that seek to limit urban geographical expansion.[6] The problem, however, is that virtually all high-income urban areas have long since become become dominated by the automobile or at least highly oriented to the automobile.[7] Hong Kong remains the most important exception, where public transport's market share remains at 73 percent, down 10 percent from 1980. In Hong Kong, however, public transport is automobile-competitive for a very large percentage of trips. At least three factors make this possible.

- Population density is very high, estimated at 77,900 per square mile in 1990 (Figure 1).
- Employment density is similarly high.
- The urban area is compact --- 75 square miles in 1990, making it feasible for public transit to provide an alternative to the automobile for most trips.

[5] From 1990 to 2000, public transport use rose 15 percent in the San Francisco area.
[6] Such policies are also referred to as "smart growth," "urban containment" and "compact city."
[7] It appears that only Hong Kong, Tokyo-Yokohama and Osaka-Kobe-Kyoto retain public transport market shares exceeding 50 percent in the high-income world. Tokyo-Yokohama and Osaka-Kobe-Kyoto retain their high public transport market shares despite the fact that they sprawl significantly. There area a number of reasons for this. First of all, massive regional rail systems were built in both urban areas, as the urban areas developed (some systems were directly associated with real estate development, similar to suburban rail systems in London and Los Angeles). These systems, which comprise a comparatively dense service 'mesh" throughout the area, would have been far too expensive to superimpose on the urban areas after they had developed. The private railway companies also provide large feeder bus networks. All suburban rail service is privately owned and operates without subsidy. Even the publicly owned transport systems operate with comparatively little subsidy. This means that, public transport is financially sustainable in these urban areas (and in some other Japanese urban areas). Further, urban expressways require a substantial toll (¥800), which combined with affordable (unsubsidized) suburban rail fares and heavy traffic congestion, helps to keep public transport market share high. All of this taken together makes travel by public transport much more convenient than in western urban areas.

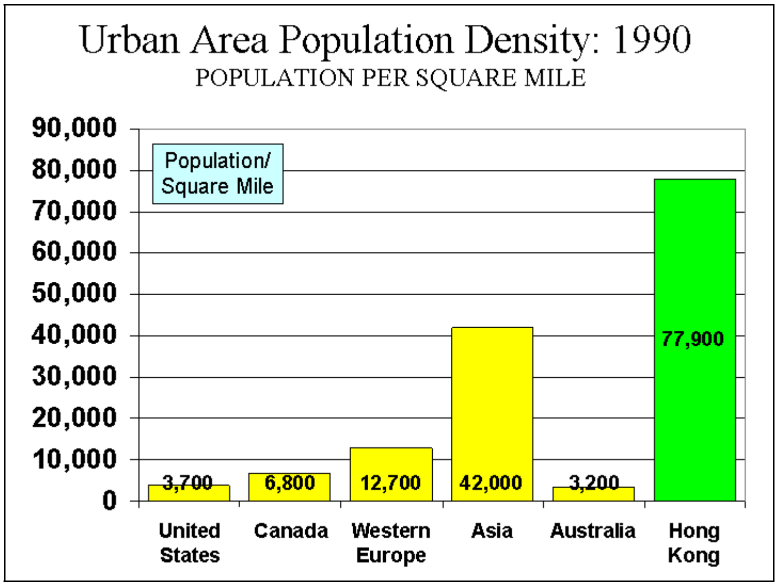

Figure 1

The Ultimate Example: Hong Kong: Among high income urban areas, it appears that Hong Kong also has the most intensive supply of public transport service per square mile (Figure 2). All of these factors suggest that Hong Kong may be the ultimate example of compact urbanization and public transport dependence and automobile competitiveness, at least in the high income world.

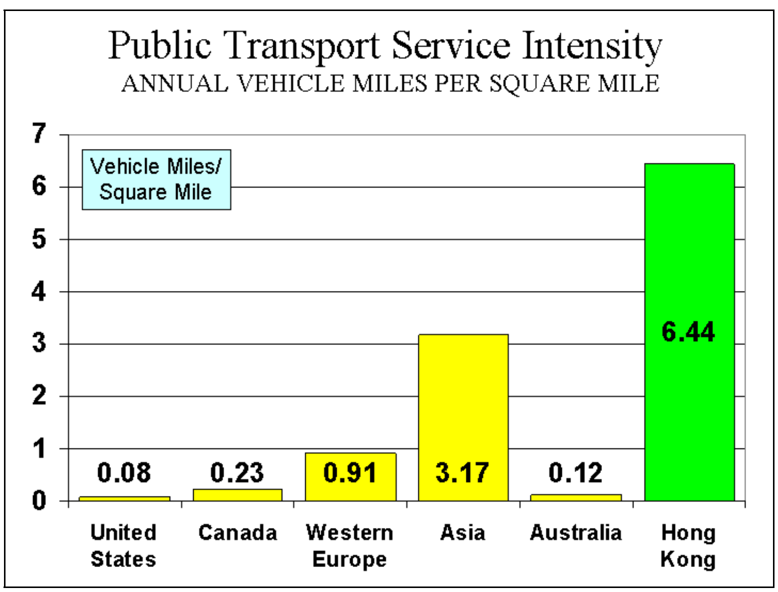

Figure 2

Smaller geographical sizes make it feasible for public transport service to be more automobile competitive. For example, if it is assumed that people will generally walk no more than 0.25 miles to obtain public transport access, then an 80 square mile urban area would require a system providing service between 320 catchment zones.[8] By comparison, a 400 square mile urban area would have 1,600 catchment zones. Thus, while the 400 square mile urban area would be five times as large as the 80 square mile urban area, the 400 square mile are would have 25 times as many potential origin-destination trip pairs.[9] Generally, the complexity of serving an urban area with automobile competitive service rises at approximately the square of the difference between a smaller and larger urban area.

Moreover, population density and employment density matter little in this calculation. The number of potential trip pairs remains virtually the same, though the volume for any particular trip is likely to be lower. People can, and do, travel from virtually anywhere in an urban area to anywhere else, and they do so when their own interests demand it. The automobile's strength in such a market is that it is demand oriented --- it can travel directly to anywhere in the urban area and at any time. Public transport, on the other hand, is supply oriented. To serve all origin-destination pairs at all times would require much higher levels of public transport service than is provided in most urban areas.

But there simply are not the resources, public or private, to provide automobile competitive public transport service to much more than the CBD and the core of the modern high-income world urban area. Because of the much larger number of trip pairs, U.S. and Western European urban areas could not achieve comprehensive public transport automobile competitiveness even with Hong Kong service intensities. For example, in one sample (Table 3) Western European urban areas average 2.9 times the land area of Hong Kong. But the number of origin-destination pair trips is approximately 8.1 times that of Hong Kong.

- This suggests that public transport service levels would need to be 8.1 times as high in Western Europe as in Hong Kong to achieve the same level of automobile competitiveness. In fact, however, public transport service averages less than one-half that of Hong Kong (0.474). To equal the public transport service effectiveness of Hong Kong, Western European urban areas would need public transport service levels 17 times that currently provided.

- More significantly, the larger U.S. urban areas would need more than 200 times the public transport service intensity of Hong Kong to serve the much larger number of origin-destination pairs. Public transit service levels average 0.200 of Hong Kong, This means that to equal the public transport service service effectiveness of Hong Kong, U.S. urban areas would need public transport service levels more than 1,000 times that currently provided.

Public transport service levels in Canada and Australia would need to be 75 and nearly 300 times as high to equal Hong Kong automobile competitiveness.

- Actual public transport service levels are much lower than that of Hong Kong, indicating that for the Western European urban areas in the sample, it would take a 20 times service

[8] Four zones of one-quarter square mile times 80 square miles.
[9] An idealized 400 square mile urban area, assumed to be square, on level land.

expansion to equal the auto-competitiveness of public transport in Hong Kong. It would take a more than 1,200 times expansion of service in the average U.S. urban area.[10]

In another paper, the author estimated that providing automobile competitive service to a typical US urban area of 400 square miles would require an annual expenditure approximating the gross income of the same area.[11]

Table 3
Urban and Public Transport Data: Average Compared to Hong Kong

Value Relative to Hong Kong	United States	Canada	Western Europe	Asia	Australia
Size of Urban Area	14.5	3.1	2.9	4.4	6.6
Origin-Destination Pairs	210.9	9.8	8.1	19.3	44.0
Public Transport Vehicle Miles[12]	0.200	0.131	0.474	2.557	0.150
Public Transport Auto-Competitiveness Factor	0.001	0.013	0.058	0.133	0.003
Public Transport Market Share	0.034	0.092	0.251	0.501	0.080
Cases	13	7	11	9	6

Hong Kong Value=1.000
Urban area sample from Kenworthy-Laube, data for 1990.

In the modern high-income world automobile oriented urban area, attracting people to public transport from their cars means, at a minimum, the provision of automobile competitive public transport service. Where such service is provided, public transport carries substantial market shares. For example, public transport has work trip market shares of 70 percent or more to well-served major central business districts (CBD) in Tokyo, Paris, London, New York, Chicago, Toronto, Sydney. But, it is rare to find a non-CBD employment center where public transport's market share is more than 20 percent.[13] Similarly, automobile competitive public transport service is rarely available for trip pairs between locations outside of the urban core, especially in Western Europe, Canada, Australia and the United States. For example, in Portland, Oregon, where some of the world's strongest urban containment policies are combined with unabashed anti-automobile, pro-public transport policies, there is little automobile competitive public transport service except within and to the core (Figure 3)

[10] The level of service required to equal Hong Kong public transport intensities in an urban area of 1,500 square miles (similar in size to Chicago, Los Angeles, Boston and Atlanta) would entail annual vehicle miles greater than are currently operated by automobiles. This occurs because of the inherent nature of a supply based transport system --- to compete with the automobile, public transport service would need to be available throughout the day and much service would simply not be used. Lower levels of service could be provided, but at whatever material percentage of automobile use public transport were to compete at, public costs would be prohibitive.

[11] www.publicpurpose.com/illusion.pdf.

[12] The Hong Kong base used in this calculation is adjusted to remove the vehicle miles attributable to multi-wagon trains, and thus represents bus vehicle miles plus rail train miles. The values for the urban areas being compared have not been so adjusted. As a result, their their service level comparisons would tend to be more favorable than if a simlar adjustment were made (reliable information for such a conversion was not available for a number of the urban areas).

[13] Perhaps the most notable exception is La Defence in Paris, which is located on the periphery of the core, with service by the regional metro (RER) and the Paris metro, regional rail service (SNCF). This makes La Defence accessible from much of the adjacent ville de Paris at auto-competitive speeds by RER and Metro lines.

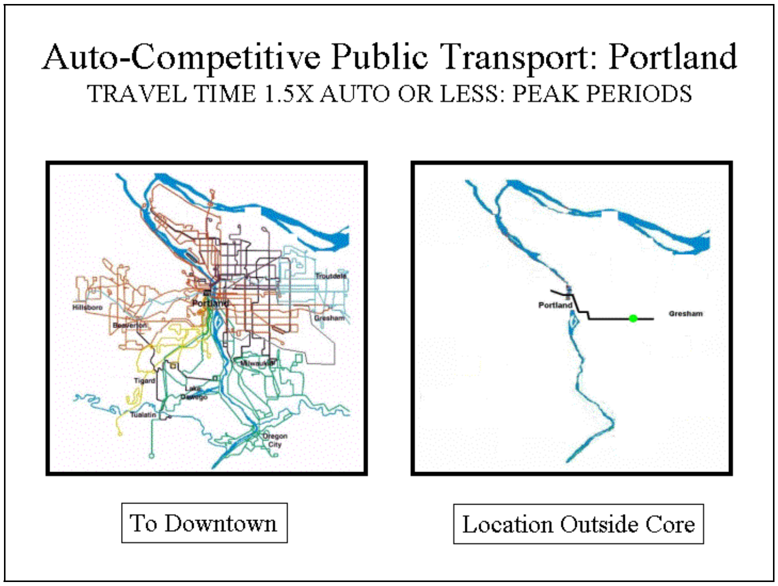

Figure 3

This, then, is the principal problem with urban transport plans that seek to attract drivers to public transport. Cars can connect virtually all of the trip pairs in the modern urban area, and usually with a shorter walk than would be required by automobile competitive transport, if it existed. It is a virtual impossibility for automobile competitive public transport to be provided to an entire urban area that is much larger than Hong Kong.

NE 23rd Enclaves: It is possible, of course, to provide much enhanced public transport service to small areas of the urban area, especially in the core. Proponents of anti-sprawl policies cite small enclaves of "pedestrian oriented development" as models for development of entire urban areas. These enclaves may include trendy restaurants and boutiques, with adjacent residential areas having been redeveloped ("gentrified"). A frequently noted example is Northeast (NE) 23rd Avenue in Portland. But small, gentrifying neighborhoods do not constitute automobile competitive public transport service throughout an urban area. What might be called "NE 23rd Enclaves" should be recognized as small area urban improvements that cannot be sustained over more than just a small part of the urban area. Many urban areas have NE 23rd Enclaves, with their side-by-side residences and retail establishments.[14] They tend to cater to a relatively small elite that includes not only neighborhood residents, but also people who travel to the enclaves from elsewhere,[15] in the urban area, often by automobile.[16] In some locations, the development of NE 23rd Enclaves has driven lower income households out of the neighborhood to areas where public transport service is less accessible, with potentially net negative social results.

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[14] Examples include Lodo in Denver, the Central West End in St. Louis, Country Club Plaza in Kansas City, the Gold Coast in Chicago, Greenville Avenue in Dallas, the Riverwalk in San Antonio, Pioneer Square in Seattle, English Bay in Vancouver, DuPont Circle in Washington, the Castro in San Francisco and others.
[15] To the extent that NE 23rd Enclaves draw auto-drivers, their function as "pedestrian oriented development" is similar to that of enclosed regional shopping centers (malls).
[16] In fact, residents of NE 23rd are now fighting proposals by the city to build multi-story parking garages to accommodate the people who arrive in the neighborhood by car (despite very good public transport access, including bus and a new urban tram).

THE LAND USE PLANNING PROBLEM

But the assumption that urban areas can become an amalgam of NE 23rd Enclaves is not the only problem with anti-sprawl policies. Both US and international data shows the following quality of life retarding characteristics (Table 4):

- Vehicle miles traveled tends to be higher where density is higher (Figure 4). [17]
- Average urban speeds tend to be lower where densities are higher.
- As a result, vehicle hours traveled are even higher than vehicle miles traveled where density is higher.

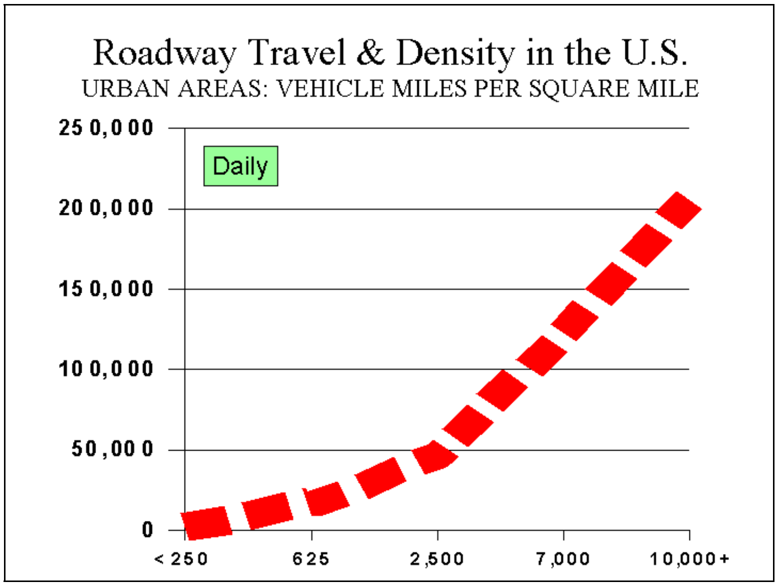

Figure 4

Within urban areas, a similar density to traffic intensity relationship is observed. For example, the city of San Francisco, by far the most dense part of the corresponding urban area, has a traffic intensity 2.25 that times of the much lower density suburbs (Figure 5).

[17] www.publicpurpose.com/hwy-intltr.htm.

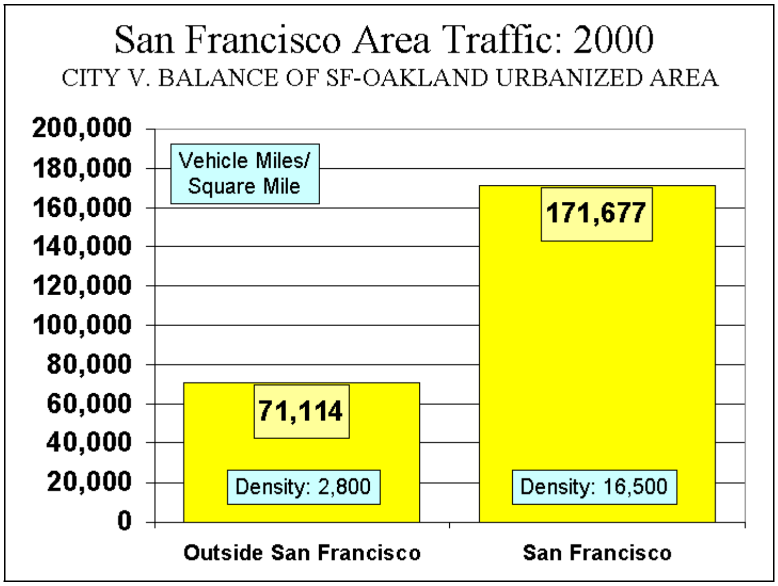

Figure 5

Because, all things being equal, automobile and truck air pollution emissions tend to be higher at lower speeds and even higher where there is more "stop and start" operation, air pollution emissions per square mile tend to be higher where density is higher (Figure 6). Thus, Australia and the United States,[18] with their less dense urban areas, tend to have lower vehicle mile intensities, higher operating speeds and lower vehicle hour intensities.

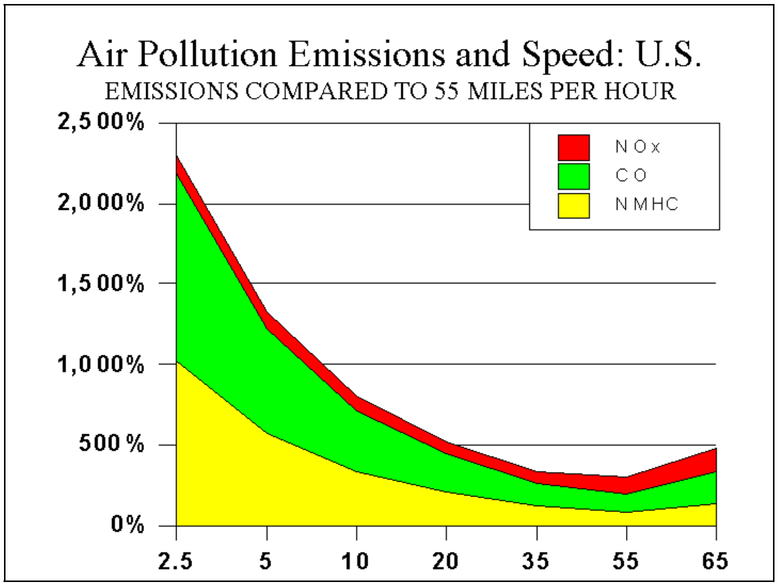

Figure 6

[18] It is often suggested that urban freeways were a principal cause of U.S. urban sprawl. However, Australian urban areas managed to sprawl at similar densities, without developing comprehensive urban freeway networks. Moreover, the period during which urban sprawl increased the most in the United States, the 1950s, predated the building of most urban freeways.

Trucks make traffic congestion more intense, because of the additional road space that they consume.[19] If it is conservatively assumed that trucks consume the space of 2.5 average sized automobiles,[20] the passenger car equivalent vehicle miles per square mile are four times as high in Asia as in Australia and 2.4 times as high as in the United States. The slower operating speeds associated with higher densities[21] make the differential even greater. Asian vehicle hours per square mile are nearly four times that of the U.S. and six times that of Australia (Table 4).

Table 4 Roadway Traffic in International Urban Areas					
Factor	United States	Canada	Western Europe	Asia	Australia
Urban Land Area (Square Miles)	1,087	235	213	329	497
Density (Population per Square Mile)	3,679	6,826	12,741	41,956	3,175
Vehicle Miles/Square Mile	79,990	92,053	116,665	147,364	43,086
Speed (Miles per Hour)	31.7	24.9	19.8	15.5	28.0
Vehicle Hours/Square Mile	2,522	3,693	5,879	9,478	1,537
Truck Weighted Vehicle Miles/Square Mile	91,508	108,227	137,282	219,658	54,717
Compared to the United States					
Urban Land Area (Square Miles)	1.00	0.22	0.20	0.30	0.46
Density (Population per Square Mile)	1.00	1.86	3.46	11.41	0.86
Vehicle Miles/Square Mile	1.00	1.15	1.46	1.84	0.54
Speed (Miles per Hour)	1.00	0.79	0.63	0.49	0.88
Vehicle Hours/Square Mile	1.00	1.46	2.33	3.76	0.61
Truck Weighted Vehicle Miles/Square Mile	1.00	1.18	1.50	2.40	0.60
Data from Kenworthy-Laube.					

Another anti-sprawl policy is planning for a jobs-housing balance. This, too, misses the mark. For example, throughout the high-income world, people tend to travel much farther than they need to for employment. In virtually all high-income world urban areas, it is possible to live close to employment. The problem is, however, that the employment that is close by may not be suitable to the education, training, preferences or housing choices of the employee. Thus, the average mechanized work trip length in Hong Kong, which covers only 75 square miles, is 5.8 miles. In Houston, which covers 1,715 square miles --- 22.6 times that of Hong Kong --- the average work trip is 13.1 miles --- only 2.3 times that of Hong Kong. In both communities, the

[19] This analysis is based upon 1990 data from Kenworthy & Laube. The later UITP *Millennium Cities Database* does not include truck volumes.
[20] In the United States, Federal Highway Administration data indicates that combination trucks (trucks with trailers, which can be single, double or triple in some states) consume 3.8 times the space of an automobile on an urban motorway.
[21] While higher density generates higher traffic intensities, it does not necessarily create more intense traffic congestion. A more dense area with a high-quality roadway system can have lower levels of traffic congestion than a lower density area with a lower quality roadway system. This is illustrated in the United States by comparing low density Atlanta (1,800 per square mile) with Dallas-Fort Worth (2,900 per square mile). Atlanta has a Roadway Congestion Index (peak period volume to capacity ratio) of 1.32 as a result of its comparatively poor roadway system, while Dallas-Fort Worth, with a better roadway system, as a Roadway Congestion Index of 1.10. Daily vehicle miles traveled in Atlanta were 57,000 per square mile in 2000, compared to Dallas-Fort Worth, at 68,000.

average employee could take employment at hundreds of thousands of jobs that are closer to home than the job actually filled. Further, the average work trip travel time in Hong Kong (44 minutes)[22] was 1.7 times that of Houston (26 minutes) in 1990. Work trip travel times rise only marginally with the size of an urban area (0.0027 minute increase per one square mile increase).[23] Each 500 per square mile increase in urban land area is associated with only a 1.4 minute increase in travel time (Figure 7).

A 2001 U.S. Census Bureau report indicates that only 17 percent of households choose their neighborhood based upon its proximity to work.[24] People choose to live farther from their jobs that planners would prefer for various reasons, such as:

- Households choose to live farther away from employment to obtain greater housing value in exchange for longer commute trips.

- While most urban residents live comparatively close to employment, the closest employment does not necessarily correspond to the education, training or personal preferences of the resident.

- Workers in multiple employee households may have employment locations that are not close to one-another, requiring at least one of the workers to travel a long distance to work.

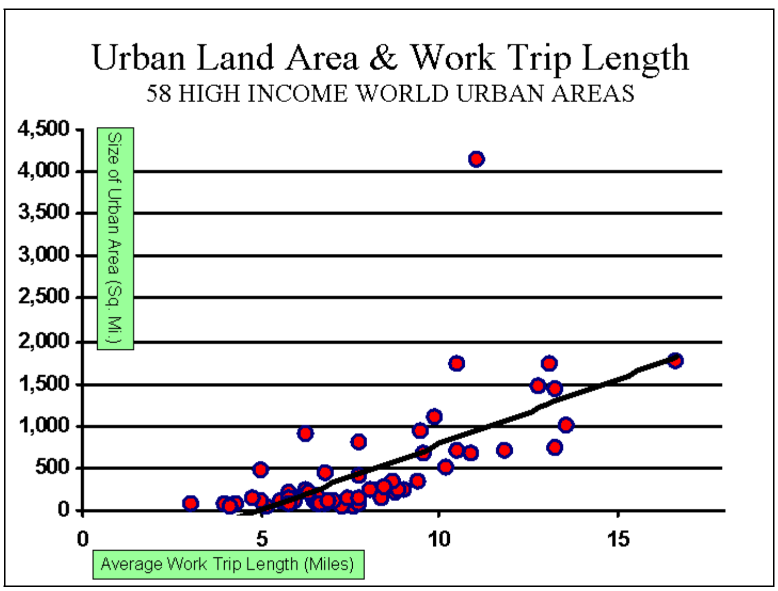

Figure 7

[22] Kenworthy-Laube.
[23] 60 observations, R2=0.422, statistically significant at the 99 percent confidence level.
[24] Calculated from 2001 Census Supplemental Survey, weighted for average distribution of owner occupied and rental units.

Urban Containment and Density: Without materially increasing density, there can be no containment of urban sprawl. Higher density is required for public transport to be able to provide an alternative to the automobile. As has been shown, to progress beyond NE 23rd Enclaves would require density increases far beyond what would be accepted by the public.[25] Similarly, achieving "livable," walkable urban areas would require much higher densities, because the critical mass for sustainable, profitable neighborhood businesses could not be achieved without much higher densities.

ASSESSMENT

Current planning policies are lacking in a coherent vision that is directed toward a better quality of life. Public transport favoring policies are not, generally, projected to result in a material shift of travel from automobiles to public transport, despite disproportionately higher spending on public transport. The urban containment policies, at most, would create the odd mixed use enclave, but would fail to produce the Hong Kong-like population densities that would, at least theoretically, make it possible for public transport to replace most automobile trips, while placing jobs and residences at close proximity.[26] Many long-term transport and urban plans simply assume that traffic congestion will get worse and worse. This dissonance between plan is irrational and reflective of a lack of vision.[27]

THE TEXAS GOVERNOR'S BUSINESS COUNCIL REPORT

Dissatisfaction with this planning method led a new to a different approach in Texas. There is a growing consensus that urban traffic congestion is the most serious transport challenge faced in the state, and a principal threat to future economic growth. The Governor's Business Council, a "blue-ribbon" panel of business executives convened by Governor Rick Perry,[28] commissioned a study to determine the cost of improving urban traffic congestion in the state's largest urban areas, Dallas-Fort Worth, Houston, San Antonio, Austin, El Paso, McAllen, Brownsville and Laredo (Figure 8).[29] The study was to be different from conventional planning in at least the following respects:

- It would be based upon a vision of improved mobility. This would require adopting a mobility improvement objective to be reached in each of the urban areas by 2025.

[25] Indeed, there are indications that even modest density increases can incite strong action. In Portland, with an average density of 3,300 per square mile, the local land use authority decided to expand the urban growth boundary in 2002 to incorporate an area that had been projected for 2040. This was apparently the result of a citizen's initiative effort that would have significantly reduce the power of the agency, which had been the result of resistance to neighborhood densification.
[26] As was noted above, however, even with Hong Kong densities and the ultimate in a jobs-housing balance produces average work trip lengths far longer than would be expected in such a compact urban area.
[27] And perhaps even ideology.
[28] Who took office upon the election of President George W. Bush, who had been governor of Texas. Governor Perry was elected to his own term of office in 2002.
[29] El Paso, McAllen, Brownsville and Laredo are referred to as "border" metropolitan areas (located on the border with Mexico).

- It would abandon the project focus of current planning and instead establish mechanisms to select projects based upon the effectiveness of their contribution to the established goal.

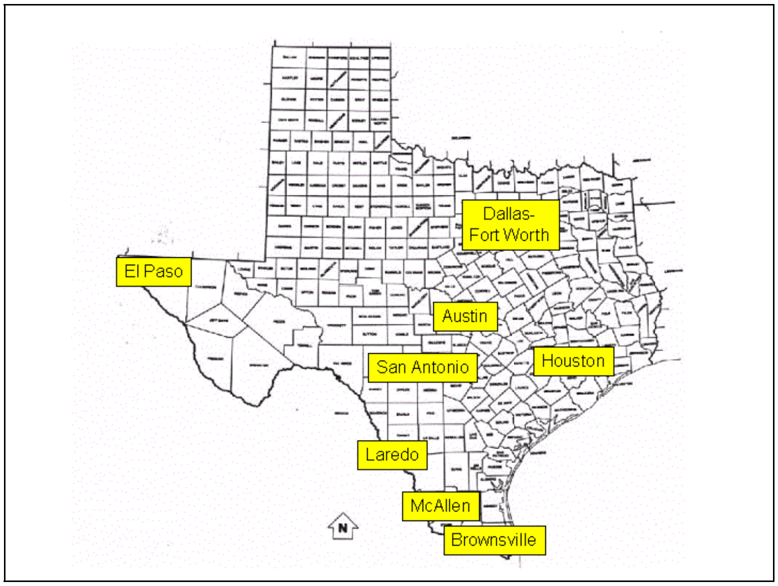

Figure 8

U.S. federal regulations require regional planning authorities to adopt long term transportation plans that are financially constrained --- plans that assume only the funding that is known to be available. The Governor's Business Council (GBC) recognized the wisdom of such planning, but felt that a "vision" plan was also needed. The new plan would not address the "what can we afford" question, but would focus the question of "what can be." The GBC report was unique, because it had long been the conventional wisdom in US urban planning that we "couldn't build our way out of congestion." The basic principle behind the GBC report was to ask the "unthinkable," --- just what would it cost to " build out of congestion." Once determining the cost, it might well be determined that it was too expensive, but the GBC was of the view that it would be irresponsible to not at least consider the question.

Texas is one of the fastest growing states in the United States, with a population now exceeding 21 million. During the 1990s, Texas passed New York to become the second largest state in population after California. Texas metropolitan areas are also among the fastest growing. From 1990 to 2000:

- Dallas-Fort Worth was the fastest growing metropolitan area in the nation out of the nine with more than 5,000,000 inhabitants between 1990 and 2000.

- Houston was third in population growth among the 11 metropolitan areas over 4,000,000, trailing Atlanta and Dallas-Fort Worth.

- Austin ranked second out of the 49 metropolitan areas without more than 1,000,000 residents (behind Las Vegas).

- McAllen ranked second out of the 81 metropolitan areas with more than 500,000 population (behind Las Vegas).

- Laredo ranked ninth out of the 260 metropolitan areas with more than 100,000.

- Brownsville grew at more than double the national rate (28 percent) of 13 percent, while El Paso grew slightly above the national rate (15 percent).

More than 80 percent of future Texas population growth is projected to be in these metropolitan areas (Table 5). Dallas-Fort Worth and Houston together are projected to add nearly 5 million, 55 percent of the growth. The largest percentage increases are expected in Laredo (94 percent), McAllen (86 percent) and Brownsville (62 percent), all located in the lower Rio Grande River Valley, along the border with Mexico. McAllen is expected to exceed 1,000,000 population.

Table 5
Texas Population Projections

Metropolitan Area	2000	2025	Change	%	Share of Change
Dallas-Fort Worth	5,031,000	7,700,000	2,669,000	53.1%	30.6%
Houston	4,644,000	6,803,000	2,159,000	46.5%	24.8%
San Antonio	1,560,000	2,074,000	514,000	32.9%	5.9%
Austin	1,160,000	1,674,000	514,000	44.3%	5.9%
McAllen	569,000	1,060,000	491,000	86.3%	5.6%
El Paso	680,000	986,000	306,000	45.0%	3.5%
Brownsville	335,000	543,000	208,000	62.1%	2.4%
Laredo	193,000	374,000	181,000	93.8%	2.1%
Total	14,172,000	21,214,000	7,042,000	49.7%	80.8%
Elsewhere	6,680,000	8,351,000	1,671,000	25.0%	19.2%
State	20,852,000	29,565,000	8,713,000	41.8%	100.0%

Calculated from Texas State Data Center projections (www.txsdc.tamu.edu)

Despite their reputation to the contrary, Texas urban areas are only slightly less dense than the national average for areas with more than 1,000,000 population. For example, San Antonio has a density of 3,257 Houston is 2,951 and Dallas-Fort Worth is 2,946, all somewhat close to Portland, at 3,340 (Figure 9).

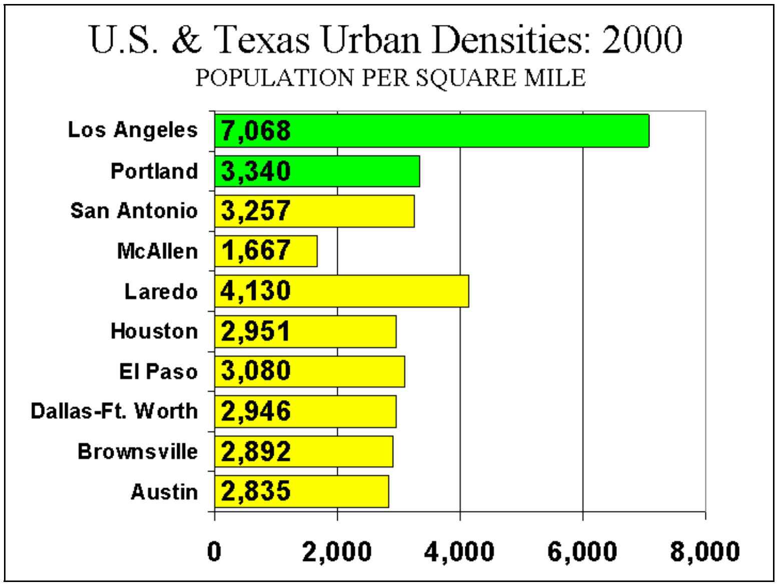

Figure 9

Like urban areas throughout the nation, Texas urban areas have experienced rapid traffic growth (Figure 10).[30] However, there is one notable exception. In the early 1980s, Houston had become the second most congested major metropolitan area, behind Los Angeles. An aggressive road building program, however, reduced traffic congestion by the early 1990s. While little expansion has taken place since then, Houston's traffic congestion has fallen to 13th in the nation, behind much smaller urban areas, such as Portland. This experience was also instrumental in encouraging Texas officials to review the potential for reducing traffic congestion by expanding roads.[31]

[30] Data is not available from before 1982.

[31] There is the concern that expanding urban roads inherently attracts new traffic --- the "induced traffic" effect. There are indications that the theory is not supported by experience. For example, from 1985 to 2000, only one US urban area substantially expanded its roadway system --- Phoenix. There, average vehicle miles traveled per person rose over the same period less than the national rate and less than the rate of Portland (www.publicpurpose.com/hwy-phx-induce.htm). Further, analysis of U.S. Federal Highway Administration research indicates that, adjusted for travel time, there is little induced traffic effect (www.publicpurpose.com/hwy-induced.htm).

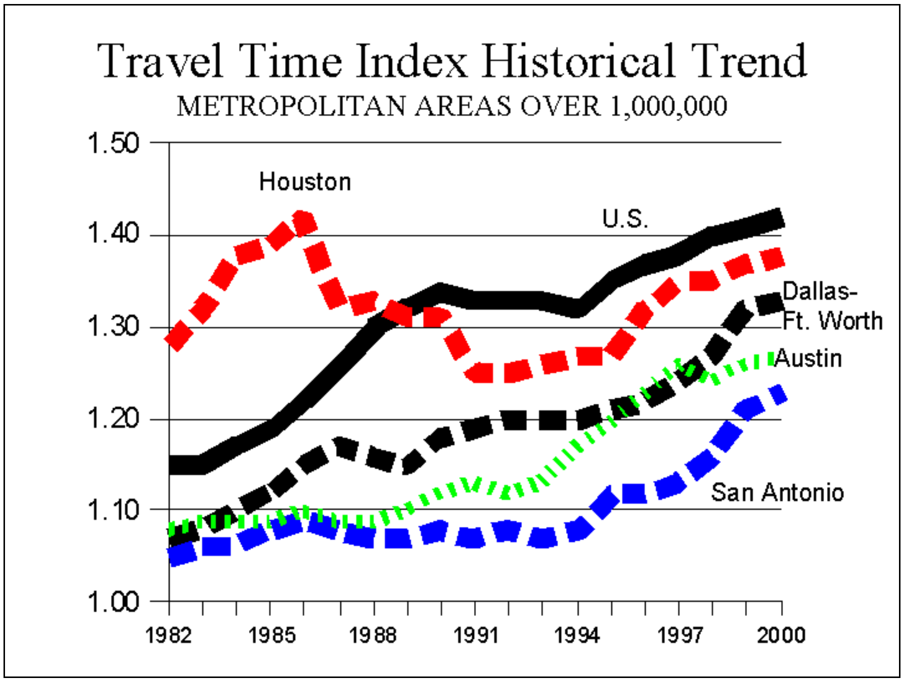

Figure 10

Continuing population growth will mean more automobile and truck traffic. The extraordinary growth rate of Texas metropolitan areas will translate into traffic growth rates ahead of the national average. Based upon current trends, three of the metropolitan areas above 1,000,000 population in 2000 are projected to have Travel Time Indexes above 2.00 by 2025 (Figure 11). This is above the 2000 value of 1.90 in Los Angeles, the worst in the nation. The fourth metropolitan area, San Antonio, would achieve a TTI greater than that of San Francisco, which ranked second in 2000. Some of the border metropolitan areas are also expected to exceed Los Angeles.

Moroever, Texas is at the most important strategic position relative to the Mexican border. The United States, Canada and Mexico approved the North American Free Trade Agreement in 1994. This has brought a substantial increase in both truck and rail freight traffic and is likely to increase more as Mexico's continuing economic progress increases trade volumes. Nearly 80 percent of trucks crossing the border between Mexico and the United States travel through Texas ports of entry, and more than one-third of that volume crosses at Laredo.

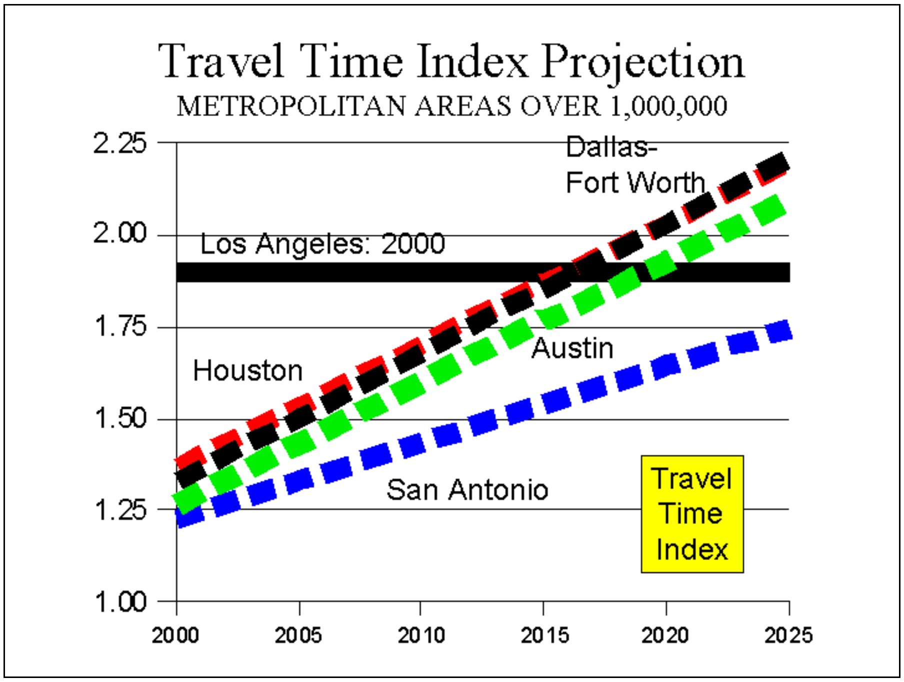

Figure 11

The Role of Public Transport: At the same time, public transport serves only a limited market in Texas (Table 6). The largest overall public transport market shares are approximately one percent, while work trip market shares are all three percent or lower. Each of the Texas metropolitan areas experienced major losses in public transport work trip market share from 1990 to 2000. This includes Dallas-Fort Worth, where a 41 percent loss and an actual loss in the number of public transport commuters occurred despite opening what many consider to be one of the nation's most successful new urban rail systems.[32]

The regional planning agencies in Dallas-Fort Worth, Houston, San Antonio and Austin project that virtually all new travel will be by highway (Figure 12). Public transport's market share in these urban areas ranges from 0.5 percent to 1.5 percent. Public transport has even smaller market shares in the border metropolitan areas.

Measuring Congestion: The Travel Time Index: The Texas Transportation Institute has established performance indicators for traffic congestion that have become the national standard. Each year the Institute publishes a "mobility" report rating traffic congestion in the major urban areas of the nation. The principle index is the "Travel Time Index," (TTI) which compares average speeds of roadway travel during peak period with average speeds during periods of no traffic congestion. For example, a TTI of 1.50 would mean that a trip that would take 30 minutes in uncongested conditions would take 45 minutes during peak periods. The highest TTI in the nation is in Los Angeles, at 1.90.[33] At the other end of the spectrum is Kansas City, with a density of 2,300 persons per square mile, a comprehensive freeway and arterial street system and

[32] Between the 1990 and 2000 census, the Dallas Area Rapid Transit District opened a three branch, 20 mile light rail system and 10 miles of suburban rail.
[33] Los Angeles is also the most dense urban area, at 7,069 persons per square mile. It is approximately 15 percent more dense than second ranking San Francisco, and 30 percent more dense than New York.

a TTI of 1.10. The highest TTI in Texas is in Houston, at 1.38, followed by Dallas-Fort Worth at 1.33, Austin at 1.27 and San Antonio at 1.23.[34] The overall average for the large metropolitan areas was 1.30. It was projected that, based upon present plans and resources, the TTI would rise, on average, to 2.09 by 2025.

Table 6
Public Transport Market Shares in Texas Metropolitan Areas

Metropolitan Area	Public Transport Market Share: All Trips: (Estimated) 2001	Public Transport Work Trip Market Share		
		2000	1990	Change
Dallas-Fort Worth	0.7%	1.7%	2.9%	-41.4%
Houston	1.0%	3.2%	4.8%	-33.3%
San Antonio	1.0%	2.8%	4.9%	-42.9%
Austin	0.9%	2.5%	4.3%	-41.9%
McAllen	0.0%	0.3%	0.6%	-50.0%
El Paso	0.9%	2.2%	3.8%	-42.1%
Brownsville	0.6%	0.7%	1.6%	-56.3%
Laredo	1.3%	2.5%	4.8%	-47.9%
Average	0.8%	2.0%	3.5%	-42.6%
Exhibit: National Urban	1.9%	4.6%	5.1%	-9.8%

Sources:
Work trip market share data: United States Census Bureau
All trips market share: www.publicpurpose.com/ut-2001urbansharer.htm

The Mobility Improvement Objective: The first step in the GBC planning process was to set a mobility improvement objective. After much discussion, it was agreed that a travel time objective of 1.15 would be set for 2025 for each urban area. In all cases but the border metropolitan areas, this would represent an improvement. However, because of the especially fast growth in the border areas, current trends would place the 2025 TTI for these areas at among the highest in the state.

[34] The Mexican border urban areas of El Paso, McAllen and Brownsville were combined for much of this analysis. Border areas had a TTI of 1.13 in 2000.

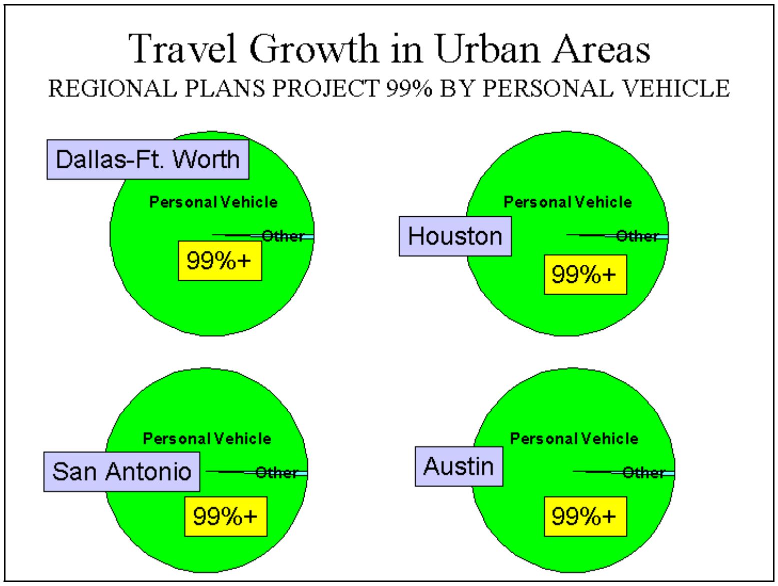

Figure 12

Building Out of Congestion: Using Texas A&M University population projections,[35] and traffic projections a broad roadway network was developed in each urban area to achieve the 1.15 TTI objective. The results through 2025 were as follows (Figure 13):[36]

- Current resources of $140 billion would be available over the planning horizon from present sources. This would not be sufficient to maintain current traffic conditions, which would deteriorate.

- To maintain current traffic conditions (as measured by the TTI) would require an additional $39 billion.

- To build the additional roadway capacity to reduce the TTI in each urban area to 1.15 would require an additional $39 billion.

[35] The official state source for such data.
[36] All figures in 2000$.

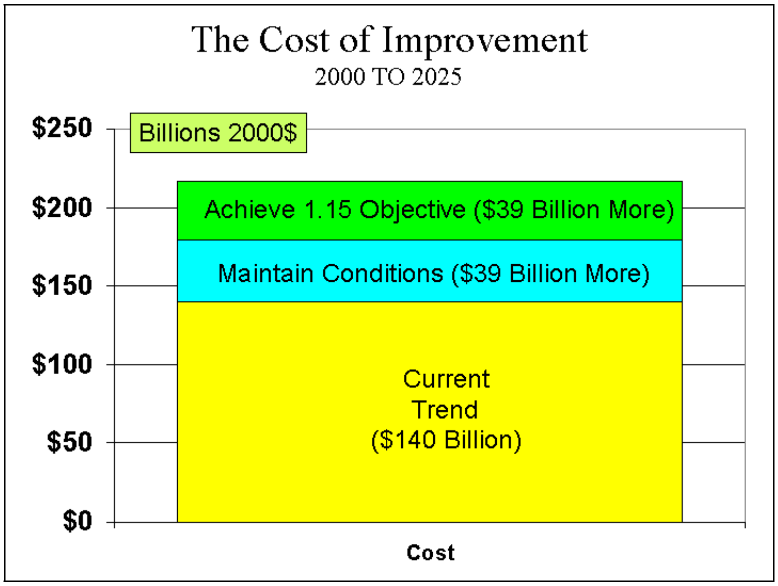

Figure 13

While these amounts appear to be large, they are modest in the context of household expenditures. A recent US government report indicated that US urban households spend approximately $7,600 annually for transportation.[37] On a per household basis, financing the $78 billion additional required to reduce the TTI to 1.15 in all of the studied Texas urban would cost $335 per year, an approximately five percent increase in household transportation expenditures. Approximately one-half of this amount would be needed simply to maintain current levels of traffic congestion, which would otherwise deteriorate even futher. On this basis it was concluded that not only can enough roadway capacity be built to handle demand, but that the cost is affordable. Further, the economic benefits were estimated at $2,118, a more than 6:1 benefit:cost ratio (Figure 14).

[37] U.S. Department of Labor, Bureau of Labor Statistics, *Consumer Expenditure Report, 2001*, www.bls.gov.

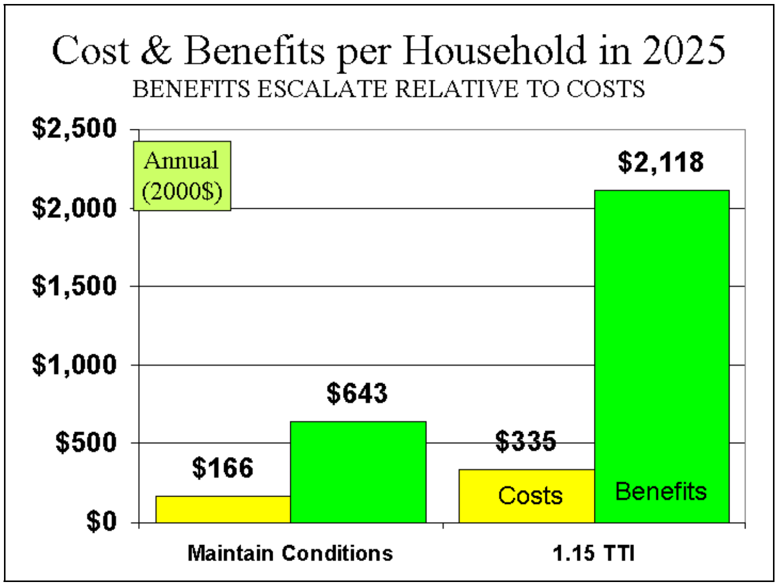

Figure 14

The Proposed Planning Process: The GBC report also proposed establishment of a more detailed long term planning process based upon the 1.15 TTI objective in each urban area, and that the Texas Department of Transportation and regional planning organizations be required to submit annual progress reports to the state legislature and governor. It was recommended that individual projects be evaluated based upon the efficiency (cost) per hour of actual travel delay to be reduced (Proposed forms in Appendices A, B & C).

Status: As a result of the GBC report, the Texas Department of Transportation was directed by Governor Perry to establish formal urban traffic reduction objectives, and a new executive office was established to oversee the program. It was expected that a formal Travel Time Index objective would be adopted during September 2003. As a result of the Governor's Business Council report, planning officials in Houston are beginning to prepare a "100 Percent Plan," which would establish the detailed blueprint for achieving the travel time objective by 2025. There are indications that other states are interested in undertaking a similar planning process.

Broader Application: The GBC report was limited to highways (roadways), because funding for public transport is separated from highway funding, as is the custom in the United States. Moreover, in the Texas metropolitan areas, the report demonstrated that there there was virtually no prospect of reducing traffic congestion through public transport strategies, virtually regardless of the price. There is no reason, however, that the GBC report process could not be applied to all urban transport investments, whether public transport or highways. The result would be minimization of travel delay at whatever level of expenditure.

The Process: Planning processes similar to the Governor's Business Council approach could be useful in applications in other urban areas, in the United States and elsewhere. The principal elements are as follows:

- Adoption of a long term travel time (mobility) objective. This might be expressed in terms of roadway traffic where public transport has little role, or it could be expressed in travel time per distance where public transport is a viable strategy. The travel time objective would be subject to pre-existing environmental and community standards as appropriate.

- Establishment of a process that identifies a potential projects that would achieve the travel time objective as quickly and inexpensively as possible.

- Evaluation of potential projects based upon their cost effective contribution toward achievement of the travel time objective.

- Adoption of a program of projects, based upon the evaluation above, to achieve the travel time objective.

- Projection of expected progress toward the travel time objective each year of the planning horizon (no less than 25 years).

- Comparison of annual travel time objective results in relation to projected values.

- Periodic reporting to appropriate parliamentary and executive bodies.

APPENDIX A: 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				
Local Systems UMO				
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			
2008			
2013			
2018			
2023			
2028			

Part 5 Local System Urban Mobility Objective (All Agencies Combined)			
	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 6 Local System Urban Mobility Objective (One Form for each Individual Agency)			
Agency			
	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 7 ROADWAY SEGMENTS				
Administering Agency	Free Flow Standard	Volume Weighted Speed Objective	% Peak Hour 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 Hour 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	% Peak Hour Time Meeting Objective	Variance
List All						
Summary						

APPENDIX B: 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			Total	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)				