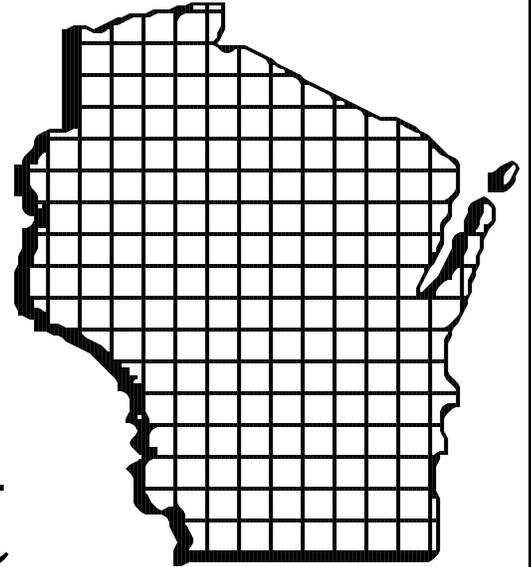


Wisconsin

Policy
Research
Institute
Report



March 1998

Volume 11, Number 3

**LIGHT RAIL IN
MILWAUKEE**

REPORT FROM THE PRESIDENT:

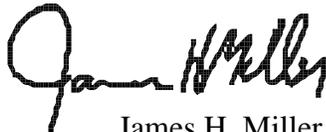
The short-term rail experiment that will begin this spring in Milwaukee will certainly impact the ongoing debate about whether light rail is the answer to metropolitan Milwaukee's traffic problems. With highway construction due to begin at the same time rail service expands, we will have some hard data for potential rail ridership in Milwaukee. This new program, however, will not present the total picture of the enormous costs involved with implementing a new light rail system for Milwaukee.

To get some sense of the feasibility of new rail systems, we contracted with an internationally known public policy and transportation consultant, Wendell Cox, to examine current light rail systems across the United States and potentially in Milwaukee. Cox has been involved with transportation policy for more than a generation. He was appointed to the Los Angeles County Transportation Commission for three terms by Mayor Tom Bradley. He has authored numerous studies, including an evaluation of high-speed rail in Florida and an analysis of the light rail proposal in Chicago, as well as transportation studies in other areas, including Amtrak.

Cox's findings paint a picture of light rail not fulfilling its promises of reducing congestion and pollution and switching riders to public transportation. Across the country, the costs of light rail have ranged anywhere from expensive to wildly extravagant. Light rail is not the answer to southeast Wisconsin's transportation problem.

There may still be other reasons for the region to desire rail service in Milwaukee. These would be a combination of boosterism and civic pride. Occasionally, public construction may be for the public good. Miller Park was not approved for the economics involved, but for other reasons. It could very well be that light rail's future lies in the same rationale that led us to continue major-league baseball in Wisconsin.

The real question is whether metropolitan Milwaukee or Wisconsin taxpayers want to pay huge subsidies for a rail transportation system that is likely to have negligible impact on transportation patterns in metropolitan Milwaukee.



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LIGHT RAIL IN MILWAUKEE

WENDELL COX

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EXECUTIVE SUMMARY

Urban rail systems — such as light rail, rapid rail, or commuter rail — are often proposed as a solution to the problems of air pollution and traffic congestion. The most significant traffic congestion occurs during weekday peak travel periods, when the majority of workers travel to and from work. Thus, the test of urban rail's success is the extent to which it reduces traffic congestion during weekday peak hours.

This report will review the national light rail experience and proposals to build light rail in Milwaukee. A commuter rail analysis is also provided.

Light Rail: The National Experience

A number of new light rail lines have been built in the United States over the past 15 years. They have, however, provided virtually no reduction of traffic congestion and, consequently, no reduction in air pollution. The percentage of people using transit to get to work has declined in all major metropolitan areas, and the decline has been as significant in the metropolitan areas that built light rail.

Light rail has negligible impact on traffic congestion, because it attracts so few automobile drivers from their cars. Most light rail riders are former bus riders, riders who did not previously make the trip, or car pool passengers. Further, the demographic trends in U.S. cities have made transit in general and light rail in particular much less effective. As residences and jobs have spread out into the suburbs and exurbs, a greater percentage of travel can only be practically accomplished by automobile. Transit's single strong market is toward downtown areas, where services tend to be focused in a "hub-spoke" configuration. Only a small percentage of non-downtown oriented trips can be quickly provided by transit. At the same time, virtually all population and employment growth continues to be in the suburbs, making transit and light rail strategies even less effective. Light rail is not an effective strategy for providing service to suburban jobs (the reverse commute), because they are dispersed so widely over a large area. For transit to serve suburban job markets requires smaller vehicles, not higher capacity systems such as light rail.

Light rail is exceedingly expensive. The most cost-effective federally funded systems have required annual subsidies of \$5,000 and more per new ride — enough to lease a well-equipped automobile. Light rail operating and capital costs per person mile are five times that of busways, which are able to provide virtually the same level of service.

Further, light rail cost and ridership projections have been faulty. A late 1980s federal study found capital costs to be 30 percent above projection, operating costs 16 percent higher, and ridership 65 percent lower. Capital-cost overruns on recent projects have averaged more than 80 percent. As a result, light rail systems have placed a financial burden on transit systems, increasing subsidy requirements in virtually every case.

Light rail has been cited for spurring development. However, much of the development is tax-subsidized, and development does not appear to be greater in light rail urban areas in comparison to non-light rail urban areas. Further, light rail urban areas do not have lower downtown office-vacancy rates than non-light rail urban areas.

Light rail is perceived as improving travel times, energy conservation, and safety. But the opposite is true.

- Light rail tends to operate at less than half the speed of automobiles during weekday peak hours. It is slower than express buses, but marginally faster than local service buses.
- Light rail consumes more energy per person mile than the automobile.
- Light rail is considerably less safe than buses and automobiles.

While light rail's transportation impacts are insignificant, its costs are very high.

Light Rail: The Milwaukee Proposal

Like other urban areas, Milwaukee has experienced significant suburbanization over the past half century. The central area, including Milwaukee County, has lost population and employment, and much of the loss has occurred in the East-West Corridor, the target area for transportation investments. Transit ridership has dropped 30 percent since 1980, though much of the loss may have been driven by fare increases.

The planning process involved the review of a number of alternatives. The Bus Alternative, which would involve a 54 percent increase in service by 2010, was used as a baseline for comparing higher-cost alternatives incorporating light rail. The two representative light rail alternatives studied would carry more riders than the Bus Alternative, largely due to manual adjustments made to the computer-model projections. At the conclusion of the planning process, a preferred alternative was chosen for further review — the Light Rail Preferred Alternative. No ridership projection was provided for this alternative, but it is estimated that it would carry fewer riders than the Bus Alternative.

Traffic projections show virtually no difference between the various alternatives. The study's light rail alternatives would remove few automobiles from roadways, while the Light Rail Preferred Alternative would remove none. Because of their minimal impact on traffic, the light rail alternatives would have minimal impact on air pollution.

The most cost-effective light rail alternative would require an annual subsidy of \$17,000 per new ride — more than \$650,000 over a career. The cost per automobile driver attracted would be even higher — at least \$180,000 annually, or \$7 million over a career. The adopted Light Rail Preferred Alternative would not attract new riders, so the cost per new ride cannot be calculated. Further, both the operating and capital cost projections appear to be low, which could create a budget shortfall of up to \$1 billion for local taxpayers.

The planning process appears to have been biased in favor of light rail. The Bus Alternative is used as a baseline and is not considered as an alternative for implementation, despite its superior cost-effectiveness. Light rail alternatives are credited with inappropriately higher ridership through manual adjustments to the computer model projections. Policies that would encourage development are applied only to light rail alternatives, not to the Bus Alternative. Finally, the selected alternative is irrational — the Light Rail Preferred Alternative would cost 140 percent more than the Bus Alternative, while serving fewer riders.

The planning process was also incomplete. It failed to consider more cost-effective, bus-service expansion alternatives and fare reductions as alternatives to the higher-cost light rail strategies. No consideration was given to using competitive contracting to lower costs and expand services. But most important, the one alternative that could solve the East-West Corridor traffic congestion problem — expansion of general-purpose freeway capacity — was not considered.

Light rail would have only imperceptible impact on traffic congestion and air pollution in Milwaukee. The Milwaukee light rail project is one of the least effective ever considered. In Milwaukee, light rail is insignificant in every respect except cost.

Commuter Rail in Milwaukee

Proposals have been advanced to operate commuter rail in the East-West Corridor and for downtown Milwaukee to become the northernmost terminal of the Chicago commuter rail system (Metra). Commuter rail would be even less effective than light rail in reducing traffic congestion and would carry significantly fewer passengers. It is estimated that the East-West Corridor route would cost at least \$16,000 annually per new automobile driver attracted, while the Chicago corridor would cost \$20,000 per year per new automobile driver attracted. Express buses could provide comparable service for considerably less.

Conclusion

Urban rail — whether light rail or commuter rail — offers virtually no hope for reducing traffic congestion and air pollution in Milwaukee, because it would remove so few automobiles from the road.

RAIL IN URBAN TRANSPORTATION

Urban areas around the developed world are wrestling with the related problems of traffic congestion and air pollution. These problems are most evident during the peak commuting hours on weekday mornings and late afternoons and evenings. A number of urban areas have attempted to reduce traffic congestion and air pollution by building urban rail systems (rapid rail, light rail, and commuter rail), in the expectation that automobile drivers could be attracted to transfer to public transit service. In the same vein, serious consideration has been given to light rail in Milwaukee and there have been proposals to establish commuter rail service as well.

This report examines the American experience with new light rail systems (built since 1980), especially with respect to reduction of traffic congestion and air pollution. It then reviews Milwaukee planning documents to evaluate the potential for using light rail to reduce traffic congestion and air pollution. A brief evaluation is also provided of commuter rail proposals.

What is Urban Rail?

There are three types of urban rail.

- **Rapid rail** (heavy rail), which operates with grade separation (no at grade street or pedestrian crossings), often in subway or elevated structures. Rapid rail is normally powered by electricity taken from a “third rail” and operates at an average speed of 19.5 miles per hour. Rapid rail is expensive to build — costs in Los Angeles are approaching \$300 million per mile. Rapid rail can carry up to 40,000 riders per hour in each direction¹ in consists of up to 10 cars. Examples of rapid rail include the New York subway system, the Chicago El, Washington’s Metrorail, the Paris Metro, and the London Underground.
- **Light rail** (surface rail), which generally operates without grade separation, though it may have some grade separation. Light rail is a contemporary name for the “streetcars” that operated in most large U.S. cities from the late 19th century to the 1950s and 1960s. Electric power is collected from overhead lines. The average speed for new U.S. systems is 16.2 miles per hour.² Light rail can carry up to 15,000 to 25,000 riders per hour in each direction in consists of up to three cars. Examples of light rail include the St. Louis Metrolink, Portland’s MAX, and the Los Angeles “Blue Line.”³
- **Commuter rail** (regional rail), which operates over freight railroad rights of way to downtown railroad stations. Propulsion may be either electric or diesel. The average operating speed is 33.2 miles per hour. Trains are often 10 cars long or more and may be “double-deck.” Examples of commuter rail systems include Chicago (Metra), New York (Long Island Railroad, Metro-North Railroad, and New Jersey Transit), and Philadelphia.

The evaluation of light rail in this report will sometimes use rapid rail examples based upon the general assumption that characteristics or performance that cannot be achieved by rapid rail are, by definition, beyond the capability of light rail.

LRT (light rail) has none of the advantages of heavy rail (high capacity and performance) and all of its disadvantages (costly, exclusive right-of-ways, and structure, fixed route structures, and an inability to operate off the rail right of way).⁴

Light Rail: Objectives and Claims

Light rail has been proposed as a solution to the urban transportation problem. Proponents claim that light rail can reduce traffic congestion and thereby air pollution and do so for lower costs than other alternatives. These principal benefits have been routinely cited in campaigns to obtain voter or public-agency approval of light rail systems.

- **Reduction of traffic congestion:** Light rail’s theoretical capacity for traffic reduction is considerable. Proponents frequently point out that a single light rail line can carry the same number of people as six lanes of freeway.

- **Reduction of air pollution:** Automobiles (private vehicles)⁵ are the principal mobile source of air pollution. To the extent that light rail is successful in reducing traffic congestion, air pollution may be reduced by a corresponding amount.
- **Cost effectiveness:** Largely because it carries higher passenger volumes per vehicle and per employee, light rail is claimed to be more cost effective than other transit alternatives, especially bus alternatives. A single driver can operate a bus, with a capacity of 60 to 75 passengers, or a two-car light rail consist carrying up to 400 passengers.

Beyond these principal benefits, additional benefits have been cited, such as:

- Reduced energy consumption.
- Development: It is suggested that light rail encourages more dense commercial and residential development, which would reduce overall levels of automobile usage.
- Improved travel times, as drivers spend less time in traffic congestion.⁶
- Improved service for inner city residents with jobs in the suburbs (“reverse commuting”).
- Improved safety.
- Reduced transit deficits (subsidies), as the higher passenger volumes improve the percentage of total costs recovered from passenger fares (and as a result, subsidy requirements are reduced).⁷

Light rail’s potential to reduce traffic congestion is by far the greatest during peak hours — and particularly with respect to the work trips that are the proximate cause of most urban traffic congestion. A simple test of light rail’s success is proposed — the extent to which light rail attracts automobile drivers during peak hours (and in consequence, removes automobiles from the road during peak hour congestion) and light rail’s relative cost effectiveness in achieving that objective. The following framework will be used for evaluating the U.S. experience in light rail and the proposed Milwaukee light rail line.

NEW LIGHT RAIL IN AMERICA

A number of new light rail lines have been opened in the United States in the past 15 years. For example:

- The most successful line is the Los Angeles “Blue Line,” which carries approximately 50,000 riders per day. Los Angeles’ two light rail lines carry 70,000 riders per day.
- San Diego carries 60,000 riders on its two new light rail lines.
- St. Louis carries more than 45,000 riders per day on two light rail corridors.⁸
- Lines in Portland, Buffalo, Sacramento, San Jose, and Baltimore carry more than 20,00 riders per day.
- Denver’s light rail line carries more than 15,000 riders per day.

Despite these large numbers, light rail carries from 30 percent of total transit ridership (Sacramento) to less than five percent (Los Angeles). As a result of this, the capability of light rail to reduce traffic congestion in peak hour is necessarily less than the overall capability of transit to reduce traffic congestion.

The Purpose of Light Rail: Peak Hour-Traffic Relief

As noted above, the fundamental purpose of light rail is to reduce traffic congestion. The most intractable and predictable traffic congestion generally occurs during the weekday morning and evening peak periods (generally 7:00 a.m. to 9:00 a.m. and 4:00 p.m. to 6:00 p.m.), often referred to as “rush hour.” Traffic congestion occurs at times other than peak hours, but it is less predictable, more geographically confined, and very often the result of temporary disruptions such as traffic accidents and construction. Peak-hour traffic congestion largely results from the fact that the overwhelming majority of work trips occur during these peak periods — without these work trips peak hour traffic congestion would be as infrequent as during off-peak hours.

1. **Traffic Congestion:** To what extent does light rail reduce traffic congestion during peak periods (and as a consequence, reduce air pollution)?
2. **Cost Effectiveness:** How does light rail compare to other strategies for reducing traffic congestion during peak periods?

Traffic Congestion and Light Rail

There is virtually no evidence that light rail has resulted in any long term or sustainable reduction in traffic congestion. United States Department of Transportation Federal Transit Administration reports have invariably concluded that light rail projects would have little impact on traffic congestion, because it removes so few automobiles from the road because so few automobile drivers are attracted to light rail (“Air Pollution and Light Rail,” below).

Peak Hour Traffic and Census Data

The most effective measure of automobile and public transit trends⁹ during weekday peak periods is the United States Census data collected on work (commute) trips, which is available is from the 1990 census.

All of the 13 urban areas that built or expanded rail systems in the 1980s experienced transit work trip market share declines (percentage of workers using public transit to get to work). The four metropolitan areas¹⁰ that opened light rail¹¹ experienced a transit work trip market share loss of 28.1 percent (from 5.35 percent to 3.84 percent), despite the expenditure of nearly \$2 billion (1997\$) to build light rail. The four metropolitan areas combined experienced an increase of 814,300 workers from 1980 to 1990, while 3,900 fewer people used public transit to get to work on a daily basis (Table 1). Only San Diego experienced a material increase in transit ridership, and even there, more than 30 times as many new commuters used automobiles. By contrast, the four light rail metropolitan areas experienced an average transit work trip market share *gain* of 5.0 percent from 1970 to 1980.¹²

TABLE 1 1980-1990 Transit Work Trip Market Share: New Light Rail Urban Areas

Urban Area	Transit Work Trip Market Share <i>Light Rail Open</i>	Transit Work Trip Market Share			New Workers	
		1980	1990	Change	All	New Transit Commuters
Buffalo	1986	6.31%	4.45%	-29.5%	31,200	(7,900)
Portland	1987	8.35%	5.36%	-35.8%	155,500	(8,600)
Sacramento	1987	3.50%	2.36%	-32.6%	250,800	900
San Diego	1982	3.23%	3.20%	-0.9%	376,600	11,700
<i>Average/Total</i>		<i>5.35%</i>	<i>3.84%</i>	<i>-28.1%</i>	<i>814,100</i>	<i>(3,900)</i>

Data from US Census Bureau

Public transit *did not* reduce traffic congestion in the urban areas that built light rail, nor did the light rail components of transit systems.

- 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 transit commuter, there were more than 275 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.

Light Rail in San Diego: Unique and Not Replicable

The nation's most cost effective new light rail system has been in San Diego. The first line was built without federal funding, which made it less expensive. (Federal regulations and mandates significantly increase light rail construction costs.) It is unusual among United States light rail lines because it was built within its cost projection and carries more riders than projected. In addition, San Diego developed its light rail line through a new, light-rail-only public agency and was not subject to the costly labor contract provisions of the area's large bus operator. (Many public transit labor contracts retain costly work rules that applied to now-discontinued light rail operations.) In the early years, operations were non-union. Even after unionization, operating costs per mile have been held below the national average for both bus and light rail systems.

Moreover, San Diego transit officials are the most cost conscious in the nation. Over the past two decades, San Diego has gradually converted bus services from public monopoly provision to competitive contracting. In this competitive environment, competitive and non-competitive bus costs per mile have dropped 30 percent relative to inflation — an accomplishment unmatched by any other United States transit agency. (During the same period, Milwaukee County Transit System costs increased by 10 percent.) The gross impact of this cost reduction has more than offset the costs of building light rail. San Diego has another advantage that cannot be replicated in most United States urban areas — one end of its light rail system is at the Mexican border, which generates a large number of rides.

The San Diego experience is unique and not practically replicable in the political and geographical environments that exist in other United States urban areas.

- 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. San Diego's performance is related to unique local policies that have resulted in considerably more favorable financial performance than other transit agencies.

Only two of the nation's metropolitan areas with more than one million population experienced transit market share increases — Houston (+28.8 percent) and Phoenix (+2.6 percent). These urban areas also expanded their bus services the most. Houston increased service 90 percent, while implementing the nation's most comprehensive express bus on HOV (high occupancy vehicle)¹³ lane system. Phoenix increased its service level two-thirds. However, because transit's market share is so small, there are more than 10 times as many new automobile commuters as transit commuters in Houston and Phoenix.¹⁴

Trends in the 1990s

Recently released U.S. Department of Transportation data indicate an acceleration of the market share loss — to a 19.5 percent decline from 1990 to 1995 (-4.2 percent annual rate, compared to a -2.2 rate from 1983 to 1990).¹⁵ And, overall 1990 to 1995 ridership data (all transit ridership, not just work trip ridership) show that public transit is attracting at best a minuscule share of the new travel in all new light rail urban areas (Table 2).¹⁶ This would suggest further work trip market share losses and virtually no progress in reducing peak hour traffic congestion.

TABLE 2 1990-1995 Transit Market Share: New Light Rail Urban Areas

	<i>New Travel (Millions of Passenger Miles)</i>	<i>New Transit Travel (Millions of Passenger Miles)</i>	<i>% of New Travel By Transit</i>	<i>New Private Passenger Miles per New Transit Passenger Mile</i>
1990s Openings				
Baltimore	3,261.0	32.1	0.98%	101
Denver	5,322.4	34.5	0.65%	153
Los Angeles	6,660.5	(30.3)	-0.45%	Negative
St. Louis	4,388.6	6.5	0.15%	671
<i>Subtotal</i>	<i>19,632.5</i>	<i>42.8</i>	<i>0.22%</i>	<i>458</i>
1980s Openings				
Buffalo	1,530.3	1.8	0.12%	828
Portland	2,915.4	52.5	1.80%	54
Sacramento	1,145.2	6.8	0.59%	168
San Diego	1,917.8	8.7	0.45%	220
San Jose	1,534.3	(5.2)	-0.34%	Negative
<i>Subtotal</i>	<i>9,042.9</i>	<i>64.6</i>	<i>0.71%</i>	<i>139</i>
Total	28675.4	107.4	0.37%	266

Calculated from NTDB and FHWA

- Transit accounted for 0.22 percent of new travel in the urban areas that opened light rail lines between 1990 and 1995, while 99.78 percent of new travel was by private vehicles, especially automobiles. There were more than 450 passenger miles of new automobile travel for every new mile of transit travel.

- Transit accounted for 0.37 percent of new travel in the urban areas that opened light rail lines between 1980 and 1990, while 99.63 percent of new travel was by private vehicle, especially automobiles. There were 139 new passenger miles of travel by private vehicle for every new mile by transit.
- Portland achieved the largest percentage of new travel by transit — 1.8 percent, while 98.2 percent of new travel was by private vehicles, principally automobiles. There were 54 miles of new, private-vehicle travel for every new mile of transit travel.¹⁷ However, virtually all of Portland’s increase was attributable to new bus rather than light rail travel.¹⁸
- Los Angeles experienced a decline in transit travel, despite spending more than \$5 billion to build two light rail lines, a rapid rail line, and six commuter rail lines.

In spite of transit’s small and steadily diminishing work trip market share, industry reports continue to paint a “rosy picture.” For example, a recent report claimed that if all transit commuters in Portland were to switch to automobiles, freeway capacity would need to be expanded by 27 percent.¹⁹ This is an absurd assertion. Only five percent of Portland’s commuters use transit — a more realistic figure would be at most one-tenth (2.7 percent).²⁰ Similarly implausible estimates were provided for other major urban areas.

Sources of Light Rail Ridership

Light rail does not reduce traffic congestion, because it attracts so few automobile drivers. For example, approximately 20 percent of Washington’s rapid rail ridership formerly drove automobiles for their trips, while 25 percent of San Diego’s light rail riders were former automobile drivers. The majority of new urban rail riders are included in the following categories:

- Former bus riders, who have been forced to transfer because their bus routes now feed rail stations instead of the former destinations (usually downtown).²¹
- Riders in “free fare” downtown zones (such as Portland, St. Louis, and Buffalo). For example, all light rail and bus service in downtown Portland is operated without fares.
- 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 (“Air Pollution and Light Rail,” below). In St. Louis, for example, many drivers park free at two East St. Louis stations and ride less than two miles to downtown. They thus avoid expensive downtown parking charges and a system of congested bridges that has suffered from a conscious policy of disinvestment. One bridge was permanently closed 30 years ago and another has been closed for nearly five years, with renovation still not commenced. Even so, light rail carries barely three percent of the traffic across the river.²² Moreover, virtually all bus service across the river has been discontinued, as riders are forced to transfer to light rail.
- Former car pool *riders*, whose car pools continue to operate or have become single-occupant trips (no automobile has been removed). This does nothing to reduce automobile use, because the automobiles remain on the road.
- New travelers.

Light rail has not reduced traffic congestion on nearby freeways.

- In Portland, traffic on the adjacent freeway has continued to grow and is now at least 58 percent higher than before light rail was opened. During the peak period, an adjacent freeway lane carries seven times as many riders as light rail in the inbound (downtown) direction. In the reverse direction, a single freeway lane carries more than 80 times the light rail line.²³

- In St. Louis, freeway traffic in the light rail corridor has continued to grow — at up to double overall rates in the St. Louis metropolitan area.²⁴ Since light rail opened, 32 of 33 new passenger miles traveled in the St. Louis area have *not* been on transit.²⁵

Light Rail and Other Strategies

Despite the perceptions to the contrary, express bus systems are capable of similar passenger volumes. Express bus systems provide nearly the same theoretical capacity as light rail — and at least as much *practical* capacity — capacity that is actually used. Express bus systems in Brazil carry 20,000 passengers per hour. In the U.S., none of the new light rail lines remotely approach this volume, much less the theoretical capacity of light rail.

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

- Because they are also open to car pools, total HOV lane passenger volumes can be much higher than light rail volumes. For example, In Washington, D.C., an HOV lane carries 13,000 riders per hour — more than double that of the most successful new light rail line — while buses in HOV lanes in New York, Los Angeles, Houston, and San Francisco carry more passengers than any new U.S. light rail line.²⁶ Ottawa’s on-street downtown bus lanes carry nearly 10,000 riders during peak hours in peak directions — approximately double that of the highest volume new U.S. light rail lines.
- HOV lanes serve a much broader employment market than transit, which can effectively serve only downtown commuters (“The Urban Travel Consumer and Light Rail,” below). 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 freeway lanes.

Because of their considerably lower costs (“Cost Effectiveness and Light Rail,” below), express bus systems and HOV lanes have *practical* capacities in the U.S. urban area far exceeding that of light rail. According to a U.S. Department of Transportation report, HOV lanes with express bus systems are five times as cost effective as light rail (cost per passenger mile).²⁷

This 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 light rail. Generally, whatever passenger volume can be accommodated by new light rail lines can be less expensively moved by express buses.

Light Rail’s Potential for Reducing Traffic Congestion in the U.S.

The light rail ridership figures, which have been characterized as impressive,²⁸ are insignificant in the context of the traffic volumes in the same urban areas. The nation’s urban freeway system — little changed from 1980 — is carrying at least 20 percent more peak hour commuters than 15 years ago and average commute times have increased only 2.5 minutes.²⁹ All of this increase is attributable to longer work trips — average commuting speed has risen by 20 percent. Faster commuting speeds have been partially attributed to the impact of people substituting a faster mode of transport — the automobile — for slower transit services.³⁰

The test of light rail’s success is not how many people are on the trains — it is how many cars light rail has removed from the road, especially during peak hour. In urban areas with and without urban rail, the situation is the same. The overwhelming majority of travel is by automobile, and virtually all of the growth in travel is by automobile. And this is not just an American phenomenon. It is increasingly the case in Europe, and the trends in Japan are similar. In Europe, the automobile market share is now 80 percent — nearly equal to that of the United States — while the automobile’s market share in Japan has increased by 400 percent in the last 30 years.³¹ Neither light rail nor transit in general have reduced traffic congestion.

Air Pollution and Light Rail

Considerable progress has been made in improving air quality in the United States. From 1970 to 1992, annual road travel increased by more than 100 percent. At the same time, transportation-related carbon monoxide emissions fell 32 percent, volatile organic compound emissions fell 53 percent, and nitrogen oxide emissions rose by one percent.³² The number of unhealthful air quality days dropped by more than two thirds in U.S. metropolitan areas from 1987 to 1996,³³ and automobile pollution is expected to drop approximately 25 percent from 1996 to 2010,³⁴ despite continued growth in miles traveled. A recent press report indicated that 1997 was the best year for air pollution in the Los Angeles area for the past 50 years³⁵ — this despite a tripling of population. Most of the improvement in air quality is attributable to improved vehicle emission technology.

Virtually none of the air pollution improvement is attributable to transit, much less light rail. Because light rail does not materially reduce automobile use, it cannot materially reduce air pollution. This is confirmed by United States Department of Transportation reports.³⁶

- The Washington, D.C., rapid rail system — which carries more than twice as many riders as the combined new light rail lines in all nine urban areas — is credited with removing barely one percent of emissions in the area.³⁷
- New rail systems — rapid rail and light rail alike — 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.*³⁸
- U.S. Department of Transportation assessments have found that light rail projects would have little air quality impact — largely because they produce little reduction in automobile usage.³⁹ For example:

Portland: It is unlikely that any of the transit alternatives would have a noticeable effect on air quality because of the very small number of auto drivers they would attract. This is in contrast to Portland's claims.

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.

Light Rail and Air Pollution: Misleading Claims in Portland

Despite the evidence that light rail has little impact on air quality, there are claims to the contrary, especially with respect to Portland. In discussing the benefits of light rail, an American Public Transit Association report characterizes "the rewards of rail investment in Portland" as: **1972:** *Downtown Portland air was so dirty it violated federal health standards one out of every three days.* **1990:** *No air quality violations.*

For transit (much less light rail) to have simply maintained the 1972 air pollution level, much less reduce it, would have required 1990 ridership to be at least 20 times greater than it was — equal to all of the bus, light rail, rapid rail and commuter rail ridership in the Chicago, Philadelphia, Boston, and Seattle metropolitan areas combined. Portland—with 1/200th of the nation's population — would have to account for 1/6th of the nation's transit ridership. To infer any relationship between improved air quality and light rail in Portland is absurd. Like virtually all other metropolitan areas in the United States, the striking improvement in air quality over the past two decades has resulted from improved vehicle emission technology. Transit has had virtually no role in the incremental improvements in air quality in Portland or any other United States urban area — because in all urban areas, transit use has declined relative to automobile use.

U.S. 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 rarely achieved ("Projections and Light Rail," below).

Moreover, attracting drivers from automobiles does not always reduce air pollution. Many of the few automobile drivers attracted to light rail drive to rail stations (at “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 relative inefficiency and higher emission rates while warming up and higher gasoline evaporation rates when cooling down.⁴⁰

Light rail is not necessarily less polluting than the automobile. The electricity that powers light 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, light 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 light rail can play an important role in achieving the recently adopted Kyoto greenhouse gas reduction targets.⁴¹

Cost-Effectiveness and Light Rail

Despite the popular perception that public transit is a cost effective form of transportation, the evidence indicates precisely the opposite. Since public subsidy programs became widespread in the 1960s and early 1970s, public transit operating costs per mile have escalated at more than double the rate of costs in the market.⁴² Transit is the only passenger or freight transportation mode that did not improve its cost effectiveness since 1980.⁴³ As a result, transit has become much more expensive than the automobile. In 1995:

- The full cost per passenger mile of operating an automobile was \$0.16.⁴⁴ Transit expenditures per passenger mile were \$0.60 — nearly four times that of the automobile.
- Transit fares have become more costly than the full cost of the automobile — \$0.17 per passenger mile. Passenger fares are approximately three times as great as the variable (perceived) cost of operating an automobile — gasoline, repairs, tires, and parking.

Light rail is expensive relative to other transit modes — 1995 expenditures were double the bus and rapid

Cost per New Ride

The FTA “cost per new ride” cost effectiveness index captures the annual capital and operating cost of a transit project in relation to the net public benefit — the increase in ridership attributable to the project (inflation adjusted). For an explanation of this index, please refer to: *Major Investment Study/Draft Environmental Impact Statement (MIS)*.

For example, if the annual capital and operating cost of a new light rail line were \$9 million and 1.5 million new riders were attracted annually, the cost per new ride would be \$6.

The cost per new ride can be used to estimate the cost per each new individual rider (a person who travels to and from work by light rail):

- The daily cost per new rider is double the cost per new ride. (This assumes that each new rider takes transit to and from a particular destination.) At six dollars per new ride, the daily cost would be \$12.
- On average, employees work 225 days per year. The annual cost per new transit commuter is thus 450 times the cost per new ride (assumes two transit trips per day). At \$6 per new ride, the annual cost would be \$2,700.
- 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 \$2,700 annually, the career cost would be \$108,000.

Until the early 1990’s, FTA considered \$6 per ride to be the maximum reasonable cost-effectiveness index.

rail rates per passenger mile.⁴⁵ This is despite the superior labor productivity of light rail — bus systems require 50 percent more operating personnel than light rail systems.⁴⁶ High-volume bus routes in U.S. central cities tend to have lower operating costs than light rail, and far lower capital costs.

Light Rail Cost per New Ride

The Federal Transit Administration (FTA) requires new rail line planning to include a cost-effectiveness index — the cost per new ride.

The cost per new ride for recently developed rail projects has averaged nearly \$18, or \$8,040 per annual new commuter per year. This equates to more than \$320,000 over a 40-year work career (Table 3). 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 (“Projections and Light Rail,” below). By comparison, in 1995, the full cost per average automobile commute is estimated at \$2.88 — \$5.76 per day, \$1,300 per year, and \$52,000 over a career.⁴⁷ All of the cost of automobile commuting is borne by the user. On the other hand, little of the cost per new ride of new light rail systems is borne by users, with most transit fares in the \$1.00 to \$2.00 range.⁴⁸

The relatively high cost per new ride reflects the fact that new urban rail systems attract comparatively few new riders, and as a consequence, few trips are attracted from automobiles. If, on average, the number of automobile drivers attracted is half of the new ridership, the annual cost per new ride would range from \$10,000 to \$40,000 —with career subsidies of \$200,000 to \$800,000.⁴⁹ The cost per new automobile driver attracted for the Los Angeles Blue Line was \$37,000 annually — approximately \$1.5 million over a career.⁵⁰

Light Rail Cost Compared to Other Types of Transit

Despite its much lower capital costs, light rail costs approximately the same as rapid rail systems per passenger mile, and light rail is considerably more expensive than express bus networks.⁵¹

- Express buses normally use general purpose roadways and, therefore, do not incur the high capital costs of light rail. Even where express buses use HOV lanes, the attributable capital cost is lower, because the cost is shared with the usually larger number of commuters in car pools using the HOV lanes.

TABLE 3 **Cost per New Ride:
Light Rail Lines Completed or Under Construction**

<i>Light Rail Line</i>	<i>Per New One-Way Ride</i>	<i>Annual</i>	<i>40-Year Career</i>
Baltimore-Airport	\$17.27	\$7,761	\$310,435
Baltimore-Hunt Valley	\$11.87	\$5,336	\$213,424
Baltimore-Penn Station	\$18.35	\$8,246	\$329,838
Dallas	\$10.54	\$4,735	\$189,415
Portland-Banfield	\$11.11	\$4,993	\$199,728
Portland-Westside	\$21.31	\$9,580	\$383,215
San Jose-Tasman	\$40.94	\$18,400	\$735,998
St. Louis-Lambert	\$11.72	\$5,270	\$210,801
<i>Average</i>	<i>\$17.89</i>	<i>\$8,040</i>	<i>\$321,607</i>

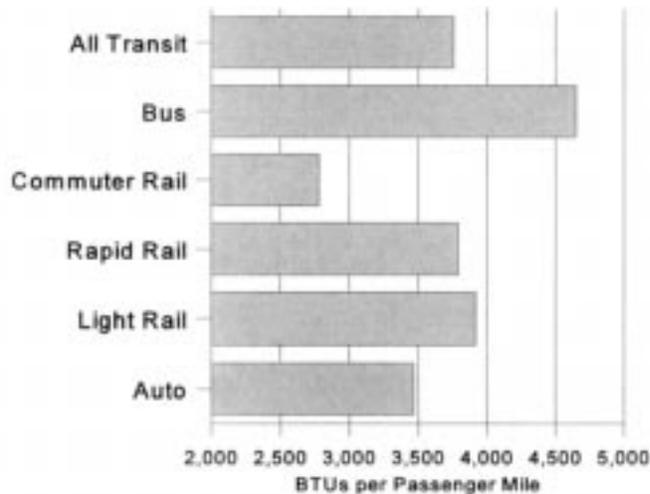
In 1994 dollars
Calculated from Federal Transit Administration data

- Five HOV lanes and the corresponding express bus systems can be built and operated for the same cost as a single light rail line, according to a U.S. Department of Transportation study.⁵²

Conclusion: Light rail is an exceedingly costly strategy to reduce traffic congestion, and more costly than other forms of transit.

Energy and Light Rail

FIGURE 1 Energy Consumption: 1995



Despite perceptions to the contrary, public transit is less fuel efficient than the automobile. Only commuter rail is more energy efficient than the automobile. In 1995, light rail consumed 13 percent more energy than the automobile per passenger mile (Figure 1).⁵³ A principal factor in the energy intensiveness of electric rail modes (light rail and rapid rail, and commuter rail to a lesser degree) is the great amount of energy required to produce electricity. For example, coal generation of electricity consumes three times as much energy as is produced. Rail construction also consumes considerable energy, which further increases its energy consumption relative to the automobile.

Conclusion: Light rail does not reduce energy consumption.

Calculated from U.S. Department of Transportation and U.S. Department of Energy data

Development and Light Rail

Light rail has been credited with encouraging new development. For example:

- In Portland, it is claimed that light rail played an important part in the placement of a new basketball arena (the “Rose Garden”) and a new convention center in central Portland. Moreover, the renovation and expansion of a regional shopping center (Lloyd Center) has also been cited as a result of light rail.
- In St. Louis, it is claimed that light rail was important in the placement of a new domed football stadium (the “TWA Dome”), a new basketball and hockey arena (“Kiel Center”), and a new convention center⁵⁴ in the downtown area.

On closer examination, however, the light rail development claims are less persuasive.

- All of the sports facilities cited above were partially or fully tax funded — arising from decisions of government, not by decisions of private investors who were attracted to develop land along light rail lines. Publicly assisted sports facilities may be built anywhere in a community, and have been built in both central city and suburban areas. Two new sports facilities are planned in central Detroit, which has no rail system. Major sports facilities have recently or will be sited in the central areas of other non-light rail cities, including Phoenix, Seattle, Minneapolis, Indianapolis, and Charlotte. It is notable that in Washington, D.C., with the nation’s most effective new urban rail system, the new football stadium (Jack Kent Cooke Stadium) was constructed beyond walking distance from the rail system.

- Convention centers are routinely built with tax subsidies, and in metropolitan areas, the largest such centers are invariably built in or near the central business district, adjacent to hotels and downtown shopping. For example, major convention centers have been built in the central areas of Seattle, Kansas City, Indianapolis, Milwaukee, San Antonio, and Los Angeles (long before construction of urban rail became a serious prospect).

There are further indications of the difficulty of attracting private investment to light rail lines. Because there has been virtually no high-density development adjacent to most light rail stations, the city of Portland is offering 10 years of property-tax forgiveness for qualifying projects within walking distance (1/4 mile) of light rail stations. This demonstrates light rail's minuscule impact on development. If light rail drove development, it would not be necessary to subsidize the private development along the route.

The largely tax-supported development in central-city areas does not represent a net gain to the urban areas (from other urban areas) — the projects would have been built somewhere within the same urban area. The critical element in any resulting development is not light rail — it is tax subsidies.

Downtown Employment and Vacancy

If light rail were having a significant effect on development, it would be expected that the areas best served — downtown areas — would be thriving, with a rising employment share and lower office-vacancy rates than in suburban areas. However, the central areas of some new light rail cities are experiencing considerable difficulty.

- Portland's central-city employment has increased 1,000 from 1990 to 1994, while suburban employment grew by nearly 94,000. The central-city share of metropolitan employment fell by nine percent over the period.⁵⁵ Downtown office vacancies continue to be higher than suburban. Further, the city of Portland government has recently relaxed parking development restrictions to make downtown more competitive,⁵⁶ and at least three major multi-story parking structures have recently been under construction along the rail line. A downtown area that had been transformed by light rail would have an excess, not a shortage of parking.
- Downtown Baltimore has experienced major job losses during the 1990s. The central-city population loss rate has more than doubled in the 1990s.⁵⁷
- Downtown St. Louis has been characterized as "fading fast."⁵⁸ A major downtown enclosed shopping center — which the developer claimed to be the largest in the nation when it opened in 1985 — has a 40 percent vacancy rate and is considering closure, and there are indications that one of downtown's two remaining department stores may close.⁵⁹ The downtown office-vacancy rate is among the highest in the nation, and triple the vacancy rate of the suburbs. The city of St. Louis' population loss rate has accelerated since light rail opened.⁶⁰
- Dallas, which opened three light rail lines in 1996, continues to have the nation's highest downtown office-vacancy rate — triple that of its suburbs, and double that of nearby downtown Fort Worth, which is not served by light rail.

If light rail were driving regional development trends, then the downtown areas they serve would be prospering relative to suburban areas. As of June 1997, downtown office vacancies were above suburban vacancies in all reported light rail urban areas⁶¹ except Sacramento. The downtown vacancy rate averaged 70 percent above the suburban rate. It would also be expected that downtowns served by light rail would have healthier vacancy rates than downtowns not served by rail. However, the average, non-rail, downtown-area vacancy rate was 15 percent below that of the light rail downtowns. And the downtown vacancy rates in the non-rail urban areas were more competitive with their suburbs — with vacancy rates only 36 percent greater than the suburban rates (compared to 70 percent higher in light rail urban areas).⁶²

Major Office-Building Development

Moreover, the most significant private office-building developments have not occurred in downtown areas served by light rail. Over the past 15 years, non-light rail urban downtown areas in Dallas,⁶³ Minneapolis, and Seattle have seen more development than San Diego. Downtown Charlotte, Indianapolis, and Nashville have experienced more new development than larger downtowns in Portland and St. Louis, as well as Buffalo, San Jose, and Sacramento. Indeed, significant office development in either downtown Minneapolis or downtown Seattle exceeds the total in all of the 1980s light rail urban areas combined (Buffalo, Portland, Sacramento, San Jose, and San Diego).⁶⁴

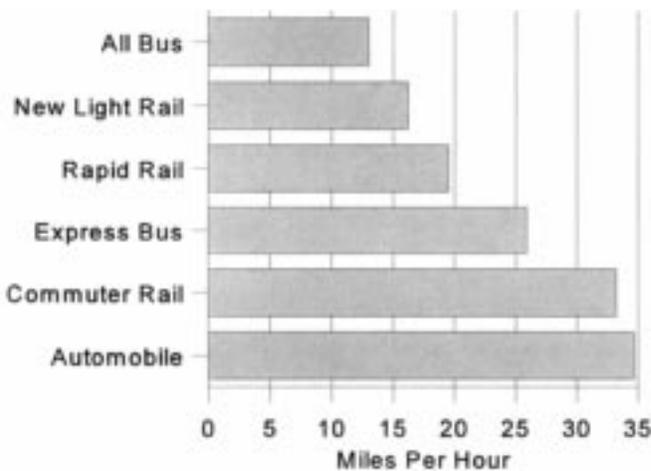
As was noted above, light rail cannot accomplish more than rapid rail (“What is Urban Rail,” above). The nation’s most effective and extensive rapid rail systems are in New York, Philadelphia, Washington (D.C.), Boston, and Chicago. Each of these urban areas has experienced very extensive suburban office development — driven not primarily by urban rail, but rather by highways. The *St. Louis Post-Dispatch*, an ardent supporter of light rail, characterized a regional light rail system as “small potatoes.”⁶⁵ With respect to driving development, light rail simply makes no difference.

Conclusion: Light rail is not a catalyst for private development except where governments provide lucrative subsidies to developers.

Travel Times and Light Rail

One of the principal reasons that urban rail has not attracted significant numbers of commuters from automobiles is its much slower operating speeds. Light rail does not improve commuting speeds for automobile commuters.

FIGURE 2 Average Commuting Speed



Calculated from National Transit Database and Nationwide Personal Transportation Study.

Light rail is slower than the automobile. At 34.7 miles per hour, average automobile commute speeds are more than double that of new light rail systems (Figure 2).⁶⁶ Speed is a crucial element in attracting automobile users. For example, one of the reasons that Portland’s light rail line has never approached its ridership projections is that its operating speed is 20 percent lower than promised, making it even less attractive for commuters.

The longer waiting time associated with transit service widens the advantage of the automobile. Including waiting times, the average transit commute trip is 31 minutes longer than the average commute by automobile — more than one hour daily (the average automobile work trip is 18.9 minutes, while the average transit work trip is 50.2 minutes).⁶⁷

Moreover, light rail provides no advantage over express buses, which have considerably higher operating speeds than light rail (25.9 miles per hour — 60 percent faster than light rail’s 16.2 miles per hour). The higher speeds of express buses are attributable to two factors: (1) express buses carry passengers from residential areas to downtown, making fewer stops than light rail; and, (2) express buses operate on free-

ways. In fact, express-bus speeds are likely to increase in the future as more freeway-expansion projects include the high occupancy vehicle (HOV) lanes favored by federal planning requirements (which must be followed to obtain federal highway funding). Further, express-bus trips are likely to require fewer transfers, adding to their speed advantage. With its comparatively slow speeds, light rail cannot be considered rapid transit.

Conclusion: Light rail does not improve travel times for either automobile or express bus commuters.

Reverse Commuting and Light Rail

Light rail has made little or no contribution to reverse commuting (central city to suburban commuting). This is because a single rail line can serve so few of the jobs in the sprawling suburban rings that surround all major U.S. cities. Urban rail in any of its forms is incapable of providing the comprehensive coverage required to serve the majority of urban area jobs that are now in the suburbs.

- In Portland, reverse-direction peak-hour volumes on light rail average less than five percent of volumes headed toward downtown.⁶⁸ *One* bus could carry all of the outbound riders over the three-hour peak period. This is not unexpected. A single rail line can serve little of a metropolitan area like Portland. More than 99 percent of Portland's sprawling suburbs are *not* within walking distance (1/4 mile) of light rail stations. When the Westside line opens, nearly doubling light rail's length, nearly 99 percent of suburban locations will still not be within walking distance of a light rail station.
- More expensive rapid rail systems are no better. Stations on Washington's extensive Metrorail system, with eight lines extending into the suburbs, are beyond walking distance from more than 98 percent of suburban locations.⁶⁹

With employment locations so widely dispersed in the suburbs ("The Light Rail-Urban Area Mismatch" below), smaller vehicles are necessarily better adapted to serving customer demand — car pools, van pools and, to a lesser degree, buses.

In fact, rail development can violate the interests of the inner-city, low-income citizens who are most dependent upon transit for their mobility. For example, in Los Angeles, an organization of bus riders has pursued successful court action on the basis that excessive funding for rail was driving up bus fares and limiting the expansion of the bus services on which low-income riders are so dependent. This and other factors led to a moratorium on rail development in Los Angeles ("Electoral Promises and Light Rail," below).

Conclusion: Light rail is not an effective means of serving reverse commute trips.

Safety and Light Rail

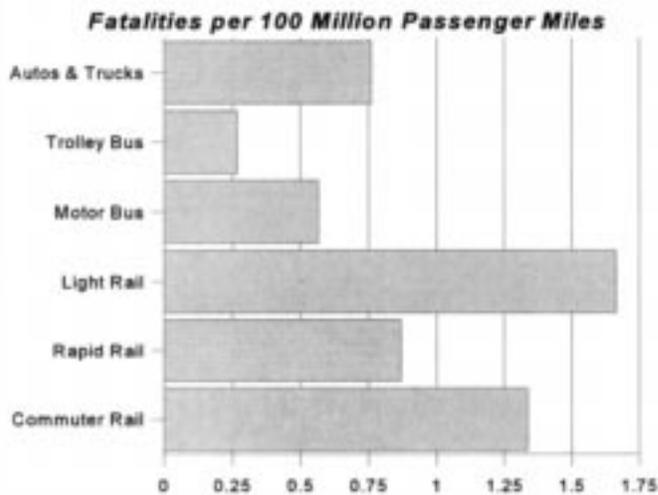
Light rail is not comparatively safe. Light rail's fatality rate is the highest among the major transit modes (light rail, rapid rail, motor bus, and trolley bus). Perhaps more surprisingly, light rail's fatality rate is more than double the urban area rate of automobiles, light trucks, and heavy trucks (Figure 3).⁷⁰ Some of light rail's higher fatality rate is attributable to the relatively large number of pedestrians killed by trains.

Conclusion: Light rail is less safe than other types of transit and the automobile.

Transit Deficits and Light Rail

Light rail has not improved the financial performance of transit agencies.

- In Buffalo and St. Louis, the additional costs of operating light rail resulted in financial crises in which temporary system closures were implemented or threatened.⁷¹

FIGURE 3 US Transit Fatality Rates: 1990-1995

Calculated from National Transit Database and Federal Highway Administration data

- In Portland, Sacramento, Los Angeles, and Baltimore, transit operating deficits (operating subsidies) have increased from pre-light rail percentages.⁷² Inclusion of capital costs would further intensify the financial degradation.

Conclusion: Light rail has worsened, not improved, transit deficits.

Projections and Light Rail

New light 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 light rail systems:⁷³

- were 30 percent more costly to build than projected (capital costs).
- were 16 percent more costly to operate than projected (operating costs).
- attracted 65 percent fewer riders than projected.

This USDOT report was disputed by the public-transit trade and federal lobbying organization, the American Public Transit Association (APTA), which indicated that:⁷⁴

- The report relied upon preliminary cost and ridership projections, which were less reliable than projections in the later planning process. However, such a view ignores the dynamics of political decision making. Once a decision has been made to proceed, there is usually no “turning back.” For example, in 1991, 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 \$140 million. By the time the final construction decision was made in 1985, costs had escalated to \$400 million, and the completed project cost to \$877 million —325 percent more than the original projection (inflation adjusted). At no 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 likely that LACTC would *not* have proceeded with the project.⁷⁵
- The 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.
- “[T]he type of forecasting errors highlighted” in the USDOT report “simply would not occur in 1990.”

Unreliable Projections: 1990s

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 2003.⁷⁶ Actual ridership was less than 20,000 in 1997, three years and 70 percent behind projection.⁷⁷ Some other projections are less unreliable, largely due to deep reductions in ridership projections as project completion nears. For example, in St. Louis, the projection of more than 40,000 was discounted to 12,000. And while daily *light rail* ridership has met the original projection, overall transit ridership remained 35 percent below projection.⁷⁸ After 10 years, Portland's transit system ridership remained at 40 percent below the projections that were to have been achieved after five years.

The planning process is often biased against bus alternatives. In Portland, for example, a busway alternative was rejected because it would "pour 500 buses an hour"⁷⁹ onto the downtown transit mall. At the time, Portland operated fewer than 450 buses. Even today, Portland requires the equivalent of fewer than 600 buses⁸⁰ 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.

One of the reasons that ridership projections have been so unreliable is that the expanded bus service that is routinely a part of the planning process is often not implemented. For example, in Portland, the feeder bus service level was less than half projection, while Sacramento's was 75 percent less.⁸¹

Capital cost projections have worsened rather than improved. Among lines opened since the USDOT report, the average capital cost overrun has been 86 percent (Table 4).⁸²

Inaccurate forecasts are not limited to light rail.⁸³ 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 light rail lines.⁸⁴ The report stated:

[C]ost overruns of 50 to 100 percent are common and that 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.⁸⁵

Conclusion: Light rail tends to cost much more than projected, carries fewer riders, and therefore imposes higher than projected costs on the taxpayers.

TABLE 4 **Capital Cost Overruns:
Rail Lines Build or Planned
Since the USDOT Report**

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

Comparison of inflation adjusted data

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

Electoral Promises and Light Rail

In some areas, urban rail promises made by public officials and transit agencies have not been kept.

- **St. Louis:** In 1987, St. Louis officials indicated that no new tax would be required to operate the planned light rail line.⁸⁶ Shortly after the light rail line opened, transit officials threatened that the line would be closed unless a new tax was authorized. In response, voters in St. Louis city and county approved a tax (1994) to operate the light rail line and build six new urban rail lines, with local transit officials claiming that the federal government would supply \$4 for each \$1 raised by the tax. There was, at the time, no prospect whatsoever of such federal funding. Further, more than anticipated was spent to operate existing bus services. By 1998, it became clear that 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 transit operations and build 12 rail lines.⁸⁷ 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 transit agency (without a corresponding service increase).⁸⁸ More recently (1998), the transit agency has imposed a moratorium on future rail construction, which would cancel or indefinitely delay most of the rail lines promised in 1980. It is reported that \$300 million⁸⁹ has been spent on the canceled rail lines. The draft regional transportation plan replaces most future rail lines with “transit ways,” which would accommodate buses and car pools.⁹⁰
- **Dallas:** In the early 1980s, Dallas voters approved a tax to build a rail system without federal funding. The program has been scaled back and federal funding is now being used.

Broken promises such as these result from the following factors:

- **Underprojection of costs:** Rail transit tends to cost much more than planners project (“Projections and Light Rail,” above). As a result, transit agencies are unable to deliver the amount of rail development planned (St. Louis, Los Angeles, and Dallas).
- **Unspecific ballot language,** such as “for transportation purposes,” puts rail-development money at risk of use to balance transit agency budgets, especially during protracted labor negotiations (Los Angeles and St. Louis).
- **Overprojection of revenues:** Transit officials, for example, have misleadingly claimed that up to 80 percent of project funding would be from the federal government (St. Louis).

Conclusion: Taxpayers have often been provided misleading information on light rail — virtually all of which is optimistic relative to actual cost and ridership performance.

The Light Rail-Urban Area Mismatch

The failure of new light rail lines to make a material contribution to improving traffic congestion and air pollution does not reflect a deficiency of the technology — light rail can *theoretically* carry a large number of people attracted from automobiles. The reality, however, is that it *does not*, because it has become obsolete with respect to the requirements of most American urban commuters and most of the modern urban area.

Suburbanization

U.S. urban areas have suburbanized considerably since World War II, with residences and employment locations sprawling over much larger areas at much lower densities (population or employment per square mile).⁹¹ Suburbanization began long before World War II — it has been identified as occurring as early as 1810 in eastern U.S. cities and accelerated with the development and expansion of light rail in the 1880s and 1890s. But over the past 50 years, the trend has accelerated even more.

Since 1950, the nation's top 25 urbanized areas⁹² have experienced population growth of 34.6 percent. At the same time, the land area covered by the same urban areas has increased six times as fast — 214 percent. The result is a 45 percent decline in population per square mile — from 6,400 in 1950 to 3,500 in 1990. The population in central cities has declined 5.5 percent, while the suburbs have experience a 218 percent population increase (Table 5).

But the reality is much worse. Among the densely populated central cities that have not made significant annexations, there has been a 22 percent population loss, from 22.1 million to 17.3 million. The suburbs in these same areas increased their population by 18.7 million.

- St. Louis experienced a population loss of 59 percent, from 856,000 in 1950 to 352,000 in 1996.

- Detroit fell 46 percent from 1,850,000 in 1950 to 1,000,000 in 1996. Detroit will soon be the first U.S. city to have fallen from above to below one million population.

- Chicago dropped 900,000 (25 percent), from 3,621,000 to 2,721,000 — the largest numeric decline.

The same declining population has occurred in most central cities from coast to coast. In western and southern cities, however, the trend has been masked by annexation.

- Portland lost 10,000 residents between 1950 and 1980, despite increasing its land area though annexation by more than 55 percent. Portland's population increase since 1980 is attributable to further significant annexations.
- Los Angeles has experienced steady population increases, largely as a result of having annexed hundreds of square miles of rural land before 1930. Nonetheless, central census tracts have experienced declining population.

As residences have become more dispersed, employment has tended to increasingly locate in the suburbs. Downtown areas employ a smaller percentage of the work force than in 1950. This means that work trip travel patterns are more random. In the past, a larger percentage of work trips were from outlying central-city or suburban areas to the central area. Now, twice as many people commuter from suburb to suburb as from suburb to central city.⁹³

But there are further complications. Travel patterns also become more complex. Unlike the pre-1950s urban area, a large percentage of women work, and significant numbers of households are headed by single parents. This means that many work trips are segmented — there is more than one purpose. The modern segmented trip does not lend itself to transit, because frequent and speedy point-to-point transit service is generally not available for the trip segments.

TABLE 5 Top 25 1950 Urbanized Areas: Trends

<i>Factor</i>	<i>1950</i>	<i>1990</i>	<i>Change</i>	<i>Percent Change</i>
Population (000)	46,948	81,510	34,562	73.6%
Land Area	7,381	23,196	15,815	214.3%
Density	6,361	3,514	(2,847)	-44.8%
Central City Population (000)	30,295	28,631	(1,664)	-5.5%
Land Area	2,776	4,346	1,570	56.5%
Density	10,913	6,588	(4,325)	-39.6%
Suburban Population (000)	16,653	52,879	36,226	217.5%
Suburban Land Area	4,605	18,850	14,245	309.3%
Density	3,616	2,805	(811)	-22.4%

Calculated from US Census Bureau data

Impact on Transit

These trends have taken a heavy toll on transit, especially high capacity modes, such as light rail. Rail transit is most effective in carrying large numbers of people traveling to the same general locations. Little of the contemporary urban travel consists of this type of mass movement.

- Since 1950, transit's share of surface (land) travel in the United States has dropped from approximately six percent to less than 1.0 percent.⁹⁴ While the nation's population has increased 72 percent, transit ridership has fallen 60 percent (1950-1995).
- Even public subsidies have failed to reverse transit's fortunes. From nearly zero in 1970, transit subsidies have risen to nearly \$20 billion annually. Yet, in 1995, transit ridership dropped to the lowest level in 20 years, as transit systems in the largest urban areas have sustained major losses — from 1990 to 1995, the ridership loss in major metropolitan areas exceed the losses for the decade of the 1980s.⁹⁵
- The percentage of work trips by transit has fallen from 12.6 percent in 1960, to 5.1 percent in 1990, a 60 percent reduction (-3.0 percent annual rate).⁹⁶ While the number of jobs in large metropolitan areas increased 28 million, transit work trip riders dropped 900,000, and data through 1995 indicate a worsening of that trend, with a 19.5 percent drop ("Traffic Congestion and Light Rail," above).⁹⁷

As urban areas spread out, it becomes much more difficult for transit to provide the same extent of transit mobility (percentage of the urban land area accessible for residents by transit at an acceptable speed). The task is more complex than simply adding service at the rate of geographic expansion — more service must be added to maintain adequate travel speed. But transit-service levels have declined, while urban areas have expanded. The point can be illustrated by the development of a "transit mobility index," which estimates the amount of transit service that would be required to provide access to the same percentage of the urban area, with the same travel times, as existed in 1950.⁹⁸ In the average urban area, this would require service expansion of more than 800 percent. This would increase the cost of transit nearly seven times — to \$185 billion annually — nearly double the amount spent to build, maintain, administer, and patrol all of the nation's highways and streets (Table 6).⁹⁹ Portland and St. Louis would require service expansions of more than 750 percent — and subsidies that exceed their respective annual city budgets.

TABLE 6 Transit Mobility Index

<i>Year</i>	<i>Average: 33 Largest Urbanized Areas</i>	<i>Portland</i>	<i>Saint Louis</i>
1950 Index	100.0	100.0	100.0
1990 Index	11.9	12.1	13.3
Change	-88.1%	-87.9%	-86.7%
Service Expansion Required to Restore 1950 Transit Mobility	737%	725%	650%
Annual Cost Increase (Billions)	\$184.3	\$0.9	\$0.7

Even this gargantuan effort would pay little in dividends. A restoration of transit's market share to the six percent 1950 level would equate to little more than one year's annual growth in private vehicle use (principally automobile) — traffic would be restored to its previous level in barely 18 months, and then resume its growth as before. Moreover, transit's speed disadvantage and relative inconvenience compared to automobiles would preclude a return to its 1950 market share, even with the massive service expansions.

In spite of this, some theorists — principally the "new urbanists" — envision a new American urban area in which automobile use is replaced by transit. The new urbanism anticipates a much more dense urban area, with

activity centers developed around rail transit stations. Road-capacity improvements would be few. In this context, European urban areas are often cited as models for U.S. urban areas to follow.

But suburbanization of U.S. urban areas has proceeded too far to be reversed. To restore the densities that would reduce automobile use and restore a significant transit market share would require nothing less than *abandonment* of the suburbs. For example, in the new urbanist favorite Portland, 80 percent of the urbanized area would need to be abandoned just to equal Paris's *metropolitan* density (achieving the Paris central-city density would require abandonment of 95 percent of the urbanized area).¹⁰⁰ New urbanist strategies could result in more dense urban areas — but urban areas still that would still be overwhelmingly dependent on the automobile. The higher densities will make traffic worse, not better.

Suburbanization is not just an American phenomenon. Across the developed world, central-city densities are falling. Since 1950, Paris has lost 700,000 residents — the same percentage loss as Chicago — while its suburbs have mushroomed. London has lost more population in 25 years than any U.S. city over the past 45 years (1.2 million), while suburban counties have grown steadily. Nonetheless, U.S. urban areas are much less dense than European — the most dense U.S. urban areas are half as dense as metropolitan Paris, one-fifth as dense as metropolitan Tokyo, and 1/25th as dense as Hong Kong.¹⁰¹

Portland's Auto-Dependent New Urbanism

Portland, Oregon, has been touted as an example of "new urbanist" success. There has been much publicity about Portland's light rail line, anti-freeway policies and 1970's "urban growth boundary," which it is claimed has resulted in significant "in-fill" development (land development within the urbanized area, as opposed to development that expands the urbanized area).

The reality falls considerably short of the claims. The city of Portland is not particularly dense — it is less dense than many suburbs — barely half the density of St. Louis, which has lost more than 50 percent of its population. If "in-fill" development were to increase city density by 25 percent — a highly unlikely prospect — Portland would remain less dense than San Jose, Denver, Milwaukee, and most other major central cities. Moreover, the Portland urbanized area is less dense than average, and every major urbanized area in the West increased its density at a greater rate than Portland in the 1980's.

While Portland has achieved virtually none of the actual success for which it is credited, it has adopted a long-term plan (through the year 2040) that incorporates "new urbanist" principles. It would increase densities, but would still be less dense than the Los Angeles urbanized area. The automobile market share would be slightly reduced, but overall traffic volumes would increase substantially. There would be little freeway expansion, leaving Portland with Los Angeles-style traffic congestion, overburdening its already under-developed freeway system.

It is by no means certain that Portland's proposed policies will be successful. A petition drive is underway to abolish the metropolitan government that adopted the 2040 plan. And, two city councilors were recently recalled in suburban Milwaukie (Oregon) for their support of Portland's "growth management" policies.

The Light Rail-Consumer Mismatch

Light rail may have been an effective strategy for the turn of the century city, or even the pre-World War II city. But it has been rendered obsolete by the forces that have produced the contemporary American urban area. Light rail's capacity to move large numbers of people is of virtually no value to the modern U.S. urban area, because it does not match the needs of the modern urban traveler. The following factors are important to the peak-hour commuter (consumer) deciding how to make the journey to work.

- **Proximity:** Consumers want service that is conveniently close to both their trip origin and destination. The trip by automobile or transit must begin and end within comfortable walking distance of both home and work. Studies have generally placed the maximum walking distance at one-quarter mile.
- **Frequency of service:** Consumers want to have the freedom to travel whenever they like. That means that service must be frequent, and it must be available virtually all day, every day.

- **Travel time:** Consumers want to get where they are going as quickly as possible. In addition, customers generally dislike transferring from one route to another — they rather prefer a through trip on the same vehicle (automobile or transit). Studies have indicated that people perceive each minute of wait time to be twice as long as a minute in travel.
- **Segmented trip convenience:** The work trip has increasingly become a segmented trip — a trip with more than one purpose. Frequent and convenient point-to-point transit service is simply not available for such trips.
- **Cost:** Work trips must be affordable.

In short, the U.S. commuter requires rapid point-to-point service, including the intermediate stops that increasingly characterize the work trip. Transit can provide point-to-point service where there are concentrations of destinations — a large number of people traveling along a corridor to the same general areas. The high volumes of automobiles on freeways do not represent significant potential for attraction to light rail. Large volumes of automobile traffic move along the same freeway corridor, but they are often not traveling to the same general area. Few of the trip origins and destinations of the travelers are within walking distance of the freeway. Destinations are widely dispersed and often require continuation of travel to locations miles off the freeway.

Transit and the Downtown Work Trip

With respect to the journey to work, transit in the United States makes a significant contribution only with respect to downtown employment, where it is not unusual for 30 percent or more of commuters to be transit riders, even in cities with modest transit ridership.

Employment densities in downtown areas may be from 10 to 100 times that of other areas within the central city, and 100 to 2,000 times that of suburban areas. This high density makes transit attractive to downtown employees. Downtown transit riders can reach their places of employment with just a short walk. However, downtown areas rarely account for more than 15 percent of metropolitan area employment.

For example, Chicago's "loop" is the second largest downtown area in the nation, with 375,000 employees per square mile — 75 times that of the rest of the city of Chicago and more than 1,800 times the density of employment in suburban counties. Yet the suburban counties have nearly three times as many workers as the "loop," which accounts for barely 10 percent of metropolitan area employment.¹⁰² On average, a transit route in the loop is within walking distance of nearly 200,000 workers per mile, 2,500 in the rest of the city of Chicago, and 100 in the suburban counties.

Transit systems provide point-to-point high frequency express bus and rail services that converge on downtown areas, offering workers direct trips from residential areas. In most cases, it is not necessary to transfer from one route to another. However, travel times are longer for transit than for the automobile. Transit's only advantage to the downtown commuter is that its fares tend to be considerably lower than downtown parking charges.

With respect to commuting to downtown, light rail adds little. Light rail is slower than express buses and much slower than the automobile. Average light rail operating speeds are barely three miles per hour faster than that of local buses,¹⁰³ and the forced transfers to light rail can lengthen travel times for transit riders by adding new waiting time between bus and rail segments of the trip. Further, downtown commuting market shares are already high, rendering further increases more difficult (Table 7).

Suburban Employment and the Transit Work Trip

Other employment areas have far lower transit work trip market shares than downtown. Suburban office centers along rapid rail lines in Washington have transit work trip market shares of five percent or less.¹⁰⁴ Other suburban employment areas typically have work trip market shares of less than two percent. There are two basic reasons for these small transit market shares.

- Lower densities:** Suburban employment densities — even in large, suburban office parks — are much lower than in downtown areas. Jobs are not stretched out along suburban transit lines, unlike downtown, and few jobs are within walking distance of a transit stop.

TABLE 7 Consumer Attractiveness: The Automobile and Transit: Work Trips to Downtown

Factor	Auto	Local Bus	Express Bus	Light Rail	Commuter Rail
Proximity to Home	●	◐	◐	○	○
Proximity to Work	●	●	●	◐	◐
Frequency of Service	●	◐	◐	◐	◐
Travel Time	●	○	◐	○	◐
Segmented Trip	●	○	○	○	○
Cost	◐	●	●	●	◐

●-Attractive ◐-Available or Acceptable ○-Unattractive or Unavailable

- Unattractive or non-existent service:** Transit service to suburban areas — or to anywhere else in the urban area except downtown — is either non-existent or exceedingly unattractive to workers. Transit provides comparatively little point-to-point service to non-downtown destinations. Transit is viable in the unlikely event that a commuter lives and works within walking distance of the same transit route. Far fewer routes serve suburban areas. Suburb-to-suburb commuting might be compared to traveling by air between two cities that are not “hubs:” virtually all trips require one or more transfers at intermediate points. This lengthens transit travel times even more. From extensive portions of an urban area, transit travel to a suburban job can require two hours or more in each direction.

The difficulty of serving the 85 percent or greater percent of employment that is not downtown is illustrated by the falling market share of car pools. Car pools carry 2.5 times the number of work trips as transit, yet car pool work trip market share dropped 32 percent in the 1980s, as virtually all employment growth was outside the downtown areas. Employment densities are so sparse in the more than 99 percent of urban land areas outside downtown that not even a form of transport in which two to four people ride together (car pools) — much less a form designed for 75 (bus) or 400 riders (light rail) — can maintain a substantial market share. Rutgers economist John Pucher, who has often advocated transit-oriented policies, notes the difficulty transit faces in serving sprawling American suburban areas.

[T]he extremely low density suburbs that dominate American metropolitan development are almost impossible to serve with public transport (transit), thus ensuring the dominance of the automobile for many decades to come.¹⁰⁵

Proposed light rail lines are often criticized for “not going to the right place” or along the appropriate corridor. *Except for downtown, there is no right place.* Residential and employment densities in suburban areas are so low that there is little difference between routes in their ability to generate traffic. Transit is exceedingly unattractive for the work trip to suburban areas,¹⁰⁶ having no advantage with respect to the factors that consumers consider in deciding how to make peak hour trips in the urban area. The automobile, on the other hand, provides the on-demand, rapid point to point service commuters to suburban jobs require (Table 8).

No Preference for Rail over Bus

Finally, reflecting the competitive ridership levels achieved by express bus systems, research indicates that commuters have no general preference for rail over buses where the service characteristics of the two are similar (such as speed and frequency).¹⁰⁷ This is consistent with the expectation that the urban travel consumer is more interested in travel time than the novelty of a travel experience on a particular type of vehicle.

TABLE 8 Consumer Attractiveness: The Automobile and Transit: Work Trips to Suburban Areas

Factor	Auto	Local Bus	Express Bus	Light Rail	Commuter Rail
Proximity to Home	●	◐	○	○	○
Proximity to Work	●	○	○	○	○
Frequency of Service	●	◐	○	○	○
Travel Time	●	○	○	○	○
Segmented Trip	●	○	○	○	○
Cost	●	●	○	○	○

●-Attractive ◐-Available or Acceptable ○-Unattractive or Unavailable

Transit’s preoccupation with light rail is counterproductive for the urban traveler, because five express bus/HOV systems carrying five times as many riders can be built and operated for the same amount of money as a single light rail line.¹⁰⁸

Conclusion: The overwhelming percentage of work trips cannot be effectively served by transit of any form, including light rail.

Why is Light Rail Being Built?

Nonetheless, urban areas are building or intend to build light rail systems. To some extent, public officials may be misled to believe — by unsupportable claims, ideology, or even nostalgia — that light rail reduces traffic congestion. While virtually none of the technical data supports this conclusion, planning documents sometimes offer conclusions that exaggerate minuscule benefits or even contradict their own analysis. This suggests a manipulated planning process, which could be the result of bias, political influence, or other factors.

A number of additional factors are responsible for the popularity of light rail among urban decision makers. 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 light rail. Just as cities lined up in the 1950s for funding to build soon-obsolete high-rise public housing, cities today queue for federal money to build rail lines that would have been obsolete decades ago.¹⁰⁹ Virtually the same economic impact would be achieved through the expenditure of federal funds on any infrastructure.

According to John Kain, Chair of the Economics Department at Harvard University, the rush to build light 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...¹¹⁰

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 light rail may bolster the civic psyche, its popularity has nothing to do with genuine transportation objectives.

Conclusion: The current light rail “building boom” is driven by false expectations and non- transportation objectives.

Light Rail: Insignificant, but Expensive

Some analysts, however, have interpreted the activity of planning and opening light rail systems as an indication that transit is playing a greater role in urban mobility.¹¹¹ Reality suggests the opposite. Every year, urban automobile use rises nearly three times the *total* amount of all transit use and more than 100 times all light rail use.¹¹² While light rail’s transportation impacts are insignificant, its costs are very high (Table 9).

Conclusions

1. **Traffic Congestion: Light rail does not reduce traffic congestion during peak periods and therefore does not reduce air pollution.**
2. **Cost-Effectiveness: Light rail is much more expensive than alternatives such as express bus systems and HOV lanes.**

TABLE 9 Summary of Conclusions: New Light Rail Lines in the United States

<i>Issue</i>	<i>Conclusion</i>
Traffic Congestion	Light rail has not reduced traffic congestion.
Air Pollution	Because light rail has not reduced traffic congestion, it has not reduced air pollution.
Cost Effectiveness	Light rail is five times more expensive than express buses and more expensive than automobiles.
Energy Consumption	Light rail consumes more energy per person mile than automobiles according to federal government data.
Development	Light rail has little impact on private development. Most development impacts are the results of public subsidy to developers.
Travel Time	Light rail is less than one-half as fast as the automobile and slower than express buses.
Reverse Commuting	Light rail is less effective than options using smaller vehicles (buses, vans and car pools).
Safety	Light rail is less safe than buses and automobiles.
Transit Deficits	Light rail has worsened transit deficits.

LIGHT RAIL IN MILWAUKEE

The “Light Rail in America” analysis above has shown that the national experience with light rail has neither reduced traffic congestion nor air pollution, and that its meager accomplishments could have been achieved for considerably less by express bus systems and HOV lanes. Nonetheless, the national experience does not necessarily predict the Milwaukee experience. This section of the report will review Milwaukee planning documents and other information to evaluate the local potential for light rail to reduce traffic congestion, reduce air pollution, and address other transportation objectives.

Light Rail Proposals

Two light rail lines have been proposed in a planning process (*Major Investment Study*, or *MIS*) that considered 10 transportation improvement alternatives for the East-West Corridor,¹¹³ including a “do-nothing” alternative (Null Alternative).¹¹⁴ The East-West Corridor stretches from Lake Michigan to beyond State Route 16 in Waukesha County, with Interstate 94 at its center.

The year 2010 performance and overall cost (in 1994\$) of each of the alternatives was evaluated in the *MIS* in relation to the Bus Alternative (*MIS* #2), which itself represents a significant improvement compared to the present (the Null Alternative). Five alternatives are representative of the approaches considered in the planning process (Table 10).¹¹⁵

TABLE 10 **Representative Alternatives**

<i>Factors</i>	<i>Bus Alternative (Baseline)</i>	<i>Light Rail Alternative</i>	<i>Busway Alternative</i>	<i>Light Rail-Busway Alternative</i>	<i>Light Rail Preferred Alternative</i>
Bus Service Increase	53.7%	45.6%	59.4%	51.0%	21.0%
New Surface Miles: Rail	0	23	0	23	15
New Surface Miles: Bus Lanes	14	4	14	4	4
New Express Miles: Rail	0	0	0	0	0
New Express Miles: Busway/HOV	0	0	16	16	16
Capital Costs	\$130,400,000	\$717,000,000	\$557,200,000	\$1,143,400,000	\$784,000,000
Annual Operating Costs	\$41,800,000	\$51,400,000	\$46,000,000	\$55,300,000	\$31,100,000
Daily Riders Compared to Null Alternative	19,370	24,220	21,890	26,520	14,450
Daily Riders Compared to 1994	4,260	9,110	6,780	11,410	(660)

Surface transit: at grade rail or bus lanes

Express transit miles: grade separated rail or bus lanes

Sources: *MIS* and calculated from *MIS* data and *Milwaukee East-West Corridor Transportation Study: Locally Light Rail Preferred Alternative*. Light Rail Preferred Alternative ridership data estimated by author

- The Bus Alternative (*MIS #2*), which the *MIS* uses as a baseline for evaluation, would expand bus service 54 percent. It would include 14 miles of new on-street bus lanes. Total capital costs would be \$130,400,000 and annual operating costs would be \$41,800,000. Relative to the Null Alternative, 19,370 additional daily riders would be carried in 2010, an increase of 4,260 from present levels (ridership is projected to drop by 15,000 daily by 2010).
- The Light Rail Alternative (*MIS #3*) would expand bus service 46 percent and add 23 miles of surface light rail operating over three lines. (1) The Western Line would operate along the I-94 corridor from south of downtown to the Milwaukee County Zoo. (2) The Northwestern Line would operate from downtown out Fond du Lac Avenue to Capitol Court. (3) The Northern Line would operate from downtown to Glendale, with a spur to the University of Wisconsin-Milwaukee. Four miles of new on-street bus lanes would also be provided (35th Street). The Light Rail Alternative is essentially the Bus Alternative with light rail added. Total capital costs would be \$717,000,000 and annual operating costs would be \$51,400,000. Relative to the Null Alternative, 24,220 additional daily riders would be carried in 2010, an increase of 9,110 from present levels.
- The Busway Alternative (*MIS #6*) would expand bus service by 59 percent, add 16 miles of HOV (express bus and car pool) lanes along Interstate 94, which would also be available to car pools (from County Road J in Waukesha County to the Marquette Interchange near downtown Milwaukee). Eight miles of new on-street bus lanes would also be provided (35th Street and Fond du Lac Avenue). Total capital costs would be \$557,200,000 and annual operating costs would be \$46,000,000. Relative to the Null Alternative, 21,890 additional daily riders would be carried in 2010, an increase of 6,780 from present levels.
- The Light Rail-Busway Alternative (*MIS #9*) would provide the light rail lines proposed in the Light Rail Alternative (*MIS #3*), the express bus lanes proposed in the Busway Alternative (*MIS #6*), and four miles of on-street bus lanes (35th Street). The Light Rail-Busway Alternative is essentially the Light Rail Alternative with a busway added. Total capital costs would be \$1,143,400,000 and annual operating costs would be \$55,300,000. Relative to the Null Alternative, 26,520 additional daily riders would be carried in 2010, an increase of 11,410 from present levels.
- The Locally Preferred Alternative¹¹⁶ (Light Rail Preferred Alternative), which was adopted at the conclusion of the planning process and represents the presently operative plan. The Light Rail Preferred Alternative is a scaled-down version of the Light Rail-Busway Alternative, with a 21 percent increase in bus service compared to the Null Alternative and smaller light rail, busway, and on-street bus lane elements.¹¹⁷ Total capital costs would be \$784,000,000 and annual operating costs would be \$31,100,000. Relative to the Null Alternative, 14,450 additional daily riders would be carried in 2010, a *reduction* of 660 from present levels.

The five representative alternatives are evaluated based upon the fundamental objectives of reducing traffic congestion and air pollution cost-effectively, using the same standard as in the national experience — reduction of traffic congestion during weekday peak hours.

Trends in the Milwaukee Area

The Milwaukee urbanized area (area of urban development) has experienced a more intense trend toward suburbanization than the average U.S. urban area, making it even more difficult for transit to serve.

- From 1950 to 1990, the population of the Milwaukee urbanized area increased 48 percent, while the land area increased 402 percent. Population per square mile dropped from 8,100 to 2,400. This 70 percent loss in density compares to a 45 percent average loss in the 25 largest U.S. urbanized areas.
- The population of the city was relatively stable from 1950 to 1990 — dropping less than two percent. However, the city's land area nearly doubled and population density fell from 12,700 to 6,600. Since its peak in 1970, the city of Milwaukee has lost 127,000 residents.

The remainder of Milwaukee County lost 5,000 residents from its peak in 1970 to 1996. The four other counties in the metropolitan area gained 200,000 residents (Table 11).

TABLE 11 Population Trends: Milwaukee Metropolitan Area

<i>Subregion</i>	<i>1970</i>	<i>1980</i>	<i>1990</i>	<i>1996</i>	<i>Change</i>
Milwaukee	717,400	636,300	628,100	590,500	-17.7%
Other Milwaukee County	336,800	328,700	331,200	331,700	-1.5%
Total: Milwaukee County	1,054,200	965,000	959,300	922,200	-13.5%
Outside Milwaukee County	520,600	605,200	647,900	720,500	38.4%
Metropolitan Area	1,574,800	1,570,200	1,607,200	1,642,700	4.3%

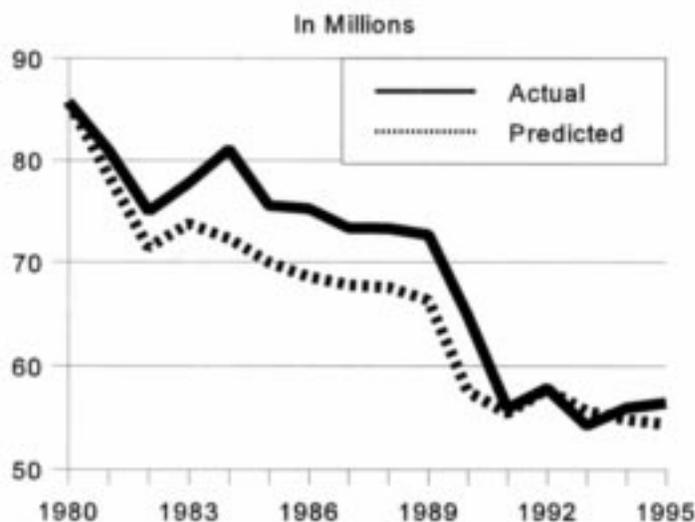
US Census Bureau data

Public Transit in Milwaukee

Reflecting the national trend in major metropolitan areas, transit ridership has fallen substantially in the Milwaukee metropolitan area. From 1980 to 1995, ridership at Milwaukee County Transit (MCTS) dropped more than 30 percent. This ridership loss is much greater than would be expected during a period that Milwaukee County's population declined approximately five percent.¹¹⁸

The most important cause appears to be fare increases, and to a lesser degree service reductions. Application of industry formulas relating fare increases and service reductions produces a very accurate estimate of transit's ridership trend in Milwaukee from 1980 to 1995 — a reduction of 36.5 percent compared to the actual reduction of 34.1 percent. More than 80 percent of the loss is related to fare increases (Figure 4).¹¹⁹ If MCTS had reduced its cost per hour by six percent (inflation-adjusted) over the period, the fare increase would not have been necessary and much of the ridership loss would likely have been avoided.¹²⁰

FIGURE 4 MCTS Actual and Predicted Ridership



Calculated from National Transit Database and American Public Transit Association data

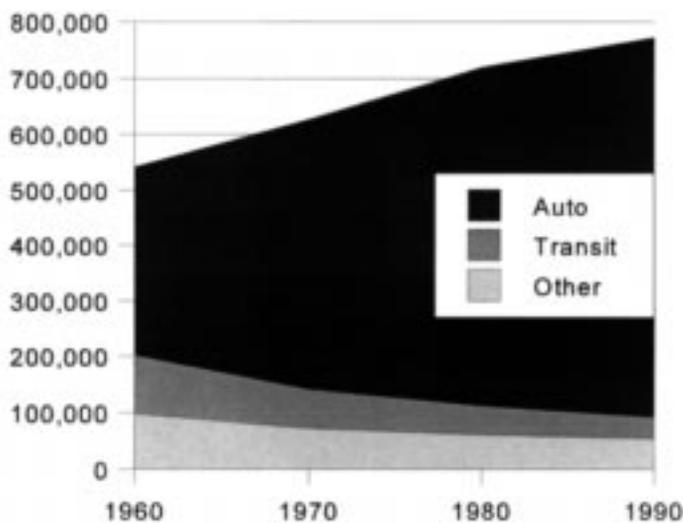
Transit's work trip market share has fallen markedly. By 1990, more people in the Milwaukee area walked to work or worked at home than commuted by transit.¹²¹

- From 1960 to 1990, transit's work trip market share dropped 75 percent (a 3.7 percent annual loss), from 19.0 percent to 4.8 percent. In 1960, 102,100 people commuted daily by transit, while only 37,500 commuted by transit in 1990. This 64,600-person reduction in transit use occurred while the number of workers was *increasing* 230,000 (Figure 5).¹²²
- In the last decade for which data are available (1980 to 1990), work trip market share dropped 31 percent, from 7.0 percent to 4.8 percent. The annual rate of loss accelerated to -4.5 percent.

Milwaukee's transit's market-share decline has continued into the 1990s. From 1990 to 1995, annual urban travel increased 1,100 million person miles, while transit ridership dropped by 25 million person miles.¹²³ It is therefore probable that there has been a further erosion of transit work trip market share in Milwaukee.

The 1990 Transit Mobility Index ("The Contemporary Urban Area and Light Rail," above), which estimates the extent of present transit service relative to what would be required to provide the 1950 level of transit access throughout the urban area, is estimated at 6.8 on a scale of 100.¹²⁴ Thus, restoration of 1950 transit access would require transit service to be expanded by nearly 1,400 percent, which could cost nearly more than \$1.3 billion annually — more than \$2,500 annually per household. This is approximately twice the size of the city of Milwaukee budget.

FIGURE 5 Daily Commuters by Mode in Milwaukee



US Census Bureau data

The Light Rail Corridor

By contrast, the East-West Corridor in which light rail would be built has accounted for most of the lost population in the Milwaukee area.

- From 1972 to 1990, the city of Milwaukee portion of the corridor lost 55,000 residents.
- From 1970 to 1990, Milwaukee County portion of the corridor lost 127,000 residents.

Population losses are expected to continue to 2010 (Table 12). The Milwaukee County portion of the corridor is expected to lose an additional 10 percent of its population over the 1990-to-2010 period (a -0.6 percent annual rate). This projection may be optimistic — Milwaukee County's overall population loss rate escalated to -1.7 percent annually from 1990 to 1996 for a loss of 37,000. During the same period, the other four metropolitan counties experienced a population increase of more than 70,000. Overall, the East-West Corridor is expected to lose 7.8 percent of its population from 1990 to 2010.

The East-West Corridor is expected to experience a net increase of nearly 50,000 jobs from 1990 to 2010, with virtually all of the increase occurring in downtown Milwaukee and Waukesha County (Table 13).

- Downtown would have the highest employment density, at 40,790 per square mile — up from the 1990 density of 33,000. Having lost 11,000 jobs from 1972 to 1990, downtown is projected to experience an increase of 21,000 jobs by 2010. If such a trend were underway, downtown vacancy rates would be low, and nearly half of the gain would have been achieved already. However, downtown Milwaukee vacancy rates, at 17 percent, are among the highest in the nation — at approximately the same rate of downtown St. Louis, which that city's newspaper refers to as "fading fast." Within the last year, one of the two major department stores has closed. Since 1990, there has been virtually no new office-building construction, and some 1980s buildings were forced to seek bankruptcy protection. It seems unlikely that the 2010 downtown employment projection will be met. In view of the critical importance of downtown employment to light rail ridership forecasts, failure to meet the optimistic downtown employment projection could result in considerably lower light rail ridership.

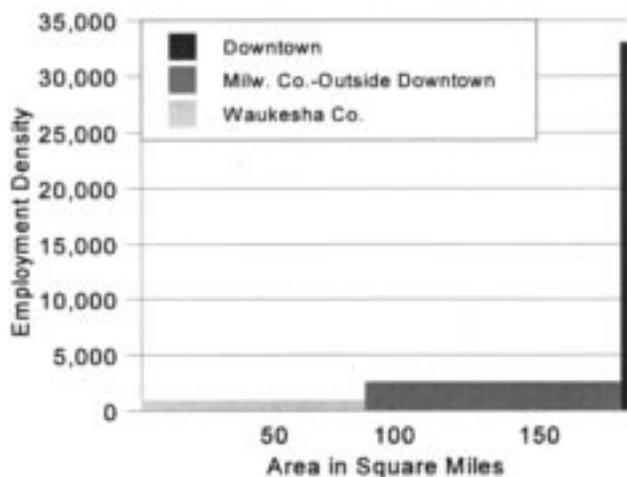
TABLE 12 East-West Corridor Population Trends

<i>Planning Area</i>	<i>1972</i>	<i>1990</i>	<i>2010</i>	<i>Change 1990-2010</i>	<i>Density 2010</i>
1. UW-M/East Side	142,000	117,000	107,000	-8.5%	5,506
2. Downtown Milwaukee	11,000	10,000	13,000	30.0%	7,473
3. Fond du Lac Avenue	128,000	112,000	98,000	-12.5%	5,190
4. Near West Side	117,000	104,000	85,000	-18.3%	5,234
5. Milwaukee County West	153,000	129,000	122,000	-5.4%	3,076
6. Waukesha County	71,000	80,000	84,000	5.0%	1,047
East-West Corridor	622,000	552,000	509,000	-7.8%	2,861
Milwaukee Portion	398,000	343,000	303,000	-11.7%	5,383
Milwaukee County Portion	551,000	472,000	425,000	-10.0%	4,352

MIS

- Other areas would have much lower employment densities — 900 to 3,700 per square mile.

As in other urban areas, downtown Milwaukee has by far the most potential for access by transit commuters. The average transit route in downtown Milwaukee is within walking distance of 16,500 jobs per mile. In the balance of the corridor within Milwaukee County, the average transit route is within walking distance of only 1,300 jobs per mile and less than 500 in Waukesha County (Figure 6).

FIGURE 6 East-West Corridor Employment Density

Calculated from MIS data

a 14 percent increase over the Null Alternative, but only a three percent increase over present ridership.¹²⁷

Traffic Congestion and Light Rail in Milwaukee

All of the ridership gain advantage of the light rail alternatives over the bus alternatives is produced by manual adjustments to the forecasts produced by the computer model (Table 14). This is consistent with the tendency to manipulate projections previously noted by Charles Lave.¹²⁸

The data developed in the planning process indicate that little, if any, traffic congestion relief would be provided by light rail.

As in most other urban areas, recurring traffic congestion in Milwaukee largely occurs during weekday peak hours. Average work trip travel time is two minutes below the national average.¹²⁵ Traffic congestion is slightly below the national average, and traffic congestion growth has been approximately average.¹²⁶

Projected Ridership

As is routine in urban transit planning, computer models were used to project ridership for the study year of 2010. Present daily transit ridership is estimated by the MIS at 154,000 daily. It is projected that by 2010, daily ridership would drop to 138,890 if there were no change in service level (Null Alternative). Overall daily system ridership under the Bus Alternative is projected at 158,260,

TABLE 13 East-West Corridor Employment Trends

<i>Planning Area</i>	<i>1972</i>	<i>1990</i>	<i>2010</i>	<i>Change 1990-2010</i>	<i>Density 2010</i>
1. UW-M/East Side	56,000	52,000	54,000	3.8%	2,779
2. Downtown Milwaukee	101,000	90,000	111,000	23.3%	40,790
3. Fond du Lac Avenue	48,000	38,000	41,000	7.9%	1,919
4. Near West Side	71,000	60,000	62,000	3.3%	3,700
5. Milwaukee County West	86,000	91,000	91,000	0.0%	2,332
6. Waukesha County	32,000	75,000	97,000	29.3%	1,208
East-West Corridor	393,000	407,000	456,000	12.0%	2,618
Milwaukee Portion	306,000	279,000	305,000	9.3%	3,819
Milwaukee County Portion	361,000	332,000	359,000	8.1%	3,823

MIS

- The computer model output projected 1,100 *fewer* daily riders for the Light Rail Alternative than for the Bus Alternative.
- The computer model output projected 1,000 more riders for the Light Rail Alternative than the Busway Alternative. However, virtually all of that advantage is attributable to the Busway element of the Light Rail-Busway Alternative — which would attract 1,300 *more* daily riders than the Light Rail-Busway Alternative.¹²⁹

The Light Rail Preferred Alternative would provide lower service levels than the Bus Alternative and carry an estimated three percent fewer riders, with or without manual adjustments.¹³⁰

The manual adjustments to the computer model output do not appear to be appropriate. The manual adjustments credit light rail with higher numbers of off-peak (mid-day) trips, including mid-day trips and special-event trips. Experience in other cities indicates that a large percentage of the mid-day trips would either be new or replace walking trips, thus having no impact on traffic congestion. While special-event ridership could reduce automobile use, it would do virtually nothing to reduce weekday peak-period traffic congestion. Moreover, neither the Bus Alternative nor the Busway Alternatives include the mid-day and special-events services provided by light rail. This is despite the fact that there is no significant customer preference for rail service over comparable bus service (“The Urban Travel Consumer and Light Rail,” above) and effective mid-day bus service and special-event service

TABLE 14 Daily Ridership by Alternative

<i>Alternative</i>	<i>Computer Model Output</i>	<i>Manual Adjustment to Computer Model Output</i>		<i>Ridership Compared to Bus Alternative</i>	
		<i>Computer Model Output</i>	<i>Computer Model Output + Manual Adjustment</i>	<i>Model Output</i>	<i>With Manual Adjustment</i>
Null	138,890	0	138,890	na	na
Bus	155,900	2,360	158,260	0.0%	0.0%
Light Rail	154,800	8,310	163,110	-0.7%	3.1%
Busway	158,200	2,580	160,780	1.5%	1.6%
Light Rail-Busway	156,900	8,510	165,410	0.6%	4.5%
Light Rail Preferred	147,400	5,900	153,300	-5.5%	-3.1%

MIS

could be provided by bus.¹³¹ For example, the downtown Los Angeles shuttle bus system attracts 21,000 passengers daily — more than some light rail lines. Service is provided on five routes at five minute frequencies throughout the day, including mid-day, demonstrating the ability of buses to attract the type of mid-day rider the Milwaukee analysis presumes can only be attracted by light rail.¹³² (Downtown Los Angeles has less than twice the employment of downtown Milwaukee.) These manual adjustments to the computer model indicate that the planning process is skewed in favor of light rail and against the bus alternatives.

Impact on Traffic Volumes

Freeway and street traffic in the East-West Corridor is expected to increase 25 percent by 2010. The *MIS* projects 2010 traffic volumes (vehicle counts) at 15 points throughout the study area (Table 15). None of the transit alternatives would reduce traffic volumes from present levels.¹³³

- The Light Rail Alternative would remove an average of 73 more vehicles trips daily than the Bus Alternative (37 automobile round trips) — 0.05 percent of traffic. Of the projected travel volume, light rail would attract one automobile out of every 2,000. Assuming each removed automobile takes an inbound and outbound trip each day, the riders transferring from the removed automobiles to transit could be carried in a single bus.
- Daily traffic under the Light Rail-Busway Alternative would be 213 vehicle trips lower than under the Bus Alternative (107 automobile round trips) — one automobile removed out of every 677 vehicles. Assuming each removed automobile takes an inbound and outbound trip each day, the riders transferring from the removed automobiles to transit could be carried in three buses.

The Light Rail Preferred Alternative — a derivative of the Light Rail-Busway Alternative, can be expected to remove approximately 250 *fewer* automobiles than the Bus Alternative, because transit service would be considerably lower. Moreover, along I-94 itself (five counting points), the Light Rail Preferred Alternative would have little impact on traffic, attracting a minuscule portion of the traffic volume growth (Figure 7).¹³⁴

TABLE 15 East-West Corridor Average Traffic Volumes and Impact of Light Rail

<i>Alternative</i>	<i>Daily Average Vehicle Count: 2010</i>	<i>Compare to Bus Alternative</i>		
		<i>Change in Average Vehicle Count (Automobiles Removed)</i>	<i>Percentage Reduction in Vehicle Count</i>	<i>Vehicles per Each Automobile Removed</i>
Null	144,653			
Bus	144,640			
Light Rail	144,567	(73)	-0.051%	1,971
Busway	144,380	(260)	-0.180%	555
Light Rail-Busway	144,427	(213)	-0.147%	677
Light Rail Preferred	144,897	257	no reduction	no reduction

Calculated from data in Table 4.13, MIS

Moreover, none of the I-94 highway improvement alternatives would provide sufficient capacity for anticipated traffic in 2010.¹³⁵ While the excess demand is well within the theoretical ability of light rail to carry (six freeway lanes in each direction), it is a practical impossibility because light rail does not attract ridership that even remotely approaches its capacity.

However, even these imperceptible results may be unachievable. The Preferred Light Rail Alternative includes less than one-half the bus service increase proposed in all other alternatives. Thus, in Milwaukee, as in other cities before, there is already evidence that the planned bus service expansion is being sacrificed, which would reduce ridership. Moreover, the average speed of the proposed Milwaukee light rail service is high relative to other new light rail systems in the United States.¹³⁶ These factors, along with the frequently recurring tendency to over-project ridership on such projects, could produce ridership levels considerably below forecast planned (“Projections and Light Rail,” above).

Yet *MIS* concludes that each of the transit alternatives¹³⁷ would “provide travel benefits ... with regard to reductions in ... daily auto trips, and traffic volumes ...”¹³⁸ The *MIS* further indicates that “these benefits — the ability to reduce auto volumes and therefore improve on-street vehicular operations — are traceable to the diversion of motorists to transit (as shown on table 7.1) ...”¹³⁹ These favorable conclusions do not follow from the *MIS* projections that all of the transit alternatives would reduce traffic volumes less than one percent.

Conclusion: Light rail would have no perceivable impact on traffic congestion in the East- West Corridor.

Air Pollution and Light Rail in Milwaukee

There is little difference between the light rail alternatives and the Bus Alternative in air pollution reduction. Moreover, none of the alternatives are very effective¹⁴⁰

- The Light Rail Alternative results in a 0.01 percent point *increase* in air pollution compared to the Bus Alternative, which reduces pollution by a minuscule 0.36 percent. Calculated from *MIS* data
- The Light Rail-Busway Alternative results in 0.08 percent point reduction in air pollution compared to the Bus Alternative — still a minuscule reduction of 0.43 percent. Virtually all of this small advantage occurs due to the busway component. The Busway Alternative is 0.01 percentage points less polluting than the Light Rail-Busway Alternative.

In addition, even these negligible air pollution impacts may be optimistic, in light of the tendency of light rail systems to carry fewer riders than forecast, and thus to remove fewer automobiles than expected (“Projections and Light Rail,” above).

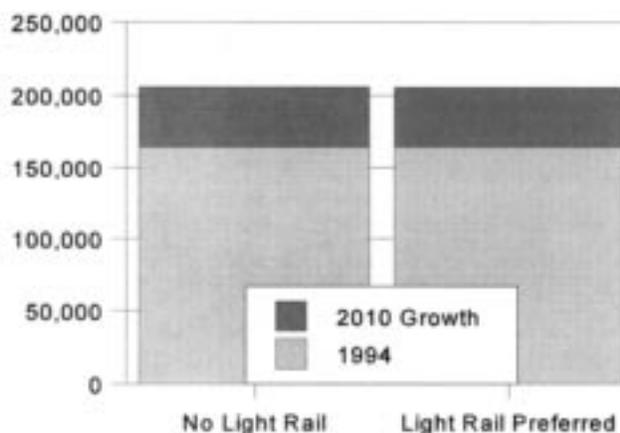
The *MIS* notes that transit improvements generally have little effect on air quality:

In most projects, however, environmental impact analyses have shown that the relative effects of transit projects (Even sizable ones) on the air quality of a region or sub-regions are not dramatic.¹⁴¹

The *MIS* further projects no material improvement in air quality from light rail in Milwaukee.

It should be noted that the change in emissions due to a mode shift to LRT from automobile would be negligible since there is very little modal shift detected in ridership analyses. There is no impact when comparing the air quality effects between alternatives.¹⁴²

FIGURE 7 I-94 Corridor Traffic and Light Rail Preferred Alternative



These data are consistent with the assessment of the United States Department of Transportation:

Milwaukee is a “severe” non-attainment area for ozone and an attainment area for carbon monoxide. The alternatives would have a minimal effect on reducing pollutant emissions.¹⁴³

Nonetheless, the *MIS* concludes:

The proposed alternatives would result in improvements to air quality because of the diversion of trips from automobiles to transit...¹⁴⁴

Again, this favorable conclusion does not follow from the *MIS* projections. All of the transit alternatives would reduce air pollution less than 0.5 percent.

Conclusion: Air pollution would not be materially improved by light rail or any of the transit alternatives.

Cost-Effectiveness and Light Rail in Milwaukee

The light rail alternatives would attract little additional ridership relative to the Bus Alternative, but at great cost.

- The Light Rail Alternative would attract two percent more riders than the Bus Alternative, at an annualized capital and operating cost of 163 percent higher.
- The Light Rail-Busway Alternative would attract five percent more ridership than the Bus Alternative at an annualized capital and operating cost that is 270 percent higher.
- The Light Rail Preferred Alternative would attract three percent fewer riders than the Bus Alternative, while costing 140 percent more annually (Figure 8).

Cost per New Ride

Data in the *MIS* indicate that the 2010 cost per rider of the present system would be \$1.61 (\$725 annually per commuter). The cost per new ride under the Bus Alternative would be more than five times higher — \$8.90 — approximately \$4,000 annually for each new commuter, or \$160,000 over a 40-year career. The light rail alternatives would be even more costly, and among the most costly for any project ever considered in the United States.¹⁴⁵

- The cost per new ride for the Light Rail Alternative is projected at \$38.14 (relative to the Bus Alternative). This would amount to \$17,143 annually for each new daily commuter or \$685,000 over a 40-year career.¹⁴⁶ On an annual basis, this is more than the national average family income of the lower 20 percent of households.¹⁴⁷ Moreover, all of new Light Rail Alternative riders are the result of manual adjustments to projected patronage — the computer model predicted Light Rail Alternative ridership to be *lower* than Bus Alternative ridership, despite the Light Rail Alternative’s much higher capital and operating cost.
- The cost per new ride for the Light Rail Alternative is projected at \$61.16 (relative to the Bus Alternative). This would amount to \$27,490 annually for each new daily commuter, or \$1.1 million over a 40-year career (Table 16). On an annual basis, this is more than the average family income of the lower 40 percent of households.¹⁴⁸
- The *MIS* estimates that the Busway Alternative would have a higher cost per new ride than the Light Rail-Busway Alternative. *All* of this advantage is attributable to manual adjustments to projected ridership (“Traffic Congestion and Light Rail in Milwaukee,” above).¹⁴⁹

- Because there would be no net additional transit riders under the Light Rail Preferred Alternative in comparison to the Bus Alternative, it is not possible to calculate a cost per new ride.

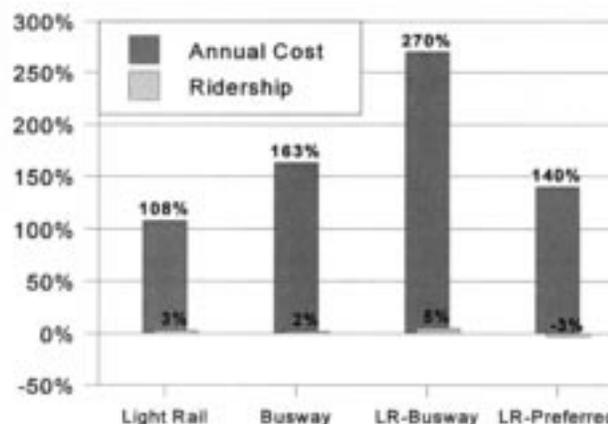
Passenger fares would cover little of the additional expense — a subsidy of 98.5 percent or more would be required for all of the alternatives. Today, transit subsidies in the Milwaukee area are approximately 70 percent.

Cost per New Peak-Hour Automobile Removed

The cost per automobile removed during peak periods would be even greater (Table 17). A large portion of the manual adjustment (to the computer model projections) that produces the light rail ridership advantage over bus alternatives is mid-day trips and special events trips, neither of which reduce traffic congestion during peak hour. This leaves relatively few new trips that are generated by the removal of automobiles (automobile drivers attracted to light rail) and not all of them would be during weekday peak hours. If one-half of the remaining new ridership is composed of automobile drivers, automobiles replaced by transit trips and costs would be as follows:¹⁵⁰

- The Light Rail Alternative would remove a daily average of 360 daily automobile trips, or 180 automobiles daily (two trips per automobile). The cost per *individual* automobile removed by the Light Rail Alternative would be \$691 per trip, \$310,000 annually, or \$12,400,000 over a 40-year career.
- The Light Rail-Busway Alternative would remove a daily average of 1,410 daily automobile trips, or 705 automobiles daily (two trips per automobile). The cost per *individual* automobile removed by the Light Rail Alternative would be \$410 per trip, \$184,000 annually, or \$7,400,000 over a 40-year career.

FIGURE 8 Comparison of Alternatives to Bus Alternative



Calculated from MIS data.
Light Rail Preferred data estimated by author

TABLE 16 Cost per New Ride

Factor	Compared to Bus Alternative			
	Light Rail	Busway	Light Rail-Busway	Preferred Light Rail
Daily New One-Way Rides	4,850	2,520	7,150	(4,920)
Annual New Rides	1,466,000	722,000	2,124,000	(1,461,000)
Annual Operating and Capital Cost	\$55,890,000	\$73,690,000	\$129,880,000	\$73,100,000
Cost per New Ride	\$38.14	\$102.13	\$61.16	Cannot be
Annual Cost	\$17,143	\$45,906	\$27,490	Calculated:
40 Year Career Cost	\$685,734	\$1,836,235	\$1,099,619	No New
Estimated Subsidy	98.5%	99.4%	99.0%	Riders

Preferred Light Rail Alternative: author's estimates
Other alternatives:

First four lines from MIS
Annual Cost, 40 Year Cost & Subsidy calculated from data in MIS

TABLE 17 Minimum Cost per Weekday Automobile Removed

<i>Factor</i>	<i>Light Rail</i>	Compared to Bus Alternative		<i>Preferred Light Rail</i>
		<i>Busway</i>	<i>Light Rail-Busway</i>	
Annual Cost	\$55,890,000	\$73,690,000	\$129,880,000	\$73,100,000
Automobiles Removed	180	575	705	(1,980)
Annual Cost per Automobile	\$310,500	\$128,157	\$184,227	<i>Cannot be</i>
Cost per Automobile Trip Removed	\$691	\$285	\$410	<i>Calculated: No</i>
Career Cost	\$12,420,000	\$5,126,261	\$7,369,078	<i>New Riders</i>

Average number of automobiles removed calculated from Table 4.13, *MIS*

Two trips per day assumed per automobile

Light Rail Preferred Alternative data: author's estimates

- The Light Rail Preferred Alternative would provide significantly lower levels of service than the Bus Alternative and would, therefore, remove fewer automobiles. It is thus not possible to calculate a cost per automobile removed by light rail.

It is likely that the cost per peak hour automobile removed would be higher, since not all diversions from the automobile would be during weekday peak travel periods.

Operating Costs

The 2010 transit system operating costs appear to be low. The *MIS* assumes that 2010 unit operating will be the same as present (in 1994 dollars). However, MCTS unit costs rose nearly 10 percent, adjusted for inflation from 1980 to 1995,¹⁵¹ a rate typical for U.S. transit agencies. A continuation of the 1980-1995 escalation rate would increase costs by another 10 percent by 2010. This would increase annual operating costs by from \$13 million under the Light Rail Preferred Alternative to \$16 million under the Light Rail-Busway Alternative.

Data in the *MIS* indicate that the cost per mile of light rail service would be \$9.78 in 2010. The average for eight new light rail systems was \$10.39 in 1995¹⁵² — six percent higher than projected for Milwaukee. But there is an indication that the Milwaukee light rail project will be particularly costly to operate relative to other light rail systems. The labor productivity normally attributed to light rail are not evident in the *MIS*. The Light Rail Alternative requires 3.2 percent *more* personnel per ride than the Bus Alternative, and the Light Rail-Busway Alternative requires 2.3 percent more personnel per ride than the Busway Alternative. Nationally, bus systems require 50 percent more operating personnel per passenger than light rail systems. The higher than average labor costs could translate into a nearly 50 percent operating cost overrun. This suggests that annual operating costs could be at least \$5 million higher than projected. Annual light rail and bus operating costs could be \$18 million more than projected.

Capital Costs

The capital cost of the light rail line appears to be low relative to other projects in the nation. The Light Rail Preferred Alternative cost per mile of light rail is \$29.6 million. The average for 10 systems currently under development is 59 percent higher. Reflecting the difficulty of projecting major capital project costs, the *MIS* indicates that costs are “expected to change in subsequent phases of project development ...”¹⁵³

Virtually all U.S. light rail projects have become more expensive as the planing process has proceeded. The Milwaukee Light Rail Preferred Alternative light rail line is projected to cost more than one-third less than the average of 10 light rail projects in planning or development (Table 18). A 50 to 100 percent cost overrun is well within the range of possibility (“Projections and Light Rail,” above). Combined with the already-low capital-cost

estimate, this could add \$600 million to \$1 billion to the capital cost of light rail.¹⁵⁴ This cost would be the liability of local taxpayers — approximately \$1,500 to \$2,500 per household in Milwaukee and Waukesha Counties.

Conclusion: The projected operating and capital costs of light rail in Milwaukee appear to be significantly understated.

Energy and Light Rail in Milwaukee

The light rail alternatives would reduce annual energy consumption marginally in comparison with the Bus Alternative, but the much higher energy consumption required to build light rail would render the light rail alternatives less energy efficient.

- The Bus Alternative would *increase* overall energy consumption 140 gigajoules annually. Construction would require 260 gigajoules.¹⁵⁵
- The Light Rail Alternative would increase overall energy consumption 130 gigajoules annually. But construction would require 1,330 gigajoules, which would mean that it would take 107 years to recover the excess energy consumed in construction.¹⁵⁶
- The Light Rail-Busway Alternative would increase overall energy consumption 110 gigajoules annually. But construction would require 4,360 gigajoules, which would mean that it would take 137 years to recover the excess energy consumed in construction.¹⁵⁷

Light rail would never produce a net energy benefit relative to the Bus Alternative, because long before the more than 100 years required to nullify the construction energy consumption, the light rail system would require rebuilding.

Further, *all* of the transit alternatives would result in *higher* energy consumption than doing nothing (the Null Alternative), reflecting the fact that the automobile has become more fuel efficient than transit (“Energy and Light Rail,” above). However, the higher energy consumption that would be produced by substituting light rail use for automobile use would be small, because so few automobile trips would be replaced by transit trips.

Conclusion: Light rail in Milwaukee would not reduce energy consumption.

Development and Light Rail in Milwaukee

The *MIS* projects larger development impacts for light rail alternatives than for the Bus Alternative. But the light rail advantage is substantially the result of policy assumptions applied to the light rail alternative, but not to the Bus Alternative.

The *MIS* projects that the light rail alternative would attract nearly 11,000 jobs and 1,200 new residences relative to the bus alternatives. These new jobs and residences would not, however, be new to the Milwaukee area, but would rather be reallocations within the area. These projections, however, are dependent upon implementation

TABLE 18 Light Rail Projects in Planning or Construction

<i>Project</i>	<i>Cost per Mile (Millions)</i>
Austin	\$25.9
Cincinnati	\$24.4
Columbus	\$37.3
Kansas City	\$26.7
Minneapolis-St. Paul	\$58.1
New Jersey Waterfront	\$50.7
Portland-South/North	\$112.0
Portland-Westside	\$50.6
Sacramento-South	\$46.9
San Jose-Tasman	\$38.7
<i>Average</i>	<i>\$47.1</i>
Milwaukee: Light Rail Preferred Alternative	\$29.6

Calculated from FTA and *MIS* data

of a number of land use (zoning) policies, physical improvements, and higher levels of bus service to park-and-ride lots. Without implementation of these policies and actions, the *MIS* attributes no sustainable employment or residential location gain to the light rail alternatives relative to the bus alternatives.¹⁵⁸

There are two problems with the *MIS* analysis with respect to development:

- Some of the proposed land use policies could entail considerable political opposition. Moreover, these new jobs and residences are merely reallocations within the Milwaukee area, not additions from outside.
- The *MIS* does not review a scenario in which the same land use policies would be applied to the bus alternatives, yet most could be readily applied. This demonstrates a planning-process bias against bus alternatives.

Even so, the *MIS* projects little urban development impact from light rail.

[I]t is unlikely that even maximum development around all LRT stations would have a substantial impact on overall land-use patterns in the East-West Corridor. The total area around all stations is simply too small in proportion to the overall area.¹⁵⁹

It is not likely that the proposed transportation alternatives in the corridor would substantially change established regional land use patterns.¹⁶⁰

Conclusion: Light rail would have little or no impact on development or employment and has not been shown to be superior to bus alternatives.

Travel Time and Light Rail in Milwaukee

Light rail would operate at speeds well below that of the automobile, even during the “rush hours” along I-94. Light rail’s operating speed is estimated a 19.2 miles per hour.¹⁶¹ This is slower than the average I-94 rush-hour speeds projected if *no* freeway improvements are made (28 to 38 miles per hour). Thus, light rail would provide no travel time savings for automobile users. This is consistent with information in the *MIS*, which projects improved travel times only for existing transit riders.¹⁶² Addition of the Busway would increase I-94 speeds to a range of 37 to 46 miles per hour on the general purpose lanes, and 55 miles per hour on the Busway¹⁶³ (“The Urban Travel Consumer and Light Rail,” above).

Conclusion: Light rail in Milwaukee will not improve travel times for automobile commuters.

Reverse Commuting and Light Rail in Milwaukee

Light rail would do little to provide for reverse commuting in the Milwaukee area, despite the fact that it is an important objective. According to the *MIS*:

An important goal ... is to improve connections between workers and jobs. One of the problems ... is the jobs and workers “mismatch” in the Milwaukee area. Similar to many older urban areas, population and employment growth is occurring at a rapid rate in the outlying suburban areas and is declining or remaining stable in most parts of Milwaukee County. ... there is a reservoir of unfilled jobs available in Waukesha County, and a large unemployed, or under-employed, transit dependent ridership in the Milwaukee central city.

The light rail alternatives are generally not as effective as the Bus Alternative in providing “job-mismatch” (reverse-commute) trips (Table 19).

- The Light Rail Alternative would carry 196 *fewer* daily commuters from low income areas to suburban areas than the Bus Alternative. The Light Rail Alternative would carry 18 more high density area residential commuters daily to suburban areas — a number that could be comfortably carried by a single bus or two

TABLE 19 Reverse Commuting: New Daily Commuters Served Compared to Bus Alternative

<i>Alternative</i>	<i>Low Income Areas to Suburban Jobs</i>	<i>High Density Residential Areas to Suburban Jobs</i>	<i>Total Reverse Commuters Served</i>
Light Rail	(196)	18	(178)
Busway	35	23	58
Light Rail-Busway	(170)	36	(134)
Light Rail Preferred	<i>No estimate provided. Lower light rail and bus service levels would indicate fewer trips than Light Rail alternative</i>		

Calculated from MIS Table 7.3
Light Rail Preferred Alternative: author's estimates

van pools. The Light Rail Alternative would carry 178 *fewer* reverse commuters daily than the Bus Alternative.

- The Light Rail-Busway Alternative would carry 170 *fewer* daily commuters from low income areas to suburban areas than the Bus Alternative. The Light Rail-Busway Alternative would carry 36 more high density area residential commuters daily to suburban areas — a number that could be comfortably carried by a single bus or four van pools. The Light Rail-Busway Alternative would carry 134 *fewer* reverse commuters daily than the Bus Alternative.¹⁶⁴

Because of its lower bus and light rail service levels, the Light Rail Preferred Alternative would provide fewer reverse-commute trips than any of the bus or other light rail alternatives.

Nonetheless, the *MIS* characterizes the Light Rail Preferred Alternative as “greatly improving the ‘worker to job’ transit links now lacking in the corridor.”¹⁶⁵ Again, this conclusion does not follow from the data. The addition of, at most, 100 new reverse commuters daily falls far short of significance in this corridor with more than 500,000 jobs.¹⁶⁶

Safety and Light Rail in Milwaukee

The national data (“Safety and Light Rail,” above) indicate that travel by light rail is considerably less safe than travel by automobile. In contrast, the *MIS* indicates that improved safety will occur as a result of the reduction in automobile travel,¹⁶⁷ while providing no substantiating evidence. However, light rail’s greater danger should be of little impact, since so few automobile drivers would be attracted from safer automobile travel.

Conclusion: Light rail in Milwaukee will not improve safety relative to either automobiles or the bus alternatives.

Transit Deficits and Light Rail in Milwaukee

Like elsewhere, light rail would not reduce the transit deficit in Milwaukee (“Transit Deficits and Light Rail,” above). All transit alternatives would significantly reduce the percentage of operating and capital costs recovered from passenger fares (fare ratio). The Bus Alternative would reduce the fare ratio to 18 percent from the present 23 percent.¹⁶⁸ Both light rail alternatives would reduce the fare ratio to under 14 percent.

Conclusion: Light rail in Milwaukee would *increase* the transit deficit.

The Planning Process and Light Rail in Milwaukee

The East-West Corridor planning process was flawed in three respects. It evaluated the alternatives on an uneven basis, and it excluded viable alternatives that would have produced more favorable results. Finally, the planning process produced an irrational conclusion — a recommendation not consistent with the data on which it was based.

Prejudicial Treatment Favoring Light Rail Alternatives

The structure of the planning process favored light rail alternatives over bus alternatives.

1. **The Bus Alternative is eliminated from consideration.** The planning process evaluates the alternatives in relation to the Bus Alternative, rather than the status quo (Null Alternative).¹⁶⁹ This eliminates the Bus Alternative from consideration, since no standard of reasonableness is suggested or applied that would eliminate other alternatives for being excessively costly.¹⁷⁰ This method masks the cost effectiveness of the Bus Alternative. All alternatives, *including* the Bus Alternative, should be evaluated in relation to the status quo — the Null Alternative. This would make clear the diminishing returns that result from the proposed alternatives. The Bus Alternative is considerably more costly than the Null Alternative, while the Light Rail Alternatives are even more costly in relation to the Bus Alternative.
2. **Manual adjustments are used to raise light rail ridership more than bus ridership.** As was noted above (“Traffic Congestion and Light Rail in Milwaukee”), virtually all of the light rail ridership advantages over bus ridership are attributable to manual adjustments to the computer model results. This inappropriately prejudices the planning process toward the light rail alternatives and against the bus alternatives (Figures 9 and 10).
3. **Policies and actions to increase development are applied to the light rail alternatives, but not to the bus alternatives.** The policies and actions analysis that produces the light rail alternatives jobs and residences advantage was not applied to the bus alternatives. This inappropriately discriminates against bus alternatives.
4. **Selection of the Light Rail Preferred Alternative.** The bias against bus alternatives continues into the decision making and evaluation process. The conclusion of the planning process — selection of the Light Rail Preferred Alternative — is irrational based upon the project alternatives. It would cost 140 percent more than the Bus Alternative, but would carry 3.1 percent fewer riders. This result makes it clear that, for whatever reason, the planning process was not driven by the objective of maximizing transit or transportation benefit in Milwaukee. It also raises the possibility that the dynamics of the planning process were directed toward an outcome that incorporates light rail.

Excluded Alternatives

The planning process failed to consider a number of more effective alternatives. For example:

- **Major Bus Service Expansion** within Light Rail-Busway Alternative operating budget: If bus service were expanded within the annual operating costs of the most expensive alternative considered (the Light Rail-Busway Alternative), daily ridership could be increased to 189,200 — at least 24,000 more than the Light Rail Alternatives.¹⁷¹
- **Bus Preferred Alternative:** If the operating funding planned in the Light Rail Preferred Alternative were instead used to finance expanded bus service, 2010 ridership would be 152,900 — 400 below the 153,300 projected for the Light Rail Preferred Alternative (0.3 percent less).
- **Reducing passenger fares:** Passenger fares in Milwaukee have risen rapidly, and ridership has fallen in response. Lower fares attract higher ridership levels. A 1982 fare reduction increased Los Angeles ridership by more than 40 percent — at a cost of \$275 annually per new ride — 1/60th of the least expensive

light rail alternative in Milwaukee.¹⁷² It is estimated that a 20 percent fare reduction would produce the same ridership level as the Light Rail Preferred Alternative for one-fifth the operating cost and without a nearly \$450 million expenditure for light rail construction.¹⁷³

- Competitive contracting:** Conversion of bus service to competitive contracting, which would make it possible to increase bus service levels — and thus ridership — without increasing the operating budget. The conversion to competitive contracting could be implemented within the employee attrition rate, so that layoffs would be avoided and all expanded service would be competitively contracted. It is estimated that the additional cost of operating the expanded service under the Bus Alternative would be a third less.¹⁷⁴ Major public transit systems are being or have been fully converted to competitive contracting in London, Copenhagen, Stockholm (bus and rail), Helsinki, Melbourne (bus and rail), Las Vegas, and elsewhere.¹⁷⁵
- Freeway expansion:** The overall purpose of the planning process was to address the transportation problems of the East-West Corridor — including the freeway and its traffic. In 1994, I-94 traffic was above capacity only at 76th Street. By 2010, I-94 is expected to face serious capacity deficits from 76th Street *outbound* into Waukesha County. The most serious developing traffic congestion in the Milwaukee area is not in the central area — it is outside downtown and especially in the suburbs. According to the analysis in the *MIS*, light rail would do virtually nothing to relieve this excess travel demand (growing traffic congestion), because it would remove so few automobiles from the road (Figure 11).

Eliminating the Bus Alternative

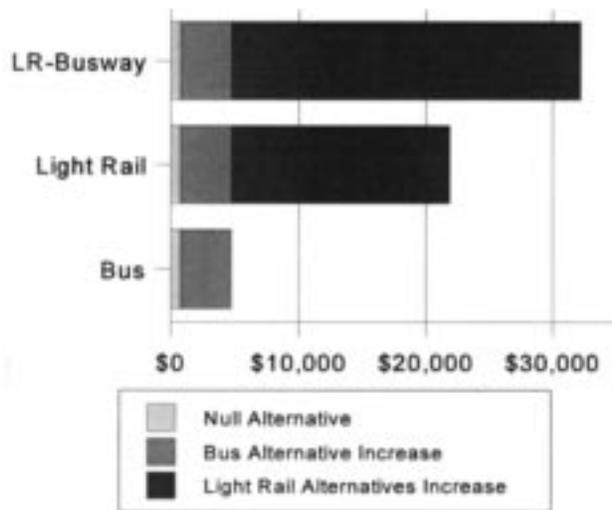
The flaw of the approach that evaluates alternatives in relation to the Bus Alternative can be illustrated by an analogy.

In making a decision about purchasing a new automobile, a consumer might consider three alternatives — Car A, costing \$15,000; Car B, costing \$45,000 and Car C, costing \$60,000 (for the sake of simplicity it is assumed that price would be the driving factor in the decision).

If the consumer followed the East-West Corridor planning approach, the decision would be made based in relation to the cost of Car A — Car B would be purchased, because its price is \$30,000 greater than Car A — less than the \$45,000 higher price for Car C. The very nature of this decision-making process would eliminate Car A from consideration. The rational decision would be to chose Car A.

Such a process is irrational. The rational consumer would compare the prices of all alternatives, including Car A.

FIGURE 9 Annual Cost per New Rider by Alternative

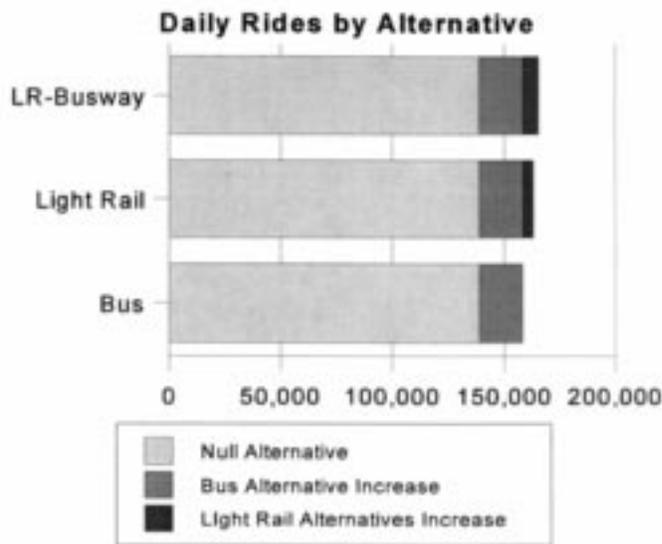


Calculated from *MIS* data

The excess demand could be handled by the addition of a general purpose freeway lane in each direction in the short segments where freeway capacity is expected to be insufficient to handle the traffic demand. This alternative was not considered.

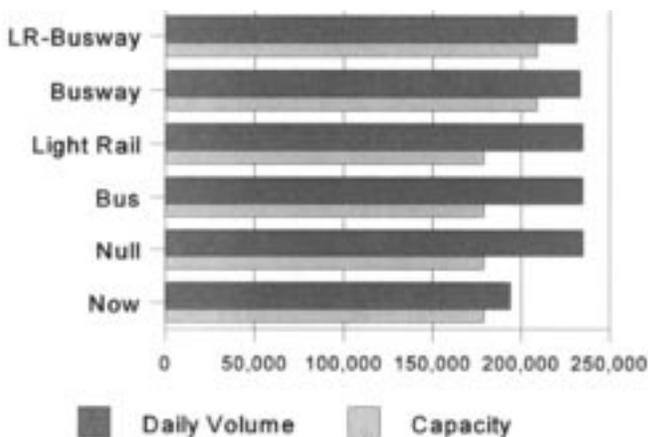
Despite its substantial theoretical capacity, light rail's practical capacity makes it more expensive than the addition of general purpose freeway lanes. It is estimated that the addition of a general-purpose freeway lane where traffic would exceed capacity in 2010 would cost approximately \$125 million¹⁷⁶ — \$0.90 per new passenger trip — \$400 per year, and \$16,000 over a 40-year career.¹⁷⁷ Moreover, the new freeway lanes would require no public subsidy — the project would be fi-

FIGURE 10 Daily Rides by Alternative



Calculated from MIS data

FIGURE 11 Traffic Capacity and Volume by Alternative: I-94 Corridor at 76th Street



MIS Table #4.13

Light Rail in Milwaukee: Insignificant, But Expensive

The data developed in the East-West Corridor planning process proves that there is little to be gained by implementation of light rail. There is little material difference between the performance of the Bus Alternative and the light rail alternatives. None would materially reduce traffic congestion or air pollution during peak periods or any other time.

The light rail alternatives attract an infinitesimal number of automobile drivers relative to the Bus Alternative. The most favorable projections of 37 to 107 daily automobiles would be imperceptible on highways leading to the smallest farming communities,¹⁷⁹ much less one of the nation’s largest urban areas.

nanced by highway user fees (gasoline taxes, etc.). By comparison, light rail’s cost per new ride is, at the least 40 times greater (\$38.14) — but, more important, light rail is realistically capable of only attracting a small fraction of the automobile drivers necessary to solve the traffic capacity problem in the corridor.

The problem that precipitated the East-West Corridor planning process remains to be addressed, because the solution (freeway expansion) has been excluded. This is not unique to Milwaukee. In recent years, expansion of freeways has become more difficult politically. For example, A recent Washington, D.C., Board of Trade study said that “the region must shun ‘political correctness,’” contending that “the conclusion is unavoidable that *the region’s fundamental transportation need is to significantly expand highway and bridge capacity*” (emphasis in original).¹⁷⁸ After spending \$12 billion to build the nation’s most successful and comprehensive new rapid rail system, it has become clear that solving the urban transportation problem requires solutions that better handle automobiles, which continue to carry the overwhelming majority of trips in the Washington, D.C., area.

The final product of the planning process was a Light Rail Preferred Alternative that requires capital expenditures of nearly \$2.1 billion for both freeway and transit improvements, but fails to solve the problem of traffic congestion in the corridor.

Conclusion: The planning process was biased, incomplete, and produced a result that would do little to reduce traffic congestion in the East-West Corridor.

At the same time, light rail's cost is exorbitant.

- The most favorable light rail alternative studied would require a lifetime subsidy of more nearly \$50 million per *individual* new automobile commuter. The exorbitant expense of the light rail alternatives (from nearly \$7 million to \$12 million over an *individual* driver's career) would seem to be sufficient to require no further illustration. But the dreadfully poor results from the *MIS* did not deter local officials from proceeding with an even *less* cost effective alternative for further development — the Preferred Light Rail Alternative. Therefore, it is appropriate to cite additional contextual examples.

If all automobile trips in Milwaukee were to receive the same level of subsidy that is required by light rail to remove a single automobile, an annual subsidy of \$750 billion would be required — equal to the annual combined personal income of Wisconsin, Michigan, Minnesota, Iowa, Missouri, North Dakota, South Dakota, and Nebraska — and more than all the combined U.S. corporate income taxes and employee and employer contributions to Social Security in 1996.¹⁸⁰

- The Preferred Light Rail Alternative would *not* attract any new automobile commuters relative to the Bus Alternative. Overall, Light Rail Preferred Alternative ridership would be three percent less than that of the Bus Alternative (including the light rail riders added by manual adjustments to the computer model output), at a 140 percent higher cost.

The planning process produced outcomes that should have been rejected out of hand as unreasonable.

- To have favorably reported on alternatives with costs per new ride of up to \$27,500 annually and lifetime costs of \$1.1 million is absurd. This is enough to lease each new ride at least *five* new automobiles in perpetuity.
- To have selected an alternative (The Light Rail Preferred Alternative) that attracts fewer automobile drivers than the much less costly Bus Alternative is irrational.

There are no unusual conditions in Milwaukee that would make it possible for light rail to reduce traffic congestion and air pollution. Indeed, the Milwaukee light rail project is one of the least effective ever considered. In Milwaukee, light rail is insignificant in every respect except cost.

Conclusion: The Light Rail Preferred Alternative produces lower ridership than the Bus Alternative at an excessively higher cost.

1. **Traffic Congestion: Data in the MIS indicate that light rail will not reduce traffic congestion during peak periods in Milwaukee.**
2. **Cost Effectiveness: Data in the MIS indicate that light rail is much more expensive than other alternatives — reviewed and unreviewed. The Light Rail Preferred Alternative is likely to cost \$18 million more annually to operate than projected, and sustain construction cost overruns of \$600 million to \$1 billion. These additional costs would be shouldered by local taxpayers.**

COMMUTER RAIL

While it was not a part of the East-West Corridor study, commuter rail has been suggested as an alternative to reduce traffic congestion.

Commuter rail systems carry large numbers of riders in four urban areas with particularly large downtowns — New York, Chicago, Philadelphia, and Boston. Five urban areas have recently opened new commuter rail lines, including Los Angeles, which opened six lines (Table 20). The new commuter rail systems carry from 1/4th to 1/750th the ridership of the four older established systems.

New Commuter Rail: The National Experience

In relation to light rail:

- New commuter rail lines are generally less expensive to build per mile, because they tend to use existing freight rail corridors and are operated with diesel locomotives (it is not necessary to build overhead lines for electric power collection).
- New commuter rail system ridership is generally lower than new light rail. Los Angeles' six commuter rail lines carry one-third the ridership of its two light rail lines. San Diego's light rail ridership is 15 times the commuter rail ridership. Miami's rapid rail system carries six times as many riders as its commuter rail line.

New commuter rail lines are not cost effective. The operating and cost per automobile driver attracted in Los Angeles is more than \$35 per ride — \$17,500 annually, or \$700,000 over a 40-year career. Operating subsidies per passenger tend to be four or more times as high as subsidies for bus, light rail, and rapid rail services in the same urban areas.¹⁸¹

The new commuter rail lines provide little assistance with respect to reverse commuting, because very few suburban jobs are within walking distance of the freight rail corridors. For example, the 45 stations of the comprehensive six line Los Angeles system are within walking distance of less than one percent of the urbanized (developed) area.

Commuter Rail and the Consumer

At nearly 40 miles per hour, the new commuter rail lines are the speediest form of public transit — 20 percent faster than the older commuter rail lines. This advantage relative to automobile speed is negated by wait time and shuttle bus trips that are necessary because commuter rail serves only a single downtown station. Suburban stations are further apart and are generally not served by comprehensive shuttle-bus systems. There is usually a single downtown station, with frequent bus service to circulate to downtown destinations beyond walking distance. Less frequent service is provided, because of the necessity to share tracks with freight services and the longer trains (higher capacity) typical of commuter rail.

TABLE 20 **Daily Commuter Rail Ridership**
3rd Quarter 1997

<i>Urban Area</i>	<i>Daily Riders</i>	<i>Notes</i>
New York	749,000	operated for decades
Chicago	298,000	operated for decades
Philadelphia	121,000	operated for decades
Boston	102,000	operated for decades
San Francisco	27,000	operated for decades
Washington-Baltimore	24,300	1 new line
Los Angeles	24,200	6 new lines
Miami	8,000	1 new line
San Diego	4,000	1 new line
Dallas-Fort Worth	1,000	1 new line

American Public Transit Association

Los Angeles: Los Angeles has developed by far the nation's most comprehensive new commuter rail system. A large percentage — 60 percent — of the ridership has been automobile drivers, a reflection of the limited level of bus service along the corridors before commuter rail was opened. With 400 miles of length and 45 stations, the system uses nearly every feasible freight rail corridor in the area. There are plans to increase system capacity by double, at an additional cost of \$1.5 billion. If the number of automobile drivers attracted were also to double, the annual cost per new automobile driver would be \$22,000 annually and nearly \$900,000 over a career.¹⁸² The subsidy per passenger (1995) is eight times that of bus, light rail, and rapid rail passengers in Los Angeles.¹⁸³ On the busiest corridor, commuter rail removes no more than one-third of a single freeway lane's capacity. In the context of transit in the Los Angeles area, commuter rail is insignificant — carrying little more than one percent of ridership. If all of the former automobile drivers riding commuter rail are assumed to be traveling to work, commuter rail would achieve a 0.1 percent work trip market share.

Miami: A commuter rail line was established in Miami to relieve traffic during the reconstruction of Interstate 95 during the late 1980s. The Florida Department of Transportation indicated that commuter rail service would continue after the reconstruction only if a daily ridership level of 14,000 was sustained. Ridership peaked at under 10,000 and has fallen 20 percent over the past three years. Each *day*, the line carries approximately the same number of passengers as a single freeway lane in a *single* hour (one direction).¹⁸⁴

Commuter Rail in Milwaukee

The conditions for commuter rail would appear to be even less favorable in Milwaukee. Traffic volumes on I-94 are less than half that of the two adjacent freeways in the Miami corridor (I-95 and Florida's Turnpike). The anticipated growth to 2010 would still leave I-94 at least 40 percent below the present Miami volumes.¹⁸⁵ The population and employment density in the Miami corridor is considerably higher than in the Milwaukee corridor. Similar comparisons with the Los Angeles results would yield the same conclusions. Because so few jobs are within walking distance of potential commuter rail stations outside downtown, there is virtually no potential for commuter rail to attract meaningful numbers of reverse commuters.

- A proposed Waukesha County to downtown commuter rail line would require approximately \$35.00 per new automobile driver attracted — \$16,000 annually and nearly \$650,000 over a 40-year career.¹⁸⁶
- A proposed extension of Chicago's commuter rail system (Metra) from Kenosha to downtown would require approximately \$20.00 per new automobile driver attracted — \$8,700 annually and nearly \$350,000 over a 40-year career.¹⁸⁷
- The recently announced three month commuter rail service to alleviate traffic congestion during the I-94 repaving will require a public subsidy of nearly \$26.00 per new ride — \$12,000 per year per new ride and \$50,000 over a career.¹⁸⁸

Express buses could perform the same function in either corridor for much less. For example, the I-5 commuter express bus system operating from Snohomish County to Seattle carries more riders than the Miami commuter rail system at one-third the cost.¹⁸⁹ Moreover, the Seattle buses use general purpose and HOV lanes constructed for car pools *and* buses.

Conclusion: Commuter rail would be an expensive and ineffective strategy in Milwaukee.

Urban Rail in Milwaukee

Urban rail — whether light rail or commuter rail — offers virtually no hope for reducing traffic congestion and air pollution in Milwaukee, because it would remove so few automobiles from the road. Data developed in the East-West Corridor planning process demonstrate that building light rail would be very costly and would be less effective than much less costly bus options (Table 21). Similarly, commuter rail would provide virtually no traffic congestion relief, but would be more costly than bus alternatives. Building of either light rail or commuter rail would do virtually nothing to alleviate the transportation capacity deficit in the East-West Corridor.

TABLE 21 Summary of Conclusions: Milwaukee Light Rail Preferred Alternative

<i>Issue</i>	<i>Conclusion</i>
Traffic Congestion	Minuscule traffic volume reduction (0.051 percent) and less than Bus Alternative (0.070 percent). Traffic volume would be significantly above roadway capacity after light rail is built.
Air Pollution	Dependent upon traffic congestion impact. Minuscule reduction and less than Bus Alternative.
Cost Effectiveness	Negative. No new riders are attracted relative to Bus Alternative. Capital costs higher than Bus Alternative. Freeway expansion would be less expensive, while providing excess capacity.
Energy Consumption	Increases energy consumption, due to improved energy efficiency of automobiles.
Development	Development impacts dependent upon adoption of politically difficult land use policies, which could also accompany the Bus Alternative.
Travel Time	No advantage for automobile commuters. Average light rail speeds would be 30 to 50 percent slower than freeway travel speeds in general purpose lanes.
Reverse Commuting	Fewer reverse commuters would be carried than on Bus Alternative.
Safety	Light rail would be less safe than the Bus Alternative.
Transit Deficits	Light rail would increase transit deficits.

NOTES

1. A single freeway lane capacity is approximately 2,500 vehicles per hour—or nearly 4,000 people at average occupancy rates.
2. Calculated from U.S. Department of Transportation Federal Transit Administration National Transit Database (*NTDB*) and San Diego Metropolitan Transit Development Board data.
3. Some cities have established what might be characterized as “nostalgic” light rail lines, which normally provide downtown circulation or trips to tourist attractions (such as Seattle, Galveston, and Memphis). These lines perform virtually the same function as downtown circulator bus routes, such as in Los Angeles, San Antonio and Denver, but at considerably higher cost. The San Antonio downtown bus circulator system can also be considered “nostalgic,” since it uses buses designed to resemble light rail vehicles.
4. John F. Kain, “Choosing the Wrong Technology: Or How to Spend Billions and Reduce Transit Use,” *Journal of Advanced Transportation*, Winter 1988.
5. The terms “automobile” and “car” are used throughout this report to denote private vehicles, such as automobiles, vans and light trucks. The term private vehicle refers to the unavailability to the public of the vehicle, not its ownership.
6. *The Renaissance of Rail Transit in America*, Regional Plan Association, June 1991.
7. E.L. Tennyson, “How Should Light Rail Success be Measured,” *Passenger Transport*, November 13, 1995.
8. While a single line, the St. Louis and Sacramento lines are classified as two corridors because they provide service in two directions to downtown, which accounts for the overwhelming majority of trips.
9. All bus and rail services.
10. The San Jose light rail line was also opened in 1980s, but comparative data is not available because it is included in the much larger San Francisco metropolitan area.
11. All 1990, 1980 and 1970 journey-to-work information from or calculated from U.S. Census Bureau data.
12. Calculated from U.S. Census Bureau data.
13. HOV lanes provide expedited trips to buses and car pools.
14. Calculated from U.S. Census Bureau data.
15. *Nationwide Personal Transportation Study (NPTS)*, United States Department of Transportation. Data by metropolitan area will not be available until release of 2000 U.S. Census data.
16. Calculated from data in *NTDB* and *Highway Statistics*, United States Department of Transportation Federal Highway Administration, annual.
17. Because of incomplete data, no analysis was performed of the 1980 to 1990 work trip market share in San Jose. Despite the loss from 1990, San Jose’s transit travel has increased since the 1988 opening of the light rail line. Daily passenger miles are up 130,100 from 1987. This figure, however, is also minuscule — 3.1 percent compared to the new travel from 1990. It is likely that transit’s share of new travel growth is less, since road travel undoubtedly increased from 1987 to 1990.
18. Calculated from data in *NTDB* and *Highway Statistics*.
19. Donald H. Camph, *Dollars & Sense*, The Campaign for Efficient Passenger Transportation, July 1997.
20. At average occupancy rates, it is estimated that an overall traffic increase of 2.7 percent would occur (from 1990 levels). It would be necessary to expand freeway capacity only where current traffic levels are at or greater than capacity. The required freeway expansion is likely to be well below the 2.7 percent level. See: “Notes on the ‘Dollars and Sense’ Transit Report,” Internet: *The Urban Transport Fact Book*: ([www.publicpurpose.com/ut-\\$&sns.htm](http://www.publicpurpose.com/ut-$&sns.htm)).
21. *The First Four Years of Metrorail: Travel Changes*, Metropolitan Washington Council of Governments, September 1981, and *The San Diego Trolley: The First Three Years*, San Diego Association of Governments, November 1984.
22. Calculated from Missouri Department of Transportation and Bi-State Development Agency data.
23. Calculated from Tri-Met and Oregon Department of Transportation data.
24. Calculated from Missouri Department of Transportation data.

25. Calculated from National Transit Database, American Public Transit Association and Federal Highway Administration data for 1993 to 1997. 1997 highway volume estimated based upon 1995 to 1997 growth rate.
26. *Characteristics of Urban Transportation Systems*, United States Department of Transportation Federal Transit Administration, September 1992.
27. *Increasing the Productivity of the Nation's Urban Transportation Infrastructure*, John Kain, Ross Gittell, Amrita Daniere, Tsur Summerville and Liu Zhi, United States Department of Transportation Federal Transit Administration, January 1992.
28. See, for example, *The Renaissance of Rail Transit in America*.
29. Calculated from *NPTS*.
30. *NPTS*.
31. Analysis of data from U.S. Department of Transportation, European Council of Transport Ministers and Japan Ministry of Transport.
32. *Transportation Air Quality: Selected Facts and Figures*, United States Department of Transportation Federal Highway Administration, 1996.
33. *National Air Quality and Emissions Trends Report*, United States Environmental Protection Agency, 1996.
34. Calculated from United States Environmental Protection Agency, National Air Pollutant Emission Trends Report, 1900-1996, 1997.
35. "Skies Blue Again in LA.—Cleanest Air in 50 Years," *San Francisco Chronicle*, December 30, 1997.
36. *Report on Funding Levels and Allocation of Funds*, Report of the Secretary of Transportation to the United States Congress, annual.
37. *Clear Air through Transportation: Challenges in Meeting National Air Quality Standards*, United States Department of Transportation and Environmental Protection Agency, August 1993.
38. *Clear Air through Transportation: Challenges in meeting National Air Quality Standards*.
39. *Report on Funding Levels and Allocation of Funds*.
40. *Clear Air through Transportation: Challenges in Meeting National Air Quality Standards*.
41. Whether or not human induced "global warming" exists or is significant is beyond the scope of this paper.
42. Wendell Cox, Jean Love & Samuel A. Brunelli, *Reinventing Transit: Putting Customers First*, American Legislative Exchange Council, December 1993.
43. "Productivity Trends by Passenger Transport Mode," *The Public Purpose: The Urban Transport Fact Book*, Internet: (www.publicpurpose.com/ut-prod.htm).
44. Much higher automobile costs per mile are frequently cited. Most sources use a vehicle mile measure, rather than passenger mile, and assume the costs for a new automobile. The average automobile in the United States is approximately eight years old, not new. Calculated from U.S. Bureau of Commerce and United States Department of Transportation data.
45. All figures calculated from U.S. Department of Transportation data.
46. Calculated from *NTDB*.
47. In 1995, \$598 billion was spent by automobile and light truck users to operate on 3.7 trillion miles - \$0.16 per person mile (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 11.8 miles—\$0.24 per person mile, or \$2.88 per one way trip. Data from U.S. Department of Transportation and United States Department of Commerce.
48. In Milwaukee County the base bus fare is \$1.35.
49. Forty five percent of new rail riders were former automobile drivers in Washington and fifty five percent were former automobile drivers in San Diego (*The First Four Years of Metrorail: Travel Changes* and *The San Diego Trolley: The First Three Years*).
50. Peter Gordon and Harry W. Richardson, *The Counterplan for Transportation in Southern California: Spend Less, Serve More*, Reason Foundation, 1994.
51. *Increasing the Productivity of the Nation's Urban Transportation Infrastructure*.

52. *Increasing the Productivity of the Nation's Urban Transportation Infrastructure.*
53. Automobile and transit bus data from *Transportation Energy Data Book*, United States Department of Energy, Oak Ridge National Laboratory, August 1997. Rail data calculated from *NTDB*. All data includes power generation and refining energy consumption.
54. *Dollars & Sense.*
55. "The Central City 2000 Strategy" recommendations of the Central City Task Force, July 23, 1996.
56. "Portland Lifts Limits on Parking Spaces," *The Oregonian*, October 2, 1997.
57. Compared to the 1980s' rate. Calculated from U.S. Census Bureau data.
58. "Special Report: Downtown St. Louis: Fading Fast", *St. Louis Post-Dispatch*, December 8, 1996.
59. "St. Louis Centre's Owner Considers Cutting Losses, Abandoning Mall," *St. Louis Post-Dispatch*, January 25, 1998.
60. This is not to suggest that light rail accelerated the population loss, only that light rail is not significant.
61. Baltimore, Dallas, Denver, Los Angeles, Portland, Sacramento, San Diego, San Jose, St. Louis.
62. Vacancy analysis based upon data in *Office Vacancy Index of the United States: Second Quarter 1997*, CB Commercial, Internet: (www.cbcommercial.com/corp/vacoff2q97.htm).
63. Light rail has recently opened in Dallas. Virtually all major new office buildings were completed well before light rail.
64. Analysis of private office buildings over 29 stories constructed since 1984.
65. "Expansion and Cooperation: Lambert Field," (editorial), *St. Louis Post-Dispatch*, November 30, 1997.
66. Data from *NTDB* and *NPTS*.
67. *NPTS*, 1990.
68. Calculated from Oregon Department of Transportation and Tri-Met data.
69. Assumes a maximum walking distance of 1/4 mile.
70. Occupant and pedestrian fatalities per 100,000,000 passenger miles. Calculated using 1990-1995 United States Department of Transportation data.
71. "Buffaloed in Buffalo," *The Wall Street Journal*, April 5, 1990 and "Auditor Takes Aim at Metrolink Loan," *St. Louis Post-Dispatch*, July 12, 1994.
72. Calculated from *NTDB*.
73. *Urban Rail Transit Projects: Forecast Versus Actual Ridership and Costs*, United States Department of Transportation, Urban Mass Transportation Administration, October 1989.
74. *APTA Response to the UMTA Report 'Urban Rail Transit Projects: Forecast Versus Actual Ridership and Costs*, American Public Transit Association, September 1990.
75. The author was a member of the Los Angeles County Transportation Commission from 1977 to 1985, and served on the LACTC Rail Transit Committee.
76. Los Angeles Metro Green Line Norwalk-El Segundo, Los Angeles County Transportation Commission, 1989.
77. *Bus and Rail Performance Report*, Los Angeles County Metropolitan Transportation Authority, 1997.
78. In 1985, St. Louis carried 112,000 daily passenger trips. It was projected that daily passenger trips would increase to 172,500 by 1995, after completion of the light rail line. Using passenger mile statistics, it is estimated that daily passenger trips declined 4 percent from 1985 to 1995.
79. *The Renaissance of Rail Transit in America.*
80. Bus equivalents calculated by converting light rail cars to 2.3 buses.

81. *Urban Rail Transit Projects: Forecast Versus Actual Ridership and Costs.*
82. *Report on Funding Levels and Allocation of Funds.*
83. For example, the new Denver International Airport cost at least 300 percent more than projected (including debt service), the Channel Tunnel between England and France experienced a cost overrun of over 100 percent, and the Boston Central Artery highway project will cost double projections by the time it is finished (see Wendell Cox, *Evaluation of the FDOT-FOX Tampa Orlando-Miami High Speed Rail Proposal*, James Madison Institute, April 1997).
84. 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.
85. Charles A. Lave, "Playing the Rail Forecasting Game," *TR News*, September-October 1991.
86. "Danforth Opposes Request Made by Beuchner for Light-Rail Study," *St. Louis Post-Dispatch*, August 5, 1987.
87. 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.
88. 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.
89. Richard Simon, "MTA to Suspend Work of 3 Key Rail Lines," *Los Angeles Times*, January 15, 1998.
90. *Community Link 21: Draft 98 Regional Transportation Plan*, Southern California Association of Governments, 1997.
91. The discussion in this section is based upon analysis of U.S. Census Bureau "urbanized area" data. Urbanized areas are defined to exclude the non-urban (largely rural) land that is included in the periphery of metropolitan areas (metropolitan statistical areas), which are defined by counties.
92. Calculated from U.S. Census Bureau data.
93. *Commuting in America II*, Eno Foundation, U.S. Bureau of Transportation Statistics, Internet: (<http://www.bts.gov>).
94. 1950 transit market share estimated from *Federal Highway Administration* data. 1996 transit market share estimated using data from *Highway Statistics*.
95. "U.S. Metropolitan Area Population & Public Transport Ridership: 1980-1990," "U.S. Urban Public Transport: 1990-1995 Ridership By Metropolitan Area," *The Public Purpose: Urban Transport Fact Book*, Internet: (www.publicpurpose.com/utx-usmd.htm).
96. U.S. Census Bureau data.
97. *NPTS*, 1995.
98. Assumes service reduction at the national rate and a doubling of service intensity to improve speeds in the larger urbanized area to better compete with automobile speeds.
99. Calculated from Highway Statistics.
100. To achieve the densities of the city of Paris would require abandonment of 95 percent of Portland's urban land area.
101. Calculated from U.S. Census Bureau international data.
102. Calculated from Northeast Illinois Planning Commission and U.S. Census Bureau data.
103. *NTDB*.
104. Wolfgang Zuckerman, *End of the Road: The World Car Crisis and How We Solve It*, Post Mills, VT: Chelsea Green, 1991.
105. John Pucher and Christian Lefevre, *The Urban Transport Crisis in Europe and North America*, London: MacMillan Press, Ltd., 1996.
106. Transit is even less competitive with the automobile with respect to non-work trips, because service is less comprehensive and frequent during non-peak hours.
107. Moshe Ben-Akiva and Takayuki Morikawa, *Ridership Attraction of Rail Compared with Bus*, Urban Mass Transportation Administration, December 1991.

108. *Increasing the Productivity of the Nation's Urban Transportation Infrastructure.*
109. In "Choosing the Wrong Technology: Or How to Spend Billions and Reduce Transit 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 too expensive.
110. "Choosing the Wrong Technology: Or How to Spend Billions and Reduce Transit Use."
111. For example, see syndicated columnist Neal Peirce, "Transit's Growing Throughout U.S.," *St. Louis Post-Dispatch*, August 26, 1997.
112. From 1990 to 1995, the annual increase in annual urban street and highway person miles was 104 billion. Total public transit bus and rail person miles were approximately 37 billion in 1995. Light rail person miles were 0.9 billion in 1995. Calculated from *NTDB*, *NPTS* and *Highway Statistics* data.
113. The East-West Corridor includes I-94 from downtown to Waukesha County.
114. *Major Investment Study/Draft Environmental Impact Statement (MIS)*, United States Department of Transportation, Federal Highway Administration, Federal Transit Administration and Wisconsin Department of Transportation, October 1996.
115. The planning process included alternatives for maintaining or improving the Interstate 94 freeway. This paper does not review general purpose freeway alternatives.
116. *Milwaukee East-West Corridor Transportation Study: Locally Light Rail Preferred Alternative*, Wisconsin Department of Transportation, Federal Highway Administration and Federal Transit Administration, May 1997. Costs are for 2014, in 1994 dollars.
117. Ridership projections are not provided for the *Light Rail Preferred Alternative in Milwaukee East-West Corridor Transportation Study: Locally Light Rail Preferred Alternative*. This report has estimated ridership by comparing light rail and bus service levels for the Light Rail Preferred Alternative to the alternatives reviewed in the *MIS*.
118. The recently announced ridership increase for 1997 restores barely 10 percent of the ridership lost since 1980. This analysis relies on 1995 data because it is the latest data available in an industry standard format (National Transit Database).
119. The American Public Transit Association (APTA) estimates that a -0.36 reduction ridership is associated with each 1.00 percent increase in fares. It is assumed that a 0.65 percent ridership loss is generated by each 1.00 percent reduction in service.
120. Despite the general overall increase in transit unit costs, some transit agencies were successful in reducing their costs per hour more than five percent from 1980 to 1995, such as Chicago, San Diego Salt Lake City and St. Louis.
121. All data from or calculated from U.S. Census Bureau data.
122. U.S. Census Bureau.
123. Calculated from *NTDB* and *Highway Statistics*.
124. Assumes a transit service reduction consistent with the national average.
125. U.S. Census Bureau data.
126. According to FHWA-Texas Transportation Institute data, Milwaukee has a Roadway Congestion Index of 1.00, compared to the national metropolitan average of 1.05. Milwaukee's traffic congestion growth ranks 25th out of the 50 urban areas surveyed (from 1988 to 1994).
127. Calculated from data in *MIS*.
128. Lave.
129. *MIS* Table #4.4.
130. Ridership estimated using ratio of bus and light rail service increase relative to the Light Rail-Busway Alternative.
131. A number of transit systems provide effective bus service for mid-day downtown circulation and special events. Examples include Los Angeles (downtown circulation), San Antonio and Denver (both systems provide bus downtown circulation and special event service).
132. Information from city of Los Angeles Department of Transportation.
133. Calculated from data in *MIS*.
134. Light Rail Preferred Alternative traffic volumes estimated based upon ratio of change in traffic volume to transit ridership in the Bus Alternative.

135. Five of the 15 screen line projections show above capacity traffic.
136. The average operating speed of new U.S. light rail lines is 16.2 miles per hour. The Milwaukee operating speed is projected to be nearly 20 percent higher—19.2 miles per hour.
137. Alternatives other than the Null Alternative.
138. *MIS* p. 7-5.
139. *MIS* p. 7-5. Table 7-1 contains no information on “diversion of motorists to transit.”
140. Calculated from *MIS* page 5-39.
141. *MIS* page 5-37.
142. *MIS* Page 5-42.
143. *Report on Funding Levels and Allocation of Funds*.
144. *MIS* p. 7-8.
145. Even the least costly alternative, the Bus Alternative, is relatively expensive compared to automobile commuting, which costs \$2.88 per work trip (“Cost Effectiveness and Light Rail,” above).
146. 224.75 annual work days assumed. Two trips per work day.
147. Comparative data from U.S. Department of Labor Bureau of Labor Statistics Consumer Expenditure series.
148. U.S. Department of Labor Consumer Expenditure data.
149. Without those adjustments, Light Rail-Busway Alternative ridership would be lower and have a cost per new ride of \$437 (\$197,000 per year and \$7.8 million over a 40 year career). The Busway Alternative would cost \$112 per new rider *MIS* calculation method using unadjusted computer model ridership projections.
150. Assumes that 50 percent of new riders would be automobile drivers. In Washington, 45 percent of new riders were automobile drivers (*The First Four Years of Metrorail: Travel Changes*), while 55 percent of new riders were former automobile drivers in San Diego (*The San Diego Trolley: The First Three Years*). All automobile drivers diverted are assumed to be in the peak hour (this has the effect of potentially overstating the number of automobiles removed by light rail during peak hour).
151. Calculated from National Transit Database data.
152. San Diego is excluded from this calculation due to the structural factors that have kept San Diego costs well below industry averages.
153. *MIS* p. 7-16.
154. This assumes that projected capital costs should be no less than average, and that subsequent cost escalation would be 50 percent to 100 percent (consistent with industry experience).
155. *MIS* Table #5.35.
156. Calculation (1,330-260)/10.
157. Calculation: (4,360-260)/30.
158. The light rail alternatives would create more construction jobs than the bus alternatives, reflecting the greater intensity of construction activity that would be attached to building light rail. The same higher level of construction employment would be accomplished, however, by any construction project or combination of projects of similar magnitude.
159. *MIS* page 5-6.
160. *MIS* page S-14.
161. *MIS* page 4-47.
162. While it is projected that transit users would benefit from improved travel times, this would do nothing to reduce traffic congestion or air pollution.

163. Higher speeds would be possible with a higher speed limit.
164. *MIS* Table #7.3.
165. LPA p. 1-1.
166. No projection was made for the Light Rail Preferred Alternative. If the Light Rail Preferred Alternative were to equal the performance of the Light Rail-Busway Alternative, approximately 100 reverse commuters would be served relative to the Null Alternative. It would be considerably less costly to provide the few new reverse commuters with a leased car or free taxi ride.
167. *MIS*, p. 4-59.
168. Fares compared to operating and capital costs.
169. This planning approach is consistent with federal guidelines, which should be revised to eliminate this bias toward higher cost alternatives.
170. It would seem that a standard would be appropriate. In a society in which the average employee is paid approximately \$35,000 per year, an annual subsidy per new rider of \$27,500 (Light Rail Busway Alternative) could be construed as inappropriately high. The selection of the Light Rail Preferred Alternative—based on the Light Rail-Busway Alternative demonstrates that there is no standard. The Preferred Alternative would attract fewer riders than the Bus Alternative, and spend nearly \$700 million in the process.
171. Assumes service elasticity of +0.65 (each one percent increase in service produces a 0.65 percent increase in ridership).
172. Wendell Cox, *VIA Metropolitan Transit: Opportunity Analysis*, San Antonio, TX: Texas Public Policy Foundation, November 1997.
173. Calculated from MCTS and *MIS* data using the APTA fare elasticity formula.
174. Assumes an annual conversion rate of six percent, with operating cost savings of 30 percent (the approximate national average).
175. Wendell Cox, Jean Love and Nick Newton, *Competition in Public Transport: International State of the Art*, Paper delivered to the Fifth International Conference on Competition and Ownership in Passenger Transport (Leeds, UK), May 1997.
176. The over-capacity sections of I-94 comprise approximately one-half of the freeway length in the planning area. It is assumed that the addition of a new general purpose lane in each direction would be approximately one-half the cost of adding non-barrier separated busway along the entire freeway length—approximately \$125 million.
177. This assumes the projected 30,000 daily increase in vehicular trips on I-94 and average vehicle occupancy of 1.6.
178. *Transportation Study 1997: Executive Summary*, The Greater Washington Board of Trade, 1997.
179. Table: East-West Corridor Traffic Volumes, above.
180. First quarter annualized personal income, per the U.S. Department of Commerce data. Social Security taxes and federal corporate income taxes combined were approximately \$675 billion in 1996.
181. Calculated from *NTDB*.
182. Calculated from Southern California Regional Rail Authority data, with Milwaukee annual capital factors used.
183. Calculated from *NTDB* data.
184. Calculated from *NTDB* and *APTA* data.
185. Calculated from *MIS* and Florida Department of Transportation data.
186. Calculated from data in Bruce Murphy, “Rapid Transit,” *Milwaukee*, February 1998. Assumption: automobile driver attraction at the Los Angeles rate.
187. Calculated from Southeast Wisconsin Regional Planning Commission projections cited in “Metra to Milwaukee Price: 140.7 million,” *The Milwaukee Journal-Sentinel*, January 31, 1998. Assumption: automobile driver attraction at the Los Angeles rate (60 percent of riders are former automobile drivers).
188. Assumes 1,000 daily riders, with 40 percent of riders attracted from carpools or the existing express bus service.
189. Calculated from *NTDB* and *APTA* data.

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