COMMUTER RAIL (SUBURBAN RAIL, REGIONAL RAIL) IN THE UNITED STATES: INTERNATIONAL CONTEXT
Virtually No Potential for Traffic Congestion Reduction

October 2003

EXECUTIVE SUMMARY

Traffic congestion is intensifying. US urban areas are experiencing rapidly increasing traffic congestion. Most major US urban areas now have urban roadway systems that operate above capacity at peak period.

Commuter rail is proposed as a solution to traffic congestion. Commuter rail, which uses conventional trains on regional freight rail lines is being proposed in a number of areas as a strategy for diverting travel demand from highways.

Pre-automobile commuter rail systems are the most successful: Throughout the automotive world, the most successful commuter rail systems and the most successful public transport systems are in urban areas that have a substantial component of pre-automobile development. In these urban areas, the commuter rail systems were built before widespread automobile ownership was achieved. The three most extensive systems, Tokyo-Yokohama, Osaka-Kobe-Kyoto and Nagoya provide automobile competitive service throughout their urban areas, largely on commuter rail. Public transport market shares range from 25 percent to 57 percent, with significant commuter rail components. In Tokyo-Yokohama alone, commuter rail ridership exceeds all public transport ridership in the United States, at more nearly 35 million daily.. Paris, London and Sydney, the next three largest commuter rail systems, are radically oriented to central business districts and provide auto-competitive service to the core from the suburbs. Public transport market shares are lower, at from 15 percent to 24 percent. The largest US systems, New York, Chicago, Boston and Philadelphia also provide auto-competitive service from the suburbs to the core. Public transport market shares range from three percent to nine percent in these urban areas. In New York it is estimated that daily ridership is 800,000.

Automotive era systems are less significant. Washington-Baltimore and Los Angeles have developed commuter rail systems during the automotive era. The most extensive automobile era system is in Los Angeles, which has the automotive world's 10th most extensive commuter rail

system.. Daily ridership is approximately 30,000, far below that of the pre-automobile systems. Other individual commuter rail lines have been built in

Keys to success: The most successful public transport systems in automotive urban areas are where there are both pre-automobile urbanization and pre-automobile commuter rail systems.

- **Pre-automobile urbanization is required:** Higher percentages of pre-automobile urbanization are associated with the highest ridership levels. This is because pre-automobile residential and employment densities are higher than automobile era densities, and can be served more efficiently by public transport. US urban areas do not have high shares of pre-automobile urbanization.
- **Pre-automobile commuter rail systems are required:** All of the high ridership commuter rail systems are pre-automobile systems (built with or before the urbanization). Virtually no automobile era commuter rail system in the United States carries more than 0.1 percent of travel.

Even so, where these conditions for success exist, public transport's role has been declining, because urban development trends are counter to public transport's strengths.

- **Public transport market shares are not sustainable in the automotive urban area.** Virtually without exception, public transport market share is dropping in automotive urban areas, even those with the most successful commuter rail systems).
- **Development is becoming less conducive to public transport service.** Virtually all high-density urban areas are becoming less dense. Further, their central business districts, which are so crucial to maintaining public transport market share, are declining in their share of metropolitan employment.

INTRODUCTION

Urban traffic congestion has become one of the most important issues in America's urban areas. The Texas Transportation Institute recently reported that freeways and expressways in 33 of the 40 urban areas with more than 1,000,000 population operate at above capacity during peak hour. A number of issues have made it difficult to expand the roadway system to meet the demand, from funding constraints, to neighborhood concerns, to outright philosophical opposition.

As a result, in many urban areas, attention has been directed to developing alternatives to reduce traffic congestion, especially through new public transport programs. These include

- Metros (subways or elevateds), which are fully grade separated (elevated or in tunnel) and very expensive to build (more than $200 million per mile).
- Light rail, which is historic streetcar technology generally operating with grade crossings (protected from automobiles by crossing gates). This is considerably less expensive, at approximately $50 million per mile.
- Commuter rail, which serves suburban areas using conventional trains on freight tracks or other trains on tracks largely dedicated to commuter rail service. Sometimes commuter rail services are electrified they are powered by diesel. In either case, trains may include locomotives or self powered units. New applications in the United States have typically cost $5 million to $10 million per mile. Commuter rail is also referred to as suburban rail or regional rail.

The highest capacity systems are subway; light rail systems provide intermediate capacity and the lowest capacity systems are commuter rail. Because of its lower cost relative to subways and light rail commuter rail systems have become a popular transportation improvement strategy. New commuter rail systems, like the other forms of urban rail, is implemented for two principal reasons --- to address traffic congestion and to provide alternatives to the automobile ("transportation choice").

THE ROLE OF COMMUTER RAIL

The most successful public transport systems in high automobile ownership urban areas ('automotive urban areas") depend to a large degree on commuter rail.[1] This is because a dense network of commuter rail service can provide the backbone of a regional public transport system that is capable of providing automobile competitive public transport service throughout the sprawling modern urban area. The principal role of commuter rail is to extend public transport service beyond what is usually a well served urban core to the sprawling suburbs. Even the most dense automotive urban areas sprawl substantially. For example, the Tokyo-Yokohama urban area, the world's largest and among the most dense automotive urban areas, covers more land area than the state of Rhode Island. Within the core, the largest public transport systems typically have high capacity metro systems, together with extensive bus service.

[1] For the purposes of this analysis, an automotive urban area is any urban area in a nation that has achieved the 1930 US automobile ownership rate of 0.75 automobiles (including sport-utility vehicles) per household. Generally, automotive urban areas include all urban areas in Western Europe, the United States, Japan, Canada, New Zealand and Australia.

The United States has five of the 15 most extensive (in route miles) commuter rail systems among automotive urban areas (New York, Chicago, Los Angeles, Boston and Philadelphia. Generally, however, ridership intensity (passengers per mile) is lower in the United States than in other automotive urban areas (Table 1). With the exception of Los Angeles, the 15 most extensive commuter rail systems are all considered pre-automobile, because they were largely developed before the achievement of high automobile ownership rates. Most components of the pre-automobile systems were developed with or before the sprawl of the urban areas, and indeed were part of the cause of the sprawl. In some urban areas, such as Tokyo-Yokohama and London, sprawling suburban development resulted from initiatives by rail companies to build housing as their systems expanded.

Table 1
Most Extensive Automotive Urban Area Commuter Rail Systems

Rank	Urban Area	Annual Boardings (000,000)	Route Miles	Million Boardings /Mile	Compared to New York	Exhibit: Public transport Market Share	Pre-Auto Commuter Rail System?
1	London	580	1,912	0.303	1.25	18.8%	YES
2	Tokyo-Yokohama	10,589	1,779	5.952	24.47	56.7%	YES
3	Sydney	267	1,273	0.252	1.04	13.6%	YES
4	Rhine-Ruhr	204	1,251	0.163	0.67	11.2%	YES
5	Osaka-Kobe-Kyoto	3,602	1,095	3.288	13.52	59.5%	YES
6	Paris	913	1,012	0.903	3.71	24.1%	YES
7	New York	238	979	0.243	1.00	9.3%	YES
8	Nagoya	650	528	1.231	5.06	24.6%	YES
9	Los Angeles	8	415	0.019	0.08	1.4%	NO
10	Chicago	76	333	0.228	0.94	3.6%	YES
11	Boston	37	328	0.112	0.46	3.8%	YES
12	Philadelphia	29	304	0.094	0.39	2.9%	YES
13	Munich	225	275	0.818	3.36	29.4%	YES
14	Vienna	90	271	0.332	1.36	24.8%	YES
15	Zurich	72	236	0.305	1.25	24.0%	YES

All systems except Los Angeles are largely pre-automobile. Substantial automotive era improvements occurred in Paris, Munich and Philadelphia.
Source: Derived from National Public transport Database and *Jane's Urban Transport* (multiple editions)

US Commuter rail ridership has increased substantially over the past two decades. Commuter rail had reached a peak of 6.9 billion annual passenger miles in 1929, and fell to 6.3 billion by 1980. Since 1980, ridership has increased nearly 50 percent to 9.4 billion passenger miles (Figure 1), with the bulk of the increase during the 1990s. From 1990 to 2000, approximately one-third of public transport's new passenger miles were commuter rail.

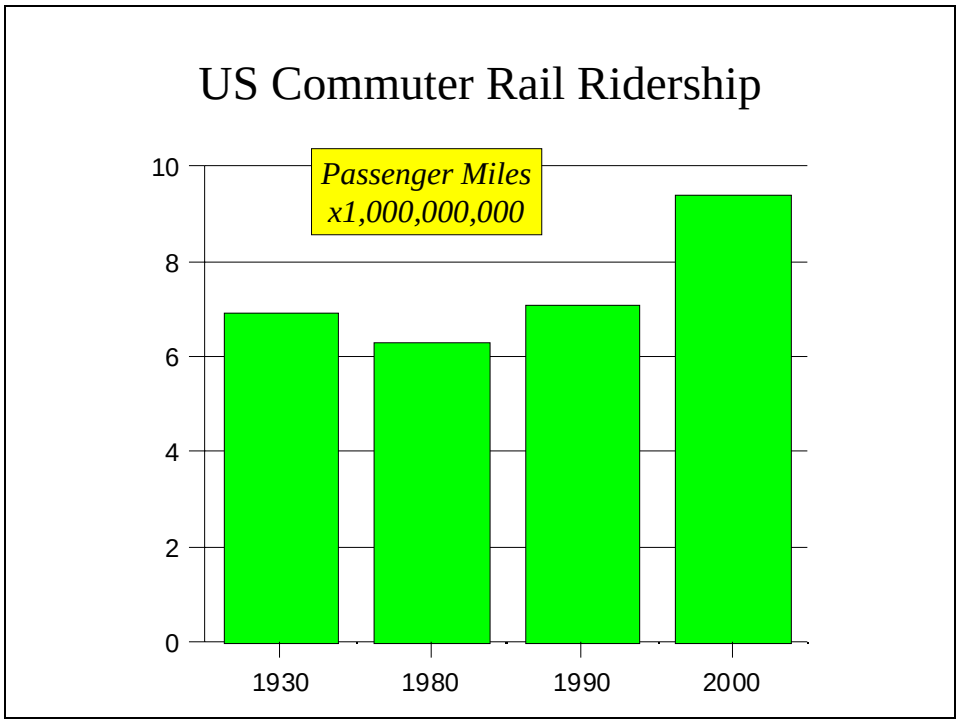

Figure 1

A number of commuter rail systems were opened or expanded during the 1990s. Nonetheless, more than 93 percent of commuter rail ridership is in the largest pre-automobile systems, located in New York, Chicago, Boston and Philadelphia.[2] These systems were largely established before the wide availability of the automobile. Further, more than 80 percent of the commuter rail growth in the 1990s was in the historic systems.

This paper evaluates the policy implications of new commuter rail systems, especially its potential to play a material part in controlling urban traffic congestion. Three broad classifications of commuter rail systems are analyze, pre-automobile systems (international and US), US automobile era systems and proposed new US systems.

PRE-AUTOMOBILE COMMUTER RAIL SYSTEMS

The most successful commuter rail systems, both in the United States and internationally, were largely constructed before broad automobile ownership was achieved.

The US achieved high levels of automobile ownership much earlier than other economies. In the decade between 1920 and 1930, automobile ownership per household rose from 0.33 to 0.77 in the United States. In Canada, Australia, Western Europe and Japan it would take from 25 to 55 years longer to reach the US 1930 level of automobile ownership (Table 2). By 1930, the vast of US households owned their own cars and had thus had the choice of automobility. And, while

[2] There are also historic commuter rail lines in Washington-Baltimore and San Francisco, but there did not constitute regional commuter rail systems.

Canada, Western Europe and Japan have all now entered the age of automobility, more than 120 percent, a substantially greater growth rate than that of any other nation that has achieved automobility. Automobile ownership has continue to rise in the United States and remains the highest in the world, at over 1.5 automobiles per household (including sport utility vehicles).

Transportation technologies have a significant impact on development and land use patterns. Throughout history, as transportation technologies have allowed people to live further from where they work, urban areas have sprawled. Indeed, since 1960, the rate of sprawl (rate of population density loss) has been greater in Canadian Western European and Japanese urban areas than in the United States.[3] Before 1960, however, the high US automobile ownership rate induced greater sprawl. For the purposes of comparison, a threshold of 15,000 persons per square mile is used to estimate the extent of pre-automobile development in urban areas.[4]

Table 2
Years Since Attaining
US 1930 Automobile Ownership Rate

Area	High Automobile Ownership Years	Growth in High Automobile Ownership Years
Japan	15	4%
United Kingdom	20	6%
France	30	16%
Australia	35	68%
Canada	45	92%
United States	70	123%

Source: Calculated from *Statistical Abstract of the United States* (multiple editions), INSEE and *World Motor Vehicle Data* (1993 Edition), American Automobile Manufacturers Association.

The pre-automobile systems reviewed are six of the most highly patronized in the automotive world: Tokyo, Osaka, Nagoya, Paris London and Sydney (Appendix Table A)[5] and the four US systems: New York, Chicago, Boston and Philadelphia (Appendix Table B). New York ranks eighth among automotive urban areas in ridership (Figures 2 and 3).

[3] Calculated from data in Jeffrey R. Kenworthy, Felix B. Laube and others, *An International Sourcebook of Automobile Dependence in Cities: 1960-1990* (Boulder: University Press of Colorado), 1999.
[4] Among US cities that achieved more than 400,000 population, at least New York, Chicago, Philadelphia, Boston, Baltimore, San Francisco, Milwaukee and Newark reached densities of more than 15,000. It is likely that if undeveloped areas were excluded from 1920 data, a number of other cities were above 15,000 per square mile.
[5]Berlin, which ranks sixth, is not reviewed because it has only recently become automotive and with the recent communist past and its related urban form is not considered relevant to this analysis.

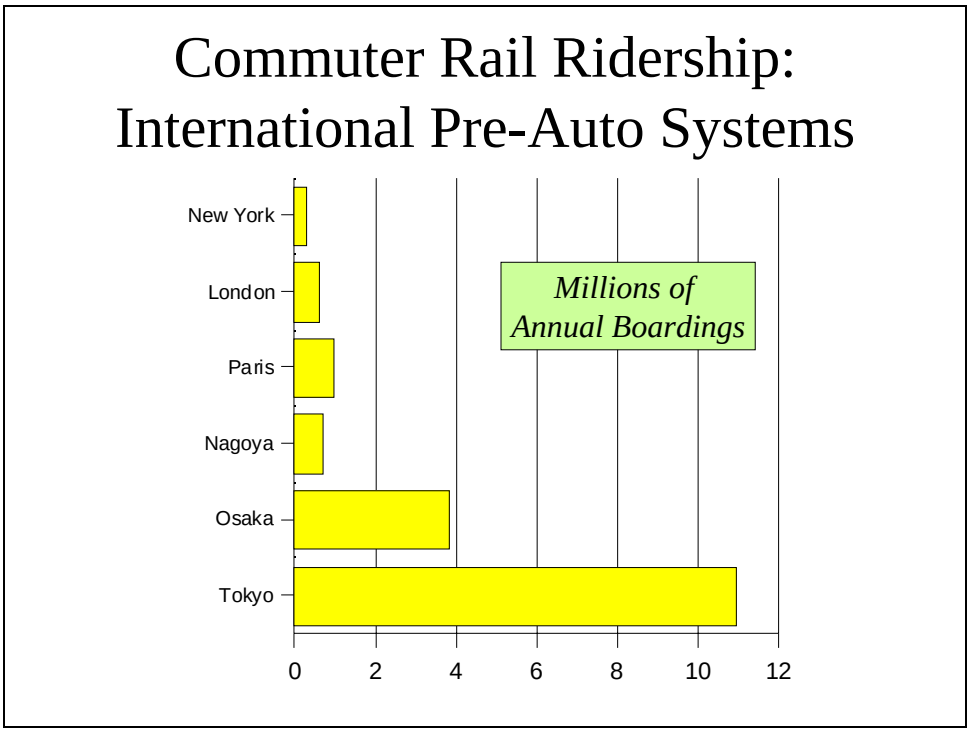

Figure 2

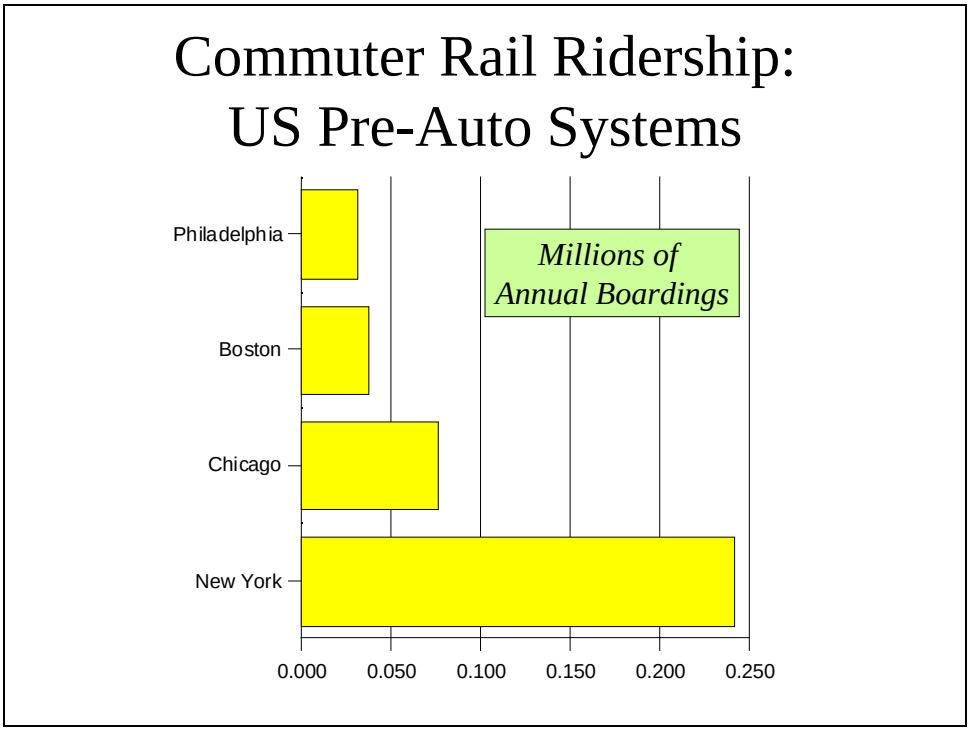

Figure 3

Tokyo-Yokohama: Tokyo-Yokohama (Tokyo) is the world's largest urban area, with approximately 31,200,000 people, 1.5 times the population of the New York urban area. Tokyo is also one of the automotive world's most densely populated urban areas, at more than 15,000 persons per square mile. The urban area covers more than 2,000 square miles, greater than that of the Boston or Los Angeles urban areas. The Tokyo continuously built-up urban area, in geographical expanse, is larger than all others in the world except for New York and Chicago.

Because auto ownership rates reached the US 1930 automobile era threshold only in the middle 1980s, much of the Tokyo-Yokohama area is of a pre-automobile design. Population growth in Tokyo-Yokohama's automobile era has been only five percent since that time. Approximately 71 percent of the population lives in areas above 15,000 density (pre-automotive densities), which account for 46 percent of the land area

Tokyo has the automotive world's most successful public transport system. More than 15 billion annual rides are carried, which is 60 percent more than all of the public transport systems in the United States combined. Approximately 57 percent of all travel in Tokyo is by public transport.[6] Tokyo maintains the highest public transport market share among urban areas with high-automobile ownership.

Most of Tokyo's public transport ridership is on the privately owned commuter rail lines,[7] which carry 10.6 billion annual trips, a level comparable to that of all public transport in the United States and Canada combined. Commuter rail carries more than two-thirds of public transport ridership in the Tokyo-Yokohama area (Figure 4). The routes extend nearly 1,800 miles with more than 1,200 stations on more than 60 lines. The routes are virtually all without interference from freight trains. Finally, the commuter rail routes are profitable, receiving neither capital nor operating subsidies.

The commuter rail system feeds two of the world's largest subway systems in Tokyo, as well as the Yokohama subway system and the Chiba urban monorail system. Some of the commuter rail trains continue in and through the central city on subway tracks, a type of service coordination limited to urban areas in Japan. In addition, most of the commuter railroad companies have dense bus networks that feed the rail systems. It is estimated that nearly 5,000 buses are engaged in these systems, which is more buses that operate in Los Angeles and Denver combined.[8] There are, in addition, conventional city bus systems.

[6] Calculated from data in Jean Vivier, "Millennium Cities Database for Sustainable Mobility: Analyses and Recommendations," UITP (International Union of Public Transport), Brussels: May 2001.
[7] This includes East Japan Railway, formerly owned by the national government.
[8] Estimated from data in *Janes Urban Transport*,(multiple editions).

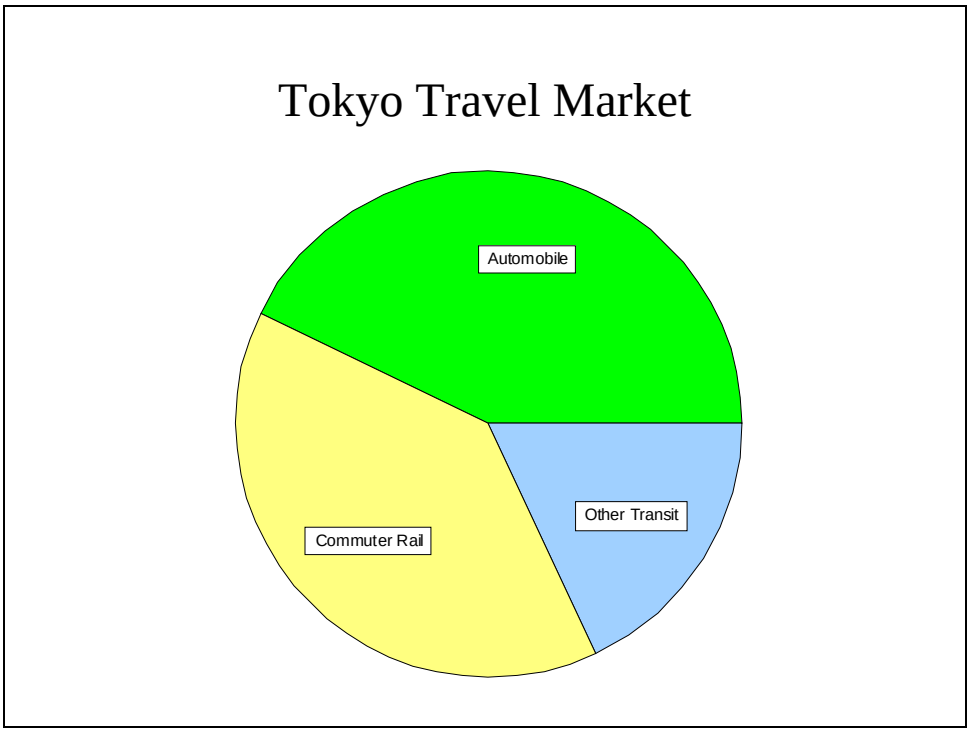

Figure 4

There are 0.61 commuter rail stations in the Tokyo area per square mile (one for each 1.6 square miles) of developed land area, which when combined with the high density connecting bus networks, and intense traffic congestion makes public transport highly competitive with the automobile throughout the entire area. From one-third to 90 percent of services operate every five minutes or less during off-peak periods.[9] On average, automobile operating speeds are 15 miles per hour, one-third less than that of public transport trips.[10]

Most of the commuter rail system was constructed before the urban expansion that followed World War II, when Tokyo-Yokohama housed approximately two-thirds fewer people. Commuter rail ridership very dense, at 6 million per line mile annually, by the highest among automotive urban areas.

The central business district (CBD) is surrounded by the Yamanote Loop, a commuter rail line inside of which are more than 4.2 million jobs, with more than 2.4 million in the core CBD, the largest in the world. This represents 15 percent of metropolitan area employment. Overall employment levels have declined in Japanese urban areas in recent years. However, the rate of loss in the central business district has more than double that of the suburbs. [11]

[9] *Compariaison des systems de transport de quarte metropoles (Four City Report),* IAURIF (Paris, 1988)
[10] Calculated from Kenworthy & Laube.
[11] Calculated from Japan Statistical Bureau data.

Some trains end their journeys at stations near or on the Yamanote Loop, where riders transfer to a dense mesh of subway lines that provide convenient access throughout the central area. Other commuter rail trains, as noted above, continue their operations onto city-owned subway lines.

Nonetheless, public transport's market share is dropping in Tokyo. Within the central city of Tokyo ("Ku area"),[12] 78 percent of trips were by public transport in 1998, down less than two percent from 1975. But much larger losses are being registered in the suburbs. Public transport's share of trips is still a significant, at 47 percent. This, however, represents a 32 percent loss since 1975, reflecting the rising importance of the automobile. Approximately 75 percent of the urban area population is outside the former city of Tokyo, along with nearly 60 percent of the employment.

Further, despite the late achievement of high auto ownership rates, traffic is very congested in Tokyo, at 119,000 vehicle miles per square mile. This compares to a US average of under 50,000, and the 113,000 in the nation's most congested area, Los Angeles.

A number of factors contribute to the success of commuter rail and public transport in Tokyo. The extent of pre-automobile development (the result of reaching high-automotive status late), the extensive commuter rail system and connecting bus systems, the higher public transport system speeds and the high service frequency combine to make public transport competitive with the automobile throughout the urban area.

Osaka-Kobe-Kyoto: Osaka-Kobe-Kyoto (Osaka), with 15,250,000 million people, is the second largest urban area in Japan, and is approximately the same size as the Los Angeles commuter rail service area (Los Angeles and Riverside-San Bernardino urban areas). Osaka is dense, at 14,500 per square mile, covering 1,100 square miles, similar to the size of Minneapolis-St. Paul, Paris or Buenos Aires. Like Tokyo, approximately 73 percent of the population lives in areas with more than 15,000 per square mile, and these areas constitute 43 percent of the developed land area.

Osaka has the second highest public transport ridership in the automotive world, at nearly six billion annual trips, two-thirds the total of all public transport systems in the United States. Osaka's public transport market share is greater than that of any high-income urban area other than Hong Kong, at 59.5 percent.[13] Also like Tokyo, most public transport ridership is on private commuter rail lines, which carry 3.6 billion rides annually, more than all of the public transport in Paris, London or New York. Commuter rail carries more than one-quarter of all travel in the Osaka area (Figure 5).

Osaka has more than 1,000 miles of commuter rail routes with nearly 1,000 stations on more than 30 lines. Some of these routes operate onto city subway lines, while others penetrate the Osaka Loop. The commuter rail lines interface with subway systems in Osaka, Kobe and Kyoto. In addition, the private railroad companies provide a dense network of connecting services, estimated at more than 2,500 buses (this is more than all the buses in the Chicago metropolitan

[12] The central city of Tokyo was abolished during World War II and is simply a part of the Prefecture of Tokyo. Statistical data, however, is maintained for the 23 wards (Ku area) that constituted the city of Tokyo.
[13] Calculated from International Union of Public Transport *Millennium Cities Database*, for 1995. Hong Kong has a public transport market share of 73.2 percent.

area). There are, in addition, conventional city bus systems. The commuter rail system is privately owned, and operates without either capital or operating subsidy.

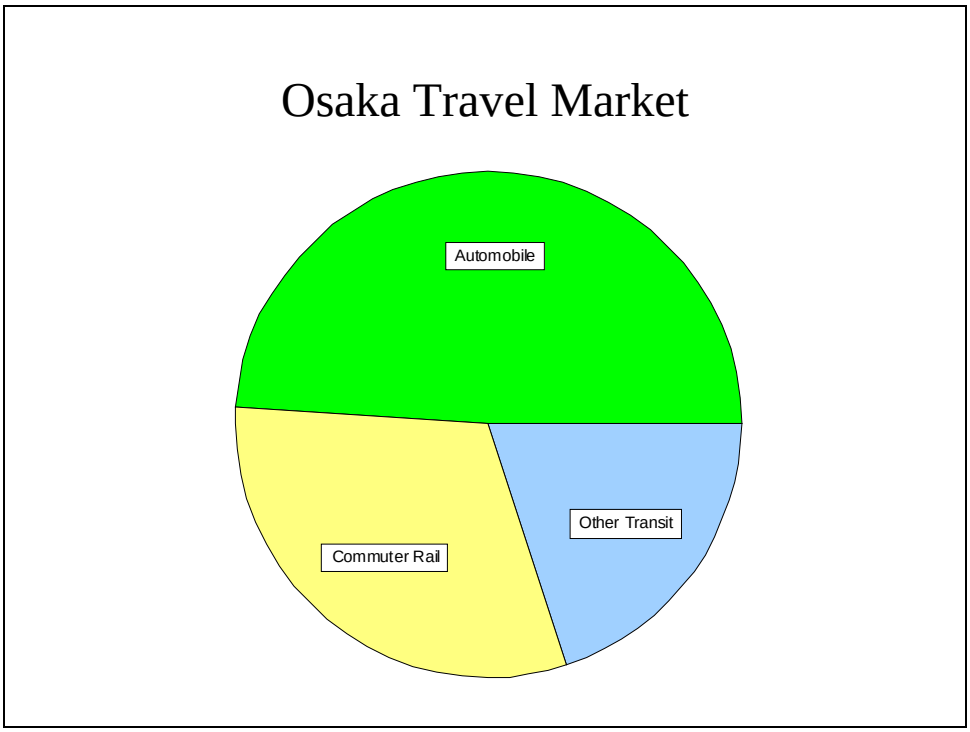

Figure 5

There are 1.01 commuter rail station per square mile, which makes the Osaka system considerably more dense in access than even Tokyo.

Like Tokyo, most of the commuter rail system was constructed before the urban expansion that followed World War II, when Osaka-Kobe-Kyoto housed approximately two-thirds fewer people. Commuter rail ridership very dense, at 3.3 million per line mile annually, second to Tokyo among automotive urban areas.

Osaka has the world's third largest core central business district, at 1.3 million jobs. This represents 16 percent of metropolitan area employment. Like Tokyo, Osaka has a commuter rail loop around its central area (the Osaka Loop), inside of which are 1.5 jobs. The rate of job loss in the central business district has been nearly double that of the suburbs.[14]

A number of commuter rail services penetrate the loop, including some services that share tracks with the metro system. But, similar to Tokyo, public transport's market share is dropping. From 1975 to 1998, public transport's share of trips dropped nearly 20 percent in Osaka-Kobe-Kyoto.[15]

[14] Calculated from Japan Statistical Bureau data.
[15]Calculated from Japan Ministry of Transport data..

The keys to Osaka's commuter rail success would appear to be the same as in Tokyo --- faster public transport travel speeds, the expansive, coordinated system and the fact that most of the urban form was established before broad automobile ownership was achieved.

Like Tokyo, the success of commuter rail in Osaka results from the extensiveness of pre-automobile development (the result of reaching high-automotive status late), the extensive commuter rail system and connecting bus systems, the higher public transport system speeds and the high service frequency. These factors combine to make public transport competitive with the automobile throughout the urban area.

Nagoya: Japan's third largest urban area is substantially different. With a population of 8 million, Nagoya is approximately the same size as Chicago, but is much less dense than Tokyo or Osaka, at 7,400 per square mile. It is barely five percent more dense than the Los Angeles urban area. Only one-quarter of the Nagoya population lives in areas with more than 15,000 density, which constitute less than 10 percent of the land area

Nonetherless, Nagoya has a comprehensive commuter rail system with more than 500 miles of route operating over 35 routes and serving more than 800 stations. The systems are owned by private railroad companies, which also operate approximately 800 buses, in addition to conventional city bus systems. There are 0.77 commuter rail stations per square mile (one for each 1.3 square miles) of developed land area,, which, like Osaka, makes it a more dense system than even Tokyo. Nagoya's commuter rail system operates without either capital or operating subsidies.

Like Tokyo and Osaka, the central area is served by a mesh of metro lines that provide convenient access to the central business district's more than 400,000 jobs. This represents seven percent of metropolitan area employment. The rate of job loss in the central business district has been four times that of the suburbs.[16]

Public transport's overall market share is, however, smaller in Nagoya, at approximately 25 percent, with nearly one-half of that accounted for by commuter rail. Annual commuter rail ridership is approximately 650 million, approximately 1.5 times the combined US annual total (Figure 6).

[16] Calculated from Japan Statistical Bureau data.

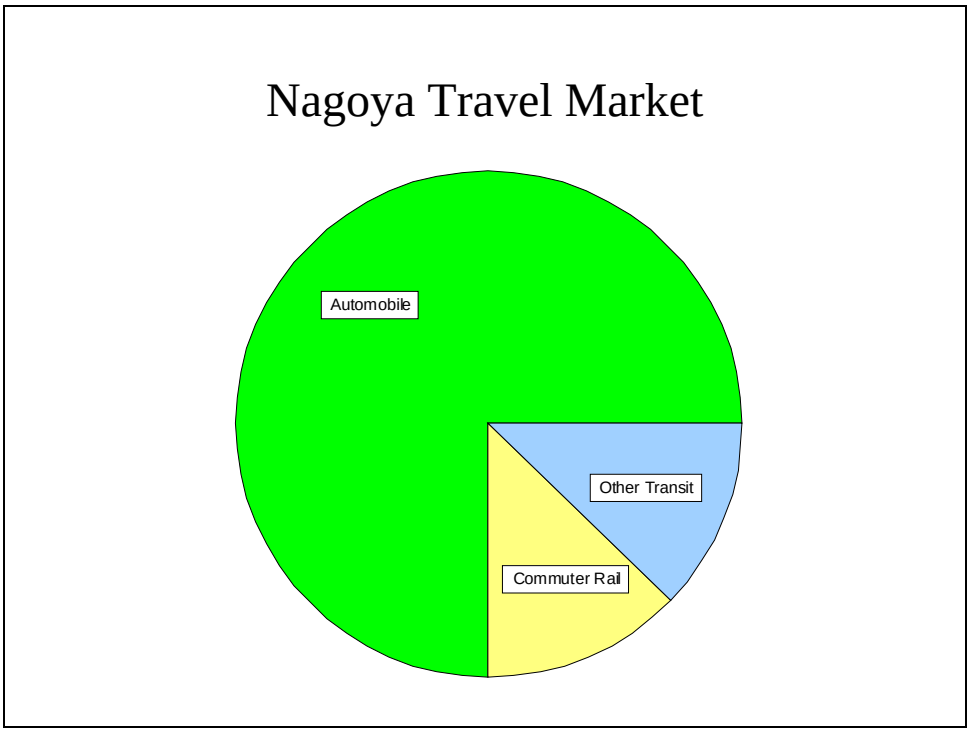

Figure 6

The much lower population density and public transport market shares reflect the fact that Nagoya has become far more automobile oriented that either Tokyo or Osaka. With respect to both of these indicators, Nagoya has come to resemble the urban and transport form of European urban areas more than that of the two larger Japanese urban areas. Despite one of the world's most comprehensive commuter rail systems, Nagoya has become an auto-dominated urban area.

Like Tokyo and Osaka, the success of commuter rail in Nagoya results from the extensiveness of pre-automobile development (the result of reaching high-automotive status late), the extensive commuter rail system and connecting bus systems, the higher public transport system speeds and the high service frequency. These factors combine to make public transport competitive with the automobile throughout the urban area.

Paris: Europe's largest public transport system is in Paris, which has 9.7 million people and a population density of 9,100 per square mile. Approximately 24 percent of travel in the Paris area is on public transport, and more than one-quarter of that is on commuter rail (Figure 7). The core of the system is the RER (regional express) system, which provides services from the suburbs through the city in tunnels that have been largely constructed in the last thirty years. In addition, many lines converge on intercity railroad stations (such as Gare du Nord or Gare Montparnasse) located at the periphery of the Paris central business district, The commuter rail system extends to over 1,000 route miles on more than 40 routes, with more than 500 stations. There are 0.51 commuter rail stations per square mile (one for each 2.0 square miles) of developed land. In the central business district, people walk to their destinations or catch metro, bus or regional express services to complete their journeys. Annual commuter rail ridership is more than 900 million

rides, equal to all of the public transport ridership in Washington-Baltimore and Boston combined.

Average public transport system operating speeds are 23.6 miles per hour, nearly 50 percent faster than the 16 mile per hour automobile rate. Service frequencies, however, are significantly lower than in Tokyo, with from zero to 12 percent of service operating on five minute frequencies or greater during off-peak hours. The commuter rail system is operated by public authorities and receives operating subsidies. Virtually all capital costs are subsidized.

The central business district has nearly 900,000 jobs. This represents 17 percent of metropolitan area employment. The central business district is, however, losing market share quickly. From 1990 to 1999, CBD employment declined nearly 200,000 jobs, while job growth in the outer suburbs was nearly 140,000.[17]

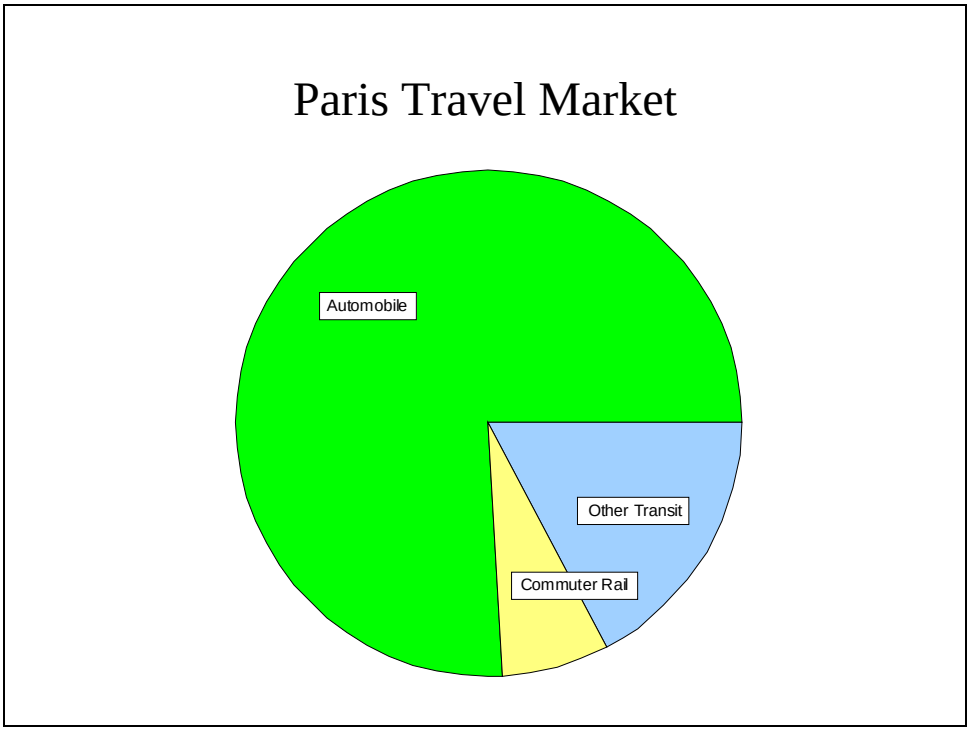

Figure 7

But, the Paris commuter rail system operates considerably lower service frequencies and does not provide the extent of regional connectivity as the Japanese systems. As a result, a somewhat lower level of automobile competitive service is provided from the suburbs to the core, while little service is provided between suburban origins and destinations. Public transport's share of trips within the city of Paris is 67 percent, while the share between suburban locations and Paris is 59 percent, while public transport travel within the suburbs is much lower, at 15 percent. Nonetheless, by US standards, this suburban public transport market share is very high. In Paris,

[17] Calculated from INSEE data.

like other European urban areas, lower income households are more concentrated in suburban locations. No automobile households number 23 percent in suburban Paris, well above US suburban levels. Travel demand within the suburbs is more than double the travel in and to the core (Table 3).[18]

Table 3
Travel in the Paris Metropolitan Area

Sector	Overall Share of Trips	Public transport Share of Trips
Within Paris	13.2%	66.8%
Suburbs-Paris	16.4%	58.9%
Within Suburbs	70.4%	15.4%
Source: IAURIF, Paris		

London: With 12.2 million people and a population density of 7,600 per square mile, London has the continent's second largest public transport system, which carries an estimated 19 percent[19] of travel in the area. Commuter rail represents approximately 20 percent of public transport travel, or four percent of overall travel (Figure 8). However, unlike the Japanese urban areas and Paris commuter rail lines do not operate through the central city. Virtually all lines end at intercity railroad stations (such as King's Cross or Waterloo) on an inner metro loop (the "Circle Line"), and there is no through running of commuter rail trains onto the metro lines. London has nearly 2,000 miles of commuter rail, which is served by more than 700 stations on more than 40 lines. There are 0.47 commuter rail stations per square mile (one for each 2.1 square miles) of developed land. Average service frequencies are higher than Paris, but well below that of Paris, at from 15 to 50 percent with five minute frequencies off-peak. Services are operated under competitive contract by private carriers, which receive operating subsidies. There are also capital subsidies.

The principal destination served is the central business district, which contains 1.3 million jobs. Like Paris, however, central business district employment has fallen. The loss was more than 250,000 from 1961 to 1991.[20] This represents 21 percent of metropolitan area employment. Annual commuter rail ridership is 580 million, approximately equal to all of the public transport ridership in the Chicago area.

[18] Data from INSEE, 1999.
[19] Estimated from UK Government Statistical Office data.
[20] Calculated from Kenworthy & Laube.

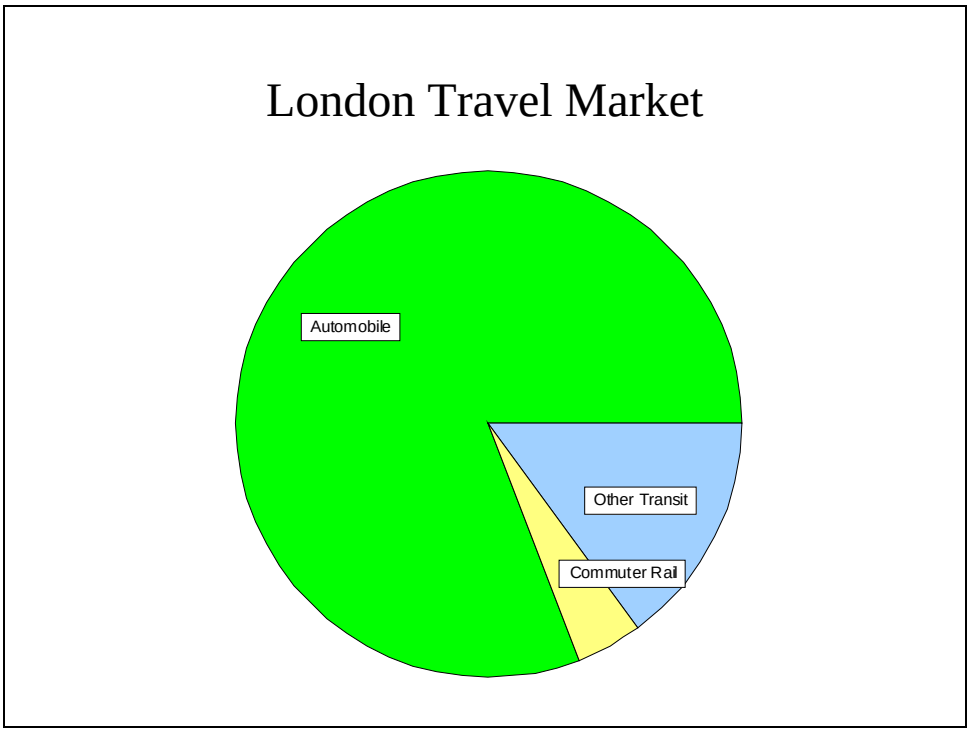

Figure 8

Like Paris, the London commuter rail system operates considerably lower service frequencies and does not provide the extent of regional connectivity as the Japanese systems. As a result, a somewhat lower level of automobile competitive service is provided from the suburbs to the core, while little service is provided between suburban origins and destinations.

Public transport's ability to serve trips within the suburbs is particularly hampered by London's urban form, which was imposed upon the area by government. Starting in the 1930s, London established a "green belt" approximately 10 miles wide outside what is now the Greater London Authority [21](an area of 620 square miles and 7.1 million population). As a result, the suburban expansion that would have occurred adjacent to the central city occurred farther from the city. Suburban London is thus virtually wholly composed of "leap frog" developments spread over 3,000 square miles, of which approximately 1,000 square miles is urbanized. This "hyper-sprawl" is even more difficult for public transport to serve with respect to suburban trips than the typical sprawl pattern of virtually all other urban areas in North America, Western Europe and Japan..

Sydney: Sydney is the largest urban area in Australia, with approximately 3.5 million inhabitants spread over 800 square miles, for a population density 4,400 per square mile. Only one percent of Sydney is developed at pre-automobile densities, however, Australia reached US 1930

[21] Because of its unconventional urban form, much data on the London area is limited to the Greater London Authority, which represents less than 60 percent of the urban area population. This analysis considers the entire London urban area, which includes the suburbs that extend far beyond the Green Belt.

automobile ownership rates only in the mid-1960s. Sydney's public transport market share is very high for a low density urban area, at 13.6 percent (only Toronto, at 15.2 percent is higher among urban areas in the US, Canada, Australia and New Zealand). Commuter rail accounts for 5.6 percent of travel in the area (Figure 9).

There are more than 1,250 commuter rail route miles and 300 stations located on 15 lines throughout the urban area. There are 0.38 commuter rail stations per square mile (one for each 2.65 square miles) of developed land. Commuter rail ridership is 41 percent of the public transport total.

Sydney has the automotive world's sixth most patronized commuter rail system, and the third most extensive in terms of route miles. Virtually all of the system predates high automobile ownership. Unlike the London and New York systems and many other systems in Western Europe and the United States, the Sydney system operates through the central business district, providing through service. In this respect, the Sydney system is similar to that of Paris, though does not have the dense mesh of service provided in the Japanese urban areas. Moreover, the system has a major secondary hub outside the downtown area (where public transport's work trip market share is more than 70 percent), in Parramatta. Parramatta is also unique in being a hub for the suburban privately operated bus system. The central business district has approximately 10 percent of the region's employment, while Parramatta has approximately one percent (a public transport work trip market share of under 30 percent) This two hub system substantially increases the extent of automobile competitive service available in the Sydney

Nonetheless, automobile competitive public transport service is generally limited to the two hubs. There is little automobile competitive service between suburban locations, which account for 85 percent of the population and 65 percent of the employment.[22]

[22] Based upon the inner city as defined by Kenworthy and Laube.

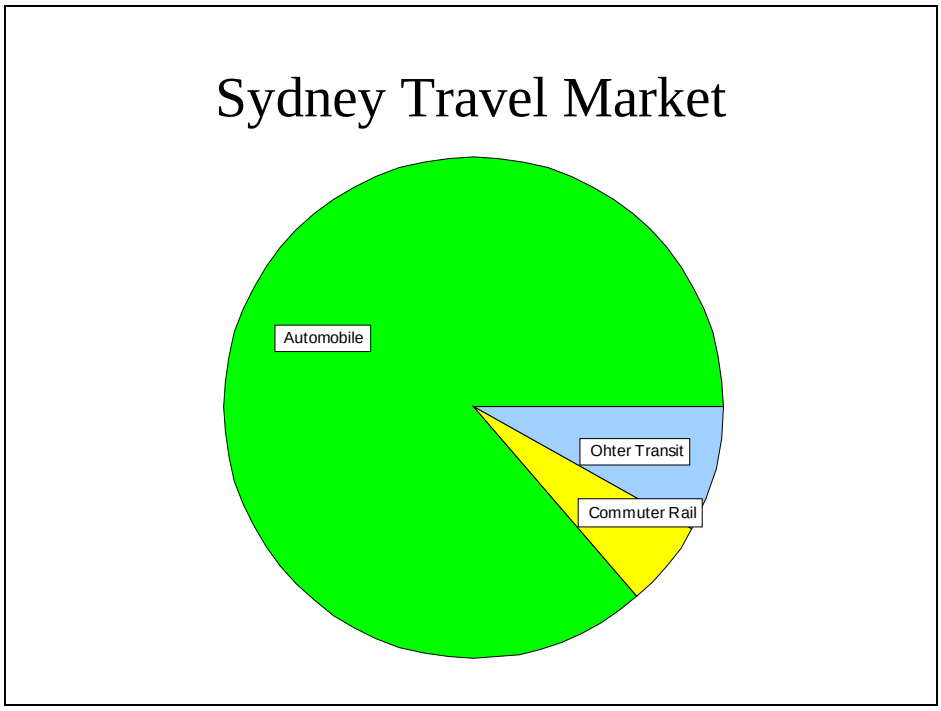

Figure 9

New York: The New York commuter rail service area consists of 20.3 million people, spread over 4,700 square miles at an average population density of 4,300 per square mile. Approximately five percent of the urban land area is at pre-automobile population densities (above 15,000 per square mile), though this accounts for 44 percent of the population (9.0 million). Approximately 40 percent of the population is in the core city of New York.

The New York central business district (Manhattan) is the world's second largest, with approximately 1.7 million jobs.[23] This represents 19 percent of metropolitan area employment. Further, few new jobs have been created downtown. From 1960 to 1990, more than 96 percent of the new jobs in the metropolitan area were created outside downtown.[24]

New York has by far the nation's highest public transport market share, at more than 9 percent. Commuter rail ridership is approximately 240 million boardings annually (approximately 800,000 daily), and represents approximately 0.7 percent of travel in the area (Figure 10). Unlike the Japanese urban areas and Paris, public transport operating speeds are slower than automobile speeds. Public transport operates at 21.2 miles per hour, while automobiles average 23.8 miles per hour.

The New York commuter rail system is by far the largest in the nation. There are nearly 1,000 miles of route and 400 stations on nearly 30 routes. Most service terminates in the New York central business district (Manhattan) at either Penn Station or Grand Central Station. Transfers

[23] US Census Bureau, 1990.
[24] Calculated from Kenworthy & Laube.

can be made at each of these stations to subway services or buses. There is, however, no through running of commuter rail trains on subway routes. and no commuter rail trains run through the central business district. There are 0.09 commuter rail stations per square mile (one for each 11.7 square miles) of urban land. This is barely one-tenth of the Tokyo station density. Further, service frequencies are somewhat sparse, with from zero to 12 percent of services operating every five minutes off peak.

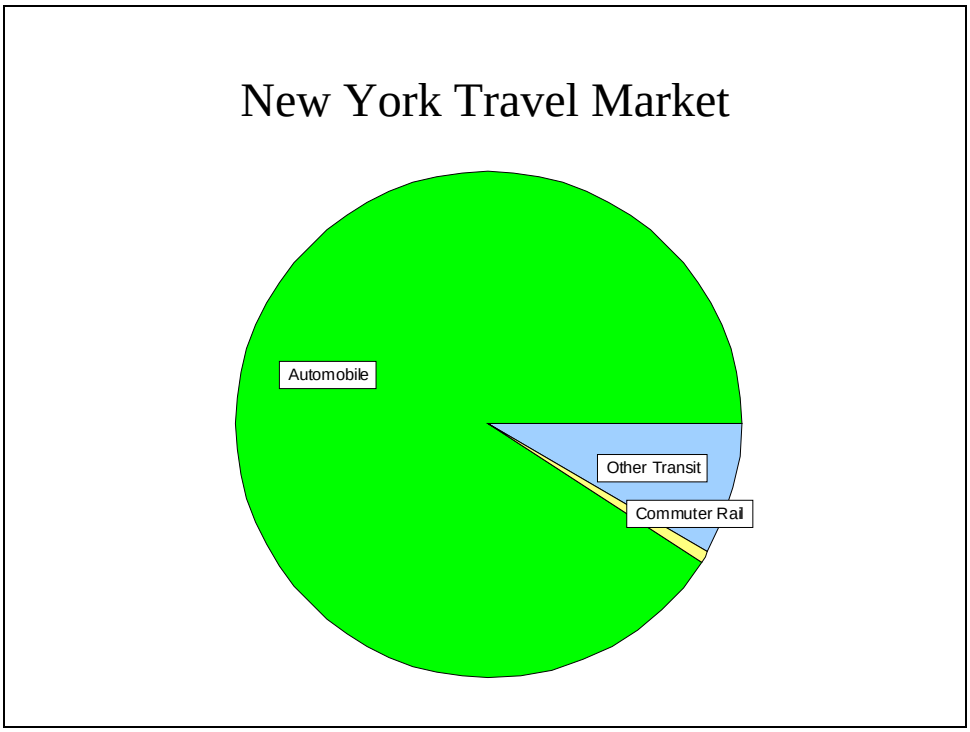

Figure 10

As a result, in New York commuter rail is principally a downtown oriented system. Auto-competitive service is provided to the central business district from throughout the urban area. In the downtown area. Commuter rail carries 14 percent of commuters to the central business district. Commuter rail appears to have a significant impact on traffic congestion to downtown (Figure 11), with nearly 250,000 commuters converging on less than 10 square miles (27,000 per square mile). This represents more than the total number of jobs in all but a few of the nation's downtown areas.[25]

However, little auto-competitive service is available in the rest of the area, which is reflected by commuter rail's much smaller share at one percent outside downtown. It is estimated that there are 1,100 daily passenger miles of commuter rail ridership that is not oriented to downtown.[26] This compares to 63,000 daily vehicle miles (100,000 person miles) per square mile of road travel in the New York area.[27]

[25] Only Chicago, San Francisco, Boston, Washington and Philadelphia have more than 250,000 downtown jobs.
[26] 1990 data.
[27] Assumes national vehicle occupancy ratio of 1.6.

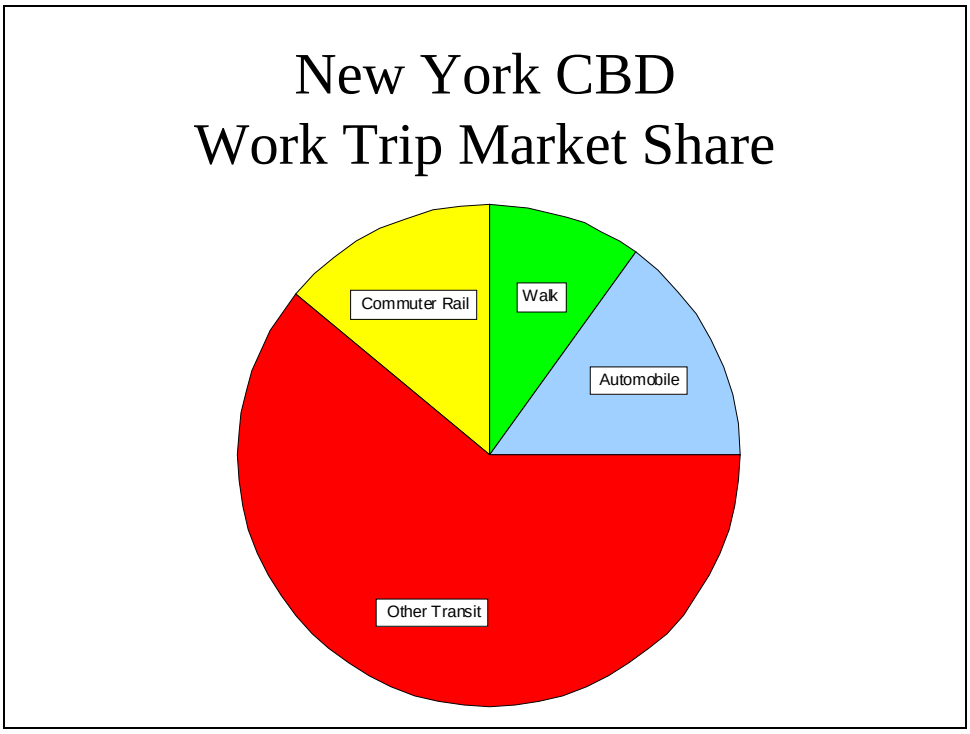

Figure 11

Chicago: The Chicago commuter rail service area consists of 8.3 million people, spread over 2,100 square miles at an average population density of 3,900 per square mile. Public transport's share of travel is below four percent. Public transport operates at 22.9 miles per hour, below the 27.9 mile per hour automobile speed.

Approximately four percent of the urban land area is at pre-automobile population densities (above 15,000 per square mile), while 24 percent (2.0 million) of the population lives in this area. The Chicago central business district is the nation's second largest, with nearly 500,000 jobs.[28] This represents 13 percent of the metropolitan area's employment. Further, few new jobs have been created downtown. From 1960 to 1990, more than 96 percent of the new jobs in the metropolitan area were created outside downtown.[29]

Chicago has the nation's second largest commuter rail system, with approximately 75 million boardings annually (300,000 daily), which is approximately 0.5 percent of travel in the area (Figure 12). There are more than 300 miles of route and 250 stations on 11 routes. There are 0.12 stations per square mile of urban land (one station for each 8.5 square miles). Most service terminates at stations on the periphery of downtown. Transfers can be made at these stations to elevated rail services or buses. There is, however, no through running of commuter rail trains on

[28] US Census Bureau, 1990.
[29] Calculated from Kenworthy & Laube.

elevated or subway routes. and no commuter rail trains run through the central business district. The commuter rail system is operated by government agencies, and receives operating subsidies. All capital costs are subsidized.

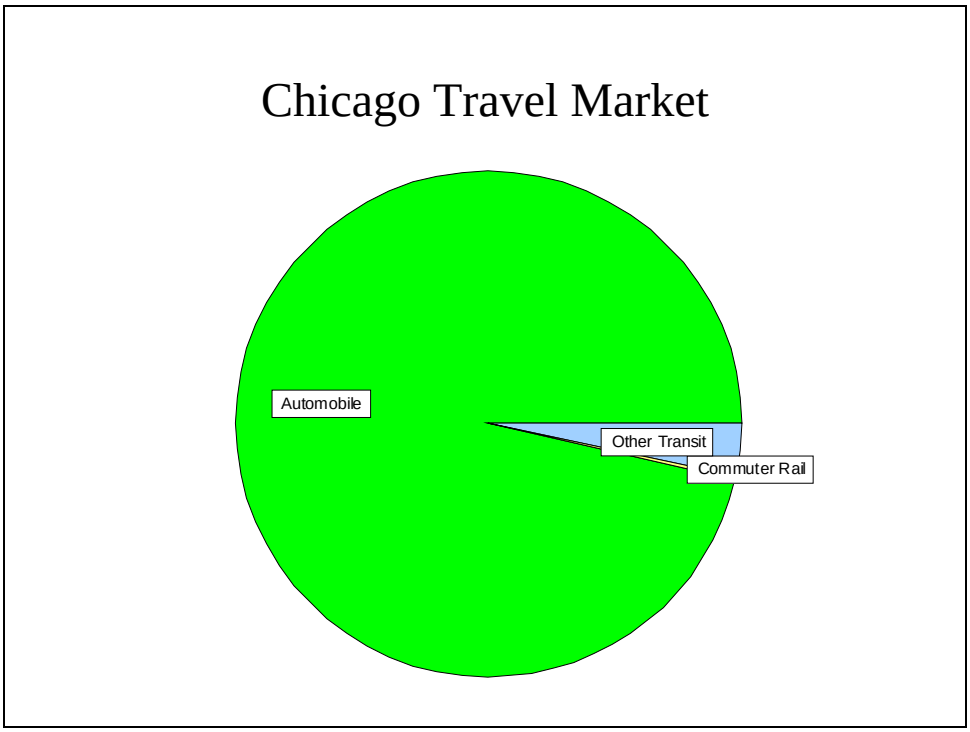

Figure 12

Like New York, commuter rail in Chicago is principally a downtown oriented system. Auto-competitive service is provided to the central business district from throughout the urban area. In the downtown area, commuter rail carries 23 percent of commuters (Figure 13), the highest downtown commuter rail share in the nation. More than 120,000 commuter rail riders converge on the three square mile central business district, without which it is likely that traffic would be much worse (36,000 per square mile). However, little auto-competitive service is available in the rest of the area, which is reflected by commuter rail's much smaller share at 0.3 percent outside downtown. Outside downtown only 11,000 commuters are spread among destinations throughout more than 1,500 square miles.[30] It is estimated that there are approximately 250 daily passenger miles of commuter rail ridership not oriented to downtown.[31] This compares to 58,000 daily vehicle miles per square mile (93,000 person miles) of road travel in the Chicago area.

The scant level of suburban to suburban automobile competitive public transport services is illustrated by a review of suburban to suburban commuting in the Chicago area. The average trip time, not including walking to and from the public transport stops was 2:39. This is more than three times the average public transport work trip (most of which are either to downtown or

[30] 1990 data.
[31] 1990 data.

within the city of Chicago) of 49.7 minutes. It is also more than 5.5 times the average work trip length for non-public transport trips (mostly automobile) in the Chicago area.[32] The shortest work trip was 43 minutes, while the longest was 3:56.[33]

Chicago's commuter rail system provides a automobile competitive service to the downtown area. But, as the analysis above indicates, there is little automobile competitive service within the suburban areas, which account for approximately 65 percent of both residences and jobs.

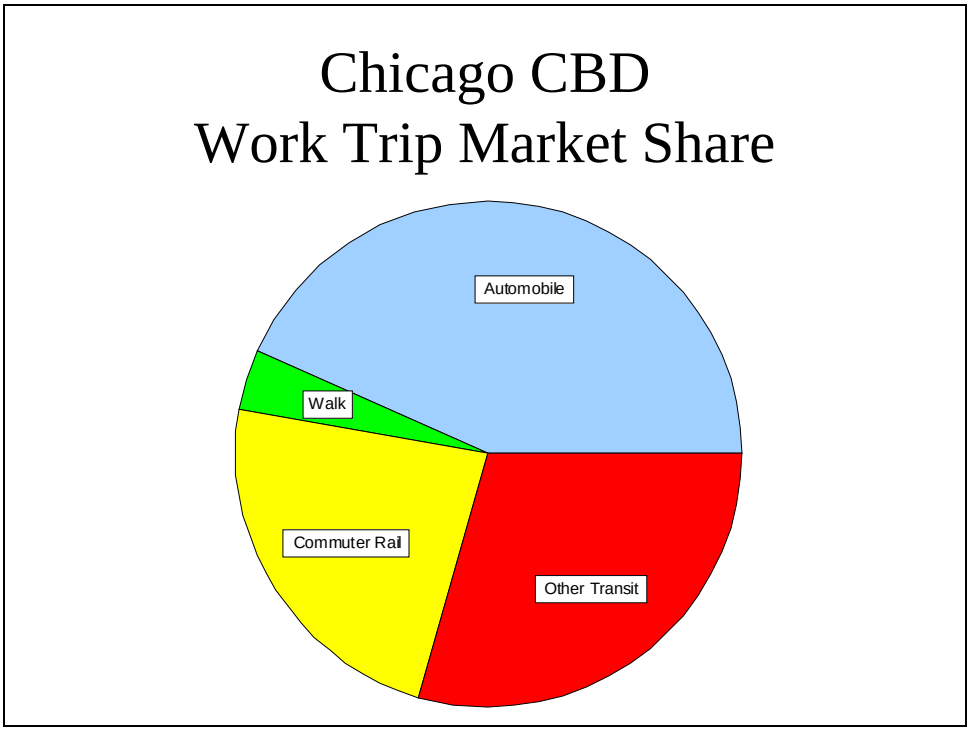

Figure 13

Boston: The Boston commuter rail service area consists of 4.0 million people, spread over 1,700 square miles at an average population density of 2,300 per square mile. Public transport's share of travel is less than four percent. The average automobile travel speed of 32.5 miles per hour is well above that of public transport, at 18.3 miles per hour.

Approximately two percent of the urban land area is at pre-automobile population densities (above 15,000 per square mile), and 20 percent of the population lives at such densities (800,000). The Boston central business district is one of the nation's largest, with 280,000 jobs.[34] This represents 13 percent of the metropolitan area's employment. Further, downtown

[32] 2000 Census data.
[33] This analysis used the Regional Transportation Authority (http://tripsweb.rtachicago.com/) trip planner for work trips from the suburban Orland Mall area to approximately 60 suburban locations built into the trip planner.
[34] US Census Bureau, 1990.

employment is declining. From 1960 to 1990, downtown employment declined approximately 15,000, while employment in the rest of the metropolitan area increased more than 700,000.[35]

Boston has the nation's third largest commuter rail ridership, with approximately 36 million boardings annually (135,000 daily), which is approximately 0.4 percent of travel in the area (Figure 14). There are more than 300 miles of route and 100 stations on 13 routes. There are 0.07 stations per square mile of urban land (one station per every 15 square miles). Most service terminates at North Station and South Station. Transfers can be made at these stations to subway and light rail services or buses. There is, however, no through running of commuter rail trains on light rail or subway routes. and no commuter rail trains run through the central business district. The commuter rail system is operated by a contractor (Amtrak), and receives operating subsidies. All capital costs are subsidized.

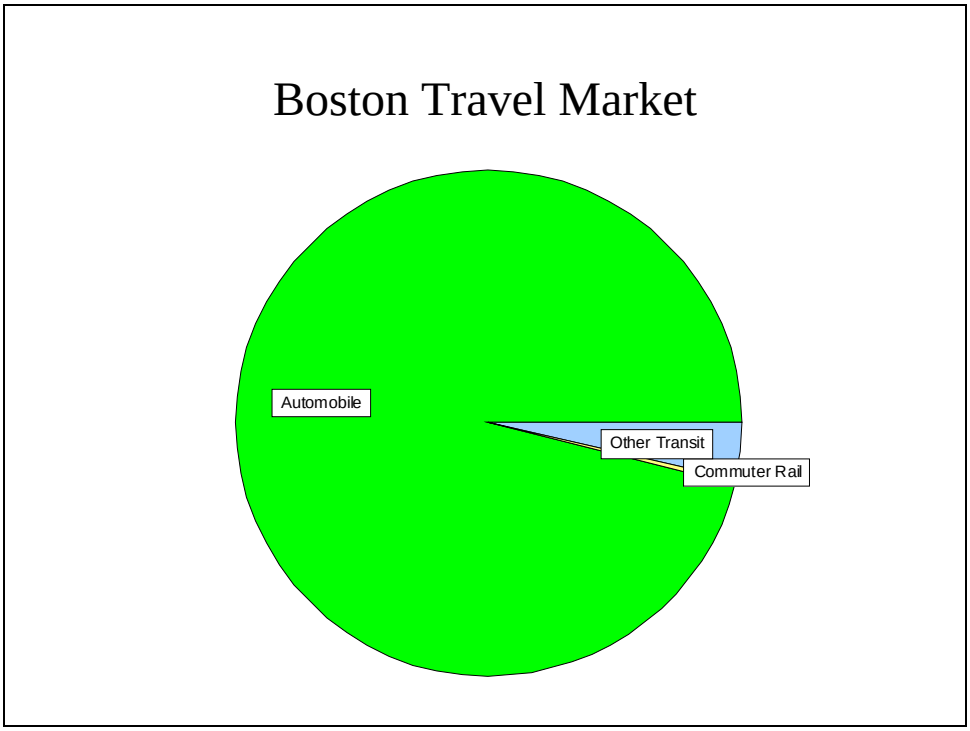

Figure 14

Commuter rail in Boston is also principally a downtown oriented system. Auto-competitive service is provided to the central business district from throughout the urban area. Commuter rail carries eight percent of commuters (Figure 15). Outside downtown, commuter rail's work trip market share is approximately 0.4 percent. It is estimated that there are approximately 400 daily passenger miles of commuter rail ridership not oriented to downtown.[36] This compares to 43,000 daily vehicle miles per square mile (70,000 person miles) of road travel in the Boston area.

[35] Calculated from Kenworthy & Laube.
[36] 1990 data.

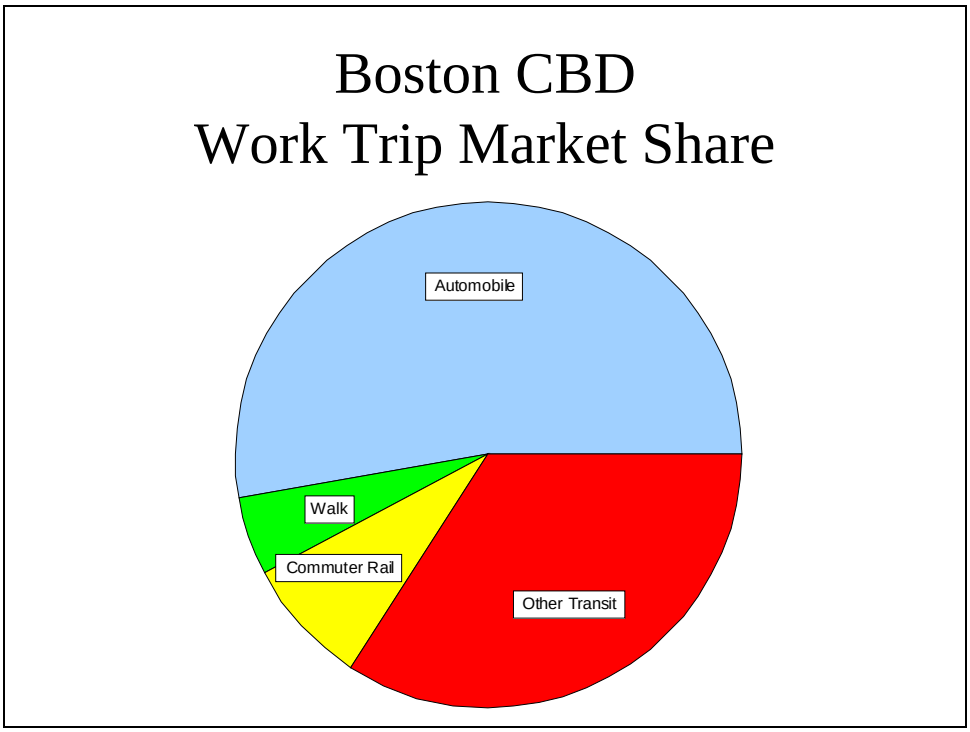

Figure 15

Philadelphia: The Philadelphia commuter rail service area consists of 5.1 million people, spread over 1,800 square miles at an average population density of 2,900 per square mile. Approximately 2.7 percent of the urban land area is at pre-automobile population densities (above 15,000 per square mile), and 22 percent of the population (1.1 million) lives at these densities. The Philadelphia central business district is the one of the nation's largest, with 350,000 jobs.[37] This represents 14 percent of the metropolitan area's employment. Public transport's work trip market share to downtown is approximately 40 percent, compared to three percent outside downtown.

Public transport's share of travel is below three percent., with a commuter rail share of 0.3 percent (Figure 16). Philadelphia has the nation's fourth largest commuter rail ridership, with approximately 30 million boardings annually (100,000 daily), which is approximately 0.3 percent of travel in the area. There are more than 300 miles of route and 175 stations on 13 routes. There are 0.10 stations per square mile of urban land (one station per every 10 square miles). Most service terminates at one of three downtown stations. Philadelphia, however, is unique in having commuter rail trains that run through the downtown area. This was made possible by the construction of a tunnel connector in the early 1980s. Nonetheless, commuter rail ridership is less with the new tunnel than before.[38]

[37] US Census Bureau, 1990.
[38] Commuter rail ridership declined six percent from 1980 to 2000 according to the National Public transport Database.

The commuter rail system is operated by a government agency, and receives operating subsidies. All capital costs are subsidized.

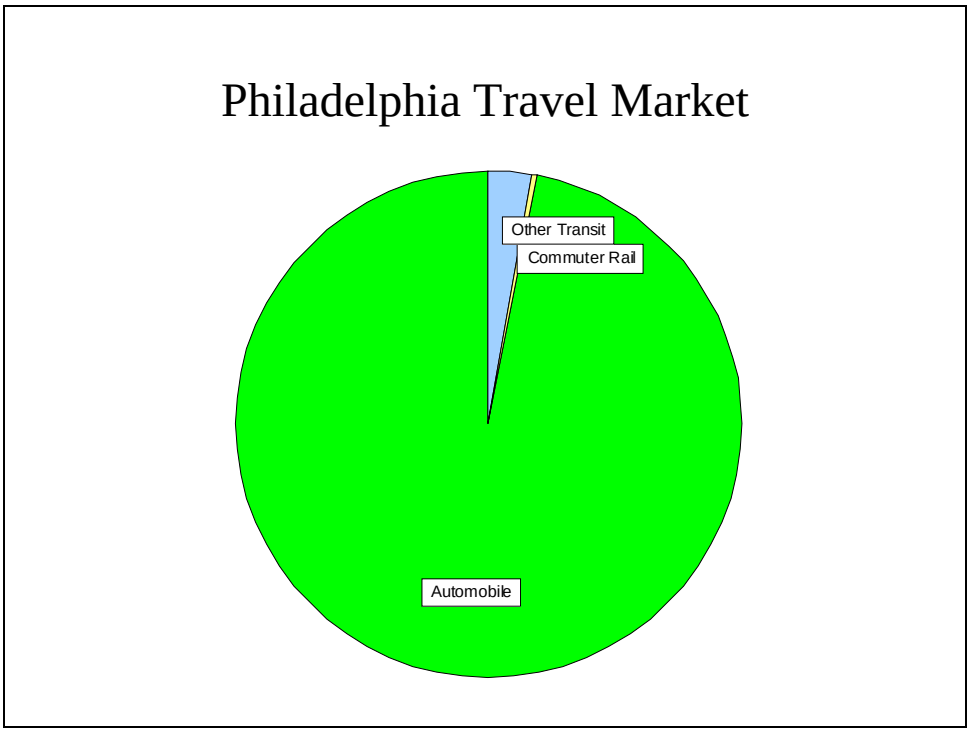

Figure 16

Transfers can be made at these stations to subway services or buses. There is, however, no through running of commuter rail trains on subway routes.

Commuter rail in Philadelphia is also principally a downtown oriented system. Auto-competitive service is provided to the central business district from throughout the urban area. Commuter rail carries nine percent of commuters (Figure 17). Outside downtown, commuter rail's work trip market share is approximately 0.6 percent. It is estimated that there are approximately 225 daily passenger miles of commuter rail ridership not oriented to downtown.[39] This compares to 57,000 daily vehicle miles of road travel per square mile (91,000 person miles) in the Philadelphia area.

[39] 1990 data.

Figure 17

Other Systems: San Francisco also has a pre-automobile commuter rail line, but not a regional commuter rail system. The Washington-Baltimore area also has pre-automobile commuter rail lines, but additions have created a more regional system, which is considered under "Automotive Era Systems" below.

AUTOMOTIVE ERA SYSTEMS

A number of new commuter rail lines have opened in recent years. In two cases, regional systems have been developed (Washington-Baltimore and Los Angeles), while elsewhere the new services have been individual commuter rail lines. In each case, these new lines have used existing freight railways to operate service in service areas that long ago had developed as. automotive urban areas (Appendix Table C).

Washington-Baltimore: Washington-Baltimore has both pre-auto and automotive era commuter rail lines. It is analyzed as an automotive era system because the level of service has been significantly expanded in recent years by the new line openings and service expansion.

The Washington-Baltimore commuter rail service area consists of 6.0 million people, spread over 1,800 square miles at an average population density of 3,300 per square mile. Approximately one percent of the urban land area is at pre-automobile population densities (above 15,000 per square mile), and public transport's share of urban travel is below three

percent. In the Washington area, average public transport operating speeds are 20.0 miles per hour, below the 26.3 mile per hour average for automobiles.

The Washington central business district is the one of the nation's largest, with 350,000 jobs, while downtown Baltimore has 130,000 jobs.[40] This represents 19 percent of the metropolitan area's employment. Public transport's work trip market share to downtown Washington is approximately 40 percent, and 25 percent to downtown Baltimore. This compares to approximately seven percent outside the downtown areas.

Commuter rail service has been expanded in the Washington-Baltimore area over the past ten years. There are now five routes operating over nearly 200 miles with more than 50 stations. There are 0.03 stations per square mile of urban land (33 square miles per station). Annual ridership is approximately eight million, with daily ridership of 36,000. This is approximately 0.5 percent of travel in the area (Figure 18). All services terminate at stations on the periphery of the downtown areas (Camden Yards and Penn Station in Baltimore and Union Station in Washington). The commuter rail system is operated by government agencies, and receives operating subsidies. All capital costs are subsidized. Transfers can be made at these stations to subway services, light rail or buses. There is, however, no through running of commuter rail trains on subway routes.

The Washington-Baltimore area has had some of the most significant public transport improvements in the nation. They include a 100 mile subway in the Washington area, a single line subway in Baltimore, light rail lines in Baltimore and commuter rail expansions. Despite these improvements, public transport's share of travel is slightly below 1983 levels[41] and public transport's work trip market share dropped 20 percent during the last decade.[42] At the same time, the peak hour travel times increased 23 percent in the Washington area and 21 percent in the Baltimore area.[43]

Commuter rail in Washington-Baltimore is also principally a downtown oriented system. Auto-competitive service is provided to the central business district from throughout the urban area. It is estimated that there are less than 100 daily passenger miles per square mile of commuter rail ridership that are not oriented to downtown.[44] This compares to 75,000 daily vehicle miles of road travel per square mile (120,000 person miles) in the Washington-Baltimore area.

[40] US Census Bureau, 1990.
[41] Public transport's share of person miles dropped from 3.4 percent to 3.3 percent (estimated from National Public transport Database and Texas Transportation Institute data, assuming the national average vehicle occupancy rate of 1.6).1983 represents first data available in present format.
[42] Calculated from US Census Bureau data.
[43] Calculated from Texas Transportation Institute Travel Time Index.
[44] 1990 data.

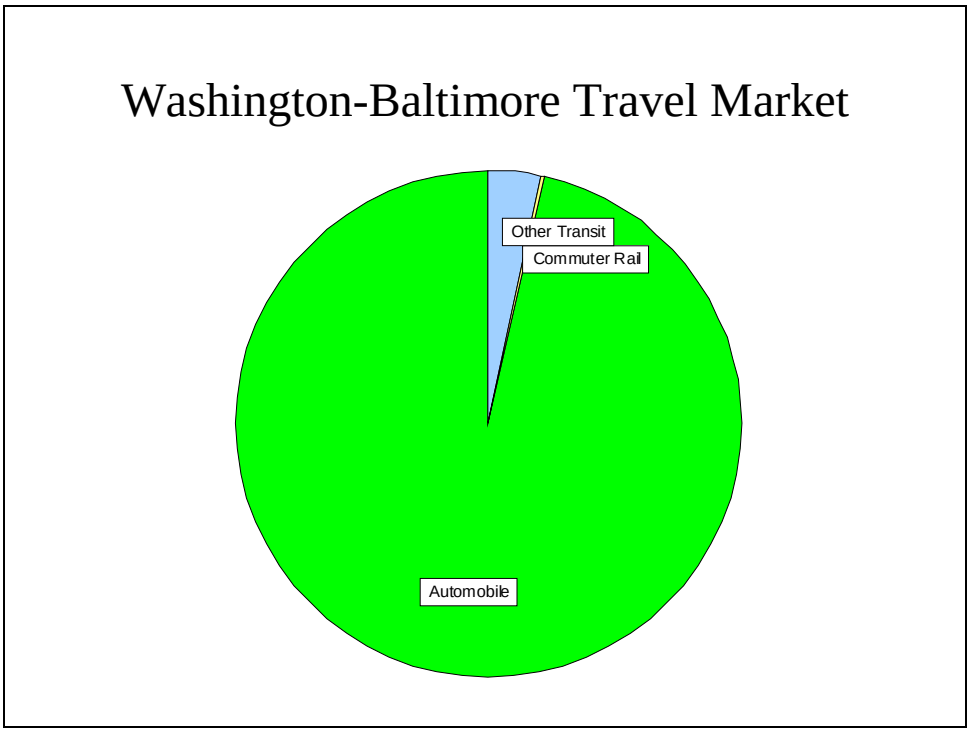

Figure 18

Los Angeles: Los Angeles is the only urban area in the United States to have developed a regional commuter rail system in decades. The system opened in the early 1990s and now extends to more than 400 miles, with approximately 50 stations on seven routes. The system length is second only to New York in the United States and the 10th most extensive in the world.[45] There are 0.02 stations per square mile of urban land (one for each 48 square miles).. The 56 mile San Bernardino to Los Angeles line is by far the nation's most successful new commuter rail route, carrying more than 10,000 riders daily.[46]

The Los Angeles commuter rail system serves an area[47] of 14 million people, spread over 2,300 square miles at an average population density of 6,100 per square mile. Approximately 6.5 percent of the urban land area is at pre-automobile population densities (above 15,000 per square mile), accounting for 23 percent of the population (3.2 million). However, much of the pre-automobile density in Los Angeles actually represents post-automobile development. Los Angeles is virtually alone among major automotive world urban areas in having experienced a significant increase in density since 1950. The core of Los Angeles in 2000 was 35 percent more dense than in 1950. Almost all of the high density areas of Los Angeles were developed after high levels of automobile ownership were achieved. Thus, despite the pre-automobile densities,

[45] Among systems for which data is available (*Janes Urban Transport Systems* and Federal Public transport Administration).
[46] http://www.metrolinktrains.com/
[47] Includes Los Angeles, Oxnard, Simi Valley, Santa Clarita, Lancaster, Mission Viejo and San Bernardino-Riverside urbanized areas (areas served by commuter rail system). The core Los Angeles urbanized area has the nation's highest population density, at 7,068 persons per square mile.

there is an automobile era urban form, including wide streets and a comparatively dense freeway system.

Public transport's share of travel is less than 1.5 percent, with commuter rail accounting for 0.2 percent of travel (Figure 19). Average automobile travel speeds are 27.9 miles per hour, more than double the 12.4 miles per hour of public transport.

The Los Angeles central business district, at 170,000 employees, represents only 2.5 percent of metropolitan employment. From 1960 to 1990, more than 99 percent of new jobs were created outside the downtown area.

Most commuter rail services terminate at Union Station, located on the northern periphery of the downtown area. Los Angeles commuter rail ridership, however, is considerably lower than that of other large commuter rail systems, at 8.1 million annually, or 31,000 daily. This is approximately 0.02 percent of travel in the metropolitan area. The commuter rail operator estimates that 2.9 percent of adjacent freeway traffic is diverted by commuter rail during peak travel hours.[48]

Figure 19

Transfers can be made at Union Station to the subway line or buses. There is, however, no through running of commuter rail trains on the subway.

[48] http://www.metrolinktrains.com/

Commuter rail in Los Angeles is also principally a downtown oriented system. Auto-competitive service is provided to the central business district from throughout the urban area. Approximately 70 percent[49] of riders terminate at Union Station, which means that there are approximately 100 passenger miles per square mile to destinations outside downtown. This compares to daily roadway travel of 105,000 vehicle miles per square mile (168,000 person miles).

Individual Routes

Other new commuter rail services have been established in a number of urban areas. In each case, these have been individual routes, rather than regional systems as in Los Angeles.

Miami: A 70 mile commuter rail line was established in the late 1980s, operating from Miami, through Fort Lauderdale to West Palm Beach. Public transport's market share in this area is approximately 1.3 percent, and commuter rail represents two percent of public transport ridership. Total daily ridership is approximately 8,500. The commuter rail agency plans to upgrade the line and expand service, and projects ridership of 42,100 per day. This figure, which would be more than four time the most successful new commuter light rail line (Los Angeles-San Bernardino) in the nation is considered highly optimistic.

San Diego: San Diego has opened a 43 mile commuter rail line. Public transport's market share in San Diego is approximately 1.5 percent and commuter rail represents less than two percent of this total. Daily ridership is approximately 5,000.

Dallas-Fort Worth: Dallas-Fort Worth has opened a 35 mile line between the two cities. Public transport's market share in the area is less than one percent, and commuter rail represents less than three percent of this total. Daily ridership is approximately 6,000.

Seattle: Seattle has opened a 35 mile commuter rail line from Tacoma to Seattle. This line carries approximately 2,000 per day, which represents less than 0.5 percent of public transport ridership in the Seattle area. Seattle's public transport market share is less than two percent.

San Francisco-San Jose: A new route, the Altamont Commuter Express has been established from San Jose to the San Joaquin Valley. Ridership is 3,000 daily

New London A new route from New London to New Haven (Connecticut Shoreliner") carries approximately 1,200 passengers per day.

Burlington, Vermont: The new *Champlain Flyer* was carrying between 150 and 500 passengers daily to this urban area, which is the smallest in the nation with a commuter rail line (population 105,000). Ridership is highest during the summer tourist season, and passenger fares are not charged. Service was canceled in 2003.

Each of the new individual routes carries a relatively too few riders to too few destinations to make a perceivable difference in traffic congestion. In each case, the extent of pre-auto

[49] http://www.metrolinktrains.com/

urbanization is small. Moreover, auto-competitive service is, at best, limited to downtown locations.

PROPOSED SYSTEMS

A number of other urban areas are also planning commuter rail lines, such as Kansas City, Minneapolis-St. Paul, Atlanta, Portland and Nashville. In Minneapolis-St. Paul, the "Northstar" commuter rail line is projected to carry 10,400 daily passengers, while the other lines would carry 5,000 or fewer. The Minneapolis-St. Paul projection is considered highly optimistic, because it would exceed that of the San Bernardino line in Los Angeles, which is the most successful new commuter rail line. Unlike the Northstar line, the San Bernardino line travels through highly urbanized territory along virtually its entire route.

Madison, Wisconsin is planning a system of 64 miles that its consultants have projected will carry 26,000 daily riders. Even so, if this projection were met, transit's share of travel in the Madison area would have little impact on traffic congestion, with transit's market share well below two percent.[50]. This figure is nearly equal to that of Los Angeles, with seven times as much route and 40 times as much population. This appears to be even more optimistic than the Minneapolis-St. Paul projection.[51]

As with the new systems and lines, ridership on the proposed commuter rail lines is projected to be too small to materially impact traffic congestion.

ANALYSIS

At least two conclusions are obvious from the examination of commuter rail systems. The first is that public transit market shares are much lower in the United States than in other automotive nations and the second is that people ---even in the United States --- will ride public transit (and commuter rail) where it is competitive with the automobile.

Generally, public transit ridership is much lower in US urban areas than in those of other automotive nations. Approximately two percent of US urban travel is by transit.[52] Transit's market share was more than double that in Canada and Australia, seven times the US figure in Western Europe and nearly 14 times as high in Japan (Table 4).

Table 5
International Transit Market Share and Population Density

Area	Transit Market Share	Compared to US	Urban Population Density	Compared to US

[50] Estimated from data in Dane County planning documents (www.co.dane.wi.us/rail/crfs/final) and Federal Highway Administration data.
[51] International research has indicated that large infrastructure projects, such as commuter rail lines, are characterized by ridership projections that are very optimistic.(see, for example: Mette K. Skamris and Bent Flyvbjerg, "Accuracy of Traffic Forecasts and Cost Estimates on Large Transportation Projects," *Transportation Research Record* (Washington, DC: Transportation Research Board, National Research Council), 1996).
[52]Estimated from Federal Transit Administration and Federal Highway Administration data for 1999.

United States	2%	1.0	3,462	1.0
Canada	9%	4.5	3,741	1.1
Western Europe	26%	13.0	14,245	4.1
Asia (Affluent)	42%	21.0	34,706	10.0
Australia	7%	3.5	3,175	0.9
Source: Calculated from Vivier, Kenworthy & Laube. US data for urban areas over 1,000,000 population, Canada data for urban areas over 500,000 population, Asia and Australia..				

There is considerable evidence that transit is attractive to large numbers of people even in automotive urban areas. In Tokyo-Yokohama and Osaka-Kobe-Kyoto, for example, more than 50 percent of travel is on public transit. A number of European urban areas attract more than 20 percent

Even in the more highly automotive United States, there is substantial evidence that people will use transit. For example, 75 percent of commuters to Manhattan's central business district use transit to get to work. This compares to only 15 percent using cars. More than one-half of commuters to the Chicago central business district use transit. The median transit work trip market share to the nation's 40 largest downtown areas was, however, a much lower 16.6 percent. Further, outside downtown, the transit work trip median market share was an even lower 3.4 percent. And, there, non-downtown employment centers accounted for more than 90 percent of metropolitan employment.[53]

This section will review the factors that drive commuter rail ridership and its potential to improve traffic congestion in US metropolitan areas.

Pre-Automobile Commuter Rail Systems and Urbanization: Generally, urban areas with greater pre-automobile development have higher public transit market shares. US urban areas, with their earlier automobility, tend to have much lower public transit market shares (Table 5). Moreover, the greater population growth that has occurred during the automotive era in the United States (Table 2, above) means that more of the urban area has been either developed or redeveloped to accommodate the automobile.

In this longer period of automotive urban development, the US has built more comprehensive urban highway systems, higher capacity and better integrated arterial (surface street) systems. The automobile has emerged as the most convenient way to travel in the United States because much of the urban form has been built to accommodate it. In virtually all US urban areas, automobile travel speeds are quicker than transit speeds. By comparison, in Western Europe and Japan, transit travel times tend to be superior to that of the automobile. Nonetheless, the higher transit operating speeds in Western Europe are of little assistance for the suburb to suburb trips that are a majority of urban travel, but for which there is little or no automobile competitive transit service.

[53] Calculated from US Census Transportation Planning Package, 1990.

Another pre-automobile characteristic of urban areas is the large, concentrated central business districts. These districts have undergone significant development since wide automobile ownership has been achieved. But, virtually no dense central business districts have been built since broad automobile ownership was achieved.

Moreover, the highest transit market shares are in urban areas that have extensive commuter rail systems that predate the automobile. In these areas, the commuter rail system was built either before or as the urban area expanded. On the other hand, newer commuter rail systems tend to have far lower ridership levels and their urban areas far lower public transit market shares. This is illustrated by Los Angeles, with the 10th most extensive commuter rail system, yet with ridership that is 1/30th that of New York and less than 1/1000th that of Tokyo-Yokohama.

Table 5
Pre-Automobile Urbanization and Transit

Urban Area	Urban Land at Pre-Automobile Densities	Years to Attain US 1930 Auto Ownership Rate	Transit Market Share
Tokyo-Yokohama	55%	55	57%
Osaka-Kobe-Kyoto	51%	55	51%
Nagoya	9%	55	25%
Paris	18%	40	24%
London	8%	50	19%
Sydney	1%	35	14%
New York	5%	0	9%
Chicago	4%	0	4%
Boston	2%	0	4%
Philadelphia	3%	0	3%
Washington-Baltimore	1%	0	3%
Los Angeles	6%	0	1%
San Diego	2%	0	1%
Miami	2%	0	1%
Dallas-Fort Worth	0%	0	1%
Seattle	0%	0	2%

Source: Calculated from national census data.

Transit Market Share Trends: The higher densities of international urban areas, their higher transit market share and more extensive transit systems (especially commuter rail systems) have led some analysts to suggest the potential for the US to aspire to international urban forms (higher population densities) and higher transit market shares by constructing urban rail systems.

However, neither European nor Japanese urban areas built their way into larger transit market shares. And, with few exceptions, transit's market share has been dropping (Table 6). Similarly, journey to work market shares have been dropping throughout the automotive world (Table 7)

The high transit market shares that exist today in Tokyo and Osaka, for example, are below those of two decades ago. Tokyo dropped 16 percent from 1975 to 1998, while transit's market share in the Tokyo suburbs dropped 31 percent. Over the same period, transit's market share dropped 19 percent in Osaka. The decline has been even greater in Nagoya, at 45 percent from 1975 to 1998. Market share data is available for nine Western European urban areas since 1980. Overall, the annual loss is 1.7 percent, with only one urban area (Zurich) experiencing and increase (0.2 percent annually). Paris, with the largest transit system in Western Europe experienced a nearly one-half decline in market share from 1960 to 1995..[54] From 1960 to 1990, Sydney's transit market share dropped 40 percent. Losses in work trip market share have also been evident throughout the automotive world (Table 8).

Further, the central business district, which is the most significant transit destination in both pre-automobile and automotive era urban areas is losing market share throughout the automotive world. Since 1960, 13 percent or less of new employment in the United States, Canada, Australia, Japan and Western Europe has been in the central business districts (Table 6). The loss of central business district employment share has contributed to transit's market share loss throughout the automotive world.

These losses have continued even as downtown areas have become better served by major transit improvements. From 1994 to 1995, downtown Los Angeles lost employment, while metropolitan employment gained. In Dallas-Fort Worth, downtown employment expansion represented less than one percent of job growth. In Minneapolis-St. Paul, where the "Northstar" commuter rail line is planned, downtown employment growth has also been less than one percent of the metropolitan total.[55]

Table 6
Change in Transit Market Share: 1960-2000

	1960	2000	Change in Transit Market Share
New York	31.2%	9.3%	-70.2%
Chicago	19.9%	3.6%	-81.7%
Boston	12.7%	3.8%	-70.4%
Los Angeles	3.2%	1.4%	-56.2%
United States (Urban)	7.1%	1.9%	-73.2%

Source: Derived from Kenworthy & Laube, National Transit Database and Federal Highway Administration.

[54] Calculated from data in Vivier (above) and Jeffrey R. Kenworthy, Felix B. Laube and others, *An International Sourcebook of Automobile Dependence in Cities: 1960-1990* (Boulder: University Press of Colorado), 1999.
[55] Calculated from US Census Bureau *County Business Patterns* data.

Table 7 Change in Transit Journey to Work Market Share: International 1970-1990	
Area (Cases)	Change
United States (All)	-39.6%
Canada (2)	-3.2%
Western Europe (10)	-18.4%
Japan (Tokyo)	-24.4%
Australia (4)	-49.6%
Source: Calculated from Kenworthy & Laube.	

Table 8 Trend in Downtown Job Share	
Area (Cases)	CBD Share of New Jobs Since 1960
United States (11)	3.3%
Canada (7)	8.2%
Australia (5)	1.0%
Japan (Tokyo)	13.7%
Western Europe (9)	-20.2%
Source: Calculated from Kenworthy & Laube.	

US urban areas have experienced substantial market share losses over the past 40 years. In 1960, the New York transit market share was above the present share of most Western European urban areas, including Paris, and above Nagoya. Today New York's share is below virtually all major Western European urban area transit market shares. In 1960 Chicago had a transit market share above the present share of London (Table 7).

These market share losses are in stark contrast to the conclusion of a recent report that attempted to quantify the energy savings from increasing transit's market share 10 times in the United States (below). In view of the fact that transit's market share has trended downward for decades, such a radical reversal is considered unrealistic.

There are, however virtually no cases of "building into" materially higher transit market shares. Of course, because of the less dense and less centralized urban form, it would be even more difficult in the United States.[56]

[56] A recent report *Conserving Energy and Preserving the Environment: The Role of Public Transportation*, (Robert J. Shapiro, Kevin A. Hassett and Frank S. Arnold, commissioned by the American Public Transportation

NEW US COMMUTER RAIL AND TRAFFIC CONGESTION

Potential to Reduce Traffic Congestion: The 2000 US Census data indicates that commuter rail journey to work[57] ridership enjoyed a substantial increase, from 574,000 in 1990 to 658,000 in 2000. This represents a three percent market share increase (from 0.49 percent to 0.51), which compares to an overall public transport market share loss of 10 percent.[58] More than one-half of the increase was in the four large pre-automobile systems (New York, Chicago, Boston and Philadelphia).

These increases, which include commuter rail, however, are too small to have a material impact on metropolitan traffic congestion. The Texas Transportation Institute conducts an annual roadway congestion survey for the Federal Highway Administration that includes an estimate of the number of automobile commuters that would have to transfer to public transport on an annual basis to stop traffic congestion from growing. In the case of each US urban area with a commuter rail system the annual increase in public transport commuting was small compared to the number required to *stop* the growth of traffic congestion. In Los Angeles, Washington-Baltimore, Chicago and New York, the annual new peak period public transport riders required would need to be 85 or more times the increase in public transport commuters (Table 4).

Table 4
New Public transport Commuters Required to Stop Traffic Growth

Urban Area	Daily Commuters (One-Way)	1990-2000 Annual Change in Public transport Commuters	Multiple of Change to Equal Requirement
New York	280,000	2,257	124
Chicago	122,000	434	281
Philadelphia	50,000	(152)	NA
Boston	35,500	1,819	20
Washington-Baltimore	93,000	869	107
Los Angeles	126,000	1,479	85
Source: Texas Transportation Institute and US Census Bureau			

Finally, the minimal impacts of in Los Angeles demonstrate the limits of commuter rail as a strategy for relieving traffic congestion. Los Angeles represents the only US urban area that has established an entire new regional commuter rail system. The 10th most extensive system in the automotive world, its seven lines divert only 2.9 percent of traffic from adjacent freeways during peak hour. Metrolink, the system operator, estimates that under 22,000 cars are taken off the road

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Association) suggested that the United States could save considerable amounts of energy if "European" transit market shares were achieved.

[57] While the journey to work represents approximately 25 percent of urban travel, its concentration during the morning and evening periods makes it the principal cause of the most significant recurring traffic congestion.

[58] Calculated from US Census Bureau data.

by the commuter rail system (at most 11,000 per peak hour).[59] This represents less than 10 percent of the *annual* requirement for new peak period riders that would be necessary to stop traffic congestion growth in Los Angeles (Table 16, above)

This system serves an urban area of 14 million, which is the most densely populated in the United States. At its core is downtown Los Angeles, which has more employment than any downtown area that does not already have commuter rail. It is highly unlikely that another commuter rail system so extensive as that of Los Angeles will ever be built. What Los Angeles indicates is that even the most substantial efforts to implement commuter rail have little impact on traffic congestion.

Finally, as noted above, public transport and commuter rail tend to provide automobile competitive service only to downtown areas. Yet, downtowns represent barely 10 percent of employment in the modern urban area. As a result, commuter rail has no potential to impact the 90 percent of employment and employment related traffic destined to locations outside downtown areas.

Four US urban areas (New York, Chicago, Boston and Philadelphia) have pre-automobile commuter rail systems, and in those areas nearly all travel is by car except to or within the core. US urban areas do not have the high degree of pre-automobile urbanization that would be necessary for public transport (or commuter rail) to materially reduce traffic congestion. This is best illustrated by Los Angeles, which has in the last decade built the automotive world's 10th most extensive commuter rail system, which accounts for 0.2 percent and removes no more than three percent of traffic from adjacent freeways during peak hours, according to the regional commuter rail authority.

There is virtually no potential for new commuter rail systems or lines to reduce traffic congestion in US urban areas.

[59] http://www.metrolinktrains.com/

APPENDIX TABLES

Appendix Table A
International Pre-Automobile Commuter Rail Systems

	Tokyo	Osaka	Nagoya	Paris	London	Sydney
DEMOGRAPHICS						
Population (000)	31,200	15,250	8,050	9,650	12,230	3,539
Urban Area (Square Miles)	2,030	1,050	1,090	1,060	1,600	811
Population Density	15,369	14,524	7,385	9,104	7,644	4,365
Gross Product/Capita 1999	$28,327	$25,376	$28,535	$32,343	$27,365	$25,643
Compared to Tokyo	0.0%	-10.4%	0.7%	14.2%	-3.4%	-9.5%
CENTRALIZATION						
% Population>15,000 Density	71%	70%	24%	56%	23%	1%
% Land>15,000 Density	46%	43%	9%	18%	8%	0%
Core Population Share	26%	17%	27%	22%	59%	15%
Suburban Population Share	74%	83%	73%	78%	41%	85%
CBD (Downtown) Employment Share	16%	18%	13%	17%	16%	11%
Outside CBD Employment Share	84%	82%	88%	83%	84%	89%
Employment in CBD (000)	2,434	1,380	500	891	1,099	175
PUBLIC TRANSPORT SYSTEM						
Public transport Market Share	56.7%	59.5%	24.6%	24.1%	17.1%	13.6%
Public transport/Auto Speed	1.6			1.5		
COMMUTER RAIL						
Commuter Rail Market Share	39.5%	36.4%	12.0%	7.2%	3.7%	5.6%
Compared to New York	59.9	53.3	18.2	11.0	5.6	8.5
Miles of Route	1,779	1,095	528	1,012	2,260	1,273
Stations	1,243	1,065	843	540	940	306
Station Density	0.61	1.01	0.77	0.51	0.59	0.38
Operating Subsidy?	No	No	No	Yes	Yes	Yes
Capital Subsidy	No	No	No	100%	100%	100%
Share with Freight?	No	No	No	Little	Little	Little
HIGHWAYS						
Traffic Density (Vehicle Miles/Sq.Mi.)	118,854			83,462		
Compared to Tokyo	0.0%			-29.8%		

EXTENT OF AUTO COMPETITIVE PUBLIC TRANSPORT SERVICE						
Within Core	HIGH	HIGH	HIGH	HIGH	HIGH	HIGH
Suburbs to Core	HIGH	HIGH	HIGH	MIDDLE	MIDDLE	MIDDLE
Within Suburbs	HIGH	HIGH	HIGH	LOW	NIL	NIL

Appendix Table B
United States Pre-Automobile Commuter Rail Systems

	New York	Chicago	Boston	Philadelphia
DEMOGRAPHICS				
Population (000)	20,253	8,307	4,032	5,149
Urban Area (Square Miles)	4,711	2,123	1,736	1,799
Population Density	4,299	3,913	2,323	2,862
Gross Product/Capita 1999	$43,805	$39,384	$40,301	$36,025
Compared to Tokyo	54.6%	39.0%	42.3%	27.2%
CENTRALIZATION				
% Population>15,000 Density	44%	24%	20%	22%
% Land>15,000 Density	5%	4%	2%	3%
Core Population Share	40%	35%	15%	29%
Suburban Population Share	60%	65%	85%	71%
CBD (Downtown) Employment Share	19%	13%	13%	14%
Outside CBD Employment Share	81%	87%	87%	86%
Employment in CBD (000)	1,733	485	280	351
PUBLIC TRANSPORT SYSTEM				
Public transport Market Share	9.0%	3.6%	3.8%	2.9%
Public transport/Auto Speed	0.9	0.8	0.6	
COMMUTER RAIL				
Commuter Rail Market Share	0.7%	0.5%	0.4%	0.3%
Compared to New York	1.0	0.7	0.6	0.4
Miles of Route	979	333	328	304
Stations	404	250	116	176
Station Density	0.09	0.12	0.07	0.10
Operating Subsidy?	Yes	Yes	Yes	Yes
Capital Subsidy	100%	100%	100%	100%
Share with Freight?	Little	Little	Little	Little

HIGHWAYS				
Traffic Density (Vehicle Miles/Sq.Mi.)	63,312	57,968	43,350	57,168
Compared to Tokyo	-46.7%	-51.2%	-63.5%	-51.9%
EXTENT OF AUTO COMPETITIVE PUBLIC TRANSPORT SERVICE				
Within Core	HIGH	HIGH	HIGH	HIGH
Suburbs to Core	MIDDLE	MIDDLE	MIDDLE	MIDDLE
Within Suburbs	NIL	NIL	NIL	NIL

Appendix Table C
United States Automobile Era Commuter Rail Systems and Lines

	Washington-Baltimore	Los Angeles	San Diego	Miami	Dallas-Fort Worth	Seattle
DEMOGRAPHICS						
Population (000)	6,010	14,000	2,674	4,919	4,146	2,712
Urban Area (Square Miles)	1,840	2,299	782	1,116	1,407	954
Population Density	3,266	6,090	3,419	4,408	2,947	2,843
Gross Product/Capita 1999	$41,316	$33,486	$34,495	$31,261	$40,306	$38,928
Compared to Tokyo	45.9%	18.2%	21.8%	10.4%	42.3%	37.4%
CENTRALIZATION						
% Population>15,000 Density	10%	23%	3%	7%	2%	2%
% Land>15,000 Density	1%	6%	2%	2%	0%	0%
Core Population Share	20%	26%	46%	7%	29%	21%
Suburban Population Share	80%	74%	54%	93%	71%	79%
CBD (Downtown) Employment Share	19%	2%	6%	2%	6%	12%
Outside CBD Employment Share	81%	98%	94%	98%	94%	88%
Employment in CBD (000)	444	167	73	41	112	171
PUBLIC TRANSPORT SYSTEM						
Public transport Market Share	3.3%	1.4%	1.5%	1.3%	0.5%	1.8%
Public transport/Auto Speed	0.8	0.4	0.5			
COMMUTER RAIL						
Commuter Rail Market Share	0.05%	0.02%	0.02%	0.03%	0.01%	0.01%
Compared to New York	0.08	0.03	0.03	0.04	0.02	0.01
Miles of Route	191	415	43	71	35	34

Stations	56	48	9	19	9	7
Station Density	0.03	0.02	0.01	0.02	0.01	0.01
Operating Subsidy?	Yes	Yes	Yes	Yes	Yes	Yes
Capital Subsidy	100%	100%	100%	100%	100%	0%
Share with Freight?	Yes	Yes	Yes	Yes	Yes	Yes
HIGHWAYS						
Traffic Density (Vehicle Miles/Sq.Mi.)	74,798	104,970	85,687	109,613	68,077	60,936
Compared to Tokyo	-37.1%	-11.7%	-27.9%	-7.8%	-42.7%	-48.7%
EXTENT OF AUTO COMPETITIVE PUBLIC TRANSPORT SERVICE						
Within Core	HIGH	HIGH	HIGH	HIGH	HIGH	HIGH
Suburbs to Core	MIDDLE	MIDDLE	MIDDLE	MIDDLE	MIDDLE	MIDDLE
Within Suburbs	NIL	NIL	NIL	NIL	NIL	NIL

Note: Washington-Baltimore CBD data is for Washington and Baltimore.

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