NEW LIGHT RAIL
IN
THE UNITED STATES:
PROMISE AND REALITY

Prepared for the:
Road Transport Forum New Zealand
and the
New Zealand Automobile Association

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1 February 2000

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EXECUTIVE SUMMARY

Light Rail: The Promise. As elsewhere in the developed world, US urban areas are experiencing increasing levels of traffic congestion. There is a perception that traffic congestion and future traffic growth can be alleviated by building light rail systems, which it is posited, would attract travel from automobiles and roadways. As a result, a number of US urban areas have built new light rail systems and many more are considering such systems.

Recurring traffic congestion is largely limited to peak travel hours, during which most travel to and from employment occurs. Automobile occupancy rates during peak hours are comparatively low, while work destinations tend to be more highly concentrated than destinations for other trip types. As a result of its ability to move large numbers of people to concentrated destinations, public transport (and light rail) has the greatest potential to reduce traffic congestion during peak travel periods.

This report evaluates the US light rail experience with respect to its primary purpose --- reduction of traffic congestion. The evaluation criteria are (1) the extent to which traffic congestion is reduced, (2) whether or not such results could have been obtained less expensively by other alternatives, and (3) whether the planning process leading to the selection of light rail was objective.

Background: Public Transport in the United States. Public transport has been declining for decades in the United States. Annual per capita ridership is at its lowest level in more than 100 years, having dropped 27 percent since 1980. Public transport carries a comparatively small urban market share, exceeding five percent in only one metropolitan area and two percent in only seven. At the same time, the trends is sharply downward in public transport’s most lucrative market, the work trip, with a more than 60 percent reduction since 1960.

Public transport’s continuing market decline results from two primary factors.

- US urban areas have undergone significant commercial and residential suburbanization. The dense central business districts (downtowns) are no longer dominant, now representing barely 10 percent of metropolitan employment. Downtown represents the only location to which automobile competitive public transport service is available. As a result, public transport’s potential for reducing traffic congestion is limited to this rather small market. People who commute to work outside downtown areas tend to have much lower incomes and limited automobile availability.

- Service has been artificially constrained: Public transport productivity has declined markedly and, unlike much of the western world, there has been little effort to inject competition into public transport to control excessive costs. As a result, higher subsidies have not returned a correspondingly higher level of service.

Light Rail and Public Transport Ridership. The ten new light rail systems in the United States carry from 8,000 to 40,000 daily boardings per downtown oriented corridor. This figure includes “free fare” and reduced fare riders in six downtown areas. On average, public transport ridership has increased 27 percent since before light rail opened, with 19 percent being attributable to light rail.

Most light rail riders (60 percent) are former bus riders. Often these riders have been forced to transfer because their bus routes have been truncated at light rail stations. The longer travel times that result from bus to rail transfers have induced some riders to use automobiles for longer portions or all of their work trips. In some urban areas, public transport dependent riders have been disadvantaged by fare increases and service limitations that are traceable to light rail. Passenger surveys indicate that under 25 percent would have made the trip as automobile drivers before light rail.

Public transport carries such a small market share that light rail’s impact has been virtually imperceivable. On average, public transport’s market share has risen from 1.02 percent to 1.10 percent. In new light rail urban areas, light rail has captured 0.61 percent of new travel. Similarly, US Census Bureau data indicates that public transport’s market share dropped in all metropolitan areas that opened light rail systems in the 1980s.

Based upon trends in roadway use and public transport ridership it is estimated that light rail has reduced automobile traffic volumes the equivalent of less than 20 days natural growth: If light rail had not been built, current traffic volumes would have been achieved only 20 days earlier. For example, in St. Louis, if light rail had not been built, the roadway traffic volume achieved on June 30, 1997 would have been instead reached on June 12, 1997 --- a cost of $50 million per day.

Proponents have claimed that light rail can carry the passenger volume of up to six lanes of motorway traffic. In fact, light rail averages 1/5th the passenger volume of a *single* motorway lane, and 4/10ths the volume of a surface arterial street lane. Even during peak periods, light rail carries substantially fewer people than a single motorway lane. In fact, US light rail systems do not generally operate sufficient service levels to carry the capacity of a single motorway lane.

Moreover, light rail will not better position urban areas to deal with traffic congestion in the future. The overwhelming majority of commercial and residential development continues in the suburban areas that cannot be effectively served by public transport.

Perhaps surprisingly, the experience is similar in Europe, where public transport market shares are stable or dropping and automobile use is rising. Suburban trips in European urban areas are little better served by public transport than in the United States.

Light rail is incapable of reducing traffic congestion because it is too slow to attract automobile drivers, and because it can carry a substantial number of people only to downtown, a small market where public transport's market share is already at its highest (and thus there is little potential for growth).

Light Rail and Development: Light rail has been predicted by proponents to have a significant capability for reshaping urban areas. However, little unsubsidized, market based light rail development has occurred. Moreover, even if it were to occur, traffic would be worsened, because the overwhelming majority of trips would be made to the new development by automobile.

Light Rail as an Alternative to the Automobile. It has been suggested that light rail would provide automobile users with a travel alternative. In fact, downtown commuters already have public transport alternatives, while commuters to the 90 percent of employment locations outside downtown do not. Light rail would provide no alternative to that 90 percent of commuters.

Light Rail and Costs: The cost to build and operate light rail averages $1.79 per passenger kilometer, of which approximately 10 percent is recovered from passenger fares. Because comparatively few new riders are attracted, the cost per new one-way ride averages over $36. This means that it would be less expensive to lease a new car for each new commuter, and in some cases a luxury car could be leased.

Generally, light rail cost construction costs much more than projected. In some cases, costs have increased by as much as 325 percent compared to original projections. This has necessitated tax increases in some urban areas.

Light Rail Compared to Express Buses. Express buses are capable of carrying passenger capacities as great as light rail, and they can do so for 1/7th the cost. Sometimes, the planning process leading to the choice of light rail has not been objective, because bus alternatives are under designed. Despite their comparative cost effectiveness, however, express buses do not represent a significant opportunity for reducing traffic congestion, because so little of the employment market is concentrated downtown.

Light Rail Compared to Motorways. Proponents often claim that light rail is less costly than building motorways. This, however, is misleading, because light rail carries so little passenger volume compared to motorways. On average the cost to build and operate motorways, including private automobile costs, are 1/7th that of light rail per passenger kilometer.

Light Rail and Safety. Despite perceptions to the contrary, light rail is not comparatively safe. From 1990 to 1997, light rail was less safe than both buses and urban automobiles.

Light Rail and Energy Consumption. Despite perceptions to the contrary, light rail is not particularly energy efficient. Automobiles and commercial aircraft are more energy efficient per passenger kilometer.

Why Light Rail is Being Chosen. Light rail is being chosen for three primary reasons.

- Concern about Traffic Congestion: There is considerable concern among urban residents about rising levels of traffic congestion, and there is a perception that light rail will reduce traffic congestion. This perception, for which there is no objective evidence, is encouraged by public transport agencies and light rail proponents.

- Civic Pride: There is a perception that light rail is a prerequisite to becoming a "world class city."

- Availability of Federal Funding: Local government seek to improve their own economies by capturing federal (national) funding that is dedicated to building rail systems. Virtually the same economic impact would occur from the expenditure of federal funding on any infrastructure, regardless of need. Nonetheless, some urban areas have refused federal funding for light rail, and most tax referendums for light rail fail.

Light Rail: The Reality. The spatial structure of the modern US urban area renders new light rail systems a highly ineffective and expensive strategy for traffic reduction, mobility and access. The new light rail systems have generally failed relative to the evaluation criteria. They have failed to materially reduce traffic congestion and are more expensive than express bus systems and motorway expansion. Moreover, the planning process has been insufficiently objective.

1. LIGHT RAIL: THE PROMISE

Urban areas around the United States are experiencing intensifying roadway traffic congestion. In major U.S. urban areas[1], traffic congestion increased one-third from 1982 to 1997.[2] Average traffic volume increased by 68 percent while the capacity of urban roadway systems was expanded 31 percent.[3] (In contrast to rising traffic congestion, significant progress has been made in reducing air pollution, largely due to improved vehicle emission technology. See Appendix: Air Pollution and Light Rail).

Light rail is often suggested as a strategy for reducing traffic congestion. Proponents suggest that light rail can attract a significant number of drivers from automobiles. As a result, it has been suggested that light rail is a substitute for roadway and motorway construction. In some urban areas, funding that would have been used to build motorways has been spent instead to build light rail.[4] Proponents have claimed that light rail can carry the equivalent passenger volume of two to six lanes of motorway.[5]

The hope of reducing traffic congestion has been a primary factor propelling the construction of new light rail systems in a number of US metropolitan areas since 1980. Light rail systems have been opened in Baltimore, Buffalo, Dallas, Denver, Los Angeles, Portland, Salt Lake City,[6] Sacramento, St. Louis and San Jose.

In 1998, the United States Congress enacted a new public transport and highway bill that authorized funding for urban rail systems to be built in metropolitan areas[7] ranging from the

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1. The term “urban area” is to denote the entire urban agglomeration. The term “city” is not used because it can denote a specific legally incorporated public jurisdiction. In the United States, urban areas (also called urbanized areas) contain numerous cities.

2. Change in US Department of Transportation Federal Highway Administration/Texas Transportation Institute Roadway Congestion Index for urban areas over one million population.

3. Limited access highway (motorway and tollway) and arterial street lane kilometers.

4. Examples are Portland and Sacramento. In Los Angeles a motorway project was scaled back to allow funding of a light rail line in the median.

5. A single urban motorway lane has a capacity of 2,500 vehicles per hour, which converts to approximately 2,750 travelers during peak periods (average automobile occupancy of approximately 1.1). A six lane motorway has the capacity to move approximately 8,250 people per hour in one direction (3 * 2,750) per direction during peak periods .

6. This line opened in December 1999. There is insufficient data to be included in this analysis.

7. Metropolitan areas are larger than urban areas. They include expanses of rural territories, because they are defined based upon county boundaries (except in the six New England states of Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island and Vermont, where they are defined based upon municipal boundaries).

largest, New York, (population of 20.1 million) to 232nd ranked[8] Sioux City, Iowa (population 120,000).

While reduction of traffic congestion is the prime objective of urban rail, other benefits have also been cited, such as urban development impacts, provision of alternative transport modes, reduction of energy consumption and improved transport safety.

Public Transport's Most Lucrative Market: Traffic congestion in US urban areas is largely a weekday peak travel hour phenomenon.[9] During other periods, most traffic congestion is non-recurring, the result of traffic accidents or construction. The demand for road space is greater during weekday peak periods because most employees travel to and from work during that period and there is a higher proportion of school and university related trips. The demand for road space during weekday peak periods is intensified by the comparatively low vehicle occupancy of approximately 1.1. This compares to an overall vehicle occupancy rate of 1.6 throughout the day.[10]

Travel demand in the congested weekday peak period is theoretically well matched to public transport. Because of the lower automobile occupancy rates during weekday peak periods, each automobile user attracted should remove 0.91 automobiles, in comparison to the 0.63 automobiles that would be removed throughout the day (due to the higher automobile occupancy rate). Moreover, the nature of much of the weekday peak period travel demand --- work and school trips --- is more geographically concentrated, which should also improve public transport's match to the market. Public transport's potential to reduce traffic congestion is thus greatest during the period of greatest traffic congestion --- weekday peak travel periods, especially the work trip.

This report focuses on the experience with new light rail systems in the United States. However, new Metro[11] systems have also been opened in Atlanta, Baltimore, Los Angeles, Miami and Washington. These grade separated[12] systems operate more rapidly than light rail (averaging 38.4 kilometers per hour, compared to 28.2 for light rail) and, as a result,

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8 As of July 1, 1999, there were 276 metropolitan areas in the United States, according to the United States Census Bureau.

9 Urban rail projects are sometimes cited as useful for supporting special events, such as the Olympic games or athletic events. Such events produce only temporary and localized traffic impacts and are exceedingly expensive as justification for rail systems. A federal earmark of more than $1,000 million was legislated to build a second light rail line in Salt Lake City to support the winter Olympics in 2002, however financial scandals relating to the International Olympic Committee's award of the games to Salt Lake City have made the expenditure of this funding less likely.

10 This calculation in includes weekday peak periods.

11 Fully grade separated systems, which are also called undergrounds, subways, elevateds or heavy rail.

12 All roadway, pedestrian and rail crossings are by bridge or flyover.

have considerably higher capacity. (They are also much more expensive to build and operate.) Two such systems, in Washington and Atlanta are far more comprehensive than the other Metros and light rail systems, having been built throughout major portions of the urban area.

- Washington's rail system extends 145 kilometers and has cost approximately $20,000 million.[13]

- Atlanta's rail system extends 65 kilometers and has cost approximately $8,000 million.

These two systems are referenced throughout the report as indicative of the upper limit of what can be achieved by building urban rail in the United States. Because of its much lower capacity and speed, light rail's maximum potential is considerably less than has been obtained by these Metros.

Evaluation Criteria: Based upon the primary objective of reducing traffic congestion, light rail or any other transport investment is evaluated using the following criteria (Table #1):

- Does the proposed project materially reduce traffic congestion during peak hours?

- Is the proposed project the most cost effective strategy for achieving the reduction in traffic congestion?

- Has the planning process included an objective analysis of all reasonable alternatives?

The fundamental test of light rail's success is the extent to which it reduces traffic congestion during peak travel periods, in relation to both the level of traffic congestion and other transport alternatives. The number of people riding light rail --- often suggested by light rail promoters as a criteria --- is largely irrelevant to this criteria, because a significant portion of its ridership may not be former automobile drivers (such as automobile passengers, bus riders and people who would not have otherwise traveled).

[13] All dollar amounts in this report are New Zealand dollars, converted at the January 12, 2000 rate of 1.93 New Zealand dollars to the US dollar.

Table #1 Urban Rail Evaluation Criteria	
No.	Criteria
1	EFFECTIVENESS: Does the proposed project materially reduce traffic congestion during peak hours?
2	COST EFFICIENCY: Is the proposed project the most cost effective strategy for achieving the reduction in traffic congestion?
3	OBJECTIVITY: Has the planning process included an objective analysis of all reasonable alternatives?

2. BACKGROUND: PUBLIC TRANSPORT IN THE UNITED STATES

US public transport ridership fell 85 percent from 1945 to 1970. In the years around 1970, local, state and federal subsidy programs were established. More than $750,000 million[14] has been spent on public transport subsidies, with annual subsides now approaching $40,000 million.

For a time, public transport ridership increased, rising 14 percent from 1970 to 1981. By 1997, however, ridership had fallen back to approximately the 1970 level.[15] Over the same period of time, the population of US metropolitan areas has risen nearly 35 percent.[16] As a result, annual per capital public transport ridership has been falling for decades. From its peak at the end of World War II to 1970, ridership dropped nearly 70 percent (Figure #1), while population was increasing 29 percent.

- Annual per capita ridership is at the lowest level in 100 years, 27 percent below 1970.[17]

- In relation to overall urban travel,[18] public transport's market share has dropped more than 40 percent since 1980, with the downward trend accelerating in the

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14 This is more than was spent to build the nation's 65,000 kilometer motorway system.

15 Unless otherwise noted, all ridership data is based upon American Public Transportation Association data and the United States Department of Transportation Federal Transit Administration National Transit Database. Data is for motor bus, trolley bus (electric bus), light rail (tram) and metro (heavy rail, subway, elevated or underground).

16 1999 geographical area definitions. Internet: www.demographia.com/db-usmetfr1900.dbf.

17 Calculated from US Census Bureau, National Public Transit Database and American Public Transit Association data.

18 Roadway and public transport passenger kilometers.

1990s.[19] In 1997, public transport accounted for less than two percent of urban travel nationally,[20] down 75 percent from 1960.[21]

- In 1997, public transport's market share exceeded five percent in one metropolitan area (New York) and exceeded two percent in six others (Honolulu, Chicago, San Francisco, Washington-Baltimore, Philadelphia and Boston).[22] In all other metropolitan areas, public transport's market share is below two percent.

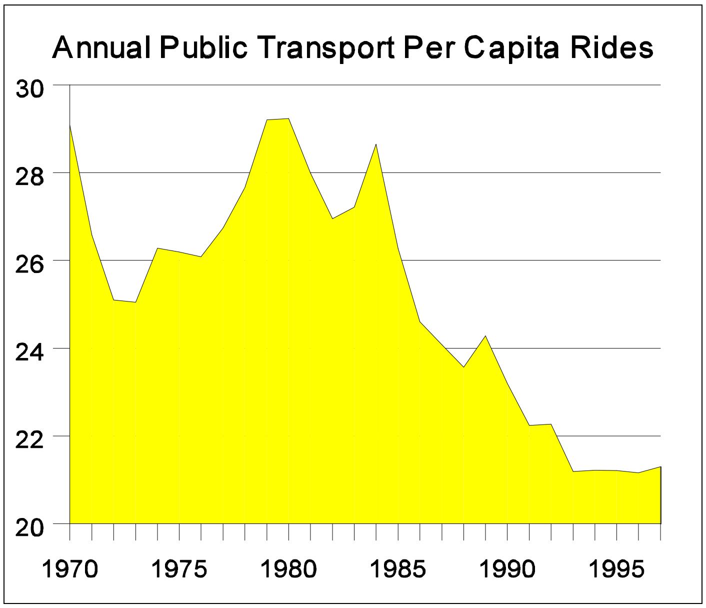

Figure 1
Estimated from National Transit Database and American Public Transit Association data.

Journey to Work: Public transport is losing its work trip market share at a rate almost as great as the overall market share loss. From 1960 to 1990, public transport's market share declined 60 percent (Figure #2), compared to an overall market share loss of 70 percent.[23]

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19 From 1980 to 1990, public transport's urban market share dropped 3.5 percent annually. From 1990 to 1995, the annual loss was 4.8 percent. Estimated from Federal Highway Administration, National Public Transit Database and American Public Transit Association data.

20 *Nationwide Personal Transportation Study, 1995.*

21 Internet: www.publicpurpose.com/ut-ptshare45.htm.

22 Internet: www.publicpurpose.com/ut-97usptdata1.htm.

23 US Census Bureau.

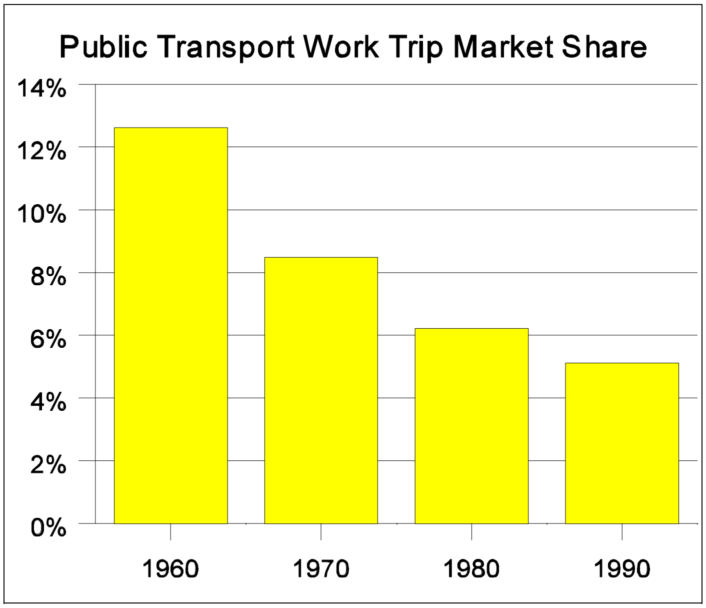

Figure 2
US Census Bureau data.

Perhaps the most important factors in public transport's decline are:

- Suburbanization of residences and jobs: From 1950 to 1990, the population of urban areas with more than one million population increased 94 percent, while the corresponding urban land area expanded 245 percent [24] (a phenomenon pejoratively referred to as "urban sprawl[25]). More than 90 percent of public transport ridership is in these largest urban areas.[26] Over this period, the nation's dense central business districts (downtowns) have become considerably less dominant. The lower population and employment density pattern that has emerged makes urban areas much more difficult for public transport to serve.

  The frequent, no-transfer service that is capable of attracting automobile commuting workers focuses only on the historic downtown areas (downtown areas established before 1930). This is because only the historic downtown areas have sufficient employment densities to allow large numbers of people to walk to work from public transport stops. Public transport accounts for a significant market share in some historic downtown areas --- nearly 75 percent in New York, 60 percent in Chicago and more than 25 percent in seven other areas (Brooklyn, San Francisco, Boston,

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[24] Calculated from US Census data (latest data is 1990).

[25] Despite perceptions to the contrary, lower population densities (suburbanization) is associated in the United States with *lower* levels of traffic congestion and *lower* levels of air pollution. Wendell Cox *The President's New Sprawl Initiative: Program in Search of A Problem* , (Washington: The Heritage Foundation), March 1999.

[26] Derived from National Public Transit Database data.

Philadelphia, Washington, Seattle and Pittsburgh).[27] But historic downtowns are no longer the dominant regional employment centers. On average, barely 10 percent of employment in major metropolitan areas is in downtown areas. Even the world's largest central business district, in New York, accounts for less than 20 percent of the metropolitan area's employment.[28]

Non-downtown employment centers, including the large "edge city" office parks, have far lower densities than downtown, structures built well back from the street.[29] Non-downtown employment areas typically attract much lower public transport work trip market shares, with virtually no significant suburban employment center exceeding a 20 per cent work trip market share. Workers wishing to use public transport to non-downtown locations are faced with time consuming transfers, often in uncomfortable weather conditions, and slow, non-express operation, if there is service at all.

Because light rail and other public transport modes are incapable of providing significant automobile competitive service that is not focused on downtown, non-downtown public transport commuters tend to be public transport "captives" --- having little or no access to automobiles. This is evident in average income figures. Non-downtown commuters have incomes 40 percent below average.[30]

On average, then, for 90 percent of work locations, public transport cannot provide service that is auto-competitive. And, where auto-competitive service is provided, the historic downtowns, public transport's market share is already sizeable and little increase is likely.

- Declining public transport productivity has artificially constrained service levels. Since 1970, public transport costs have increased more than double that of market prices (inflation adjusted).[31] These excessive costs could have provided significant resources for service expansion to respond to suburbanization and better perform in competition with the automobile. As in the United States, subsidized public transport throughout the developed world had been characterized by inordinate cost escalation until recently. The obvious antidote to cost escalation is competition,

27 Calculated from US Census Bureau data, 1990.

28 "Employment: Major US Central Business Districts," *Demographic Briefs*, Internet: www.demographia.com/dm-uscbd.htm, December 1999.

29 Edge cities typically have buildings up to 30, with some approaching 70 stories, but because of sparse building patterns have much lower employment densities.

30 "Average Income of Commuters: Public Transport & Single Occupant Auto: Metropolitan Areas with the 25 Largest Central Business Districts (Downtowns)," *The Urban Transport Fact Book*, Internet: www.publicpurpose.com/ut-25cbd$.htm, October 1998.

31 Wendell Cox, *The 1999 Texas Transit Opportunity Analysis: Capital Metropolitan Transit Authority,* (San Antonio: Texas Public Policy Foundation), 1999.

especially through competitive tendering, which has been adopted by western nations such as Australia, Denmark, the European Union, New Zealand, South Africa and the United Kingdom. A small number of U.S. public transport agencies have implemented significant competition programs, most notably San Diego and Las Vegas. However, governments in the United States have undertaken virtually no programs to require conversion to competitive processes in public transport.[32]

3. LIGHT RAIL AND PUBLIC TRANSPORT RIDERSHIP

The new light rail systems range from 8.5 two-way route kilometers in Denver to 66.1 in Los Angeles. The highest daily volumes are carried by Los Angeles, at 77,000 daily boardings,[33] San Diego, at 72,800 and Portland, at 60,400. Denver, Buffalo and San Jose all attract fewer than 25,000 daily boardings. In Buffalo, Dallas, Portland, Sacramento, San Jose and St. Louis, ridership is inflated due to the operation of a downtown area “free fare” zone or reduced fare zone.

Because downtown represents the most important attractor and generator of light rail trips, the number of boardings, a useful indicator for comparison of patronage is boardings per downtown oriented corridor.[34] On average, the systems achieve 18,600 boardings per downtown oriented corridor.

- The highest boardings per downtown oriented corridor is in Los Angeles, with 38,500. Portland is second with 30,200 .

- Baltimore, Dallas, Denver and San Jose achieved less than 12,500 daily boardings per downtown oriented corridor. The lowest was Denver, at approximately 8,000 (Table #2).

By comparison, in the peak year of public transport ridership in Los Angeles, one bus route achieved more than 70,000 daily boardings, while 35 achieved more than 12,500.[35]

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32 The only exception is the state of Colorado, which requires the Denver public transport agency to competitively tender 35 percent of its service.

33 In the United States, the National Transit Database requires public transport agencies to report “boardings,” as opposed to passenger journeys. A single trip may include more than one boarding, such as a trip requiring transfer from one bus to another (two boardings) or transfer from a bus to rail (two boardings). Because light rail tends to increase transfer ratios, it can increase the total system boardings without increasing passenger journeys.

34 A downtown oriented light rail corridor is any light rail line that approaches downtown. Thus, a single line that runs from east of downtown to west of downtown will count as two downtown oriented corridors. A line that operates from east of downtown to downtown will count as a single downtown oriented corridor. Measuring ridership per downtown corridor is important, because downtown is the dominant origin and destination location of public transport trips in US urban areas.

35 Southern California Rapid Transit District data.

Table #2 New Light Rail Systems: Daily Boardings: 1999: 2nd Quarter					
Urban Area	Weekday Boardings	One Way Route Kilometers	Downtown Oriented Corridors	Boardings per Downtown Oriented Corridor	Reduced or Free Fare Zone?
Baltimore	31,900	40.4	3	10,633	No
Buffalo	23,700	10.0	1	23,700	Yes
Dallas	37,000	31.9	3	12,333	Yes
Denver	15,900	8.5	2	7,950	No
Los Angeles	77,000	66.1	2	38,500	No
Portland	60,400	52.6	2	30,200	Yes
Sacramento	28,500	32.7	2	14,250	Yes
San Diego	72,800	74.7	3	24,267	No
San Jose	22,200	38.9	2	11,100	Yes
St. Louis	40,700	28.9	2	20,350	Yes
Total	410,100	384.8	22	18,641	
American Public Transit Association data. Sacramento data for 1998: 4th Quarter St. Louis data for 1999: 1st Quarter					

Ridership Trends in New Light Rail Urban Areas: From prior to light rail opening to 1997, total public transport usage rose in eight of 10 urban areas (measured in passenger kilometers).[36] Among the urban areas that have experienced public transport ridership increases, light rail is responsible for a 20 percent increase (Table #3).[37]

- Light rail was responsible for more than a 30 percent increase in public transport ridership in St. Louis and San Diego.

- Light rail was responsible for a 20 to 30 percent increase in public transport ridership in Portland, Sacramento and San Jose.

- A 13.5 percent ridership increase is attributable to light rail in Dallas.[38]

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36 Passenger kilometers are used to eliminate the effect of double counting that results from the use of boardings rather than passenger journeys as the measure of ridership. Because light rail increases transfer ratios, it can increase boardings without increasing passenger journeys.

37 Base year public transport ridership is the average of the three years previous to the rail system opening, except for San Diego, where passenger kilometer data is unavailable before 1981.

38 For this calculation, the two Dallas bus systems are analyzed separately.

- A five percent or less ridership increase is attributable to light rail in Denver and Baltimore.

- Overall public transport ridership declined in Los Angeles and Buffalo.

Table #3
Change in Public Transport Ridership

Urban Area	Final Year of Base	Base	1997	Change	% Change	LRT	Maximum Attributable to Light Rail	Maximum %
Baltimore	1991	611.6	624.7	13.1	2.1%	70.6	13.1	2.1%
Buffalo	1985	171.3	125.6	(45.7)	-26.7%	25.6	0.0	0.0%
Dallas	1995	377.8	447.6	69.8	18.5%	69.5	49.7	13.1%
Denver	1993	372.3	500.8	128.5	34.5%	19.4	19.4	5.2%
Los Angeles	1990	2,678.3	2,393.0	(285.4)	-10.7%	273.3	0.0	0.0%
Portland	1986	303.8	457.2	153.4	50.5%	88.1	88.1	29.0%
Sacramento	1986	144.0	182.4	38.5	26.7%	61.8	38.5	26.7%
San Diego	1981	274.1	528.5	254.4	92.8%	83.5	83.5	30.5%
San Jose	1987	231.8	349.0	117.3	50.6%	49.9	49.9	21.5%
St. Louis	1992	297.4	389.7	92.3	31.0%	146.3	92.3	31.0%
Total/Average		5,462.3	5,998.5	536.2	26.9%	887.9	434.5	18.9%

Calculated from National Transit Database.

Source of Light Rail Ridership: Despite more that 15 years experience with new light rail systems, there has been no comprehensive national evaluation of the source of light rail ridership.[39] Local rider surveys have identified a number of sources, such as:[40]

- Former bus riders, who have been forced to transfer because their bus routes now feed rail stations instead of the former destinations (usually downtown). In St. Louis virtually all bus service across the Mississippi River has been discontinued, as former bus riders have been forced to transfer to rail. Approximately 60 percent of light rail ridership is former bus riders.

39 Such a study would need to comprehensively analyze the travel patterns of riders before and after light rail, including the impact of any altered automobile use. It would need to consider, for example, the extent to which light rail increases traffic volumes by encouraging former express bus riders to use automobiles for part or all of their journey, the extent to which automobile drivers have abandoned their automobiles to use light rail, and a number of other factors. Local rider surveys have not included such comprehensive analysis.

40 Calculated from data in Metropolitan Washington Council of Governments, *The First Four Years of Metrorail: Travel Changes*, September 1981) and San Diego Association of Governments, *The San Diego Trolley: The First Three Years*, November 1984) and Jonathan E. D. Richmond, *New Rail Transit Investments - A Review* (Cambridge: Harvard University John F. Kennedy School of Government), 1998.

- Riders in “free fare” or reduced fare downtown zones (Buffalo, Dallas, Portland, Sacramento, San Jose and St. Louis). These include a large number of shopping or lunch trips that might have otherwise been taken on foot.

- Drivers who use free downtown peripheral parking at rail stations to avoid downtown parking charges and ride short distances to their jobs. This reduces automobile use by a minuscule amount and because so much of an automobile’s pollution occurs in starting and stopping, the air pollution impacts are at best minimal (Section 2.3). In St. Louis, for example, many drivers park free at two East St. Louis stations and ride less than three kilometers to downtown. They thus avoid expensive downtown parking charges and a system of congested bridges that has suffered from a conscious policy of disinvestment.[41] Even so, the rail line carries barely three percent of the traffic across the river.[42]

- Former car pool *riders*, whose car pools continue to operate or have become single occupant trips (no automobile has been removed). This does not reduce automobile use, because the automobiles remain on the road.

- New travelers (people who would not have made the trip if rail were not available). These are referred to as “induced” trips, and would include a large percentage of the trips in free fare or reduced fare zones in downtown areas.

- Former automobile drivers who use light rail for a major portion of their journey. It appears that such former automobile drivers represent between 20 and 25 percent of light rail ridership. However, because stations are within walking distance of so little of the urban area, these former drivers tend to access light rail by automobile.[43]

Impact on Ridership: Light rail has caused some negative impacts on existing public transport ridership.

- Public transport dependent riders often face a degradation of service, as a result of being forced to transfer from connecting buses to light rail, which tends to lengthen travel times.

- More affluent express bus service customers can also experience longer trip times as a result of a forced transfer to light rail. This can drive such passengers away, or as in the case of Denver, encourages automobile use by former bus patrons to light rail stations that are closer to downtown. In this case, light rail has encouraged

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41 One bridge was permanently closed 30 years ago and another has been closed for nearly five years, with renovation still not commenced. Two bridges are open.

42 Calculated from Missouri Department of Transportation and Bi-State Development Agency data.

43 Generally, few former automobile drivers are attracted to feeder bus systems, the use of which tends to make light rail even less competitive with the automobile in terms of travel time.

greater automobile use. The cross-Mississippi River corridor in St. Louis has experienced a similar phenomenon, with former express bus riders transferring to automobile use for travel to downtown.[44]

- In some urban areas, higher than expected light rail costs have resulted in larger fare increases, lower levels of bus service and severe overcrowding of bus services. In Los Angeles, this led to litigation in which advocates for the public transport dependent have obtained a moratorium on further rail expansion, as funding is now being directed back into the bus system.[45]

Impact on Public Transport Market Share: As was noted above (Section 2), public transport's market share is small in the United States, including areas that have built new light rail lines (Table #4).

- The average public transport market share in new light rail urban areas dropped from 1.10 percent to 1.02 percent from before light rail opening to 1997.[46]

- As a result of overall public transport ridership increases (bus and light rail), market share rose in Dallas, Denver, San Diego, San Jose and St. Louis. However, even after the increases all of these urban areas have very small public transport market shares --- 0.71 percent to 1.34 percent.

- Public transport market share declined 22 percent in Portland.

- Public transport market share declined in the other new light rail urban areas (Baltimore, Buffalo, Los Angeles and Sacramento).

Table #4
Public Transport Market Share

Metropolitan Area	Last Year of Base	Before Light Rail	1997	Change
Baltimore	1991	1.73%	1.51%	-12.9%
Buffalo	1985	1.27%	0.66%	-48.2%
Dallas	1995	0.68%	0.73%	7.5%
Denver	1993	1.13%	1.34%	18.6%

44 Jonathan E. D. Richmond, *New Rail Transit Investments - A Review* (Cambridge: Harvard University John F. Kennedy School of Government), 1998, pages 25 and 42.

45 It has been suggested that light rail can provide public transport dependent riders with access to employment in suburban locations. Light rail, however, makes so little of the urban area accessible that it makes little difference. In fact, because of its higher costs, light rail has the potential to retard access for the public transport dependent, by consuming resources that could be used to provide higher levels of access with expanded bus service.

46 Roadway traffic data is unavailable for before 1982. As a result, the San Diego data applies only to the second and subsequent lines, which were opened in 1990 or later.

Table #4 Public Transport Market Share				
Metropolitan Area	Last Year of Base	Before Light Rail	1997	Change
Los Angeles	1990	1.12%	0.93%	-17.0%
Portland	1986	2.04%	1.60%	-21.7%
Sacramento	1986	0.80%	0.71%	-11.4%
San Diego	1989	0.78%	0.99%	28.0%
San Jose	1987	0.83%	1.03%	24.6%
St. Louis	1992	0.66%	0.71%	8.1%
Average		1.10%	1.02%	-7.5%
Estimated from National Transit Database and Federal Highway Administration data.				

Thus, while critics of light rail often point to ridership that often falls short of projection,[47] the more fundamental difficulty is that the volumes carried by light rail are miniscule in relation to travel in both corridors and urban areas. Even where ridership projections are achieved the passenger volumes are insignificant.

Light Rail New Travel Capture Rate: Light rail is responsible for, on average, 0.61 percent of new travel in urban areas that have experienced public transport usage increases (Table #5). This means that one out of each 164 new passenger kilometers has been on light rail.

- San Diego has achieved the highest capture rate of new travel, at 1.53 percent.

- All other new light rail systems have attracted a share of new travel that is less than one percent.

- In Baltimore and Los Angeles, light rail has made no contribution to new travel, because overall public transport ridership has fallen.

Table #5 Light Rail Impact: Attributable Increase in Ridership Compared to All Travel and New Travel		
Metropolitan Area	Share of All Travel	Share of New Travel Since Before Light Rail

47 Don Pickrell, *Urban Rail Public Transit Projects: Forecast Versus Actual Ridership and Costs,* United States Department of Transportation, Urban Mass Transportation Administration, October 1989.

Baltimore	0.03%	0.21%
Buffalo	0.00%	0.00%
Dallas	0.08%	0.88%
Denver	0.05%	0.45%
Los Angeles	0.00%	0.00%
Portland	0.31%	0.65%
Sacramento	0.15%	0.50%
San Diego	0.16%	1.53%
San Jose	0.15%	0.87%
St. Louis	0.17%	0.97%
Average	0.11%	0.61%
Calculated from National Transit Database and Federal Highway Administration data.		

Journey to Work: During the 1980s, public transport work trip market share declined in all 39 metropolitan areas with more than one million population, except for Houston and Phoenix. In those two metropolitan areas, much of the increased public transport ridership was in response to bus service expansions.[48] At the same time, public transport work trip market share declined in *all* nine metropolitan areas that built new rail systems (Table #6).[49] For example:

- In Buffalo, transit work trip market share dropped 29.5 percent. The number of workers using transit dropped 7,900, despite a 31,200 increase in workers.

- In Portland, transit work trip market share dropped 35.8 percent during the 1980s. The number of workers using transit dropped 8,600 despite a 155,500 increase in workers. In contrast, during the 1970s, Portland's work trip market share *increased* 38.4 percent, in response to lower fares and bus service expansion.

- In Sacramento, transit work trip market share dropped 32.6 percent. The number of workers using transit rose 900, compared to a 250,800 increase in workers. For each new public transport commuter, there were more than 275 new private vehicle commuters. In contrast, during the 1970s, Sacramento's work trip market share *increased* 42.3 percent, due to lower fares and bus service expansion.

- In San Diego, transit work trip market share dropped 0.9 percent, by far the most favorable performance of the new light rail urban areas. The number of workers using transit rose 11,700, compared to a 376,600 increase in workers. For each new public transport commuter, there were more than 30 new private vehicle commuters.

48 Houston and Phoenix do not have light rail.

49 Calculated from US Census Bureau data (1990 is most recent data, 2000 data will be available in 2001 or 200).

- By far the most successful new rail system was Washington's Metro, which by 1990 was nearly 115 kilometers in length (more than double the length of the second most extensive system, Atlanta). Yet, public transport in Washington attracted barely one out of eleven new workers in the 1980s, and public transport's market share declined 11.5 percent.

Table #6
Public Transport Journey to Work Market Share: New Rail Cities

Metropolitan Areas	1980	1990	Change	New Workers	New Public Transport Commuters	Type of New Rail
Atlanta	7.39%	4.59%	-37.9%	531,706	(2,196)	Metro
Baltimore	9.95%	7.39%	-25.7%	222,867	(8,334)	Metro
Buffalo	6.31%	4.45%	-29.5%	31,272	(7,905)	Light Rail
Miami	4.75%	4.21%	-11.4%	322,960	7,370	Metro
Portland	8.35%	5.36%	-35.8%	155,579	(8,672)	Light Rail
Sacramento	3.50%	2.36%	-32.6%	250,816	959	Light Rail
San Diego	3.23%	3.20%	-0.9%	376,667	11,797	Light Rail
San Jose	3.10%	3.00%	-3.2%	135,408	3,401	Light Rail
Washington	15.07%	13.34%	-11.5%	654,491	60,324	Metro
Average	6.85%	5.32%	-22.3%			
Total				2,681,766	56,745	

Source: US Census Bureau

4. LIGHT RAIL AND TRAFFIC CONGESTION

Roadway traffic continues to grow at a substantial rate, 3.5 percent annually in urban areas from 1982 to 1997. This rate of growth exceeds public transport's overall market share in all but three metropolitan areas (New York, Honolulu and Chicago) and is more than double the public transport market share in any new light rail metropolitan area. With such small public transport market shares, it takes little time for any public transport ridership increase to be nullified by the growth in roadway use. As a result, any ridership increase attributable to any public transport mode, such as light rail will be largely imperceivable, in relation to the growth in traffic volumes. On average, where light rail has increased public transport ridership, it has been equal to 20 days of growth in roadway passenger kilometers.[50] (Figure #3)

[50] Estimated reduction in traffic due to public transport ridership growth divided by annual metropolitan traffic growth rate (in vehicle kilometers).

- In St. Louis, light rail has reduced traffic volumes by the equivalent of 18 days of natural growth.[51] If the St. Louis rail system had not been built, the travel volumes reached on June 30, 1997 would instead have been reached less than three weeks earlier, on June 12, 1997. The cost of diverting one day's travel growth to light rail was $50 million.[52]

- In Portland, light rail has reduced traffic volumes by the equivalent of 26 days of natural growth.[53] If the Portland rail system had not been built, the traffic volumes reached on June 30, 1997 would instead have been reached on June 4, 1997. The cost of diverting one day's travel growth to light rail was nearly $20 million.[54]

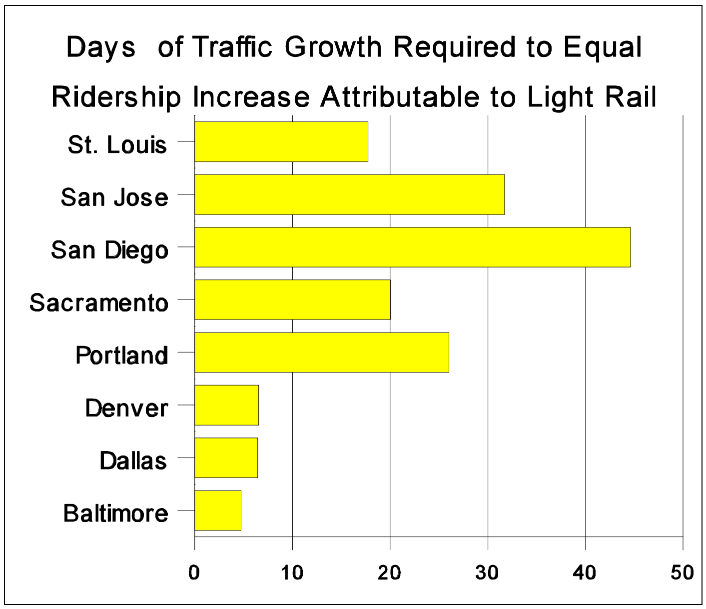

Figure 3
Calculated from 1997 Federal Highway Administration data and National Transit Database.

Reducing Traffic Congestion: The Record: New U.S. light rail lines carry only modest volumes in comparison to motorways. In no case has light rail attracted enough drivers out of their cars to materially reduce traffic congestion (Figure #4).

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51 Increase in public transport ridership attributable to light rail (passenger kilometers) divided by annual increase in roadway passenger kilometers. Estimated from National Transit Database and Federal Highway Administration data..

52 The St. Louis rail capital cost was nearly $900 million.

53 Increase in public transport ridership attributable to light rail (passenger kilometers) divided by annual increase in roadway passenger kilometers. Estimated from National Transit Database and Federal Highway Administration data..

54 The Portland rail capital cost was nearly $500 million.

- On average new U.S. light rail lines carry 85 percent *less* volume than a single motorway lane couplet (2 lanes of motorway, one operating in each direction).

- St. Louis has the highest light rail volume: 70 percent less than a single motorway lane couplet.

- Portland carries 82 percent less than a single motorway lane couplet.

- San Jose has the lowest volume at 93 percent less than a motorway lane couplet.

New US light rail system volumes are also lower than the average two way arterial (major surface street with traffic signals) lane couplet (Figure #5).

- On average new U.S. light rail lines carry 60 percent less volume than a single arterial lane couplet.

- St. Louis has the highest light rail volume, at 22 percent below that of a single arterial lane couplet.

- Portland carries 51 percent less volume than a single arterial lane couplet.

- San Jose has the lowest light rail volume, at 83 percent below an arterial lane couplet.

Moreover, the actual impact on traffic congestion is likely to be considerably less, since the majority of light rail riders are not former automobile drivers. If it is assumed that 25 percent of light rail ridership is composed of former automobile drivers (Section 3), the following estimates are yielded:

- The average new light rail line attracts the equivalent of approximately three percent of a two-way motorway lane (15 percent times 22 percent).

- The average new light rail line attracts the equivalent of approximately nine percent of a two-way arterial lane (40 percent times 22 percent).

As a recent Harvard University study found:

> *In no case has new rail service been shown to have a noticeable impact on highway congestion.*[55]

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[55] Richmond, p. 95.

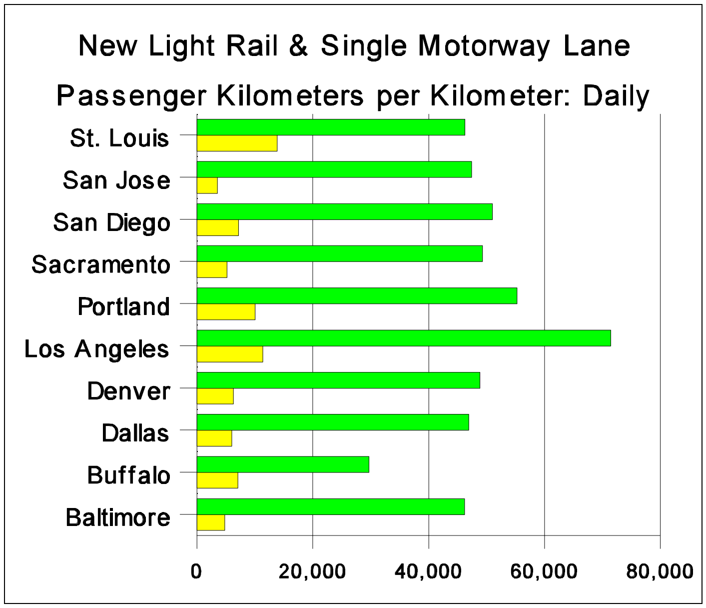

Figure 4
Calculated from 1997 Federal Highway Administration data and National Transit Database.

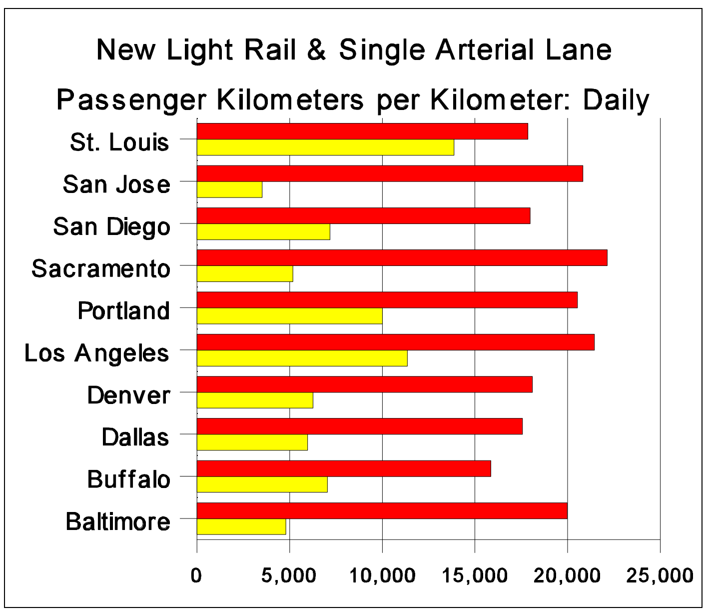

Figure 5
Calculated from 1997 Federal Highway Administration data and National Transit Database.

While definitive corridor research has not been conducted, there are indications that light rail has made little or no difference with respect to traffic on adjacent roadways:

- In Portland, traffic on the adjacent motorway (Interstate 84) has continued to grow and is now at least 58 percent higher than before light rail was opened. Traffic has grown at a greater rate than the other radial (downtown oriented) motorways in the area.[56]

- In St. Louis, motorway traffic in the light rail corridor has grown greater than that of other radial motorways in the St. Louis area.[57]

Peak Hour Volumes: Moreover, during peak travel hours light rail carries comparatively few riders compared to motorway lanes, though data is not generally available.

- In Portland inbound (toward downtown) light rail volume averages approximately 1,100 per hour during the 6:00 a.m. to 9:00 a.m. peak period. By comparison, each lane of the adjacent motorway (Interstate 84) carries approximately 2,600 people per hour --- nearly 2.5 times the volume of the light rail line. Outbound, each motorway lane carries 1,500 persons hourly, 28 times the light rail average of 55 during the same period (Figure #6). Overall, during the morning peak period, the motorway carries more than 10 times the volume of the light rail line.[58]

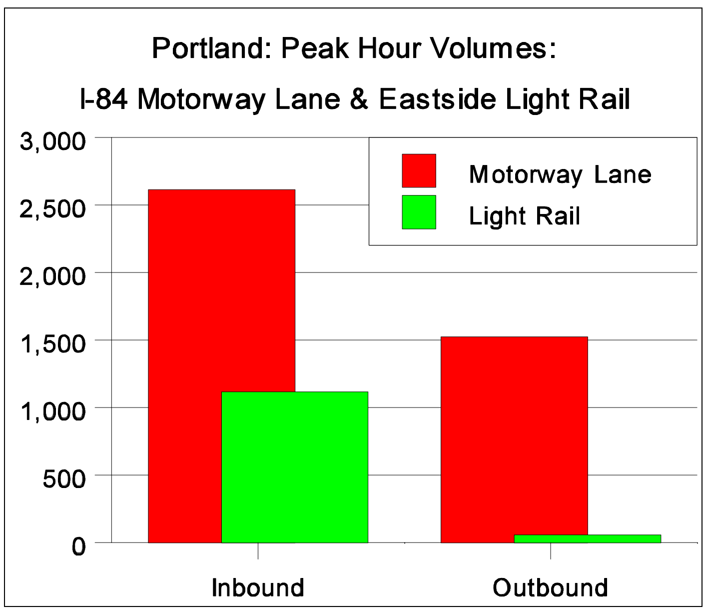

Figure 6
Calculated from Oregon Transportation Institute data.

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56 Calculated from Oregon Department of Transportation data.

57 Calculated from Missouri Department of Transportation data.

58 Oregon Transportation Institute, *Max Versus Banfield Freeway: A Comparison of Actual Passenger Usage*, Internet: www.hevanet.com/oti/MVFE.htm, based upon Oregon Department of Transportation and Tri-County Metropolitan Transit District data, 1994.

- In St. Louis, inbound peak hour light rail ridership is approximately 60 percent less than the capacity of a single motorway lane. When an approach to the busiest downtown Mississippi River bridge was closed for weeks due to accident damage, many commuters experienced a doubling in their travel times. Yet light rail's volume increased only to a level 40 percent below that of a single motorway lane.[59] This reflects the fact that, even in the vicinity of downtown, there is only a modest market for light rail.

Theoretical and Practical Capacity: These findings appear to contradict the often cited claim that a light rail line has the same person carrying capacity as up to six motorway lanes. In fact, no U.S. new light rail line provides a capacity equal to that of a single motorway lane. The gap between theory and reality is the result of two factors: (1) Public transport systems generally provide less light rail capacity than is provided by a single motorway lane; and (2) public transport demand is considerably less than motorway demand.

For example, St. Louis, with one of the nation's most intensively used new light rail lines, provides seating capacity for fewer than 900 passengers each peak hour --- one-third the capacity of a motorway lane. With a "crush" load of standing passengers, the St. Louis line could achieve a passenger volume of nearly 2,000, still 25 percent below that of a motorway lane.

Future Traffic Congestion Reduction: It is sometimes suggested that light rail will reduce future traffic congestion growth, or provide capacity for growth. However, virtually all projections in urban areas around the US indicate that commercial and residential development will continue to be dominated by the suburban areas that cannot be served by light rail.

- Even in downtowns with light rail, transit encounters significant difficulty in maintaining its market share. Over a period of two years, light rail's work trip market share in downtown St. Louis has dropped by 10 percent.[60]

- Over the longer term, the presence of light rail is imperceivable. In San Diego, traffic on downtown oriented motorways over nearly 20 years in corridors served by light rail has increased *more* than that of motorways in corridors without light rail.[61] Among five radially oriented motorways, the two serving light rail corridors increased

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[59] Ellen Perlman, "The Little Engine that Might," *Governing Magazine*, August 1998. Highway volumes from the Missouri Department of Transportation.

[60] Charlene Proust, "Downtown gains workers and businesses, survey shows," *St. Louis Post-Dispatch*, 4 March 1999. This survey further indicated that all downtown employment growth was outside the core of the downtown area, where light rail is most effective.

[61] Calculated from California Department of Transportation traffic counts on downtown oriented motorways from 1978 to 1997.

at a greater rate than two of the three not serving such corridors.[62] This is an indication that the traffic growth patterns typical of US urban areas simply overwhelm any impact that can be obtained from light rail.

- The futility of reducing traffic congestion with new rail strategies[63] is illustrated by Atlanta's experience. Over the past 20 years, Atlanta has opened the nation's fastest operating metro (subway or heavy rail) system. Yet, only downtown has direct, no transfer service from throughout the area, and less than one percent of the urban area is within walking distance of a rail station.[64] Meanwhile, traffic volumes have more than doubled over the same period, and Atlanta has received considerable publicity for having some of the nation's worst traffic congestion.

European Experience: Results have been similar in Europe, despite its higher population densities, more comprehensive public transport systems, higher petrol prices, lower income[65] and more focused cities. There may be an expectation that traffic will become so intolerable that people will switch to public transport instead. If that were possible, it would occur in Europe with its much worse urban traffic congestion. But there is virtually no evidence in Europe (or the United States) to support such a proposition. In European urban areas automobile market share has increased at the expense of public transport, despite the much higher level of public transport service. The problem is that even in congested conditions, the automobile tends to provide more direct and quicker travel than public transport --- and in many cases convenient public transport service is simply unavailable. Automobile drivers have no incentive to improve traffic conditions for other drivers by switching to public transport and increasing their own travel times

- Despite their extensive rail systems, average travel speeds in central London and central Paris are considerably slower than in US urban cores: (20.5 and 18.9 kilometers per hour respectively.

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62 This is not to suggest that light rail increases motorway traffic, it is rather an indication that light rail has virtually no impact on traffic trends.

63 Urban rail can make a material contribution in some applications. Where population densities are extremely high, such as Hong Kong (150,000 per square kilometer), or where central business districts are exceptionally large, such as in New York, London, Paris and Tokyo (all approximately one to two million employment), rail can make a significant difference in traffic congestion. Ridership is so high in London and Tokyo that systems earn an operating profit (before depreciation). Even so, traffic conditions in all of these urban centers is far worse than in most US urbanized areas. By comparison, US urbanized areas all have population densities of under 3,750 per square kilometer and the largest central business districts outside New York have less than one-fifth its employment level.

64 The area within walking distance (0.4 kilometer) of a rail station is approximately 19 square kilometers, out of an urbanized area of 4,800 square kilometers

65 OECD purchasing power parity basis.

- Zurich, Switzerland spent $3,000 million to significantly expand its rail system since 1990, to reduce traffic congestion. While public transport ridership rose, no traffic reduction occurred (population 600,000, population per square kilometer more than 5,000).

- A new automated guideway system in Toulouse, France reduced traffic congestion by one percent (population 650,000, population per square kilometer more than 7,500).[66]

The relatively high public transport market shares in Europe compared to the US may lead to the impression public transport is gaining at the expense of the automobile. Nothing could be further from the truth. European automobile use has grown at three times the US rate since 1970, largely as a result of increasing affluence. In recent decades, public transport market shares have dropped from even higher levels in Europe as increased affluence has made the automobile affordable for more people. While modest public transport market share gains have occurred in a few European cities, the ridership has come largely at the expense of walking and bicycling, not the automobile. In Europe (as in the United States) rail's record at attracting people out of automobiles has been insignificant[67] as:

> *...no such transfer has ever taken place*.[68]

It is improbable that US urban areas, with their lower population densities and greater employment dispersion would experience significant transfers of market share from automobiles to public transport, when their European counterparts, with more favorable conditions, have not.

Why Urban Rail Has So Little Impact on Traffic Volumes: Light rail is incapable of materially reducing traffic congestion or its growth in US urban areas for two basic reasons.

1. Light rail is slow, with new systems averaging 28 kilometers per hour (Figure #7).[69] Light rail project speed projections have been optimistic. In Portland, Buffalo and Sacramento, light rail operates approximately 20 percent slower than was projected in the planning process.[70] Even during congested peak hours, it takes 50 to 100

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[66] Christian Gerondeau, *Transport in Europe* (Boston, MA: Artech House, Inc.) , 1997.

[67] Singapore is an exception, having reduced traffic congestion by imposing vehicle tolls surrounding its central business district.

[68] Gerondeau, p. 87.

[69] Calculated from Federal Public transport Administration, National Public Transit Database, 1996.

[70] Calculated from Pickrell.

percent longer to complete work trips by rail than by automobile.[71] There is little hope that this will be changed by worsening traffic congestion, since commuters make adjustments to keep their work trips from becoming too lengthy. Automobile work trip travel times have changed little in recent decades,[72] as commuters have adjusted by changing work and residence locations in manners that minimize travel time.[73]

Public transport's travel time disadvantage is illustrated by Washington, which has built by far the nation's most expensive and comprehensive new rail system. In 1990, the average work trip by single occupant automobile was 25.7 minutes. The average work trip on the rail system was 44.5 minutes --- nearly 75 percent longer.[74]

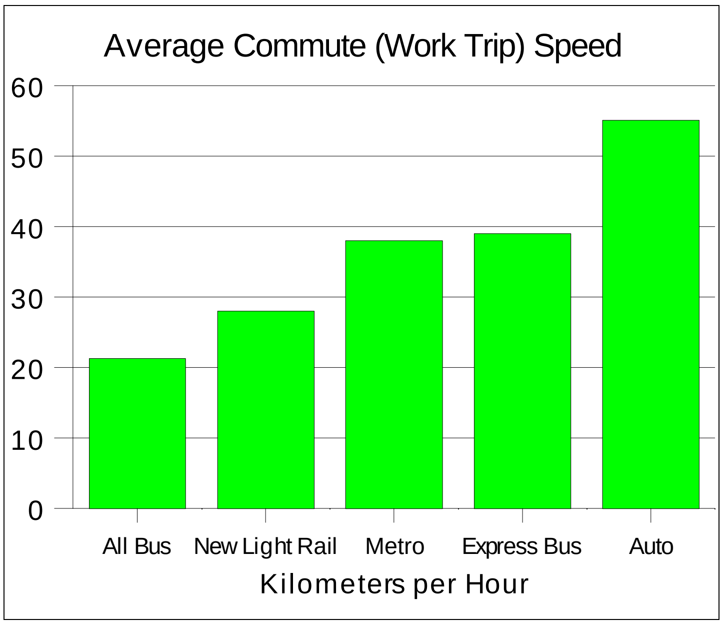

Figure 7
Calculated from U.S. Department of Transportation data.

[71] Other forms of public transport, such as subways and express buses are faster than light rail, but still generally slower than automobiles.

[72] Average work trip travel times were lower in 1995 than 1969, according to the Nationwide Personal Transportation Survey. A recent American Broadcasting Company (ABC) poll found that commuting time had changed little over the last decade.

[73] The median job tenure of US employees workers is less than four years. People change residences in metropolitan area, on average, every 11 years (US Bureau of Labor Statistics and US Census Bureau data).

[74] US Census Bureau data (latest available).

2. Light rail provides auto competitive trips only to downtown, which is a small part of the modern urban area. This is a disadvantage shared with other forms of public transport, even the far more expensive and rapid heavy rail systems ("subways" or "metros").

5. LIGHT RAIL AND DEVELOPMENT

Light rail is often promoted as a mechanism of urban development. The thesis is that light rail will concentrate development, thereby reshaping the urban area into spatial patterns that reduce automobile dependency, while generating more favorable traffic and access.

Light rail has generally not produced market oriented development, much less reshaped urban areas. The majority of development cited by light rail promoters has been either government projects or tax subsidized. Portland and St. Louis have built publicly financed sports facilities (stadiums) and convention centers. Similar publicly financed facilities have been built in the core of non-light rail urban areas, such as Detroit, Charlotte, Kansas City, Indianapolis, Seattle, Minneapolis, and others.

Portland's urban planners predicted that light rail would result in a "re-urbanization" of the corridor, causing a rapid conversion to high density uses in the light rail corridor, a reduction in the growth rate outside the corridor, a reduction in automobile use and ownership, among other impacts.[75] In fact, this has not occurred. Faced with the reality of little development, the city of Portland now grants 10 years of property tax abatement for developments within walking distance of light rail stations.[76] Tax and subsidy policy, not light rail, is the driver of any such development.

No metropolitan area of more than one million population has a downtown office vacancy rate that is one-half that of Dallas, at 32.0 percent. This is down 1.7 percentage points since before light rail opened. Neighboring Houston, which does not have light rail, has experience a decline in office vacancies from 21.9 percent to 9.8 percent over the same period. Nationally, the average downtown office vacancy rate has fallen from 14.6 percent to 9.0 percent.[77]

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75 S. M. Edner, G. B. Arrington, Jr., *Urban Decision Making for Transportation Investment: Portland's Light Rail Public transport Line*, (Washington: US Department of Transportation), 1985, as summarized in Peter Newman and Jeffrey Kenworthy, *Cities and Automobile Dependence: An International Sourcebook*, (Aldershot, UK: Gower Technical), 1991.

76 Portland has gained an international reputation as a result of its policies intended to reshape the urban form to discourage automobile use and encourage public transport use. Its efforts have fallen short of success, as Portland has become one of the 10 most congested urban areas in the United States, having risen from 16th before light rail was opened.

77 Downtown office vacancy rates from CB Richard Ellis (1999 3rd quarter compared to 1996 2nd quarter).

When and if light rail oriented development occurs, it will make traffic and air pollution worse, not better. This is because the overwhelming majority of trips to new developments will continue to be by automobile.

- Atlanta's public transport oriented commercial Midtown district[78] is served by the metro. Yet this development, largely built since the metro opened, has produced greater traffic congestion, not less. More than 95 percent of commuters to this employment center commute by automobile, instead of public transport (Figure #8).[79]

- Virtually the same problem exists with respect to public transport oriented residential development. For example, the development around the Ballston, Virginia (Washington, DC) subway station is five times as dense as neighboring communities, and generates four times as many vehicle trips per hectare.[80] Not only is traffic congestion worsened around the public transport oriented development, but air pollution is an order of magnitude worse, because of the inevitably slower average speed of vehicles in the area and higher automobile densities.[81]

Any significant new commercial and residential development along light rail lines will increase both traffic congestion and air pollution. The overwhelming majority of travel will continue to be by automobile and that travel will be concentrated in a smaller area if light rail generates significant development.

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78 Between 1986 and 1994, 10 new buildings ranging from 10 stories to 50 stories were built in Midtown. (Erick Ferguson, "Office Development, Parking Management and Travel Behavior: The Case of Midtown Atlanta," *Journal of Transportation and Statistics*, May 1999.)

79 Erick Ferguson, "Office Development, Parking Management and Travel Behavior: The Case of Midtown Atlanta," *Journal of Transportation and Statistics*, May 1999.

80 "Public transport Oriented Development (TOD): Vision and Reality," *Innovation Briefs*, May-June 1999.

81 Slower roadway speeds generally tend to increase air pollution. Among the two of the three primary mobile source pollutants (CO and VOX), the optimal average operating speed is approximately 90 kilometers per hour. Average speeds of 60 kilometers per hour produce approximately 30 percent more pollution, 30 kilometers per hour 110 percent to 140 percent more and 15 kilometers per hour 335 percent to 380 percent more. With respect to the third primary mobile source pollutant, (NOX) the optimum average speed is approximately 30 kilometers per hour, though 70 kilometers per hour produces little additional pollution. Above 70 kilometers per hour NOX pollution increases more rapidly. Thus, with respect to air pollution, optimum operating speeds is approximately 70 kilometers per hour. Nationally, average work trip speeds are less than 55 kilometers per hour, indicating that air pollution could be generally improved by increasing average automobile operating speeds.

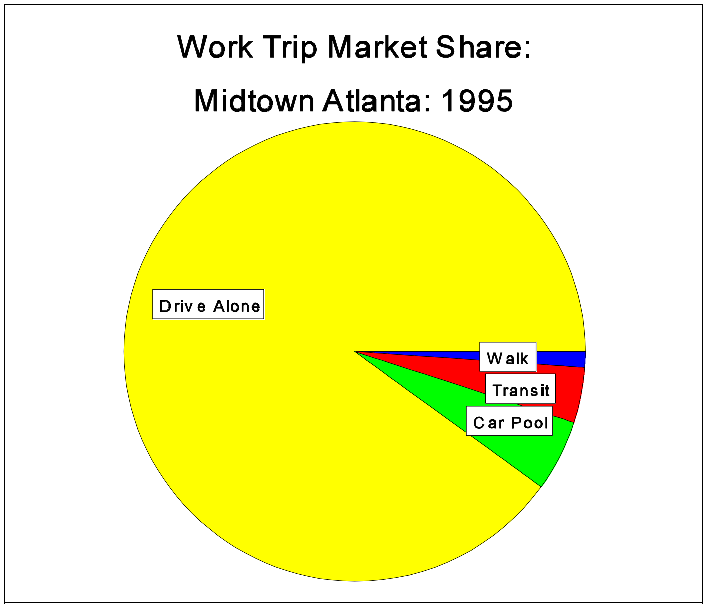

Figure 8
Based upon Fitzgerald.

If public transport were able to “reshape” cities, then it would have already occurred in Washington and Atlanta. In these two urban areas, nearly $30,000 million has been spent to build expensive heavy rail systems that radiate from the downtown areas. Because of their higher operating speeds and the number of lines that have been built, the development that they have encouraged is far greater than could be expected from the slower and more limited light rail systems. At a few suburban stations there has been office and residential construction. But work trip market shares at these locations is far lower than in the historic downtown areas (the case of Atlanta’s Midtown was described above), as the overwhelming percentage of commuting to the new jobs has been by automobile. As a result, traffic congestion throughout the Washington and Atlanta urbanized areas has become among the worst in the nation (2nd and 8th out of 68 urban areas in 1997).[82]

6. LIGHT RAIL AS AN ALTERNATIVE TO THE AUTOMOBILE

Another benefit that is attributed to light rail is that it provides a transportation alternative to people who might otherwise travel by automobile. As the discussion above has shown (Section 3), comparatively few automobile drivers are attracted to light rail. But more fundamentally, comprehensive public transport service, including express bus services that operates faster than light rail, is already provided to virtually all major downtown areas in the nation. An attractive public transport alternative, therefore, is already available to potential patrons in the markets that would be served by light rail.

[82] In 1997, Washington had the second highest Roadway Congestion Index and Atlanta had the eighth highest.

On the other hand, convenient public transport is not available as an alternative for approximately 90 percent of employment trips and a larger percentage of other trips. Light rail does not change this. It makes little sense to provide a new public transport alternative to markets already served when the overwhelming majority of travelers continue to not have public transport as an alternative.

7. LIGHT RAIL COSTS

The average cost per passenger kilometer for the new light rail lines is $1.785, $0.586 for operating costs and $1.199 for capital costs. The most expensive system is Buffalo, at $5.120, while the least expensive is St. Louis at $0.750 (Table #7). This is nearly seven times as costly as express buses or motorway construction per passenger kilometer (Sections 8 and 9)

Table #7
Light Rail Operating and Capital Costs: 1997

Urban Area	Operating	Capital	Total
Baltimore	$0.545	$0.986	$1.531
Buffalo	$1.046	$4.074	$5.120
Dallas	$0.642	$1.768	$2.410
Denver	$0.740	$0.896	$1.636
Los Angeles	$0.534	$0.923	$1.457
Portland	$0.439	$0.603	$1.042
Sacramento	$0.462	$0.453	$0.915
San Diego	$0.224	$0.607	$0.831
San Jose	$0.972	$1.734	$2.706
St. Louis	$0.237	$0.513	$0.750
Average	$0.586	$1.199	$1.785

Operating cost calculated from National Transit Database, annual capital cost discounted at seven percent over 40 years (FTA method).

Fare Ratio: On average, new light rail systems fares equal to 11 percent of total operating and capital costs (Figure #9). The highest fare recovery ratios are in Sacramento (20 percent) and San Diego (28 percent), while the lowest are in Dallas (four percent) and Los Angeles (five percent).[83]

[83] These fare recovery ratios are well below figures normally reported in the United States, where fare recovery ratios routinely *exclude* capital costs.

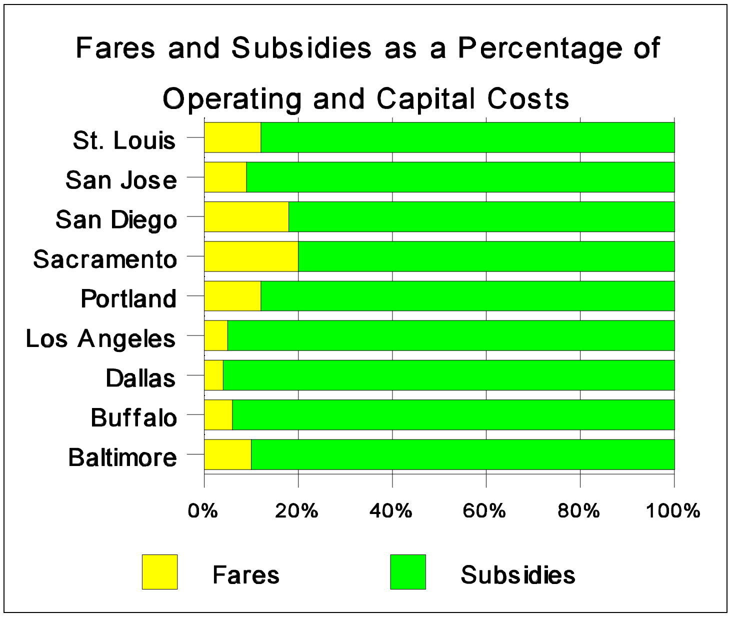

Figure 9
Estimated from data in Richmond.

Cost per New Rider: The US Federal Transit Administration (FTA) requires new rail line planning to include a cost effectiveness index --- the cost per new ride (Box: Cost per New Commuter):

The cost per new ride for new rail projects was more than $36, or $17,600 per annual new commuter per year. This equates to more than $700,000 over a 40 year work career (Table #8). In fact, a new automobile could be leased in perpetuity for all new commuters attracted to most new US light rail lines. In some cases, a luxury car, such as a Jaguar XJ8 or a BMW 7 series could be leased for less.[84] Moreover, the actual average cost per new ride is likely to be higher, because projected ridership is usually high, while cost projections tend to be low (below).

By comparison, in 1995 the full cost per average automobile commute is estimated at $5.56 --- $11.12 per day, $2,500 per year and $100,000 over a career.[85] All of the cost of automobile commuting is borne by the user.[86] On the other hand, barely 10 percent of the operating and capital costs of new rail systems (above) is borne by users.

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84 Internet: www.publicpurpose.com/ut-rail&carlease.htm.

85 In 1995 (latest data available), $598 billion was spent by users to operate on 3,700,000,000,000 miles by automobile and light truck --- $0.19 per person kilometer (average vehicle occupancy of 1.67). This calculation assumes an average vehicle occupancy of 1.1 for the work trip and an average distance of 19.3 kilometers. Data from US Department of Transportation and US Department of Commerce.

86 Internet: *The Intercity Transport Fact Book:* http://www.publicpurpose.com/trushy95.htm

The relatively high cost per new ride reflects the fact that new urban rail systems attract comparatively few new riders. Even fewer new riders are attracted from automobiles, which means that the cost per automobile removed is even higher than cost per new commuter. The cost per new automobile driver attracted for the Los Angeles Blue Line was over $70,000 annually --- nearly $3 million over a career.[87]

Box: Cost per New Commuter

The Federal Transit Administration (FTA) "cost per new ride" cost effectiveness index captures the annual capital and operating cost of a public transport project in relation to the net public benefit --- the increase in ridership attributable to the project. Until the early 1990s, FTA considered approximately $12.00 per new ride to be the maximum reasonable cost effectiveness:

For example, if the annual capital and operating cost of a new rail line were $12 million and one million new riders were attracted annually, the cost per new ride would be $12.00. The cost per new ride can be used to estimate the cost per each new individual rider:

- The daily cost per new rider is double the cost per new ride (this assumes that each new rider takes public transport to and from a particular destination). At $12.00 per new ride, the daily cost would be $24.00
- On average, employees work 225 days per year. The annual cost per new public transport commuter is thus 450 times the cost per new ride (assumes two public transport trips per day). At $12.00 per new ride, the annual cost would be $5,400.
- A lifetime cost per commuter can be calculated by multiplying the annual cost per commuter by the number of years in a work career (assumed to be 40). At $5,400 annually, the career cost would be $216,000.

Cost Projections: New US urban rail systems have usually been more expensive and less successful in attracting ridership than projected. A United States Department of Transportation (USDOT) report found that, on average, new federally funded rail systems opened from 1975 to 1987:[88]

- Were 50 percent more costly to build than projected (capital costs).

87 Peter Gordon and Harry W. Richardson, *The Counterplan for Transportation in Southern California: Spend Less, Serve More*, Reason Foundation, 1994.

88 Pickrell.

- Were 79 percent more costly to operate than projected (operating costs).

- Exhibited far higher costs per passenger, as a result of cost overruns and attracting 73 percent fewer riders than projected by computer models.

Table #8
Cost Per New Ride and Cost per New Commuter :
Urban Rail Lines in USDOT Report and Lines Under Construction in 1996

Rail Line	Actual or Projected	Annual Cost Per New One-Way Ride	Annual Cost per New Commuter	Career Cost per New Commuter (40 Year)
Baltimore-Airport	Projected	$35.01	$15,755	$630,194
Baltimore-Hunt Valley	Projected	$24.07	$10,831	$433,258
Baltimore-Penn Station	Projected	$37.20	$16,740	$669,581
Baltimore-Subway	Actual	$33.53	$15,089	$603,564
Buffalo	Actual	$26.14	$11,762	$470,477
Dallas	Projected	$21.36	$9,613	$384,518
Milwaukee	Projected	$124.01	$55,807	$2,232,261
Pittsburgh	Actual	$85.66	$38,546	$1,541,848
Portland-Banfield	Actual	$23.47	$10,560	$422,406
Portland-Westside	Projected	$43.22	$19,448	$777,937
St. Louis-Airport	Projected	$23.77	$10,698	$427,932
Sacramento	Actual	$16.15	$7,266	$290,654
Salt Lake City	Projected	$14.90	$6,707	$268,266
San Jose-Tasman	Projected	$83.01	$37,352	$1,494,099
Average		$36.46	$17,602	$704,069

In 1996$
Pittsburgh was reconstruction of an existing line.
Calculated from Federal Transit Administration data.

This USDOT report was disputed by the public transport federal lobbying organization, the American Public Transit Association (APTA):[89]

- APTA claimed that the USDOT report relied upon preliminary cost and ridership projections, which were less reliable than projections in the later planning process. This, however, fails to recognize the dynamics of political decision making. Once a decision has been made to proceed, there is usually no “turning back.” For example, in 1981 the Los Angeles County Transportation Commission (LACTC) decided to build the Los Angeles-Long Beach light rail line (Blue Line), which was projected to cost $270 million. By the time the final construction decision was made in 1985, costs had escalated to $775 million, and the completed project escalated to $1,700 million ---325 percent more than the original projection (inflation adjusted). At no

[89] American Public transport Association, *APTA Response to the UMTA Report ‘Urban Rail Public transport Projects: Forecast Versus Actual Ridership and Costs,* September 1990.

point from 1981 to opening date was serious consideration given to canceling the project. If, however, a realistic capital cost projection had been available in 1981, it is virtually certain that LACTC would *not* have proceeded with the project.[90]

- APTA claims that the USDOT report used a "biased sample arbitrarily selected to support anti-rail sentiments" The report did not use a sample, however. The USDOT report included *all* new rail lines constructed with federal subsidies from 1975 to the time the research was conducted.

- *... the type of forecasting errors highlighted* ... in the USDOT report ... *simply would not occur in 1990.* Despite APTA's assertion, the same type of forecasting errors continue. The Los Angeles "Green Line" was projected to carry 65,000 daily passengers in 1994 and 103,000 by 2003.[91] Actual ridership was less than 20,000 in 1997, three years and 70 percent behind projection.[92] Capital cost projections have worsened rather than improving. Among lines opened since the USDOT report, the average capital cost overrun has been 86 percent (Table #).[93]

Table #9
Capital Cost Overruns:
Rail Lines Built or Planned Since the USDOT Report

Line	Capital Cost Overrun
Los Angeles-Green Line	53%
Los Angeles-Blue Line	149%
Portland-Westside	184%
St. Louis	45%
San Jose	35%
Baltimore-Central	49%
Average	86%

Comparison of inflation adjusted data

Calculated from Federal Public transport Administration, Los Angeles County Transportation Commission, Maryland Department of Transportation and Bi-State Development Agency (St. Louis) data.

90 The author was a member of the Los Angeles County Transportation Commission from 1977 to 1985, and served on the LACTC Rail Construction Committee and Finance Review Committee.

91 *Los Angeles Metro Green Line Norwalk-El Segundo*, Los Angeles County Transportation Commission, 1989.

92 *Bus and Rail Performance Report*, Los Angeles County Metropolitan Transportation Authority, 1997.

93 *Report on Funding Levels and Allocation of Funds*

The reality is that from the time of project conception to opening, capital costs routinely rise. A recent National Academy of Sciences report confirms that underestimation of costs and overestimation of usage is a normal pattern for large infrastructure projects, including urban rail lines.[94] The report stated:

> *... cost overruns of 50 to 100 percent are common and ... overruns of more than 100 percent are not uncommon. Traffic forecasts that are off by 20 to 60 percent when compared with actual development are frequent in large transportation projects.*

There are always detailed explanations for cost escalation and failure to attract projected ridership and revenue --- some are more valid than others. But in publicly financed projects the "bottom line" is the same --- the cost of unreliable forecasts is paid by taxpayers, who as often as not have been led to believe that their bill would be considerably less. According to Dr. Charles Lave, Chair of the Economics Department at the University of California at Irvine, urban rail consultants can feel pressured to manipulate computer models to produce favorable projections. He suggests that consultants should be required to post a bond to guarantee reasonableness of their projections.[95]

Tax Increases: The failure of urban rail systems to meet their financial promises have lead to unanticipated tax increases in some areas. In other areas, systems have been scaled back because funding was insufficient to finance the higher costs of the rail projects.

- **St. Louis:** In 1987, St. Louis officials claimed that higher taxes would not be needed to operate the planned light rail line.[96] Shortly after the rail line opened, public transport officials announced that the system could not be financed with existing revenue sources and threatened that the line would be closed unless a new tax was authorized. If the rail line had been closed, the area would have been required to return the nearly $650 million federal contribution. Faced with this prospect, voters approved a tax (1994) to operate the rail line and build six new urban rail lines, with local public transport officials claiming that the federal government would supply $4.00 for each $1.00 raised by the tax. There was, at the time, no prospect of such federal funding. Further, bus operating costs rose at a higher than anticipated rate, consuming resources that had been identified for building rail.[97] It became clear that

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94 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.

95 Charles A. Lave, Playing the Rail Forecasting Game," *TR News*, September-October 1991.

96 "Danforth Opposes Request Made by Beuchner for Light-Rail Study," *St. Louis Post-Dispatch* August 5, 1987.

97 The referendum had not contained language limiting the amount of funding to be used for bus operations.

the 1994 tax would finance, at most, one new line. In 1998 voters rejected an additional tax measure that would have built less than was promised in 1994.

- **Los Angeles:** In 1980, the Los Angeles County Transportation Commission obtained voter approval for a tax increase to support public transport operations and build 12 rail lines.[98] By 1990 it became clear that the tax was insufficient to meet the rail promises, and another tax was approved by the voters. Shortly after its approval, at least one-half of the funds that had been promised for use in rail development were used to balance the operating budget of the local bus public transport agency (without a corresponding service increase).[99] Los Angeles public transport ridership peaked in 1985, at the end of a low fare program. It has since fallen 27 percent (Figure #10), despite the addition of two light rail lines, a subway and seven regional (diesel) rail lines (added by the second tax increase).[100] More recently (1998) the public transport agency has imposed a moratorium on future rail construction, which would cancel or indefinitely delay most of the rail lines promised in 1980. More than $500 million had been spent on the canceled rail lines.[101] Meanwhile, taxpayers are saddled with bonded indebtedness of more than $5,000 million, with annual debt payments rising to nearly $650 million --- more than all annual bus and rail fare revenue. Before the rail program, the public transport system had no long term bonded debt.

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98 The author of this paper was a member of the Los Angeles County Transportation Commission in 1980 and was the author of a provision that required 35 percent of tax funds to be used for rail development.

99 The language for the 1990 ballot issue did not specifically require a rail development set aside (unlike the 1980 issue) , though campaign publicity and related documents clearly stated that a certain amount would be reserved for rail development.

100 The commuter rail lines were funded by the second tax increase.

101 *Restructuring Plan*, Los Angeles County Metropolitan Transportation Authority, 1998.

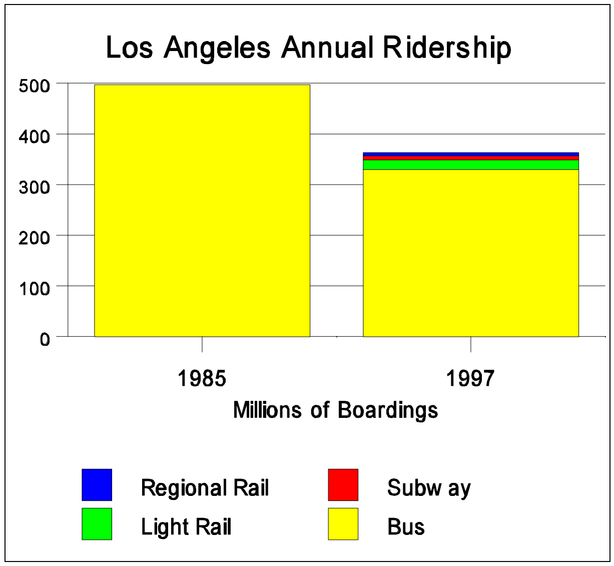

Figure 10
National Transit Database.

- **Dallas:** In the early 1980s Dallas voters approved a tax to build a 260 kilometer rail system without federal funding. Public transport system ridership was to be 500,000 daily. The program has been scaled back to 85 kilometers and federal funding is now being used,[102] while daily ridership languishes below 200,000. To deliver the originally promised plan would require a substantial new tax increase.

Unexpected tax increases can be the result of the following factors:

- Over projection of revenues: Public transport officials, for example, have misleadingly claimed that up to 80 percent of project funding would be from the federal government (St. Louis).

- Under projection of costs: Rail tends to cost much more than planners project to build and operate (Section 2.5). As a result, public transport agencies are unable to deliver the amount of rail development planned (St. Louis, Los Angeles and Dallas).

8. LIGHT RAIL COMPARED TO EXPRESS BUSES

Bus based strategies are generally more cost efficient and effective than urban rail. Express bus systems are capable of substantial passenger volumes.

- Express bus systems provide nearly the same theoretical capacity as light rail --- and at least as much *practical* capacity as both light rail and heavy rail --- capacity that is actually used. Express bus systems in Brazil carry 20,000 passengers per

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[102] Richmond, p. 23.

hour (Sao Paulo and Curitiba). Ottawa's on-street downtown bus lanes carry nearly 10,000 riders during peak hours in peak directions.

- Express buses normally use general purpose roadways and therefore do not incur the high capital costs of rail. Even where express buses use high occupancy vehicle (HOV) lanes,[103] the cost per new rider is lower, because the cost is shared with the usually larger number of commuters in car pools using the HOV lanes.

The HOV lanes used by express buses provide additional advantages that are beyond the realistic capability of urban rail in the US context.

- Because they are also open to car pools, total HOV lane passenger volumes can be much higher than rail volumes. For example, in Washington an HOV lane carries 13,000 riders per hour. Buses in HOV lanes in New York, Los Angeles, Houston and San Francisco carry more passengers than any new US light rail line.[104]

- HOV lanes serve a much broader employment market than public transport, which can effectively serve only downtown commuters. Car pools are attracted to HOV lanes for trips throughout the urban area by average operating speeds that are typically at least double that of the adjacent motorway lanes.

According to a US Department of Transportation report, HOV lanes with express bus systems are five times as cost effective as light rail and heavy rail (cost per passenger kilometer).[105] If competitive operation is assumed, HOV lanes with express bus systems are nearly seven times as cost effective as light rail, with costs per passenger kilometer estimated at $0.262 (Figure #11).[106] Generally, whatever passenger volume can be accommodated by new urban rail lines, can be less expensively moved by express buses.

Moreover, another US Department of Transportation report indicates that there is no passenger preference for rail over bus.[107] Despite this, public planning processes more

103 Exclusive lanes for car pools and public transport vehicles.

104 *Characteristics of Urban Transportation Systems,* United States Department of Transportation Federal Public transport Administration, September 1992.

105 John Kain, Ross Gittell, Amrita Daniere, Tsur Summerville and Liu Zhi, *Increasing the Productivity of the Nation's Urban Transportation Infrastructure*, United States Department of Transportation Federal Public transport Administration, January 1992.

106 Assumes $2.91 per vehicle kilometer cost and national average bus load factor.

107 Moshe Ben-Akiva, *Ridership Attraction of Rail Compared with Bus* (US Department of Transportation, 1991).

often than not conclude with the choice of rail alternatives over bus.[108] This suggests a manipulated planning process, which could be the result of bias, political influence or other factors. For example:

- In Portland, a busway alternative was rejected because it would "pour 500 buses an hour"[109] onto the downtown public transport mall. At the time, Portland operated fewer than 450 buses. Even today, Portland requires the equivalent of fewer than 600 buses throughout the entire service area[110] to operate its entire system throughout a three county service area. It was not plausible to have anticipated the convergence of 500 buses in a single hour on a single downtown bus mall in a system with such characteristics.

- In Chicago and Milwaukee, planners compared light rail to bus alternatives with much lower levels of service.[111]

Despite its superior cost effectiveness, however, bus systems are subject to similar limitations as light rail systems. Because of low population and employment densities, the potential for reducing traffic congestion with buses is very small. Nonetheless, buses can provide five to seven times the benefits of light rail for the same cost.

9. LIGHT RAIL COMPARED TO MOTORWAYS

Light rail proponents often claim that commuter rail is less costly to develop than a new motorway. In fact, light rail and motorways are similar in cost,[112] but very different in their practical passenger volumes --- motorways carry much higher volumes. To compare the cost of building light rail to that of a motorway is similar to comparing the cost of building a large store to that of a small store. The small store will, of course, cost less. But it will not produce the volumes of the large store. Infrastructure projects should be evaluated in terms of their relative use. With respect to light rail and motorways, cost per passenger kilometer is an appropriate measure.

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108 The does not mean that express bus systems should replace the high volume rapid rail and commuter rail systems serving the nation's largest downtown areas --- New York, Chicago, Philadelphia, San Francisco, Washington and Boston. However, outside these historic, most densely developed commercial centers express buses are able to provide at least the same passenger volume, with higher speeds for less than rail.

109 *The Renaissance of Rail Public transport in America.*

110 Bus equivalents calculated by converting light rail cars to 2.3 buses.

111 Wendell Cox, *Light Rail in Milwaukee* (Wisconsin Policy Research Institute, 1998 and Wendell Cox and Jean Love, *Analysis of the Chicago Central Area Circulator* (Illinois Taxpayer Education Foundation), 1995.

112 The average urban six lane motorway costs $33 million per kilometer to construct. New light rail lines tend to cost from $24 million to $48 million per kilometer.

The cost of an average urban motorway lane in the US is $0.264 per passenger kilometer. This includes $0.042 for construction and maintenance, and $0.222 for all of the private costs of vehicle ownership and operation.[113] The cost of light rail per passenger kilometer is nearly seven times as high (Figure #11). Further, virtually all motorway costs are paid by users,[114] while the subsidy to public transport users is more than 70 percent.

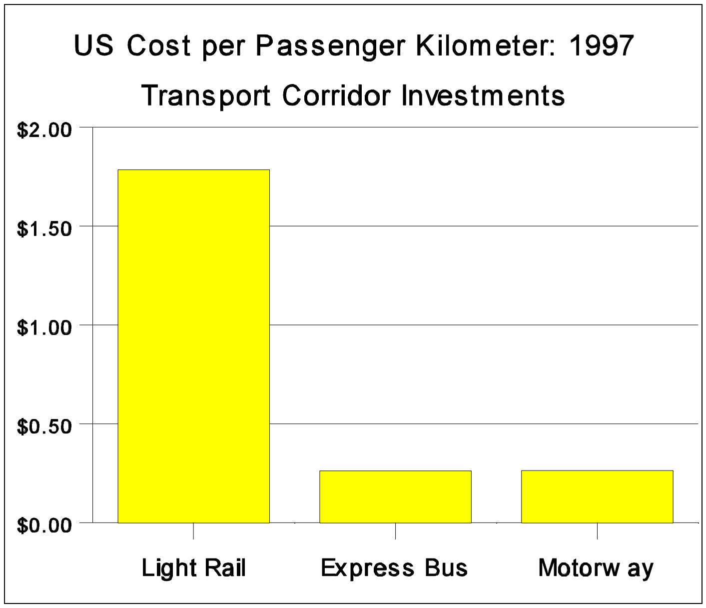

Figure 11
Calculated from Federal Highway Administration data and National Transit Database.

10. LIGHT RAIL SAFETY

Light rail is also popularly believed to be comparatively safe. However, during the 1990s, light rail has been considerably less safe than buses and metros, and less safe even than the automobile (Figure #12).[115] In recent months a single accident killed six people in Los Angeles, while fatalities on the new Portland light rail extension have generated sufficient attention to become the subject of a front page *Wall Street Journal* article.[116] The most frequent cause of light rail related fatalities is automobile drivers failing to observe rail crossing gates.

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113 Internet: www.publicpurpose.com/hwy-fy$.htm.

114 From 1993 through 1998, highway user fees (such as gasoline taxes) covered 101 percent of street and highway construction, operation, research, debt service, administration and patrol. Internet: www.publicpurpose.com/hwy-us$93&c.htm.

115 Calculated from U.S. Department of Transportation data.

116 Nancy Keates, "Light Rail Addition Domes to Portland at a Heavy Price: MAX Moves Lots of People and Runs Some Down; the Peril of Quiet Trains," *The Wall Street Journal*, December 2, 1999.

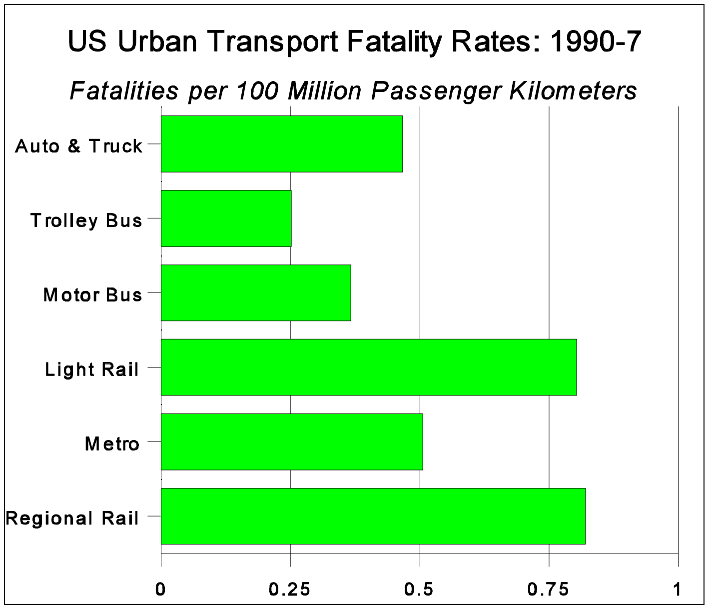

Figure 12
Calculated from US Department of Transportation data.

11. LIGHT RAIL ENERGY CONSUMPTION

Light rail is popularly thought of as an energy-efficient mode of travel. It can be if trains operate at or near capacity. But light rail vehicles average closer to empty, at 18.3 percent of capacity.[117] As a result, light rail consumes 14 percent more energy per passenger kilometer than automobiles,[118] and is more energy intensive than commercial airlines (Figure #13).[119]

117 1990 data. Later capacity usage data excluded by FTA from National Transit Database reports.

118 Includes energy consumed in fuel and power production and transmission.

119 Energy intensiveness data obtained or calculated from data in Stacey C. Davis, *Transportation Energy Data Book*, Edition 19, US Department of Energy, 1999 and the National Transit Database.

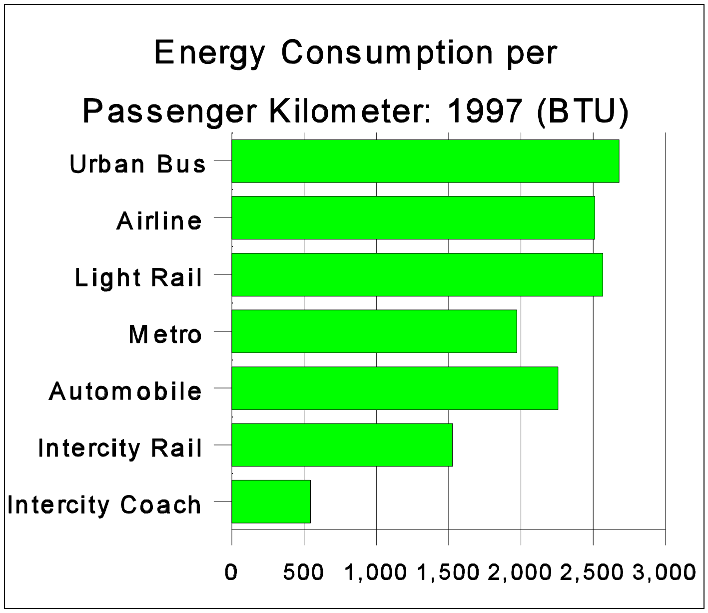

Figure 13
Calculated from U.S. Department of Energy data.

12. WHY LIGHT RAIL IS BEING CHOSEN

Light rail appears to be being built in the United States for three reasons:

- **Concern about Traffic Congestion:** Polls have indicated that traffic congestion is one of the greatest concerns of US urban residents. Public officials are led to believe, by unsupportable claims, ideology or even nostalgia, that light rail reduces traffic congestion. Virtually none of the technical data, including the planning reports used to justify light rail, support this conclusion. Nonetheless, the same, planning documents have exaggerated minuscule benefits or provided commentary that contradicts the analysis in the same reports.

- **Civic Pride:** According to John Kain, Chair of the Economics Department at Harvard University, the rush to build rail may also be traceable to:

  > *Boosterism, appeals to civic pride, the self interest of owners of CBD (central business district) and other strategically located properties, and a fondness of politicians for building monuments...*[120]

  Similar sentiments may be behind drives for other publicly subsidized infrastructure, such as convention centers and stadia. Downtown boosters often point to such “urban jewels” as being a prerequisite to “world class” city status. While rail may

[120] “Choosing the Wrong Technology: Or How to Spend Billions and Reduce Public transport Use.”

bolster the civic psyche, its popularity among public officials cannot be traced to genuine transportation objectives.

- **Availability of Federal Funding:** Perhaps the most important is the availability of federal funding. Local governments routinely seek to improve their own economies by obtaining federal funding that would otherwise go elsewhere — what could be called the "if we don't take the money, Baltimore will" syndrome. The anticipated economic impact, including job creation, is not unique to rail. Just as cities lined up in the 1950s for funding to build soon obsolete high rise public housing,[121] urban areas today queue for federal money to build rail lines that would have been obsolete decades ago.[122] Virtually the same economic impact would be achieved by the expenditure of federal funds on any infrastructure, almost regardless of need ("monument building").

  Nonetheless, some urban areas have refused to accept federal light rail funding that has been earmarked for them. Honolulu, Milwaukee and Orlando have each declined to accept hundreds of millions of dollars for light rail. In each of these cases, citizen movements were successful in canceling projects, largely out of a concern about tax increases. Moreover, since 1988, more than 80 percent of rail tax referenda have failed in the United States, despite a more than 12 to one campaign spending disadvantage.[123]

Light rail is being chosen because there are strong financial, political and psychological incentives to do so.

13. LIGHT RAIL: THE REALITY

The spatial structure of the modern US urban area renders new urban rail systems, both light rail and metros, a highly ineffective and expensive strategy for traffic reduction, mobility and access. The new light rail systems have generally failed relative to the evaluation criteria (Section 1). They have failed to materially reduce traffic congestion and they are more expensive than express bus systems or building motorways. Moreover, the planning process has been insufficiently objective (Table #10).

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121 Much of the high rise public housing built during this period has been abandoned, imploded or is scheduled for destruction.

122 In "Choosing the Wrong Technology: Or How to Spend Billions and Reduce Public transport Use," John Kain describes a mid 1960s report which he and colleagues prepared for the federal government that concluded that building rail modes would be ineffective and overly expensive.

123 Internet: www.publicpurpose.com/ut-railvtab.htm.

Table #10 Urban Rail Evaluation Criteria		
No.	Criteria	Result
1	EFFECTIVENESS: Does the proposed project materially reduce traffic congestion during peak hours?	NO. There is no evidence of material traffic reduction in response to building light rail.
2	COST EFFICIENCY: Is the proposed project the most cost effective strategy for achieving the reduction in traffic congestion?	NO. Bus and roadway construction strategies are more cost effective.
3	OBJECTIVITY: Has the planning process included an objective analysis of all reasonable alternatives?	NO: Planning processes have often exhibited biases in favor of light rail and against bus or roadway strategies.

APPENDIX: AIR POLLUTION AND LIGHT RAIL

The United States has significantly reduced air pollution from mobile sources (street and highway traffic). From 1970 to 1997, Carbon Monoxide (CO) emissions dropped 43 percent, Volatile Organic Compound (VOC) emissions fell 60 percent and Nitrous Oxide (NOx) emissions were reduced five percent.[124] At the same time, total vehicle kilometers traveled increased more than 130 percent (Figure #14).[125] Even in Los Angeles, which has had the worst air pollution in the nation, significant progress has been made, with a nearly 70 percent decline in annual days that federal ozone standards were violated from 1976 to 1998.[126] This is despite a more than 75 percent increase in traffic volumes.[127]

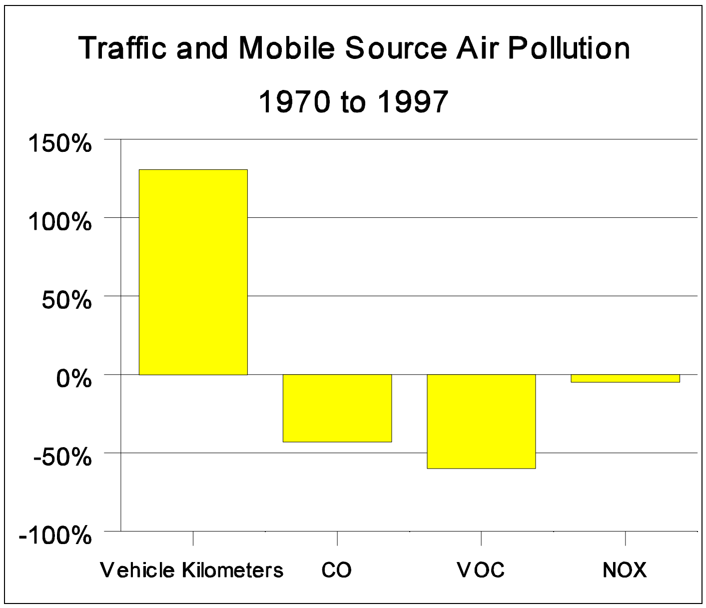

Figure 14
Calculated from US Department of Transportation and US Environmental Protection Agency data.

Because urban rail does not materially reduce automobile use, it cannot materially reduce air pollution. This is confirmed by United States Department of Transportation reports.[128]

124 Calculated from *National Air Pollutant Emission Trends Update: 1970-1997*, US Environmental Protection Agency, March 1999.

125 *National Transportation Statistics 1998* and *Highway Statistics 1997*, US Department of Transportation.

126 Southern California Air Quality Management District, Internet: www.aqmd.gov/smog/o3trend.html.

127 Estimated from Federal Highway Administration data.

128 *Report on Funding Levels and Allocation of Funds*, Report of the Secretary of Transportation to the United States Congress, annual.

- The nation’s most comprehensive and expensive new rail system (Washington, D.C.) is credited with removing barely one percent of emissions in the area.[129]

- New rail systems make only modest air quality improvements because ... *only part of the additional ridership of these systems is drawn from SOV (single occupant vehicle) users. Others are drawn from buses, car pools and latent demand.*[130]

- U.S. Department of Transportation assessments have found that rail projects would have little air quality impact --- largely because they produce little reduction in automobile usage.[131] For example

> Portland: *It is unlikely that any of the public transport alternatives would have a noticeable effect on air quality because of the very small number of auto drivers they would attract.*
>
> St. Louis: *The project will have a small (0.3%) reduction in total regional vehicle miles travelled and hence only an insignificant improvement in regional air quality.*
>
> San Jose: *The project, because of the small number of cars it removes from the road, is expected to have minimal impact on regional air quality.*

US Department of Transportation air quality assessments are essentially the same for all projects reviewed. In addition, these assessments are likely to be optimistic, because projected rail ridership figures are often not achieved (Section 2.5).

Moreover, attracting drivers from automobiles does not always reduce air pollution. Many of the automobile drivers whoa are attracted to light rail drive to stations (to “park and ride” lots). The shorter trips to rail stations may produce nearly as much pollution as the former longer trips:

> *... many riders access rail stations by automobile, meaning their trips still entail engine cold starts and subsequent cooling down. This generates the bulk of HC (hydrocarbon) emissions --- 65 from a 10 mile trip --- because of an automobile’s*

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129 United States Department of Transportation and Environmental Protection Agency, *Clean Air through Transportation: Challenges in Meeting National Air Quality Standards*, August 1993.

130 *Clean Air through Transportation: challenges in meeting National Air Quality Standards*.

131 *Report on Funding Levels and Allocation of Funds*.

relative inefficiency and higher emission rates while warming up and higher gasoline evaporation rates when cooling down.[132]

Rail systems are not necessarily less polluting than the automobile. The electricity that powers rail is more often than not generated by burning fossil fuels, which in their production consume three times as much energy as they produce. At best, electrified rail moves pollution from the urban area to the power plant. Because of its scant contribution to improved air quality, there is virtually no hope that rail can play an important role in achieving the Kyoto greenhouse gas reduction targets.

Virtually all of the motor vehicle air pollution improvement is the result of improved emission technology. And further improvements are on the way. Recently Daimler-Chrysler announced its intention to market a zero emission fuel cell vehicle by 2004.[133] Honda and Toyota are or soon will market very low emission gasoline and hybrid (gasoline-electric) cars in the United States.

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132 *Clean Air through Transportation: Challenges in Meeting National Air Quality Standards*, August 1993.

133 Jeffrey Hall, "Auto Makers Are Racing to Market 'Green' Cars Powered by Fuel Cells," *The Wall Street Journal*, March 15, 1999.

ABOUT THE AUTHOR

Wendell Cox is principal of Wendell Cox Consultancy, an international public policy firm specializing in transport, economics, labor and demographics. The firm has performed work in North America, Europe, the United Kingdom, Australia, New Zealand, Africa and Asia. Among the most notable have been an evaluation of proposed growth control proposals in the state of Pennsylvania, a series of performance analyses on major public transport systems in the state of Texas, an evaluation of the state public transport program for the Washington legislature, a performance audit of British Columbia Transit, the New Zealand competitive pricing procedures and competitive tendering projects in a number of urban areas. Wendell Cox Consultancy maintains Internet websites at:

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Wendell Cox is a member of the Amtrak Reform Council, which has the responsibility to oversee intercity rail passenger policy over the next three years. He was appointed by the Speaker of the United States House of Representatives to fill the unexpired term of New Jersey governor Christine Todd Whitman, and serves as chair of its Financial Analysis Committee. He also served for three years as Director of Policy and Legislation for the American Legislative Exchange Council (Washington) and is a Senior Fellow of the Heritage Foundation (Washington).

Wendell Cox was appointed to three terms on the Los Angeles County Transportation Commission by Los Angeles Mayor Tom Bradley. There he chaired the Service Coordination Committee and served on the Finance Review and Rail Construction Committees. In connection with these responsibilities, he also chaired two American Public Transit Association national committees (Governing Boards and Planning & Policy).

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