MEMORANDUM

To: Ald. Robert Bauman

From: Jeff Osterman, Legislative Reference Bureau

Date: July 23, 2009

Subject: DOES ADDITIONAL HIGHWAY CAPACITY REDUCE TRAFFIC CONGESTION?

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Highway reconstruction plans often call for an expansion of highway capacity through development of additional traffic lanes. The rationale for the additional capacity offered by transportation planners, elected officials and other proponents of highway expansion is that the extra lanes will reduce current and/or future traffic congestion.

The impact of additional highway capacity on traffic congestion is not so clear-cut, however. Numerous articles, studies and research projects have asserted or demonstrated that additional lanes do not reduce congestion, but instead quickly fill up as motorists take advantage of perceived improvements in mobility, resulting in a phenomenon known as "induced traffic" or "generated traffic". Consider the following:

- The understanding that new roads quickly fill up with new traffic has been around for decades. In 1925, the president of the Packard Motor Car Company stated:

  "Since the advent of the automobile…the amount of traffic carried by a main thoroughfare seems to be dependent largely upon how many the thoroughfare can carry. Increasing the width of roadway and making possible an additional lane of travel each way will in many cases find the added capacity entirely taken up within a few months, either by diversion from other less favorable routes or by actual increase in the use of cars by those living in and passing through the city in questions."

- A study by the UC-Berkeley Institute for Transportation Studies concluded that 90% of all new highway capacity added to California's metropolitan areas is filled within 4 years, and 60-70% of all new county-level highway capacity is filled within 2 years.

- The California Legislative Analyst's Office summarized the results of its research on this topic with:

  "New road capacity will typically lead to new traffic, especially in urban areas, because people and businesses benefit from the mobility that the transportation system provides and seek to use it to their benefit… Ultimately, road use will increase, leading to congestion of new road capacity. For this reason, expansion of the existing transportation will rarely alleviate congestion permanently; however, by restraining demand this tendency can be offset and existing congested roads, as well as new roads, can be made to operate efficiently."

- As reported by the Institute of Transportation Engineers, an analysis of time-series travel data for various types of roadways indicates that half of increased road capacity is consumed by induced traffic within about 5 years, and 80% of the additional capacity will eventually be consumed by additional traffic.

- The authors of the same Institute for Transportation Engineers article conclude that:

  "Planning practices that ignore generated traffic can result in inaccurate predictions and faulty decisions. This overstates the benefits of highway capacity expansion projects in congested urban areas and understates the relative benefits of alternative strategies that encourage more efficient use of existing road capacity."

- In the early 1990s, LA's 101 Freeway was expanded from 4 lanes to 5. Average rush-hour speed 10 years later was 32 mph, exactly the same as before the widening. Daily traffic volume increased 5% over the decade.

- Citing "mounting evidence," the American Public Transportation Association reports, "Increasing lane-miles by one percent may induce a nearly equivalent increase in vehicle-miles of travel within a period as short as five years. By inducing significant traffic, additional road building may do little to reduce congestion."

- While additional highway capacity is highly unlikely to reduce the number of vehicles on the road or vehicle-miles traveled, public transportation investments can provide definite congestion relief: the Maryland Department of Transportation estimates that a full railcar removes 200 vehicles from the road, a full bus 60 vehicles and a full van 12 vehicles. Transit is estimated to remove 570,000 vehicles from Maryland traffic daily. Along these same lines, the Texas Transportation Institute's annual congestion report (an analysis of 439 urban areas nationwide) states that, without public transportation, traffic congestion would have risen 16 percent since 2005.

- In a 2007 presentation to Riverside County (California) officials, Brian Taylor, director of UCLA's Institute of Transportation Studies, stated, "If you think you're doing this [adding road capacity] to get rid of traffic congestion, you're going to be sorely mistaken." He said that relief from traffic congestion usually doesn't last long because the more pleasant ride on the expanded highway tends to lure more motorists who otherwise would have avoided the road.

- In a 2009 report on solving urban traffic congestion problems, Todd Litman of the Victoria (Canada) Transport Policy Institute concludes, following an extensive analysis of highway expansion proponents' estimates of the congestion reduction impacts and economic benefits of roadway capacity expansion, that "the most effective congestion reduction program includes both transit service improvements and road pricing to give travelers better options and incentives."

- The Australian Institution of Engineers states in its policy manual:

  "New urban roads always attract traffic…the two main sources are induced traffic (trips that would not otherwise have been made had the road not been built) and diverted traffic (trips that would otherwise have followed some alternative route)."

- On its website, the Public Transport Users Association (Australia) provides several specific examples and statistical evidence from major cities in that country to support the claim that new roads create new traffic and that any reduction in traffic congestion will last only a few years.

BEYOND GRIDLOCK:

Meeting California's Transportation Needs in the Twenty First Century

Surface Transportation Policy Project

May 2000

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The Surface Transportation Policy Project is a national coalition of over 200 organizations working to promote transportation policies that protect neighborhoods, provide better travel choices and promote social equity. STPP has offices in northern California, southern California and Washington, DC. Visit http://www.transact.org/ca for more information or contact the field offices at the addresses below. STPP's California work is made possible in part by funding from the Richard and Rhoda Goldman Fund, the William and Flora Hewlett Foundation, and the David and Lucile Packard Foundation.

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CHAPTER THREE: THE UNDERLYING CAUSES OF TRAFFIC CONGESTION

The underlying causes of congestion are far more complicated than many traditional interests have historically been willing to admit. The ability of available roadway space—the most traditional method of measuring supply or capacity as expressed in lane-miles—to meet traffic demand as measured in vehicle miles traveled, is just one of a set of several underlying factors that research has found contribute to traffic congestion. From this research and from a growing body of experience in both the United States and overseas, it is apparent that traffic congestion is a symptom of a much larger problem, a problem that includes:

- **The Lack of Affordable Housing.** The lack of affordable and mixed-income housing near employment centers, and the imbalance between jobs and housing, creates the notorious two-hour commutes between places like the Central Valley and the Silicon Valley or Lancaster and Los Angeles. California is now home to seven of the ten least affordable housing markets in the country.

- **Sprawling Patterns of New Growth**. Poorly planned sprawling development and land use patterns and zoning codes that separate uses further and further apart require people to travel longer distances. Many short trips that until recently had been made by walking from home to school, between commercial establishments, from work to lunch, are now made by vehicle trips that often occur at similar times and lead to peak hour congestion around intersections and along freeways. Indeed, recent research by the U.S. Department of Transportation found that only 13 percent of the increase in driving is attributable to population growth. The remainder has been a result of a steady growth in the number of trips taken and the length of trips, both primarily products of low-density suburban development that requires ever greater levels of dependency on driving.

  To make matters worse, not only does the typical suburban development model— characterized by low-density cul-de-sacs, wide, high-speed arterials, and massive intersections—make traffic management difficult, it also makes it less cost-effective for transit to serve scattered destinations and makes walking or bicycling both inconvenient and dangerous.

- **Changes in Home to School Travel**. Whereas more than half of all kids walked or bicycled to school in the 1950s, that number has now fallen below 10 percent as streets have become more dangerous due to traffic. Combined with the loss of school bus service, the resulting trend has been an overwhelming increase in parents driving their children to school, clogging local roadways during critical peak hours. An estimated 20-25 percent of rush hour traffic on local streets and roads is now attributable to the school commute.

- **Fiscal Incentives Promoting Sprawl.** Local governments increasingly rely on "big box" commercial developments to generate local revenues through increased sales taxes. Such commercial highway strip development has proven to be incredibly inefficient from the perspective of traffic flow, generating many peak hour trips that tie up intersections for hours at a time. Numerous short vehicle trips between retail stores, services, and fast food outlets are now replacing what used to be walking trips between shops on smaller neighborhood streets and even more recently were walking trips made between stores inside shopping malls.

  Furthermore, fiscal incentives favoring commercial development over residential due to the promise of sales tax revenues has created a vast imbalance between jobs and housing in communities throughout California, requiring long distance commutes between the workplace, stores, other errands and home.

Figure 2: Population increases are often wrongly cited as the primary cause of increased traffic congestion. In reality, sprawling land use patterns are having a far greater impact on the growth in driving (source: U.S. Department of Transportation).

- **Economic Disincentives For Greater Efficiency**. The skewed pricing signals given to travelers appear to make highway travel, even at the most congested periods of the day, entirely free, while public transit and commuter rail are often perceived as too expensive. While tolls and peak hour congestion pricing are politically unpopular and must be handled carefully to ensure social equity, their absence as a traffic demand management tool greatly exacerbates roadway congestion problems.

Build It And They'll Come

A growing body of research has shown that widening highways is only a temporary solution at best to the complex problem of traffic congestion. Indeed, research has pointed to a phenomenon known as "induced traffic" that suggests new and wider highways actually create additional traffic, above and beyond what can be attributed to rapid population increases and economic growth. In larger metropolitan areas, drivers will often abandon carpools and public transit when additional roadway space is made available through highway widenings or new road construction, thus creating additional trips and more traffic. In the longer term, the promise of more convenient transportation access allows commuters to live further from work, increasing development pressures and thus fueling even more traffic demand. (It should be noted that any form of transportation can produce this effect; whether it was "streetcar suburbs" at the turn of the 20th century or new commuter trains attracting Silicon Valley workers to live in the Central Valley with the promise of a more convenient commute.)

TABLE 9: REGIONAL IMPACTS FROM "INDUCED TRAFFIC"

Metropolitan area (UZA)	Forecast annual growth rate in VMT (on freeways & arterials), assuming current growth trends	Forecast annual growth rate in VMT (on freeways & arterials), with no growth in roadway capacity	Percent of total VMT growth attributable to "induced traffic"
Bakersfield	9.0%	6.8%	24.6%
Fresno	5.8%	5.1%	12.4%
Los Angeles	-0.01%	-0.8%	100.0%
Sacramento	3.3%	1.5%	54.6%

San Diego	1.3%	0.4%	72.6%
San Francisco-Oakland	0.6%	-0.4%	100.0%
San Jose	1.3%	0.3%	73.6%
AVERAGE	3.0%	1.6%	45.2%

Note: VMT = vehicle miles traveled or overall mileage driven; Los Angeles and San Francisco have negative growth in VMT when no lane miles are constructed, thus 100% of growth is attributed to the induced travel effect. Source: Robert Noland, 2000.

The Federal Highway Administration has recently concluded that this phenomenon of "induced traffic" does in fact occur quite frequently in metropolitan areas throughout the United States. Another detailed study has also concluded that traffic in the Bay Area and Los Angeles would actually decrease if no new highway expansion took place. It also determined that two-thirds of the growth in traffic in San Jose and San Diego in the coming decades will be attributable to induced demand.

A recent study conducted by the U.C. Berkeley Institute for Transportation Studies concluded that 90 percent of all new highway capacity added to California's metropolitan areas is filled within four years, and 60 percent-70 percent of all new county-level highway capacity is filled within two years. This, authors Mark Hansen and Yuanlin Huang explain, means an additional highway lane-mile constructed in the San Francisco Bay Area, Los Angeles or San Diego regions would increase traffic by 10,000-12,000 vehicle-miles traveled per day; in Sacramento and Stockton would equate to 7,000-8,000 additional VMT; and in smaller but nonetheless rapidly growing areas like Modesto, Merced, Monterey and Bakersfield would translate into an additional 3,000-6,000 VMT per day. The authors conclude:

> "Our results suggest that the urban state highway lane miles added since 1970 have, on the whole, yielded little in the way of level of service improvements. Consistent with previous work, we find that increasing highway supply results in higher vehicle miles traveled (VMT). An induced traffic impact of such magnitude must be considered when assessing road capacity enhancements, whether in a broad policy context or on a project specific basis."

Several other reports in recent years have pointed to similar conclusions. In 1998, the Legislative Analyst's Office revealed the results of its own research on the issue and cautioned policymakers about the promise of relying solely on new highway construction in order to reduce traffic congestion throughout California:

> "New road capacity will typically lead to new traffic, especially in urban areas, because people and businesses benefit from the mobility that the transportation system provides and seek to use it to their benefit... Ultimately, road use will increase, leading to congestion of new road capacity. For this reason, expansion of the existing transportation will rarely alleviate congestion permanently; however, by restraining demand this tendency can be offset and existing congested roads, as well as new roads, can be made to operate efficiently."

The growing belief that induced traffic largely offsets any short-term congestion relief gains also led authorities in the United Kingdom to cancel more than 70 planned highway construction and road expansion projects in the 1990s alone. Similar experiences have been reported by transportation officials in Germany, Holland and Japan. Many of these countries have retooled their transportation programs to incorporate a more balanced approach to managing traffic congestion as well as a new emphasis on growth management techniques, more compact development patterns, and other land use strategies as a way of beginning to combat what officials and experts see as the underlying cause of increasing traffic volumes.

Cost-Effective Congestion Management

Combine the phenomenon of "induced traffic" with the fact that more than 50 percent of all freeway traffic jams are caused by construction-related delays or traffic accidents, and it becomes clear that what California needs is a far more sophisticated approach in trying to manage congestion. Other states have utilized a diversity of strategies including better real-time traveler information technologies, peak-hour congestion pricing, coordination of transportation and land use goals, telecommuting, staggered work hours, strong financial incentives promoting ridesharing and vanpooling, and better traffic incident management.

The experience of other states and countries in attempting to solve traffic congestion problems, in addition to the evidence provided by growing bodies of research, are absolutely critical lessons for policymakers. There is an overwhelming temptation at any level of government to want to believe in both the quick fix to a problem like traffic congestion as well as to hope that by simply throwing more money at it, the problem itself will disappear. But the futility of trying to build our way out of congestion is an emerging reality that has led many other industrialized countries to dramatically alter their approach to transportation. Instead, many states and other countries are beginning to favor more balanced and cost-effective approaches that rely on a diversity of solutions and a more sophisticated overall approach to traffic management.

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Generated traffic: Implications for transport planning

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Abstract:
Generated traffic has three different impacts to consider in transportation planning and project appraisal: 1. It reduces the congestion-reduction benefit that can result from increased road capacity. 2. It often increases external costs, such as downstream congestion, parking demand, uncompensated crash damages and environmental damages. 3. Since it consists of marginal value trips (vehicle travel consumers are most willing to shift or forego if their costs increase), consumer benefits from generated traffic tend to be modest. This article describes how generated traffic occurs, defines different types of generated traffic, discusses their impacts and describes ways to incorporate generated traffic into transport planning and modeling.

Text:
THIS FEATURE DESCRIBES GENERATED TRAFFIC AND INDUCED TRAVEL AND DISCUSSES TECHNIQUES FOR INCORPORATING THEIR IMPACTS INTO TRANSPORT PLANNING AND PROJECT EVALUATION.

TRANSPORTATION PLANNERS often compare traffic to a fluid, assuming that a certain volume of vehicles must flow through the road system like water through a network of pipes. But in many situations urban traffic is more comparable to a gas, which expands to fill available space. Road improvements that reduce users' travel costs tend to attract traffic from other routes, times and modes, and encourage longer and more frequent vehicle trips. This is called generated traffic, referring to increased vehicle traffic volumes at a particular time and location, including travel diverted from other times and routes. A portion of this additional traffic usually consists of induced travel referring to increases in total vehicle trips and distance traveled, excluding diverted traffic. Induced travel is therefore a subcategory of generated traffic.

This additional traffic reflects the economic "law of demand," which states that consumption of a good usually increases as its price (consumers' perceived costs) declines, all else being equal. Reducing congestion reduces the generalized cost of driving, thus encouraging more peak-period vehicle travel. To put this another way, most congested roads have latent travel demand: additional peak-period vehicle trips that will occur if congestion is relieved.

Generated traffic has three different impacts to consider in transportation planning and project appraisal:

1. It reduces the congestion-reduction benefit that can result from increased road capacity.

2. It often increases external costs, such as downstream congestion, parking demand, uncompensated crash damages and environmental damages. This is particularly true of induced travel.

3. Since it consists of marginal value trips (vehicle travel consumers are most willing to shift or forego if their costs increase), consumer benefits from generated traffic tend to be modest.

This is not to suggest that expanding roadway capacity provides no benefits, but generated traffic significantly affects the nature of these benefits. Ignoring generated traffic in transportation planning distorts transport decisions.
This feature describes how generated traffic occurs, defines different types of generated traffic, discusses their impacts and describes ways to incorporate generated traffic into transport planning and modeling.

DEFINING GENERATED TRAFFIC

Generated traffic is the additional vehicle travel that results from a transportation improvement. Traffic congestion causes people to defer trips that are not urgent, choose alternative destinations and modes if possible, and forego avoidable trips. Conversely, road system changes that reduce congestion increase peak-period vehicle travel.

You probably generate traffic yourself If capacity is expanded on nearby roads, you may make more peak-period trips and choose more distant destinations. You might decide, "Since Main Street was widened, I can drive downtown to run errands rather than waiting until after rush hour." When shopping for a home you might say, "Now that the new highway is being built we can consider locations further from town, since traffic will flow faster."

As a result of many such decisions, traffic congestion tends to maintain a self-limiting equilibrium. Road projects that reduce congestion cause additional peak-period vehicle trips until congestion once again constrains further growth.
Figure 1 illustrates this pattern. Traffic volumes increase until congestion develops, then the growth rate declines and achieves equilibrium, as indicated by the curve becoming horizontal. A demand projection made during the growth period will indicate that more capacity is needed, ignoring the tendency of traffic volumes to eventually level off. If additional capacity is added, there will be another period of traffic growth.

Table 1 describes different types of generated traffic. In the short run, most generated traffic consists of trips diverted from other routes, times and modes, called "Triple Convergence."2 Over the long run an increasing portion of generated traffic consists of induced travel. Some of this additional vehicle miles traveled (VMT) may occur on roads that have no added capacity, apparently because road capacity expansion "leverages" automobile-dependent land use patterns.3 For example, a new highway may encourage households and businesses to locate in suburban and exurban areas where per capita vehicle travel is higher, rather than homes in more accessible and multimodal neighborhoods.

Short-run, generated traffic effects tend to represent movement along the demand curve: reduced congestion reduces users' travel costs, but overall vehicle travel demand does not change. Long-run, induced travel effects often represent an outward shift in the demand curve as transportation and land use patterns become more automobile-oriented, and so more driving is required to access ds, services and activities.

The amount of generated traffic tends to increase over time, as more long-term decisions are influenced by the additional capacity, although, the actual occurrence of short-run and long-run impacts can be quite variable. Some short-run effects, such as mode shifts resulting from changes in consumer habits, may continue to accumulate over several years, and some long-run effects, such as changes in development patterns, can begin almost immediately after a project is announced if market conditions are suitable.

These impacts can be considered from two perspectives. Project planners are primarily concerned with generated traffic, since it affects the congestion relief provided by a change in road capacity. Others may be concerned with induced travel, since this tends to have the greatest impact on overall social costs. Simply changing the route or timing of a vehicle trip only affects a minor portion of costs. Increasing vehicle trips and travel increases many costs, including downstream congestion, road- and parking--facility costs, crashes and environmental impacts. Generated traffic that reduces demand for alternative modes or leads to more automobile-dependent land use can increase future transportation costs by reducing travel choice and access.

MEASURING AND MODELING GENERATED TRAFFIC

In recent years an accumulating body of theoretical and empirical evidence based on various analytical techniques has been used to measure generated traffic and its impacts.4 As a result, there is an emerging consensus among transportation professionals that generated traffic and induced travel are real phenomena that must be considered for accurate transport forecasts and economic analysis.5 Findings from some major studies are summarized below:

Figure 1.

Time-series travel data for various types of roadways indicate an elasticity of VMT with respect to lane miles of 0.5 in the short run and 0.8 in the long run.6 This means that half of increased roadway capacity is consumed by additional travel that would not otherwise occur within about five years, and 80 percent of increased road capacity will eventually be consumed by this induced vehicle travel. Urban roads had higher elasticity values than rural roads, as would be expected, due to higher levels of congestion and latent demand.

One study found the elasticity of California state highway traffic with respect to highway capacity to be 0.6 to 0.7 at the county level and 0.9 at the municipal level in the medium run. This means that 60 percent to 90 percent of increased road capacity is filled with new traffic within five years.7 Total vehicle travel increased 1 percent for every 2 percent to 3 percent increase in highway lane miles. Researchers conclude, "it appears that adding road capacity does little to decrease congestion because of the substantial induced traffic."8

A study by leading U.K transportation economists concludes that the elasticity of travel volume with respect to travel time is -0.5 in the short run and -1.0 in the long run.9 This means that reducing travel time on a roadway by 20 percent typically increases traffic volumes by 10 percent in the short run and 20 percent over the long run.

One study found the elasticity of vehicle travel with respect to travel time to be -0.27 in the short run and -0.57 over the long run on urban roads, and -0.67 in the short run and -1.33 in the long run on rural roads.4

The U.S. Department of Transportation (U.S. DOT) Highway Economic Requirements System (HERS) model uses a travel demand elasticity factor of -0.8 for the short run and -1.0 for the long run, meaning that if generalized costs (travel time and vehicle expenses) decrease by 10 percent, vehicle travel is expected to increase 8 percent within five years and a total of 10 percent within 20 years.10

Generated traffic also works in reverse, as shown by a detailed review of studies examining the travel impacts of temporary and permanent reductions in road capacity.11 In such cases, a significant portion of the previous vehicle traffic on the affected route did not reappear on alternative routes. The magnitude of these impacts were similar to those found for generated traffic, although the time scale of response is not necessarily symmetrical.

Of course, the amount of traffic generated by road capacity expansion varies considerably depending on conditions. It is not roadway capacity expansion itself that changes travel behavior, but rather the reduced congestion delays that result. Expanding capacity of an uncongested road will not generate traffic or induce travel (although other improvements, such as paving a dirt road or converting a low-speed road into a high-speed highway often induces vehicle travel on uncongested roads). Increasing capacity on a highly congested urban road tends to cause considerable generated traffic due to high levels of latent demand. In general, the more congested a road is, the more traffic is generated by increased capacity.

Figure 2 shows the estimated range of generated traffic under typical conditions. More than half of added capacity is filled within five years of project completion by additional traffic that would not otherwise occur, with additional but slower growth in later years.

To predict generated traffic, transportation models use "feedback," which recognizes that congestion affects travel behavior.12 Most current models can predict congestion-induced shifts in route, destination and mode, and some can predict shifts between peak and off-peak travel, but few take into account induced travel (more and longer trips).13 Most transport models treat land use development patterns as an exogenous impact unaffected by transportation decisions. Models without fall feedback give inaccurate predictions of traffic congestion and travel speeds, and so cannot accurately evaluate transport policies and projects.

Table 1.

Ignoring the travel suppression effects of congestion overestimates the magnitude of congestion problems if roadway capacity is held constant or reduced and overestimates congestion relief provided by increased road capacity. In one example, modeling a congested road network without feedback underestimated traffic speeds by more than 20 percent and overestimated total vehicle travel by more than 10 percent compared with modeling with feedback.14

Analysis techniques are now available for taking generated traffic into account in project assessment.15 Omitting these techniques tends to overstate the benefits of urban highway capacity expansion. Economic models that fail to consider generated traffic were found in one study to overvalue roadway capacity expansion benefits by 50 percent or more.16 The ranking of preferred projects often changes when feedback is correctly incorporated into project assessment analysis.17 Ignoring generated traffic tends to skew planning and investment decisions toward highway projects and away from No Build and transportation demand management alternatives such as road pricing, transit improvements and commute-trip-reduction programs.18

The Federal Highway Administration (FHWA) Spreadsheet Model for Induced Travel Estimation (SMITE) is a relatively easy-to-use sketch-planning program specifically developed to predict the amount of vehicle traffic likely to be induced by a highway improvement and its effects on consumer welfare and vehicle emissions.19 The U.K Design Manual for Roads and Bridges provides specific instructions on methods to incorporate induced traffic in roadway project economic analysis.20 It includes guidelines for determining the importance of generated traffic in a particular project analysis based on the magnitude of congestion, the elasticity of demand and the magnitude of the travel cost changes produced by the project. Depending on these factors, a simple, intermediate, or complex method is recommended for incorporating induced traffic into project appraisal. Both the FHWA spreadsheet and the U.K. analysis guidelines include recommended elasticity values of vehicle travel with respect to travel time for use in various conditions.

Figure 2.

Another way to incorporate generated traffic in project and policy analysis is to use comprehensive land use/transportation models (TRANUS and MEPLAN are examples) that track transportation improvement benefits through their impacts on land values.21 These may help solve many of the problems associated with current models that fail to address the impacts transportation decisions can have on land use.

COSTS OF GENERATED TRAFFIC

Motor-vehicle traffic imposes a variety of costs, including many that are external (not borne directly by users). External costs are particularly large for urban-peak travel, when most generated traffic occurs.22 The incremental external costs of generated traffic should be included in project evaluations ("incremental" meaning the additional external costs caused by the project's generated traffic compared with the No Build case).23

In the short run, increasing roadway capacity can reduce some external costs. Per-kilometer air emission and crash rates can decrease if traffic flows more freely, but these benefits decline over time and are usually offset as generated traffic leads to renewed congestion and as induced travel increases total vehicle trips and distance traveled.24 In some situations adding capacity can increase total congestion by concentrating traffic on a few links in the network and by reducing travel alternatives such as public transit.25

The magnitude of external costs depend on the type of generated traffic. In general, diverted vehicle trips have the smallest incremental costs. Shifts from one route to another may cause no overall change in external costs, while shifts from off-peak to peak travel can increase downstream congestion, but most other costs are unaffected. Longer trips have moderate incremental costs; they tend to increase crashes and pollution. Induced vehicle trips tend to cause large increases in external costs, including downstream congestion, increased parking costs, crashes and pollution. More dispersed land use patterns and more automobile-- dependent transportation systems are likely to impose the greatest external costs, although they are difficult to measure.26

CALCULATING CONSUMER BENEFITS

Generated traffic represents increased mobility, which provides consumer benefits that must also be considered in project evaluation. However, benefits per trip tend to be modest because generated traffic consists of marginal value vehicle travel, trips that consumers are most willing to shift or forego if their perceived costs increase. To calculate these benefits economists use the "Rule-of-Half," which states that the benefits of additional travel are worth, on average, half the per-trip savings to existing travelers.27 Some newer project evaluation models, such as the FWHA's SMITE and STEAM sketch plan programs, use the Rule-of-Half when calculating generated traffic benefits.28

Figure 3.

Figure 4.

A significant portion of consumer surplus benefits from increased mobility are often capitalized into land values. For example, highway improvements frequently increase urban periphery real estate values, and highway offramps can increase nearby commercial land values.29 These are largely economic transfers rather than net economic gains (increased property values in one area are offset by reductions in property values elsewhere).30

EXAMPLE

A four-lane, 10-kilometer (km) highway between a city and nearby suburbs is congested 1,000 hours per year in each direction. Regional travel demand is predicted to grow at 2 percent per year. A proposal is made to expand the highway to six lanes, costing $25 million in capital expenses and adding $1 million in annual operating expenses.

Figure 3 illustrates predicted traffic volumes. Without the project, peak-hour traffic is limited to 4,000 vehicles in each direction, the maximum capacity of the two-lane highway. When the model ignores the effects of generated traffic, it predicts that traffic volumes will grow at a steady 2 percent per year if the project is implemented. When generated traffic is considered, the model predicts faster growth, the basic 2 percent growth plus additional growth due to generated traffic, until volumes level off at 6,000 vehicles per hour, the maximum capacity of three lanes. Ignoring generated traffic significantly overstates the congestion-reduction benefits (higher traffic speeds) that result from increased road capacity, as indicated in Figure 4.

The model divides generated traffic into diverted trips (changes in trip time, route and mode) and induced vehicle travel (longer and increased trips), assuming that all generated traffic during the first year, and half during the second year, represents diverted trips, and the rest is induced travel. This reflects the tendency of short-run generated traffic to consist primarily of diverted trips, while over the long run an increasing portion is induced travel resulting from structural transportation and land use changes. Incremental external costs (downstream congestion, road and parking facilities, crash and environmental costs) are assumed to average 30 cents per vehicle-- kilometer of induced vehicle travel. User benefits of induced travel are calculated using the Rule-of-Half.

Figure 5 illustrates project benefits (bars above the baseline) and costs (bars below the baseline) using a standard model that ignores generated traffic. This has a positive net present value (NPV) of $50 million, indicating that the project is economically worthwhile. Figure 6 illustrates project benefits and costs when generated traffic is considered. Congestion-reduction benefits decline while additional external costs and consumer benefits are included. The NPV is -$25 million, indicating that the project is not worthwhile.

This example illustrates how generated traffic can significantly impact highway project evaluation. Of course, not every project will shift from positive to negative net present value when generated traffic impacts are considered, and sensitivity analysis should be used to represent the uncertainties associated with predicting generated traffic effects. However, in many situations even lower-bound estimates of generated traffic have significant impacts on analysis results, changing the ranking of solutions, or the optimal design and timing of roadway projects.

COUNTER ARGUMENTS

There is considerable debate about the implications of generated traffic and induced travel. Some highway advocates argue that generated traffic has minor implications for transportation decisionmaking. They emphasize that increasing roadway capacity usually reduces congestion to some degree and that generated traffic represents increased mobility that provides consumer benefits.32 Others point out that demographic and economic changes cause more growth in vehicle travel demand than increased roadway capacity.33 This feature does not disagree with these individual arguments, but makes the following points:

Increased road capacity usually does reduce traffic congestion, at least in the short and medium run. However, failing to consider generated traffic tends to overstate how much congestion will decline and the magnitude of benefits that result, often to a significant degree. To be accurate, estimates of congestion-- reduction benefits must take into account generated traffic and its incremental external costs.

Generated traffic does provide consumer benefits that certainly should be considered in project analysis. However, these benefits tend to be modest because generated traffic consists of marginal value trips, vehicle trips that consumers are most willing to shift or forego if their costs increase. These consumer benefits should be accurately identified and measured.

Many factors contribute to increased motor-vehicle use. But overall trends indicate little about the cost effectiveness of a particular policy or project. Just because demographic or economic factors increase, overall vehicle travel demand does not mean that every roadway must expand proportionally. Other strategies for improving access may provide greater overall social benefit. Only careful economic analysis of each situation, taking into account the effects of generated traffic, can identify the most cost-effective project or policy.

Generated traffic does not necessarily eliminate the benefits of increasing highway capacity, but it significantly changes the nature of these benefits. Considering generated traffic in project analysis provides a more rigorous test of benefits and a more accurate prediction of the optimal solution to transportation problems.

Figure 5.

Figure 6.

CONCLUSIONS

Urban traffic congestion tends to maintain equilibrium. Congestion reaches a point at which it discourages additional peak-period trips. If road capacity increases, peak-period vehicle trips often increase. In the short run this consists primarily of travel diverted from other times, routes and modes. Over the long run an increasing portion consists of an absolute increase in vehicle trips and travel.

Planning practices that ignore generated traffic can result in inaccurate predictions and faulty decisions. This overstates the benefits of highway capacity expansion projects in congested urban areas and understates the relative benefits of alternative strategies that encourage more efficient use of existing road capacity.

Highways with significant congestion tend to be located in major urban areas where the external costs of motor-- vehicle traffic tend to be greatest and transportation alternatives tend to be most viable. As a result, the worse the congestion, the more important it is to fully account for generated traffic and to compare capacity expansion with demand management strategies.34 Of course, each situation must be evaluated individually to determine the optimal solution to congestion problems.

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The Trip Not Taken: Some Thoughts on the Nature and Importance of Induced Travel

BY STEVEN B. COLMAN

INDUCED TRAVEL DEMAND IS A complicated issue that deserves more attention from transportation professionals. The implication of induced demand for transportation planning depends on the magnitude of induced demand, and that magnitude may be highly project-specific. If the induction is significant, transportation professionals may need to greatly alter past transportation-planning practices. Drawing conclusions based simply on past correlations between growth in traffic volumes and growth in highway capacity should be avoided. In other words, correlation does not imply causation.

Since 1945, the United States has experienced unprecedented population, economic and real-income growth. Induced travel should not include changes caused by these factors. Instead, the economist's test of "all other things remain equal" (i.e., what if we do not/did not add capacity to this facility or corridor?) should be used. Sometimes this is represented in graphs and elasticities that include all of the confounding background effects in a single elasticity, because it is difficult to separate the effects of different causal factors. Past research has often settled for using easily measured variables (e.g., capacity change) rather than using the true underlying causative factors (e.g., accessibility and travel-time changes).

To assume that traffic congestion is tied to new highway capacity is a great temptation. But, in fact, highway capacity is usually added where demand is highest, or where congestion is anticipated to occur. This results in a

"chicken and egg" question of which came first-the highway capacity or the land use? On a scattergram of the number of fire trucks owned by various cities vs. the number of annual fires, one would conclude that adding fire trucks will cause more fires in the city.

Because causal propositions are difficult to prove, the induced travel debate often revolves around ideological beliefs, with highway proponents arguing the effect is small or nonexistent, and those opposing major highway projects arguing that it is large. It is widely believed that "traffic congestion tends to maintain a self-limiting equilibrium." But if this were so, wouldn't all freeways be congested? Federal Highway Administration statistics indicate that, in 1998, just over half (56 percent) of the peak-- period travel, and only 36 percent of the route miles, on the Urban Interstate System were congested. This is only the urban portion of the system, where population densities are relatively high and one would expect congestion to occur.

More confusion is added to the debate when link (i.e., route) effects are mixed with corridor and system effects. Widening a congested route will almost assuredly attract traffic from parallel highways. Is that bad? No, in fact it is precisely what is wanted in some cases. Even if the traffic speeds remain constant on one route after widening, it is possible that speeds, vehicle emissions and collision rates may improve on the parallel route.

Travel-time reduction is just a portion of the benefits of reducing congestion. Reduc

tions in collision and pollution costs (due to steadier operating speeds), and even driver stress, need to be considered. Reductions in generalized travel costs in the corridor and system as a whole need to be considered, not just a single route.

The shape of the speed/flow rate curve is also critical to the importance of assessing benefits of additional capacity. Recent research sponsored by the Transportation Research Board shows that this curve is relatively flat (prior to traffic breakdown). This means that once capacity is added, benefits (in improved speed) may persist much longer than previous research has shown. Eventually, traffic growth may reach breakdown, and speeds will fall precipitously but that will not occur for more years than was thought even recently. Furthermore, this problem may be mitigated by limiting access to the freeway with ramp metering and intelligent transportation systems technology, to avoid or delay the onset of saturated conditions.

Induced demand is still undergoing research and discussion. Please submit comments on this topic to Lisa M. Fontana (lfontana@ite.org) at ITE Headquarters.

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THIS IS THE FULL-TEXT.

Geographic Names: United States; US

Descriptors: Traffic control; Planning; Project management; Benefit cost analysis; Consumers
Classification Codes: 2310 (CN=Planning); 9190 (CN=United States); 8350 (CN=Transportation & travel industry); 5340 (CN=Safety management)
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California; Metro Desk

Will More Freeways Bring More Traffic? Transit: Experts propose bigger, faster highways, while critics say they'll just attract more cars.

HUGO MARTIN
TIMES STAFF WRITER
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The 101 Freeway was loathsome and sluggish, with angry commuters stuck in a daily crawl across the San Fernando Valley.

State transportation officials responded 10 years ago with a $76-million freeway-widening project. It worked--for a while.

But critics compared the fix to letting out a man's tight pants to combat obesity.

Today, the 101 Freeway is again exasperatingly slow, with an average speed of about 30 mph during rush hour in each direction. And transportation officials have kicked off a $4.5-million study to find ways to make one of the nation's busiest freeways move freely again.

The 101 Freeway expansion is a prime example of the thorny dilemma facing California as officials begin to spend the largest transportation budget in state history. The extra money will mean bigger, better roads. But roadway expansions like the 101 project have shown that new freeway capacity is often quickly absorbed. And the gains from billions of tax dollars spent can seem ephemeral, at best.

"We have to recognize the total inefficiency of more and more road building and the total stupidity of paving," said Jan Lundberg, founder of the Alliance for a Paving Moratorium, a grass-roots advocacy group based in Arcata, Calif.

Lundberg and other environmentalists say it is time California weaned itself from further freeway construction. Adding more lanes will only encourage more driving, they say. In the end, California's longtime practice of building more freeways to ease gridlock will only lead to more of the same.

"Most roads don't stand up to a tough analysis," Lundberg said.

The freeway construction debate is more crucial than ever in California and particularly in Southern California, where 19 million residents will be joined by a projected 7 million more in the next 20 years.

For decades, the state has offered Californians a steady diet of asphalt to meet growing transportation demands. In the last 10 years, the California Department of Transportation has built 368 miles of carpool lanes and 125 miles of general traffic lanes in Los Angeles

County alone. Today, the state operates a 15,000-mile freeway system that costs nearly $800 million annually to maintain.

Freeway Statistics Go in Wrong Direction

It is no surprise that Californians have developed an appetite for the open road. According to census figures, a greater percentage of Californians drive alone to work now than a decade ago, from 71.6% in 1990 to 72.4% in 2000. In that same period, the number of miles driven by California motorists has jumped by 18%, according to federal transportation statistics.

State officials have substantially increased spending on buses and rail projects in recent years. But it is clear that Caltrans plans to continue to feed the unsatiable demand for more freeway miles.

By the end of the year, one in every five miles of California highways will be under repair or improvement as part of a $7-billion transportation spending package.

"We are making our roads wider, faster, safer," Gov. Gray Davis said last month as he launched the $160-million widening of Interstate 15 in the Inland Empire. "We're keeping our freeways free. And we're getting California motorists moving again."

Even more transportation money is coming down the road now that voters approved Proposition 42, which is expected to pump $36 billion from the gasoline sales tax into transportation projects over 20 years.

But environmentalists and some transportation experts say further freeway widening plans are folly because of the impact of "induced demand." It is the theory that adding new freeway lanes only encourages more driving, offering only temporary traffic relief.

Under the induced demand theory, motorists who would normally shop close to home might make a longer drive, on a newly widened freeway, to a big mall across town.

"When you reduce the cost to access a place [by cutting the drive time] you encourage traffic to that place," said David Burwell, chief executive of the Surface Transportation Policy Project in Washington, D.C. "That is just straight economics."

But the theory of induced demand is not universally accepted.

"I just don't believe it," said David Hartgen, a professor of transportation studies at the University of North Carolina. He suggests that the added traffic on new freeway lanes primarily comes from drivers who previously used surface streets or alternate highway routes. New freeway lanes, therefore, ease congestion for an entire region, Hartgen said.

Last year, UC Davis engineers compared 18 freeway segments that were expanded in the 1970s with similar freeway segments that were not improved. The research found that the traffic growth rates for the improved and unimproved freeways were indistinguishable over a 21-year period.

The study concluded that other factors, such as demographic changes, population growth and the economy, play a bigger role in creating freeway gridlock.

"Our study finds no support for the claim that capacity expansion generates traffic disproportionately on account of the act of expansion itself," the study concluded.

Getting More Drivers to Destinations Faster

Hartgen and other transportation experts say a vast majority of Californians will not use mass transit. They believe bigger, faster freeways are a must. Although most new freeway lanes eventually do become crowded, Hartgen said the extra roadway serves its purpose by getting more motorists to their destinations faster.

One example of a city that has lived by such thinking is Houston.

Throughout most of the 1990s, the Texas Department of Transportation battled traffic congestion around Houston by spending nearly $500 million a year on new freeway construction.

"We were building as fast as we could," said Norman Wigington, a spokesman for the Texas agency.

It worked. From 1990 to 1997, Houston was one of the few major cities in the nation to report a significant drop in freeway congestion. But budget restraints forced a construction pullback in the late 1990s. Freeway tie-ups and gridlock around Houston have since shot up.

"We realized we couldn't [afford to] build our way out of congestion," Wigington said.

The 101 Freeway project showed that Caltrans could not build a permanent solution to gridlock. But the construction did serve a purpose.

In 1990, before the 101 Freeway in the San Fernando Valley was widened, the freeway served an average of 280,000 motorists a day at the intersection with the San Diego Freeway. At that time, the average speed on the 101 from Woodland Hills to downtown Los Angeles during rush hours was 32 mph.

The expansion project that took nearly two years to complete added a fifth lane in each direction, plus a sixth lane for eastbound traffic just west of the San Diego Freeway.

Today, the 101 Freeway from the San Fernando Valley to downtown Los Angeles during the rush hours averages about that same 32 mph. However, the freeway now serves about 15,000 more motorists each day, an increase of about 5%.

More cars are on the way, though. By 2025, traffic on the busy freeway is projected to jump by an additional 37%.

3 Plans Launched to Fix 1 Bottleneck

State officials already have launched three improvement plans, totaling $50 million, to fix the bottleneck at the interchange of the 101 and the San Diego freeways. All three projects are expected to be completed in the next six years.

The latest 101 Freeway expansion plan will consider everything from widening the freeway again to adding a second deck with new vehicle lanes or a trolley line.

Franklin Cofod, a film editor who commutes along the 101 Freeway from his home in Thousand Oaks to his job in Burbank, said he enjoyed the benefits of the widened freeway.

"I'm convinced it did help," said Cofod, who leaves home at 6:30 a.m. to miss some of the freeway's notoriously slow rush-hour traffic.

Another widening project might ease Cofod's commute even further. But he wonders if it makes sense to go down that road again.

"It works, but it doesn't get people out of cars," he said. "It's not a long-term solution to the problem."

PHOTO: The 101 Freeway connects with the 134 and 170 in the San Fernando Valley. The 101 was widened 10 years ago, which eased traffic for a while, but now it's back to a crawl at rush hour.; PHOTOGRAPHER: BRIAN VANDER BRUG / Los Angeles Times

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The Benefits of Public Transportation

Critical Relief for Traffic Congestion

As more and more vehicles crowd the nation's roadways, traffic congestion has an increasingly debilitating effect on our quality of life. Across America, people, business and industry, the economy and the environment pay a higher and higher price for mounting congestion—through delays, lost opportunities, higher costs, increased accidents, reduced competitiveness, pollution, frustration and much more.

The data are clear: Providing fast, affordable, reliable public transportation is essential to blunting the effects of crippling congestion and providing sustained relief that:

- Protects personal freedom, choice and mobility
- Enhances access to opportunity
- Enables economic prosperity
- Protects our communities and the natural environment

Congestion: A Mounting Problem

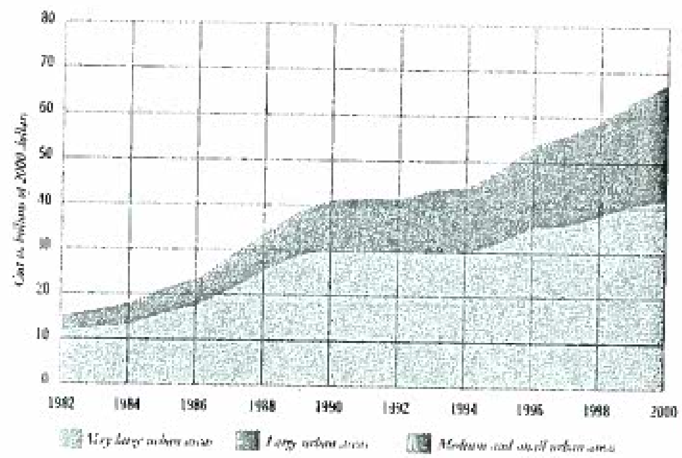
The longest-running study of traffic congestion in America—the Urban Mobility Study conducted annually for 19 years by the Texas Transportation Institute (TTI)—confirms the trend: on a daily basis, Americans are experiencing longer delays, longer periods of congestion, and the spread of congestion across more and more of the nation's roadways. This study of 75 urban areas, ranging in size from New York City to areas with 100,000+ population, suggests that traffic congestion will continue to worsen as the number of vehicle miles traveled continues to grow. The data include the following:

- Each person traveling in peak periods wastes, on average, 62 hours a year—nearly eight full working days—in congestion delays.
- Urban travelers can now expect to encounter congested roadways during seven hours of the day.
- Congestion is becoming more widespread, experienced by nearly 60 percent of urban roadways in 2000.
- Congestion is no longer confined to our largest metropolitan areas. As long ago as 1997, two-thirds of peak-period traffic was congested in areas of 500,000 or less.

"Unless we manage highway congestion, our nation will continue to incur economic costs in foregone productivity, wasted fuel, and a reduced quality of life."

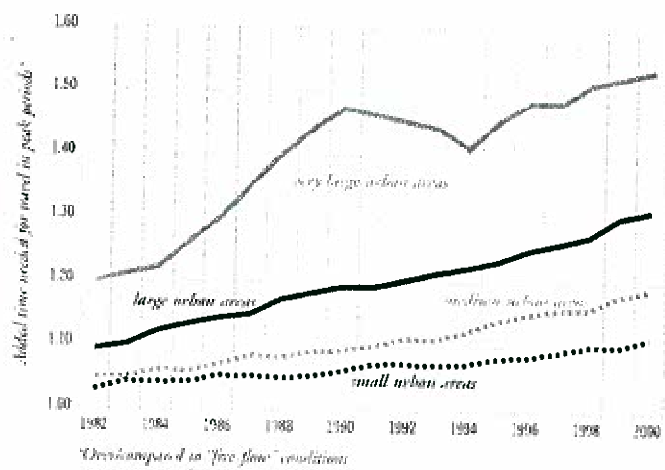
Mary E. Peters, Administrator
Federal Highway Administration

Figure 1
Annual Cost of Congestion



Source: Texas Transportation Institute, 2002 Urban Mobility Study: Mobility Issues and Measures, College Station, Texas, 2002, http://mobility.tamu.edu/ums/study/issues_measures/congestion_cost.stm

Figure 2
Growth in Peak-Period Travel Times



Source: Texas Transportation Institute, 2002 Urban Mobility Study: Mobility Issues and Measures, College Station, Texas 2002, http://mobility.tamu.edu/ums/study/issues_measures/congested_roads.stm

The Cause

Regardless of whether congestion is recurring (traffic regularly exceeds roadway capacity) or non-recurring (predictable and unpredictable events cause delays), there is one root cause of congestion: too many vehicles crowding available road space coupled with a lack of travel options.

Disproportionate increases in private vehicle use. Population and economic growth spur travel demand, which, in the absence of other travel options, results in disproportionate increases in the use of motor vehicles. From 1980 to 2000, the U.S. population grew 24 percent,[4] while the number of registered motor vehicles increased 46 percent and the number of vehicle miles traveled grew 80 percent.[3]

Chronic under-investment in public transportation and lack of travel alternatives reinforce private vehicle use. Despite recent expansion in public transportation services and resulting record ridership increases in some urban areas, relatively few Americans have access to reasonable or attractive transit options.

- Only 4.3 percent of miles on our road system are served by public transportation.
- Only 49 percent of Americans live within one-quarter mile of a transit stop.
- Nearly 60 percent of the U.S. population lives in major metropolitan areas of over 1 million, but only 8.3 percent of households have access to subway service.[5]

Business strategies require more road space. "Just-in-time" business strategies designed to keep America competitive in the global economy require smaller but more frequent deliveries, resulting in more freight traffic on our roadways and more congestion.[6]

Public policies reinforce auto-oriented patterns of development. Sprawling development patterns in America's urban and suburban areas often provide no choice but to use private vehicles for every travel need, continually increasing congestion and requiring ever more land devoted to roads and parking.

The Consequences

The breakdown of our street and highway network is exacting a fearsome price across urban and suburban America. The consequences include:

Staggering costs in lost hours, wasted fuel. According to the TTI study, in 2000 the total cost of congestion in terms of lost hours and wasted fuel was $68 billion. Nationwide, the total annual cost may approach $100 billion.[1]

Costs to individuals and families. The personal costs of congestion are also enormous.

- In 2000, each peak-period road user lost $1,160 in wasted fuel and time, including time shared with family and friends.[1] In Las Vegas, for example, where vehicle travel has increased over 80 percent, each motorist pays hundreds of dollars per year in a "hidden tax" due to delays and wasted fuel caused by traffic congestion.[7]
- The cost of owning and operating a vehicle can run as high as $6,000 or more a year.[8] In New York, where public transportation is widely available, 15.3 percent of consumer expenditures go for transportation; in Houston, where there are fewer transportation options, the figure is 23 percent—50 percent higher.[9]

Higher business costs. In an increasingly competitive global economy that relies on "just-in-time" flows of raw materials and finished products, on-time deliveries are critical. Because trucks are the sole providers of goods to 75 percent of American communities, congestion delays increase business costs.[6] As a consequence of the auto dependence that has created our congestion problem, in 2000, $71.5 billion was lost in wages and productivity due to motor vehicle injuries.[10]

Continued dependence on foreign oil. Nearly 43 percent of America's energy resources are used for transportation—compared to industrial use (39 percent) and residential use (11 percent)—and a substantial amount is consumed because of congestion.[11] The 5.7 billion gallons of gasoline wasted in congestion in 2000 (an average of 100 gallons annually by each peak-period road user) would fill 114 supertankers or 570,000 gasoline trucks.[1]

Growing Public Frustration

Traffic congestion is now a top concern of residents across the country. According to the Federal Highway Administration (FHWA), since 1995 traffic flow has been the only roadway characteristic out of eight that has experienced a decline in public satisfaction levels.[2]

The sentiment is expressed in areas around the country. For example, according to 2000 and 2001 surveys in Houston, congestion has become the number one issue, more important than the economy and crime, which topped the charts in previous surveys.[12] In Atlanta, 63 percent of residents favored expanding transportation options or reducing sprawl, compared to 22 percent who favored expanding roads.[13] Across the country, the FHWA found that 7 of 10 respondents favored expanding existing public transportation, while fewer than 4 in 10 favored building more highways to ease traffic problems.[2]

The Solution: Added Emphasis on Public Transportation

Our options are clear. To relieve congestion, our emphasis—and investment priority—must shift toward dramatic expansion of high-capacity public transportation systems, including light rail, heavy rail, commuter rail, bus rapid transit (BRT), express bus services and transit/HOV lanes. This must be coupled with targeted investments in and better management of the current highway network.

The rationales for greater emphasis on transit are powerful.

Public transportation reduces the number of vehicles on the road and vehicle miles traveled. The Maryland Department of Transportation estimates that:

- A full rail car removes 200 cars from the road.
- A full bus removes 60 cars.
- A full van removes 12 cars.[14]

Public transportation reduces hours of delay in major travel corridors. Increased public transportation use reduces delays for both public transportation riders and highway users. According to an FTA study of six urban corridors served by high-capacity rail transit:

- Public transportation passengers saved 17,400 hours daily over auto travel in the corridors.
- Remaining road users in the corridors saved 22,000 hours of delay per day due to the absence of vehicles from public transportation users.
- Travelers on surrounding roads in the corridors saved an additional 20,700 hours daily as spillover congestion was reduced.

These reductions represent a savings of $225 million annually in the six corridors analyzed.[15]

Public transportation generates substantial savings to the economy. The FTA values the aggregate benefits from transit-related congestion relief at $19.4 billion annually.[19] Another study indicates that every dollar of public funds invested in public transportation returns up to $6 in economic benefits in urban regions.[20]

Public transportation reduces the need for highway expansion. Highway expansion has become increasingly difficult and controversial. There often is not space, money and public support to add roadway capacity needed to create and sustain acceptable conditions.[1] In addition, there is mounting evidence that additions to highway capacity "induce" added traffic. Increasing lane-miles by one percent may induce a nearly equivalent increase in vehicle-miles of travel within a period as short as five years. By inducing significant traffic, additional road building may do little to reduce congestion.[22]

Congestion Relief Provided by Public Transportation

Area	*Congestion relief in key locations at critical times*
Albany, NY	*Preferential treatment for buses along a 16-mile corridor will provide riders with a 15-20 percent savings in travel time.*[15]
Los Angeles, CA	*Transit carries 30 percent of all trips into central Los Angeles. Without transit, Los Angeles would need an additional 1,400 freeway lane-miles.*[16]
Maryland	*Transit removes 570,000 cars from traffic daily.*[14]
Minneapolis, MN	*Buses in the Twin Cities bypass congestion by operating on 200 miles of bus shoulder lanes.*[17]
St. Louis, MO	*MetroLink light rail users keep 12,700 cars a day out of rush-hour traffic.*[18]
San Diego, CA	*Transit carries 18 percent of trips into San Diego, removing 35,000 cars from the road daily.*[16]
San Francisco, CA Bay Bridge Corridor	*Transit carries 38 percent of all trips in the corridor, without which a 50-percent increase in freeway capacity would be needed.*[16]

Benefits Support Other National and Local Goals

Public transportation offers a host of important ancillary benefits by taking the place of private vehicles when and where the highway network is most burdened.

Improved air quality. For every passenger-mile traveled, public transportation produces 95 percent less carbon monoxide, more than 92 percent fewer volatile organic compounds and nearly half as much carbon dioxide and nitrogen oxides.[11]

Reduced energy consumption and dependence. According to Shapiro et al:

- Energy consumed in transportation in 2000 exceeded the energy consumed in producing all the country's goods.
- Public transportation uses about one-half the fuel of private automobiles, SUVs and light trucks per passenger-mile traveled.
- Public transportation users today save the U.S. the equivalent of one month's oil imports from Saudi Arabia, over 850 million gallons a year or 45 million barrels of oil.

Preservation of land for smarter growth and more productive development. As much as one third of a city's land is devoted to serving the motor vehicles when roads, service stations and parking lots are considered. Public transportation drastically reduces the amount of land needed for cars.

- Urban rail systems can provide more capacity in a 100-foot right-of-way than a six-lane freeway requiring a 300-foot right-of-way.[18]
- Required parking spaces can be reduced 30 and 50 percent, respectively, for office and retail development in transit-intensive areas.[21]
- For a peak-period transit trip, the roadway space and time required for an auto passenger may be 25 times greater than for the time and space required for a bus passenger and 60 times greater than the time and space required for a rail transit passenger.[25]

Investing in Policies that Make Public Transportation Work

Public transportation systems in many areas are now beginning to experience their own congestion. Since 1995, public transportation ridership has grown over 22 percent—faster than both highway travel and airline travel—forcing many systems to the limits of their capacity, and sometimes beyond.

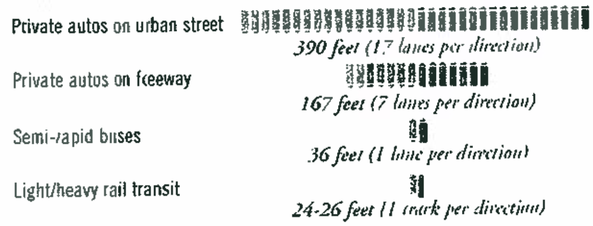
Substantial increases in public transportation investment are needed now to assure that current and planned services remain comfortable, convenient and attractive. To obtain the greatest return from that investment, however, renewed emphasis also must be placed on a number of existing, public transportation-supportive policies and initiatives.

Intelligent transportation systems (ITS). New technologies applied to both public transportation and highways can help relieve congestion. *In public transportation, universal fare systems based on "smartcard" technology; real-time, on-street customer information; and integrated scheduling and dispatching systems can dramatically enhance the attractiveness of public transportation use.*

Figure 3

Comparative Land Displacements of Different Travel Modes

Area required for transporting 15,000 persons per hour by different modes



Source: Vuchic, Vukan R., Transportation for Livable Cities, Center for Urban Policy Research, Rutgers University, New Brunswick, NJ, 1999, p. 58

The public transportation/land-use connection. As a strategy in relieving congestion, public transportation can be more effective with policies and actions that expand "transit-oriented development." *In the interest of serving travel demand more effectively with public transportation, more investment, incentives and pilot projects and programs should be introduced to encourage or provide for increased density, mixed-use and walkable design in development in major public transportation corridors.*

Enlarging and expanding the public transportation commute benefit. Employers can offer a powerful incentive to their employees to help reduce roadway congestion by offering a tax-free transit pass of up to $100 per month. The cost of this commute benefit is deductible as a normal business expense. Alternatively, the transit commute benefit can be provided through payroll deductions before taxes, with employer and employee sharing the cost, as desired. *The $100 ceiling should be raised to match parking cost deductibility, and many more businesses should be encouraged to offer the commuter benefit.*

Location-efficient mortgages. Proximity to public transportation reduces the costs of auto-oriented transportation, freeing household income for other uses, such as home mortgages. Fannie Mae, the nation's largest source of financing for home mortgages, is currently testing a 2-year, $100 million program that makes home buying more affordable for buyers locating near public transportation. *The pilot program is now underway in Chicago, Los Angeles, Orange County, San Francisco and Seattle. Watch for expansion of this partnership of public transportation agencies, mortgage lenders and housing financiers and its effect on congestion.*

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Don't expect new roads to get rid of traffic, researcher warns

By: DAVE DOWNEY - Staff Writer

RIVERSIDE -- Straining as they are to catch up with the growth that is choking area freeways, western Riverside County officials should not expect the roads to magically clear up once new lanes open, a UCLA researcher said Monday.

"If you think you're doing this to get rid of traffic congestion, you're going to be sorely disappointed," said Brian Taylor, director of the UCLA Institute of Transportation Studies, in a presentation to the Western Riverside Council of Governments' board.

The council is a regional planning agency; its 15-member board is composed of county supervisors and elected officials from area cities.

Taylor said relief from traffic congestion usually doesn't last long because the more pleasant ride that results on a particular highway tends to lure more motorists who otherwise would have avoided the road. The same is true of major public transit projects, he said.

A classic example, he said, was when Northern California officials opened the Bay Area Rapid Transit commuter rail system in the 1970s. The train's debut resulted in substantial relief for commuters driving across the San Francisco-Oakland Bay Bridge, but the pleasure was short-lived as many others decided to try out the drive. And several months later, the route was congested again, he said.

A far more effective way to reduce traffic congestion over the long term is to charge tolls on roads, and to price them in a way that prevents them from being overused and clogging up, he said.

"If you want to have a large growing metropolitan area and you don't want to have congestion, the only way to do that is through pricing," said Taylor, while emphasizing that he was not advocating any particular strategy.

He pointed to the 10 miles of toll lanes in the center of Highway 91 between the Riverside-Orange county line and Highway 55. Taylor said those toll lanes, despite representing about one-third of the road's capacity, carry nearly half its traffic.

"As a traffic management tool, it's been a resounding success," he said.

The 91 toll project works, agreed Lake Elsinore Councilman Thomas Buckley, in an interview following the meeting.

"Not only does it carry almost half the traffic, it carries it at more than twice the speed (of the other lanes)," Buckley said.

However, Buckley said he doesn't believe pricing is the only way to reduce congestion. He said adding new lanes in the traditional way -- with tax dollars -- works, too.

And County Supervisor Jeff Stone said it is misleading to suggest that tolls solve the congestion problem, because those who can't afford the charge still wind up sitting in traffic.

"I think that causes a lot of rebellion for people who are stuck on a fixed income and are trying to get home," Stone said.

County Supervisor Bob Buster said traffic congestion isn't bad enough in many parts of western Riverside County to spur commuters to pay tolls on a large scale. Buster said a study, for example, found that, if tolls were charged on the Mid County Parkway planned along the Cajalco Road corridor between Interstates 15 and 215, most people would just take other routes.

At the same time, area officials say they believe there would be plenty of interest in paying a toll to travel on congested I-15 between Lake Elsinore and the San Bernardino County line, and along jammed Highway 91 through Corona. Tolls are being considered for those areas because the local sales tax county voters supported a few years ago and the big state transportation bond they approved last fall won't be enough to build all the new roads planned for the fast-growing western part of the county.

"Reluctantly, that seems to be one of the very few solutions that is available to us if we are going to expand the freeway system in the way that our residents want it to be expanded," Stone said.

Taylor said the congestion that tends to follow quickly on the heels of expansions "doesn't mean nothing's been accomplished."

Expansion always increases the number of people who can travel back and forth, and congestion tends to be a sign of a thriving economy, whereas light traffic is a sign of an anemic one, he said.

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Public Transit Saved 646 Million Hours in Travel Delay in 2007

Texas Transportation Institute's New Congestion Report Drives Home The Value of Public Transportation to Help Alleviate Congestion

The value of public transportation has been validated once again by the newly released Texas Transportation Institute (TTI)'s annual congestion report, the 2009 Urban Mobility Report, which concludes that the cost of congestion increased in 2007 in the 439 urban areas studied.

According to the 2009 Urban Mobility Report, public transportation saved 646 million hours in travel time and 398 million gallons of fuel. Without public transportation, the report states that congestion costs would have risen 16 percent to an additional $13.7 billion since 2005. This TTI congestion report finds that in the largest urban areas, where transit is most available and used, the savings are the greatest, demonstrating the value of public transportation investment.

"This highly respected report, which shows that traffic congestion is still a major problem on our nation's roads, also drives home the value of public transit in helping to reduce congestion," said American Public Transportation Association President William Millar.

"Traffic congestion affects everyone," said Millar. "It not only wastes people's time and money, but it also hurts our country's economic productivity, makes us consume more gasoline, and damages our environment."

Public transportation promotes economic growth and helps our country meet its national goals of reducing greenhouse gases and moving to greater energy independence. Every year, 37 million metric tons of carbon emissions and 4.2 billion gallons of gasoline are saved due to U.S. public transportation use.

"Public transportation has a proven track record of helping to reduce traffic, carbon emissions, and gasoline usage, and increased investment is needed at all levels of government—federal, state, and local," said Millar. "With the September 30 expiration of SAFETEA-LU fast approaching, it is important for Congress to take immediate action to ensure that new federal legislation for public transit and highways is enacted as soon as possible."

To read the 2009 Urban Mobility Report, go to http://mobility.tamu.edu

# # #

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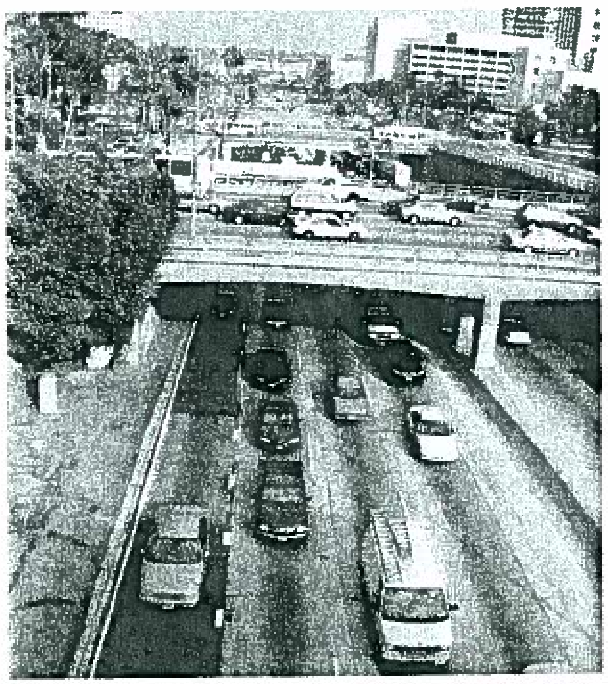
Smart Congestion Reductions

Reevaluating The Role Of Highway Expansion For Improving Urban Transportation

By
Todd Litman
Victoria Transport Policy Institute

19 June 2009



Summary

This report investigates claims that highway capacity expansion is a cost effective and desirable solution to urban traffic congestion problems. It identifies errors in proponents' analysis that overestimate the congestion reduction impacts and economic benefits of roadway capacity expansion, overlook negative impacts of induced travel, and ignore more cost effective alternatives. This is a companion to the report, *Smart Transportation Reductions II: Reevaluating The Role Of Public Transit For Improving Urban Transportation* (www.vtpi.org/cong_reliefII.pdf).

Introduction

Recent publications argue that expanding urban highways is a cost effective and desirable way to reduce traffic congestion (TDA, 2003; AHUA, 2004; Cox and Pisarski, 2004; Hartgen and Fields, 2006; Poole, 2006). They claim that highway expansion provides *congestion relief*, a seductive term since congestion is stressful and costly. People understandably want *relief*. But this may be an example of a misguided solution that exacerbates the problem it was intended to solve and has undesirable unintended consequences.

As an analogy, consider the role laxatives should play relieving constipation. Laxatives are sometimes appropriate, but it is generally best to address constipation by changing diet (more fiber and liquids) and exercise (take a walk), because laxatives' effectiveness declines with frequent use, they can hide more severe diseases, and they can exacerbate other medical problems. A physician who prescribes laxatives without investigating why the patient is constipated or considering other solutions is guilty of malpractice.

Similarly, chronic traffic congestion is often a symptom of more fundamental problems, such as inadequate mobility options that force people to drive for every trip, and dispersed land use patterns that increase travel distances. Where this is true, expanding roads may reduce symptoms in the short term but exacerbate problems over the long term.

Although roadways projects (particularly safety and surface quality improvements) can be an appropriate part of a city's transport program, continually expanding congested highways tends to be inefficient. The first highways in an area often provide large economic returns, but marginal benefits diminish as more capacity is added for the following reasons:

- The first highways projects are generally the most cost effective, because planners are smart enough to prioritize investments. For example, if there are several possible highway alignments on a corridor, those with the greatest benefits and lowest costs are generally built first, leaving less cost effective options for subsequent implementation.
- Interregional highways (those connecting cities) are generally constructed first. They tend to provide greater economic benefits and have lower unit costs than local highway expansion, due to numerous conflicts and high land costs in urban areas.
- Adding capacity tends to provide declining user benefits, since consumers are smart enough to prioritize trips. For example, if highways are congested consumers organize their lives to avoid peak automobile period trips. As highway capacity increases they travel more during peak periods, perhaps driving across town during rush hour for an errand that would be deferred, or moving further away from their worksite. Each additional vehicle mile provides smaller user benefits, since the most valued vehicle-miles are already taken.

This paper investigates claims that highway expansion is a cost effective way to reduce urban traffic congestion, and evaluates the role that roadway capacity expansion should play in improving transportation. This is a companion to the report *Smart Transportation Investments II: Reevaluating The Role Of Public Transit For Improving Urban Transportation* (Litman, 2006b).

Context

Highway expansion advocates are responding to changes in transportation planning practices during the last two decades. Traditional transport planning is *reductionist*; individual organizations are expected to solve narrowly defined problems. For example, transport agencies (then called *highway departments*) were responsible for improving vehicle traffic flow, while transit agencies were responsible for providing mobility for non-drivers, and environmental agencies were responsible for reducing pollution emissions. This type of planning often results in organizations implementing solutions to problems within their mandate that exacerbate other problems facing society, and tends to undervalue strategies that provide multiple benefits.

Modern planning is more comprehensive, taking into account additional impacts and options. It measures transport system performance differently (Litman, 2003). Traditional planning primarily measures *vehicle traffic* using indicators such as roadway level of service (LOS) ratings, average traffic speeds, and travel time indices that only reflect roadway conditions. Planners increasingly evaluate transport based on *mobility* (the movement of people and goods) and *accessibility* (the ease of reaching desired goods, services and activities), which expands the range of possible solutions to transport problems. For example, measuring transport based on *mobility* allows improvements to alternative modes to be considered, and based on *accessibility* allows more accessible land use development to be considered as possible solutions to transport problems.

Highway expansion advocates contend that efforts to increase transport system diversity and encourage more efficient use of the transportation system have been tried and failed, or are harmful to users, and so advocate a return to older transportation planning practices that define transportation simply in terms of motor vehicle traffic.

There is an alternative narrative. During the last century the U.S. built an extensive roadway system that serves users relatively well. Motorists can drive to most destinations with relative convenience, comfort and safety, except under urban-peak conditions. The main transport problems in most urban communities are traffic congestion, inadequate mobility for non-drivers, and various external costs of motor vehicle traffic, including road and parking facility costs, accidents and pollution emissions, all problems reduced with improved travel options, more efficient travel behavior, and more accessible land use development. With a mature roadway system, it may be better to increase transport diversity and encourage efficiency rather than continuing to expand highway capacity.

Evaluating Congestion

Highway expansion advocates tend to exaggerate congestion costs and bias their analysis to favor highway expansion over other types of transportation improvements.

Traffic congestion can be measured in various ways, some of which only reflect motorists' perspective and ignore congestion reduction benefits to travelers who shift modes or from more accessible land use patterns. Table 1 compares various congestion indicators and indicates whether they are comprehensive in terms of considering impacts of alternative modes and more accessible land use.

Table 1 **Roadway Congestion Indicators** (Litman, 2006)

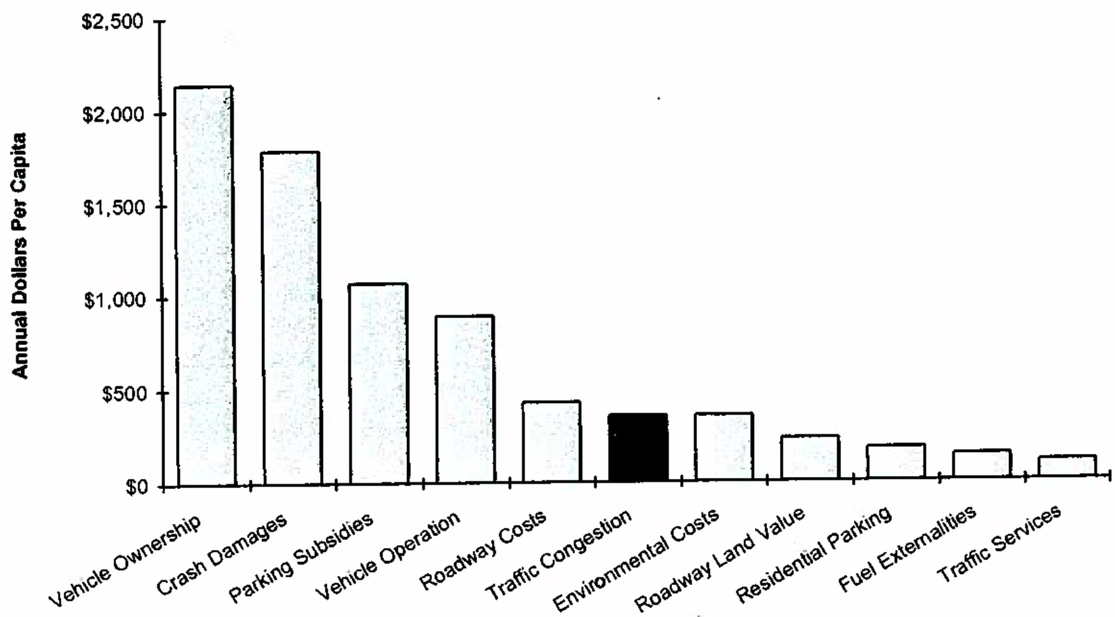
Indicator	Description	Comprehensive?
Roadway Level Of Service (LOS)	Intensity of congestion delays on a particular roadway or at an intersection, rated from A (uncongested) to F (most congested).	No
Travel Time Rate	The ratio of peak period to free-flow travel times, considering only reoccurring delays (normal congestion delays).	No
Travel Time Index	The ratio of peak period to free-flow travel times, considering both reoccurring and incident delays (e.g., traffic crashes).	No
Percent Travel Time In Congestion	Portion of peak-period vehicle or person travel that occurs under congested conditions.	No if for vehicles, yes if for people.
Congested Road Miles	Portion of roadway miles that are congested during peak periods.	No
Congested Time	Estimate of how long congested "rush hour" conditions exist	No
Congested Lane Miles	The number of peak-period lane miles of congested travel.	No
Annual Hours Of Delay	Hours of extra travel time due to congestion.	No if for vehicles, yes if for people.
Annual Delay Per Capita	Hours of extra travel time divided by area population.	Yes
Annual Delay Per Road User	Extra travel time hours divided by peak period road users.	No
Excess Fuel Consumption	Total additional fuel consumption due to congestion.	Yes
Fuel Per Capita	Additional fuel consumption divided by area population	Yes
Annual Congestion Costs	Hours of extra travel time multiplied times a travel time value, plus additional fuel costs. This is a monetized value.	Yes
Congestion Cost Per Capita	Additional travel time costs divided by area population	Yes
Congestion Burden Index (CBI)	Travel rate index multiplied by the proportion of commuters subject to congestion by driving to work.	Yes
Avg. Traffic Speed	Average peak-period vehicle travel speeds.	No
Avg. Commute Travel Time	Average commute trip time.	Yes
Avg. Per Capita Travel Time	Average total time devoted to travel.	Yes

This table summarizes various congestion cost indicators. Some only consider impacts on motorists and so ignore congestion reduction benefits of shifts to alternative modes and more accessible land use.

For example, indicators such as the *Travel Time Index* (*TTI*, the ratio of actual vehicle travel times over freeflow travel times) measure roadway congestion *intensity* but ignore *exposure*. They do not consider the degree to which travelers can avoid roadway congestion by shifting to alternative modes (such as grade-separated High Occupancy Vehicles and public transit, or telecommuting), nor the effects of land use patterns on trip distances. The TTI actually implies that congestion declines if vehicle mileage on uncongested roadways increases, as often occurs when urban fringe highway expansion stimulates more dispersed land use patterns. Other indicators, such as *Congestion Costs Per Capita*, are more comprehensive, because they account for alternative modes and travel distance, and so expand the range of possible solutions.

In addition, the TTI calculates delay relative to freeflowing traffic speeds. Most economists consider this is inappropriate, since it is equivalent to suggesting that a restaurant should be sized to accommodate all the patrons it could attract if it gave food away. This methodology exaggerates congestion cost values. A more appropriate approach is to measure delays beyond a moderate level of congestion (LOS C or D), reflecting what is economically optimal (Bertini, 2005). Winston and Langer (2004) estimated that congestion costs are actually about half of those published by the Texas Transportation Institute. Through intention or ignorance, highway expansion advocates generally select the Travel Time Index and therefore exaggerate congestion problems and undervalue alternative modes and smart growth as congestion reduction strategies.

Figure 1 **Costs Ranked by Magnitude** ("Transportation Costs," VTPI, 2005)



This figure compares various costs of automobile transportation. Congestion is a moderate cost, far lower than vehicle costs, crash damages, parking and roadway costs.

Congestion is a moderate cost compared with other transportation costs, as indicated in Figure 1. Per capita vehicle expenses average about $4,000, crash costs (including lost productivity and monetized values for pain) more than $1,500, parking facilities costs more than $1,000, and roadway costs total about $400, compared with approximately $350 per capita congestion costs estimated by the Texas Transportation Institute.

Highway expansion advocates argue that because VMT grew faster than lane-miles in recent years, there is a roadway capacity "deficit." But highway lane-miles growth rates during the Interstate Highway development period (1950s-70s) should not be compared with later periods, after the highway system was complete, when capacity expansion is only needed to address specific problems. In addition, the greatest increases in VMT involved personal and off-peak travel, and increased urban-peak travel means that more corridors achieve volume thresholds needed for efficient transit and HOV facilities. It is therefore wrong to assume that roadway lane-miles should increase with VMT.

Highway expansion advocates often extrapolate past trends to predict huge future growth in vehicle travel and traffic congestion, although demographic (aging population), economic (rising fuel prices), market (increase consumer preferences for alternative modes), transportation (declining per capita vehicle travel) and management (increased application of transportation systems management) trends are likely to reduce future traffic growth rates (Litman, 2005a). They often use older traffic models that exaggerate future congestion problems by ignoring the tendency of congestion to be self-limiting: congestion tends to limit peak-period traffic growth, as consumers respond by shifting travel time, route, mode and destination ("Traffic Model Improvements," VTPI, 2006). Predictions that roads will reach "gridlock" are generally wrong. This indicates that congestion problems will only increase significantly in areas with rapid population or freight traffic growth, and only if they fail to implement mobility management strategies.

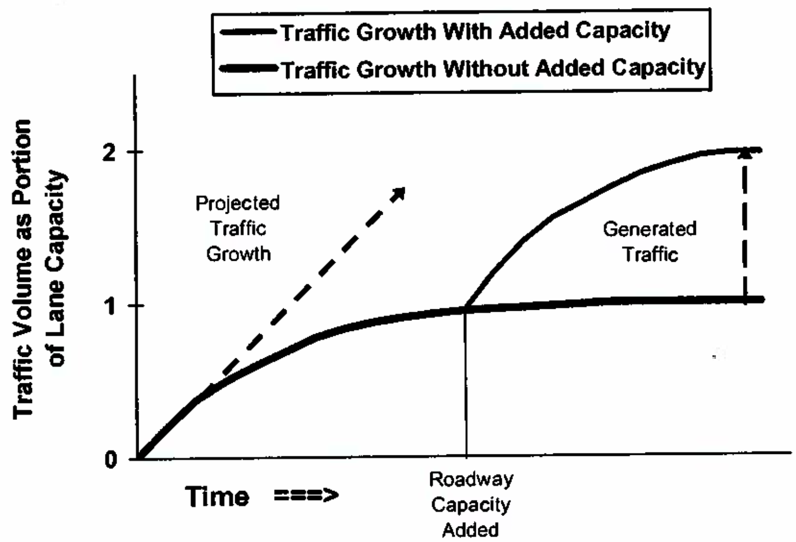
Advocates use exaggerated analysis to justify highway expansion. For example, Cox and Pisarski (2004) cite an obscure French study (Prud'homme and Lee, 1998) showing a positive relationship between employment accessibility and regional productivity to predict huge economic returns from highway capacity expansion. Although the basic concept is appropriate – urban economists find plenty of evidence that improved accessibility increases productivity (Haughwout, 2000) – the particular application is inappropriate since urban highway expansion tends to stimulate more dispersed development that *reduces* rather than *increases* accessibility (Muro and Puentes, 2004).

This is not to suggest that congestion problems should be ignored and congestion reduction efforts are unwarranted, but other costs should be considered when evaluating congestion reduction strategies. For example, it would be misguided to implement a policy or program that reduces congestion costs by 10% if doing so increased vehicle expenses, road or parking facility costs, crashes or environmental damages by just 3% each. On the other hand, a congestion reduction strategy provides far more total benefit it also helps reduce these other costs even by small amounts.

Congestion Reduction Impacts

As mentioned earlier, traffic congestion tends to maintain self-limiting equilibrium: it grows to the point that congestion delays constrain further peak-period vehicle trips, causing travelers to shift to alternative times, routes and mode, and forego lower-value trips. For example, when roads are congested you might choose a closer destination or defer a trip until later, but if congestion is reduced you make those peak-period trips. Similarly, when considering a new home or job you might accept a maximum commute 20 miles if the main highway is congested, but up to 30 miles if the highway is widened and congestion reduced. Figure 2 illustrates this effect. As a result, congestion seldom gets as severe as worst-case predictions warn, and expanding roadways tends to *generate traffic* (increase peak-period vehicle travel, including shifts in time and route) and *induce travel* (increase total vehicle mileage) compared with what would otherwise occur (Litman, 2001).

Figure 2 **How Road Capacity Expansion Generates Traffic** (Litman, 2001)



Traffic grows when roads are uncongested, but growth rates decline as congestion develops, reaching a self-limiting equilibrium (indicated by the curve becoming horizontal). If capacity is added, traffic growth continues until it reaches a new equilibrium. The additional peak-period vehicle travel that results is called "generated traffic." The portion that consists of absolute increases in vehicle travel (as opposed to shifts in time and route) is called "induced travel."

This additional vehicle travel provides direct benefits to travelers, which can be calculated and incorporated into economic evaluation using consumer surplus analysis, and imposes various external costs (Litman, 2001).

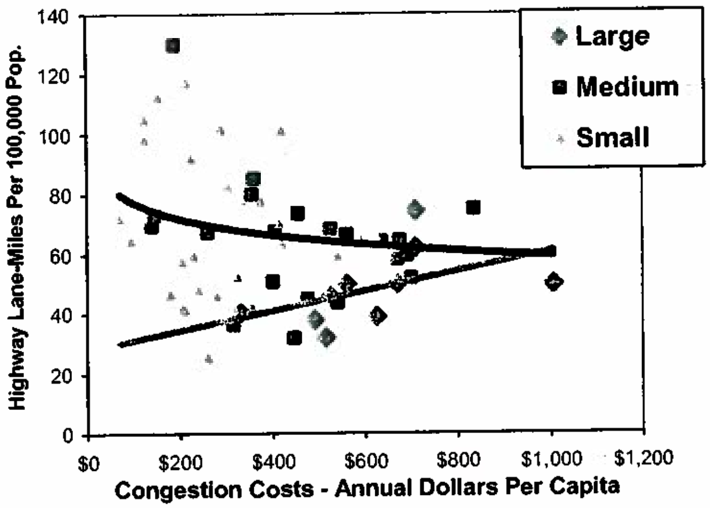
Various studies have quantified the amount of vehicle travel generated and induced by roadway expansion (TRB, 1995; Litman, 2001). Below are summaries of this research.

- Using data on California freeway expansion, traffic volumes, and various demographic and economic factors between 1980 and 1994, Cervero (2003) found the long-term elasticity of VMT with respect to traffic speed to be 0.64, meaning that a 10% increase in speed increases VMT 6.4%, so about 80% of added road capacity is filled with additional peak-period traffic.
- Time-series data indicates an elasticity of vehicle travel with respect to lane miles of 0.5 in the short run, and 0.8 in the long run (Noland, 2001). This means that half of increased roadway capacity is filled with added travel within about 5 years, and 80% of the increased capacity eventually fills. Urban roads, which tend to be most congested, had higher elasticity values than rural roads, as expected due to their greater congestion and latent demand.
- The medium-term elasticity of highway traffic with respect to California state highway capacity was measured to be 0.6-0.7 at the county level and 0.9 at the municipal level (Hansen and Huang, 1997). This means that 60-90% of increased road capacity is filled with new traffic within five years. Each 1% increase in highway lane-miles increased VMT about 0.65%.
- A major study found the following elasticity values for vehicle travel with respect to travel time: urban roads, -0.27 in the short-term and –0.57 over the long term; rural roads, –0.67 in the short term and –1.33 in the long term (Goodwin, 1996). These values are used by the U.S. Federal Highway Administration for highway project evaluation.

Because of these effects it is unsurprising that urban highway expansion provides only modest congestion reductions (STPP, 2001). As stated in the *Urban Mobility Study* (TTI, 2005), "This analysis shows that it would be almost impossible to attempt to maintain a constant congestion level with road construction alone." Zupan (2001) found that each 1% increase in VMT in a U.S. urban region was associated with a 3.5% increase in congestion delays in that region during the 1980's, but this relationship declined during the 1990s, so a 1% increase in VMT increases delays only 1%. This change may reflect increased ability of travelers to avoid peak-period driving, through flextime, telework and suburbanization of destinations, reducing the congestion delay caused by increased travel.

Highway expansion advocates generally ignore or severely understate generated traffic and induced travel impacts. For example, Cox and Pisarski (2004) use a model that only accounts for diverted traffic (trips shifted in time or route) but ignores shifts in mode, destination and trip frequency. Hartgen and Fields (2006) assume that generated traffic would fill just 15% of added roadway capacity, a figure they base on generated traffic rates during the 1960s and 1970s, which is unrealistically low when extremely congested roads are expanded. They also ignore the incremental costs that result from induced vehicle travel, such as increased downstream traffic congestion, road and parking costs, accidents and pollution emissions. They claim that roadway capacity expansion reduces fuel consumption, pollution emissions and accidents, because they measure impacts per vehicle-mile and ignore increased vehicle miles. As a result they significantly exaggerate roadway expansion benefits and understate total costs.

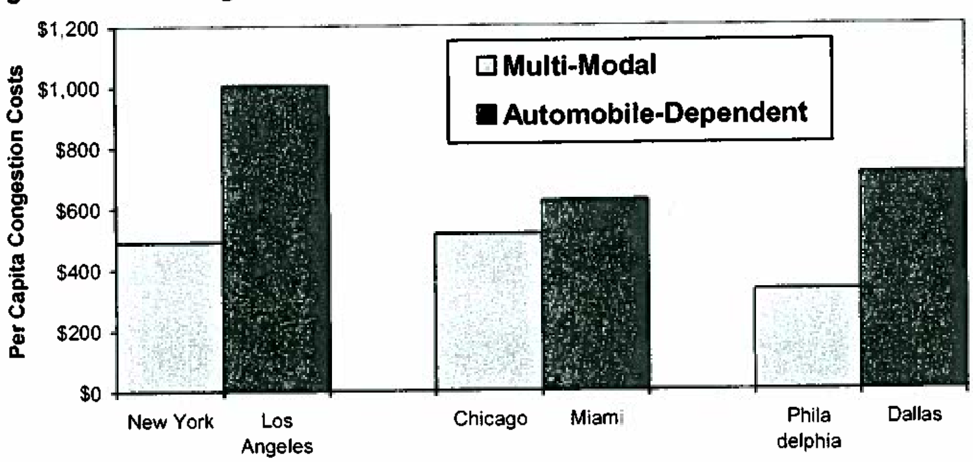
Figure 3 **Congestion Costs Versus Highway Supply** (TTI, 2003; FHWA, 2002)



This figure illustrates the relationship between highway supply and congestion costs. Overall, increased roadway supply provides a small reduction in per capita congestion costs (green line), but among large cities, congestion increases with road supply (orange line).

Figure 3 illustrates the relationship between highway lane-miles and congestion costs. Considering all cities, congestion declines with highway supply but the relationship is weak (green line): a large supply increase provides modest congestion reduction. Among the ten largest cities (orange diamonds) the relationship is negative (orange line): those with more highways tend to have more congestion. Congestion costs are significantly lower in cities with multi-modal transport systems, as illustrated in Figure 4.

Figure 4 **Congestion Costs Compared** (Litman, 2004)

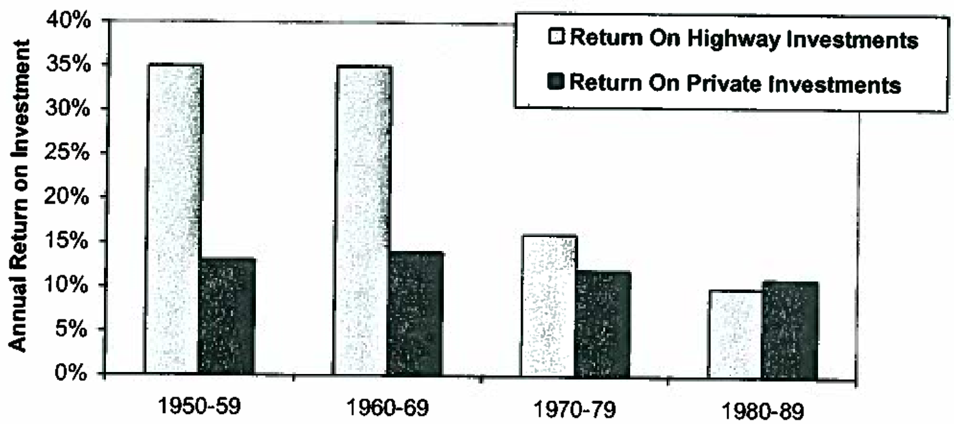


This matched pair analysis indicates that multi-modal cities have much lower per capita congestion costs than automobile-dependent cities with comparable population size.

Economic Value of Roadway Expansion

Advocates claim that highway expansion provides huge economic benefits, but their economic analysis is faulty. If roadway capacity expansion significantly increased economic productivity this effect would be easy to measure, but numerous studies show that economic returns on highway expansion investments are modest and declining (Boarnet and Haughwout, 2000; Shirley and Winston, 2004, "Economic Development Impacts," VTPI, 2006). Figure 5 shows how highway investments provided high annual economic returns during the 1950s and 60s, far higher than returns on private capital, but these declined to below that of private capital investments by the 1980s. This is what economic theory would predict, since the most cost-effective investments have already been made, so more recent projects provide less value at a higher cost.

Figure 5 **Annual Rate of Return** (Nadri and Mamuneas, 1996)



During the 1950s-70s, highway expenditures provided a high return on investment, but this has declined over time as economic theory predicts.

To the degree that highway expansion induces additional vehicle travel and stimulates sprawl it tends to be economically harmful since this increases public infrastructure and service costs ("Land Use Evaluation," VTPI, 2006) and shifts consumer expenditures to goods that provide relatively small regional business activity and employment, as indicated in Table 2. Other congestion reduction strategies provide more positive economic impacts ("Economic Development Impacts," VTPI, 2006).

Table 2 **Economic Impacts of $1 Million Expenditure** (Miller, Robison and Lahr, 1999)

Expenditure Category	Regional Income	Regional Jobs
Automobile Expenditures	$307,000	8.4
Non-automotive Consumer Expenditures	$526,000	17.0
Transit Expenditures	$1,200,000	62.2

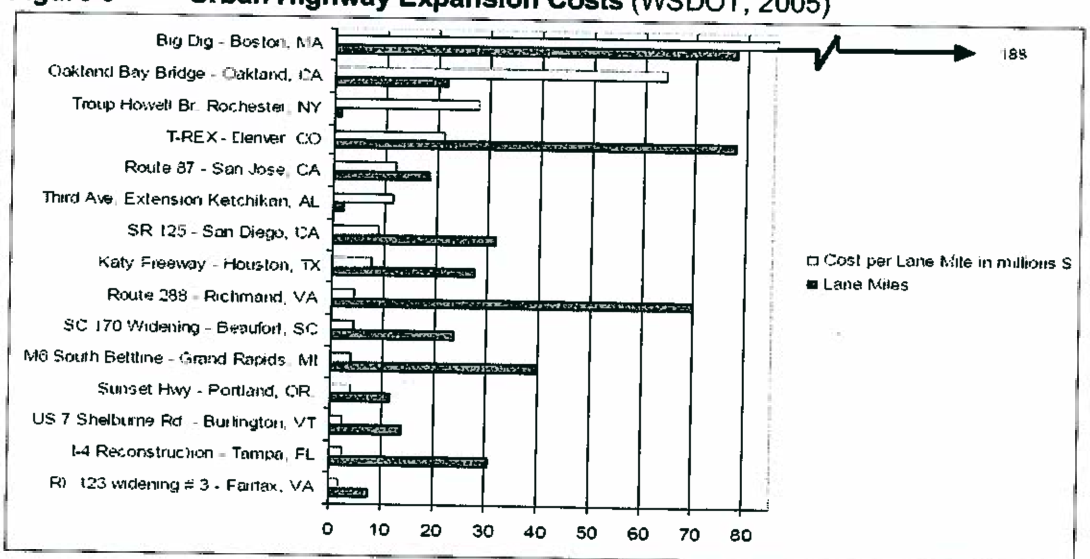
This table shows economic impacts of consumer expenditures in Texas.

Urban Highway Expansion Costs

Highway expansion advocates understate the true costs of the projects they propose. For example, Cox and Pisarski (2003) assume that highway widening costs would average $3 million per lane-mile for arterials and $6 million per lane-mile for freeways, and Hartgen and Fields (2006) assumes that severely congested highways could be expanded for $3.8 million per lane-mile on average, although these projects are mostly in dense urban areas, often requiring land acquisition, complex intersections, bridges, tunneling and community mitigation, plus the delay costs during project construction.

Many recent urban highway projects have much higher unit costs, as illustrated in Figure 6. Of 36 highway projects studied by the Washington State Department of Transportation 13 of them had costs in excess of $10 million per lane mile (WSDOT, 2005). Future projects are likely to have higher unit costs since most jurisdictions have already implemented the cheapest highway projects, and both construction costs and urban land values have increased much faster than inflation in recent years.

Figure 6 **Urban Highway Expansion Costs** (WSDOT, 2005)



This figure illustrates costs per lane-mile for recent U.S. highway projects.

Economic Principles

Economic principles require that costs be borne directly by users unless subsidies are specifically justified ("Market Principles," VTPI, 2006). This means that roadway expansion is only efficient and equitable if projects are fully financed by peak-period tolls. Few highway expansion projects could meet this test. Current U.S. road user revenues (fuel taxes, vehicle registration fees and road tolls) only finance about two-thirds of roadway expenditures – a growing portion of roadway funding comes from general taxes (Wachs, 2003; Litman, 2006a). Highway expansion advocates recommend increasing these taxes to finance their proposed projects. This is inefficient and unfair.

Proponents argue that roadway expansion would only cost a few cents per vehicle-mile, but only about 20% of total vehicle travel occurs under urban-peak conditions, only about half of this (10%) takes place on highways (as opposed to surface streets), less than half of this (<5%) experiences congestion, and less than half of this (approximately 2%) experiences severe congestion. Highway expansion proposals therefore significantly increase taxes on all consumers (even non-motorists would pay increased general taxes) to finance projects that only improve approximately 2% of vehicle mileage.

Assuming, as proponents optimistically claim, that urban highway expansion costs average just $3.8 million per lane-mile, or $140,000 annualized (assuming 7% interest over 30 years), that such lanes normally carry up to 2,000 vehicles per hour, and each lane is congested two hours daily, 300 days a year, the costs would average 12¢ per peak vehicle-mile, or about $1.00 per 8-mile trip. This is the minimum toll needed to efficiently finance the project. Of course, motorists would sometimes willingly pay such a fee for uncongested travel, but experience indicates that tolls exceeding 10¢ per vehicle-mile cause demand to decline significantly as travelers shift time, mode, route or destination to save money ("Road Pricing," VTPI, 2006).

The most effective and efficient solution to congestion is to apply variable pricing on existing highways, with tolls that increase under congested conditions, to manage demand and test users' willingness to pay for roadway improvements, called *congestion pricing* or *value pricing* ("Road Pricing," VTPI, 2006). This gives motorists an incentive to reduce peak period vehicle trips to the level a roadway can accommodate. This is more efficient than letting congestion limit traffic, as we do now, because it allows higher-value trips to outbid lower-value trips (for example, an emergency vehicle, bus with numerous passengers, or truck with valuable cargo can outbid trips that are lower value or could more easily shift to another time or mode), and provides revenue. Such pricing has proven successful in several cities, including Singapore, London and Stockholm.

In practice, revenues are seldom sufficient to finance major highway expansion since pricing reduces travel demand. Tolls can generally only finance a minor portion of total expansion costs. This represents an economic trap, since highway expansion is justified when road use is underpriced but demand is insufficient to finance expansion. Current proposals to fund highway expansion using other funding sources will be ineffective at reducing traffic congestion, are economically inefficient and unfair.

Road Pricing Traps

Road pricing (road tolls) can help reduce traffic congestion in two different and sometimes conflicting ways. In some cases, road pricing policies can create a trap, resulting in inefficient and unfair tolls. It is important that decision-makers understand these differences and their ultimate impacts when evaluating road pricing options.

Congestion pricing refers to tolls structured to reduce peak-period vehicle traffic, and therefore congestion, with higher rates during peak periods and lower rates during off-peak periods, plus features to encourage travelers to shift to alternative routes and modes. Congestion pricing and public transit improvements are complements since improved transit service reduces the fee needed to convince some travelers to shift from driving to public transit, therefore reducing the congestion toll needed to achieve a given reduction in traffic congestion. As a result, congestion pricing revenues are often used to improve public transit services.

Roadway financing tolls are designed to fund highway expansion projects. This type of road pricing is designed to maximize revenue, and so tolls are applied during both peak and off-peak periods (even though off-peak travelers do not benefit from roadway expansion), and sometimes include provisions that intentionally discourage development of alternative routes or modes, in order to force travelers to pay tolls.

Congestion pricing is a preventive strategy: it reduces congestion on existing roads and avoids the need to expand highways. It is comparable to a healthy diet, exercise and cholesterol reduction medicine, which prevent medical problems. Highway tolling to finance roadway capacity expansion is a more difficult and costly treatment, comparable to major heart surgery. Because highway capacity expansion projects have high costs, require maximum revenues (so tolls are applied to off-peak travel, and are often augmented by general taxes), sometimes include provisions that reduce route and mode options, and tend to induce additional travel that imposes additional downstream external costs, using tolls only for highway expansion is inefficient, unfair and generally undesirable.

However, there is often institutional and political resistance to pricing existing roadways. This creates a trap: efficient pricing can only be implemented after problems develop and high costs are incurred, rather than as a preventive strategy to avoid major costs. The result is comparable to a medical system that only major surgery, but not cost-effective preventive health programs.

Only if peak-period toll revenues can fully fund roadway capacity expansion can such projects be considered efficient and equitable. In practice, peak-period road toll revenues are seldom sufficient to fully fund roadway capacity expansion, typically they can finance only 20-40% of project costs. As a result, additional funds are needed from off-peak users or general taxes. The result is inefficient and unfair highway expansion projects.

If highways expansion projects are to be implemented, it is more efficient and equitable to fund them through tolls as much as possible, to prevent induced demand from quickly filling the additional capacity and creating downstream traffic problems, and so that the costs are born directly by users. But it is even more efficient to apply congestion pricing on existing highways *before* implementing expansion projects, in order to avoid or defer the need to expand highways, and test motorists willingness-to-pay for additional capacity. Efficient congestion reduction therefore requires reforms to allow congestion pricing on existing roadways.

Efficient Investment Example

Here is a simple example illustrating "smart" congestion reduction investments. Imagine a four-lane highway is on a corridor with demand of 5,000 peak period trips at zero price (if use of the road is free). Because the road can only accommodates a maximum of 4,000 peak period users (2,000 vehicles per lane) it experiences congestion that causes 1,000 potential peak-period travelers to shift to other times, routes or modes.

The efficient solution to this congestion is to price peak-period use of the highway with tolls set to maintain optimal traffic flow. This also causes 1,000 potential peak period trips to shift, preventing congestion and providing revenue. The optimal toll would vary from minute to minute and day to day to reflect demand, perhaps 2¢ per vehicle-mile for most of the commute period (such as 7:00 until 9:00 in the morning, and 4:00 until 6:00 in the evening), but up to 10¢ per vehicle-mile at the maximum peak (such as 7:50 until 8:00 in the morning, and 5:10 until 5:20 in the evening).

Expanding the highway would only be efficient if peak-period revenues are sufficient to repay all additional costs, which tests users' willingness-to-pay. Highway expansion advocates often violate efficiency principles by requiring off-peak highway users to also pay for such projects, but it is inefficient and unfair to force them to pay for projects that provide them no benefit. Off-peak users should only be required to pay for project features that benefit them, such as improved safety guards.

Assume that highway expansion would cost $8 million per lane-mile, which equals approximately $300,000 per lane-mile in annual costs, or $1,000 per day if there are 300 congested days per year. Since the expanded highway can efficiently carry up to 6,000 vehicles per hour, tolls would need to average at least 17¢ per vehicle-mile ($1,000/6,000 = $0.17) if each lane is only congested and priced one hour per day (inbound in the morning, outbound in the evening), or 8.5¢ per vehicle-mile if congested and priced twice daily. If tolls high enough to recover costs would reduce peak-period travel below 4,000 vehicles the project would not be cost effective; users would be better off with a four-lane highway and lower tolls than a six-lane highway with higher tolls.

It may be efficient to use some toll revenue to improve travel options on the corridor, such as subsidizing vanpool and bus service, contributing to construction of a rail-transit line, or supporting commute trip reduction programs (VTPI, 2006) if doing so reduces peak-period automobile travel demand and therefore highway congestion (Litman, 2006b). Many factors affect the degree to which such services reduce congestion, including their quality and speed, the ease of accessing destinations (such as worksites) by these modes, and community attitudes about their use. In some situations, alternative modes may attract few motorists and do little to reduce congestion, so highway widening is more cost effective. On the other hand, improving alternative modes provides other benefits besides highway congestion reduction, including improved mobility for non-drivers, reduced downstream congestion, parking cost savings, consumer cost savings, accident reductions, energy conservation and reduced pollution, and so may be the preferred solution even if highway widening is cheaper (Litman, 2005b).

Comparing Roadway Expansion With Alternatives

There are various possible congestion reduction strategies ("Congestion Reductions," VTPI, 2006). The best is the one with the largest net benefits per dollar invested ("Least Cost Planning," VTPI, 2006). Highway expansion advocates often fail to compare their proposals with alternatives so it is impossible to determine which is truly optimal.

Public transit improvements can reduce congestion and provide other benefits (Litman, 2006b). Virtually any corridor with enough travel demand to experience congestion has enough to support high quality vanpooling and public transit services. High quality public transit services cost about $100 annually per capita in additional subsidies but reduce consumer costs about $500 annually per capita, reduce congestion 30-50% (Figure 4); and reduce traffic fatality rates 36% compared with peer cities (Litman, 2004).

Road pricing reduced congestion in Singapore, London and Stockholm ("Road Pricing," VTPI, 2006). Reduced traffic volumes provide proportionately larger reductions in delay: pricing in London and Stockholm reduced vehicle traffic about 20% and congestion delays about 30%. Harvey and Deakin (1996) predicted that in Southern California:

- A 1¢ per vehicle-mile congestion fee reduces VMT 2.3% and congestion delay 22.5% (a 9.8 ratio).
- A $3.00 (1991 dollars) daily parking fee reduces VMT 2.7% and delay 7.5% (a 2.8 ratio).
- A 2¢ per vehicle-mile VMT fee reduces VMT 4.4% and congestion delay 9.0% (a 2.0 ratio).

Smart growth development tends to increase the *intensity* of costs such as congestion and roadway construction, due to increased density, but reduces per capita *costs*, since residents drive less and have better travel options.

As more impacts and options are considered, the value of roadway capacity expansion tends to decline and the relative benefits of alternative congestion reduction strategies increases (IEDC, 2006; VTPI, 2006), as illustrated in Table 3.

Table 3 **Roadway Expansion and Mobility Management Benefits** (Litman, 2006a)

Planning Objective	Expand Road Capacity	Public Transit Improvements	Mobility Management	Smart Growth Land Use
Congestion reduction	✓	✓	✓	×/✓
Roadway cost savings	×	✓	✓	×/✓
Parking savings	×	✓	✓	×/✓
Consumer cost savings	×	✓	✓	✓
Transport diversity	×	✓	✓	✓
Improved traffic safety	×	✓	✓	✓
Reduced pollution	×	✓	✓	✓
Energy conservation	×	✓	✓	✓
Efficient land use	×	✓	✓	✓
Improved fitness & health	×	✓	✓	✓

(✓ = helps achieve that objective. × = Contradicts that objective.) Roadway capacity expansion helps reduce congestion but by inducing additional vehicle travel it exacerbates other transport problems. Transit improvements, mobility management and smart growth help achieve many objectives.

What Does Modeling Indicate?

Older four-step traffic models are not very accurate at predicting long-term traffic congestion effects because they have fixed trip table which assume the same number of trips will be made between locations regardless of the level of congestion between them. As a result, they account for shifts in route and mode, and sometime in time, but not in destination or trip frequency ("Model Improvements," VTPI, 2006).

Newer models incorporate more factors and so are more accurate at predicting impacts of specific transportation and land use policies. Johnston (2006) summarizes results from more than three dozen long-range modeling exercises performed in the U.S. and Europe using integrated transport, land use and economic models. These indicate that the most effective way to reduce congestion is to implement integrated programs that include a combination of transit improvements, pricing (fuel taxes, parking charges, or tolls) and smart growth land use development policies. These studies indicate that a reasonable set of policies can reduce total vehicle travel by 10% to 20% over two decades, maintain or improve highway levels-of-service ratings (i.e., they reduce congestion), expand economic activity, increase transport system equity (by distributing benefits broadly), and reduce adverse environmental impacts compared to the base case. Many studies indicate that roadway expansion increases long run congestion by stimulating vehicle travel, dispersed development, and reduced travel options. Expanding road capacity, along with transit capacity, but without changing market incentives to encourage more efficient use of existing roads and parking, results in expensive transit systems with low ridership.

Recent traffic modeling of Puget Sound region transportation improvement options reached similar conclusions (WSDOT, 2006). It found that neither highway widening nor transit investments are by themselves cost effective congestion reduction strategies (although the model has fixed trip tables so it exaggerates highway expansion benefits and underestimates transit improvement benefits). The most effective congestion reduction program includes both transit service improvements and road pricing to give travelers better options and incentives. Table 4 summarizes estimated congestion reduction benefits and project costs. Both have costs that exceed congestion reduction benefits, but transit improvements are more cost effective overall since they provides many additional benefits including road and parking cost savings, consumer cost savings, crash reductions, improved mobility for non-drivers, energy conservation, emission reductions, and support for strategic land use.

Table 4 **Congestion Reduction Economic Analysis** (WSDOT, 2006)

	Congestion Reduction Benefits		Direct Project Costs	
	Lower Estimate	Higher Estimate	Lower Estimate	Higher Estimate
Highway Expansion	$1,500	$2,200	$2,500	$3,700
Transit Improvements	$480	$730	$1,200	$1,500

This table indicates estimated highway and transit congestion reduction benefits and costs, in millions of annualized dollars. Neither approach provides congestion-reduction benefits that exceed costs, but transit provides many additional benefits.

Have Alternatives Failed?

A common theme among highway expansion advocates is that alternatives, such as transit service improvements and mode shift incentives, have been tried but have failed and so should be abandoned in favor of highway expansion. They are wrong.

Only a small portion of total transportation funding is devoted to alternative modes and mobility management programs. For example, in 2004 governments in the U.S. spent about $140 billion on roads and about $26 billion dollars to support public transit. Transit therefore receives about 16% of the total (FHWA, 2005). About half of transit funding is intended to provide basic mobility to non-drivers, such as special mobility services and bus services in suburban and rural areas, so only about 8% of surface transportation budgets are spent on transit services to attract discretionary travelers (people who have the option of driving). In addition, U.S. consumers, businesses and governments devote more than $300 billion in resources to off-street parking, so only about 3% of total investment in surface transport is devoted to transit services intended to attract discretionary users. Nonmotorized transport receives an even small portion of transportation budgets, probably less than 1%, although it represents 5-10% of total trips ("Evaluating Walking and Cycling," VTPI, 2006). This does not include other external costs, such as accidents and pollution impacts, which are often reduced when travel shifts from automobile to transit (Litman, 2006).

Similarly, it is wrong to claim that mobility management strategies, such as commute trip reduction programs, HOV priority and parking pricing have been tried and failed. Although many communities have implemented some mobility management programs, most efforts are modest, representing a minority of employees, roads and parking facilities. Where appropriately implemented such programs have been successful, typically reducing vehicle trips by 10-30% among affected travelers, usually with lower total costs than accommodating an additional urban peak trip, taking into account road, parking and vehicle costs (USEPA, 2005; VTPI, 2006).

Highway expansion advocates exaggerate the portion of transportation resources devoted to alternative modes and mobility management programs because they focus on particular budgets, such as regional capital investments in cities developing major new transit systems, where more than half of total expenditures may be devoted to alternative modes for a few years. However, when all transportation budgets are considered, including parking facility expenditures, and averaged over a longer time period, the portion devoted to alternative modes is generally reasonable. Proportionately large investments in alternative modes can be justified in most communities to offset decades of planning and investments skewed toward automobiles.

Highway expansion advocates argue that it is unfair and inefficient to devote significant resources to improve public transit that carry only a small portion of total trips. But transit carries a much greater portion of travel on major urban corridors, where roadway expansion is costly and transit demand is high, and so is often the most cost effective way of reducing congestion and improving mobility.

Conclusions

Modern transportation planning considers a wider range of impacts and options than was previously common, which supports policies and programs that improve transport options, encourage more efficient travel patterns, and increase land use accessibility. These provide multiple benefits. Some people want to return to traditional planning practices that favor automobile travel and ignore other planning objectives. They advocate highway expansion to reduce congestion. Their analysis tends to:

- Exaggerate highway expansion congestion reduction impacts and economic benefits.
- Ignore or understate generated traffic and induced travel effects.
- Overlook many economic, social and environmental costs of wider highways, increased vehicle traffic and sprawled land use.
- Underestimate the true costs of expanding major urban highways.
- Fail to compare highway expansion with other transportation improvement options.

Some of these errors are subtle, technical, and even counter-intuitive. It is therefore important that decision makers and the general public become informed about issues such as the implications of different congestion indicators, the impacts of generated traffic and induced travel, the economic returns on roadway capacity expansion, and more comprehensive planning techniques.

Such projects are only cost effective if they can be funded by peak-period users. Even based on proponents' optimistic projections, highway expansion projects would cost $200 to $400 annually per urban commuter. When faced with such tolls motorists often prefer to shift route, mode or destination, so such projects cannot recover their costs. As a result, they would require funding from people who do not directly benefits, which is inefficient and inequitable. Described differently, traffic congestion results from market distortions that underprice driving and stimulate sprawl, resulting in economically excessive motor vehicle travel ("Market Principles," VTPI, 2006). Under such circumstances, expanding highways cannot reduce long term congestion, and would increase other transport problems such as downstream congestion, parking demand, accidents, pollution emissions, sprawl, and inadequate mobility for non-drivers.

Alternative strategies can reduce traffic congestion and provide other benefits. Advanced modeling indicates that the most cost effective solution to traffic congestion reduction includes a combination of transit improvements, road pricing and smart growth land use policies. This is most efficient and equitable overall because it reflects market principles, including viable consumer options, cost-based pricing and more neutral public policies.

This is not to suggest that driving is bad or that highways should never be improved. However, when all impacts and options are considered, highway expansion is significantly more costly than advocates claim and provides less overall benefit than many alternative policies and programs.

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Smart Congestion Reductions II

Reevaluating The Role Of Public Transit For Improving Urban Transportation

By
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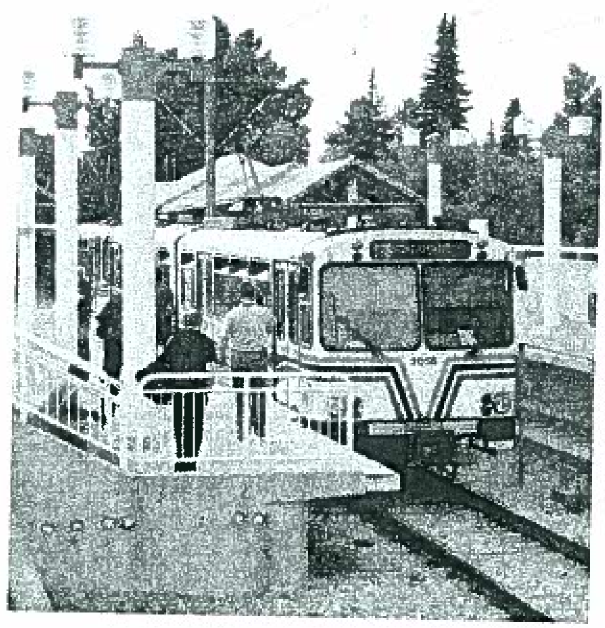
3 February 2009



Abstract

This report investigates the role that public transit can play in reducing traffic congestion and achieving other transportation improvement objectives. It evaluates criticism that urban transit investments are ineffective at reducing traffic congestion and wasteful. This is a companion to the report, *Smart Congestion Reductions: Reevaluating The Role Of Highway Expansion For Improving Urban Transportation* (www.vtpi.org/cong_relief.pdf).

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Introduction

Several recent articles criticize urban rail transit investments on grounds that they are ineffective at reducing traffic congestion and financially wasteful (Stopher, 2004; Taylor, 2004; O'Toole, 2004). This paper evaluates this criticism and investigates the role that public transit can play in reducing traffic congestion and achieving other planning objectives. This is a companion to the report *Smart Congestion Reductions: Reevaluating The Role Of Highway Expansion For Improving Urban Transportation* (Litman, 2006b).

Context

Most industrialized countries have high levels of motor vehicle ownership and extensive roadway systems that provide a high level of service under most conditions. Motorists can drive to most destinations with relative speed, comfort and safety, except under urban-peak conditions. The main transport problems facing most communities are urban-peak traffic congestion; inadequate mobility for non-drivers; and external costs of vehicle use, including road and parking facility costs, accident risk imposed on others, and various environmental impacts resulting from motor vehicle facilities and use.

The question facing policy makers and planners is whether these problems are best addressed by further expanding urban highways to accommodate more vehicle traffic, or instead to emphasize alternative forms of mobility, particular high quality, grade-separated rail transit designed to attract discretionary travelers (people who would otherwise drive). Many experts argue that major urban transit investments are justified.

Critics argue that transit investments are not cost effective, due to their high cost per reduced peak-period automobile trip and therefore cost-inefficient at reducing traffic congestion (O'Toole, 2004; Stopher, 2004). This debate partly reflects differences in how congestion is defined and measured. Traditional planning tended to evaluate transport primarily in terms of motor vehicle *traffic*, using indicators such as *roadway level of service* (LOS) ratings, *average traffic speeds*, and *travel time indices*, which only reflect roadway travel conditions. From this perspective, transit investments are only valuable to the degree that they reduce motorist delay.

However, modern planning tends to use more comprehensive analysis methods that evaluate transport system quality based on *mobility* (the movement of people and goods) and *accessibility* (the ease of reaching desired goods, services and activities). Modern planning also tends to give more consideration to other planning objectives besides congestion reduction, and to a wider range of accessibility improvement strategies, including various mobility management strategies and smart growth land use policies. More comprehensive planning tends to place a higher value on public transit investments, particularly when implemented in conjunction with supportive policies such as road and parking pricing, commute trip reduction programs, and transit oriented land use development.

Transit Congestion Reduction Benefits

High quality public transit reduces traffic congestion costs in three ways (Litman, 2005):

- High-quality, time-competitive transit tends to attract travelers who would otherwise drive, which reduces congestion on parallel roadways (described in the box below). Various studies indicate that automobile travel times tend to converge with those of grade-separated transit.

How Transit and HOV Reduces Traffic Congestion
When a road is congested, even small reductions in traffic volume can significantly increase travel speeds. For example, on a highway lane with 2,000 vehicles per hour a 5% reduction in traffic volumes will typically increase travel speed by about 20 miles per hour and eliminate stop-and-go conditions. Similar benefits occur from traffic volume reductions on congested surface streets.

Urban traffic congestion tends to maintain equilibrium. If congestion increases, people change route, destination, travel time and mode to avoid delay, and if it declines they take additional peak-period vehicle trips. Reducing the point of equilibrium is the only way to reduce long-term congestion. The quality of travel options available affects the level of congestion equilibrium: If alternatives are inferior, motorists will be motorists will resist shifting mode until congestion becomes severe. If alternatives are attractive, motorists will more readily shift mode, reducing the level of congestion equilibrium. Improving travel options can therefore reduce delay both for travelers who shift modes and those who continue to drive.

To attract discretionary riders (travelers who could drive), transit must be fast, comfortable, convenient and affordable. In particular, grade-separated transit provides a speed advantage that tends to attract motorists. When transit is faster than driving, a portion of motorists shift until the highway reaches a new equilibrium (until congestion declines so transit's time advantage attracts no more motorists). The number of motorists who shift may be small, but is enough to reduce delays. Congestion does not disappear but is never as bad as without the parallel grade-separated transit service. Several studies have found that the faster the transit service, the faster the travel speeds on parallel highways (Mogridge, 1990; Lewis and Williams, 1999; Vuchic, 1999). Comparisons between cities also indicate that total congestion delay tends to be lower in areas with good transit service (STPP, 2001; Litman, 2004a).

Shifting traffic from automobile to transit on a particular highway not only reduces congestion on that facility, it also reduces vehicle traffic discharged onto surface streets, providing "downstream" congestion reduction benefits. For example, when comparing *highway* widening with transit improvements, the analysis should account for the additional *surface streets* traffic congestion that would be avoided if transit improvement attracts highway drivers out of their cars.

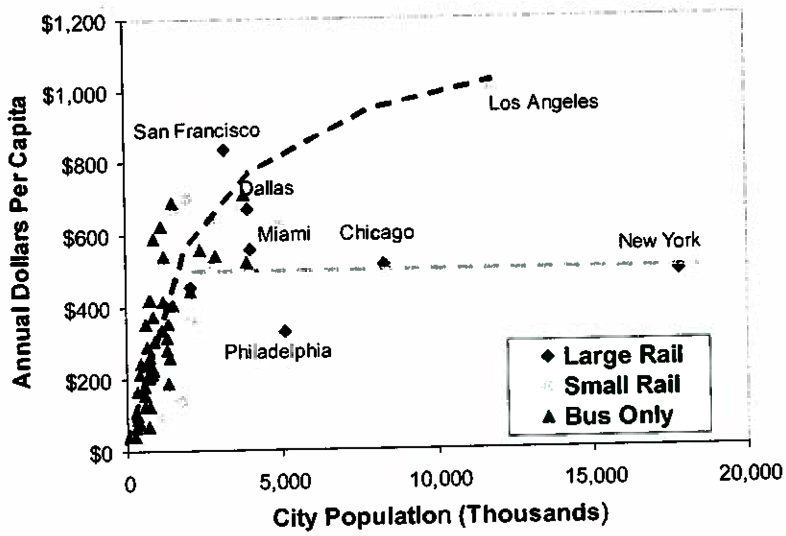
- Rail transit can stimulate transit oriented development (TODs) – compact, mixed-use, walkable urban villages where residents tend to own fewer cars and drive less than if they lived in more automobile-dependent neighborhoods ("Land Use Impacts On Transport," VTPI, 2005). Before-and-after studies indicate that households often reduce their vehicle travel when they move to transit-oriented locations (Podobnik, 2002).
- Quality transit service can reduce travel time costs to people who shift mode. Even if transit takes more minutes, many travelers consider their cost per minute lower than driving if transit service is comfortable (passengers have a seat, vehicles and stations are clean and safe, etc.), allowing passengers to relax and work ("Travel Time Costs," Litman, 2006a; Litman, 2007b).

Winston and Langer (2004) found that motorist and truck congestion delay declines in cities as rail transit mileage expands, but increases as bus transit mileage expands, apparently because buses attract fewer motorists, contribute to congestion, and do little to increase land use accessibility. Garrett and Castelazo (2004) found that congestion growth rates tend to decline in cities after light rail service begins. Baltimore's congestion index increased an average of 2.8% annually before light rail but only 1.5% annually after. Sacramento's index grew 4.5% annually before light rail but only 2.2% after. In St. Louis the index grew an average of 0.89% before light rail, and 0.86% after. Between 1998 and 2003, Portland's population grew 14%, but per capita congestion delay did not increase, possibly due to rail transit investments that significantly increased transit ridership during that period (TTI 2005). Other studies find similar results (LRN 2001).

Baum-Snow and Kahn (2005) found significantly lower average commute travel times in areas near rail transit than in otherwise comparable locations that lack rail, due to the relatively high travel speeds of grade-separated transit compared with automobile or bus commuting under the same conditions. They estimate these savings total 50,000 hours per day in Washington DC, and smaller amounts in other cities. Nelson, et al (2006) used a regional transport model to estimate transit system benefits, including direct users benefits and the congestion-reduction benefits to motorists, in Washington DC. They found that rail transit generates congestion-reduction benefits that exceed subsidies.

Texas Transportation Institute data indicate that congestion costs tend to increase with city size, but not if cities have large, well-established rail transit systems, as illustrated in Figure 1. As a result, New York and Chicago have far less congestion than Los Angeles.

Figure 1 **Congestion Costs** (Litman 2004)



In Bus Only and Small Rail cities, traffic congestion costs tend to increase with city size, as indicated by the dashed curve. But Large Rail cities do not follow this pattern. They have substantially lower congestion costs than comparable size cities.

The TTI report also calculates the congestion cost reductions provided by transit services. These savings average $279 annually per capita in *Large Rail* cities, $88 in *Small Rail* cities, and only $41 in *Bus Only* cities, and total more than $21 billion, over two-thirds of total U.S. public transit subsidies. Another indicator of transit's congestion reduction benefits is the increased traffic delay that occurs when transit service fails due to mechanical failures or strikes. For example, Lo and Hall (2006) found highway traffic speeds declined as much as 20% and rush hour duration increased significantly during the 2003 Los Angeles transit strike, although transit has only a 6.6% regional commute mode share. Speed reductions were particularly large on rail transit corridors.

Kim, Park and Sang (2008) studied traffic volumes on Twin City highways. They found that I-94 traffic volumes grew steadily between 2000 and 2004, when the Hiawatha LRT line was completed. In 2005 traffic volumes on this corridor decreased 2.1% and in 2006 they decreased 4.3%, with particularly large reductions during peak periods, although overall regional vehicle traffic grew during this period. This indicates that LRT service can significantly reduce automobile traffic volumes on parallel highways.

A Congressional Budget Office study (CBO 2008) found that increased fuel prices reduce urban highway traffic speeds and volumes. Each 50¢ per gallon (20%) gasoline price increase reduced traffic volumes on highways with parallel rail transit service by 0.7% on weekdays and 0.2% on weekends, with comparable increases in transit ridership, but no traffic reductions where found on highways that lack parallel rail service.

This leaves little doubt that high quality transit services reduce per capita congestion costs. However, this does not mean that cities with quality transit lack congestion. In fact, congestion, measured as roadway level-of-service or average traffic speeds, is often particularly intense in these cities. However, people in these cities have travel alternatives available on congested corridor, and tend to drive fewer trips and shorter distances, and so they experience fewer annual hours of congestion delay.

Transit travel is often slower on average than automobile travel, but this does not prove that transit is uncompetitive. Automobile travel speeds tend to be much lower than average on the congested urban corridors where grade-separated transit is most common. That national or regional average automobile travel speeds are higher than average rail speeds is irrelevant; what matters is their relative travel speeds on a particular corridor. The criticism that transit is slower than driving can be considered an argument for further improving transit service to increase its speeds, rather than an argument against transit.

Of course, each trip is unique. For some trips transit is not an option because it does not serve a destination, travelers need to carry special loads or require a vehicle available at work. Some travelers prefer driving because they want to smoke or have difficulty walking to transit stations. Some people enjoy driving, even in congested conditions. But that does not negate the value of transit: if quality transit is available, travelers will self-select driving or transit based on their needs and preferences. This maximizes transport system efficiency (since shifts to transit reduce traffic and parking congestion) and consumer benefits (since it allows consumers to choose the optimal option for each trip).

Major transit system expansion generally occurs in large and growing urban areas that experience increasing congestion. As a result, simplistic analysis often shows a positive correlation between rail transit and congestion. Some critics exploit this relationship to "prove" that rail transit increases congestion (O'Toole, 2004), but their analysis fails to indicate the level of congestion that would occur without rail. Critics often use indicators, such as the *Travel Time Index*, which only measure delay to motorists and so ignore delay reductions when people shift to transit, and from transit-oriented development that reduces travel distances. That index actually implies that congestion declines if residents *increase* their vehicle mileage and total travel time, for example, due to more dispersed land use, provided the additional driving occurs in less congested conditions.

Comprehensive Analysis

Critics often argue that transit investments are cost ineffective due to their relatively high cost per unit of congestion reduction, assuming that traffic congestion is the only significant transport problem. More comprehensive analysis considers other benefits, such as those listed in Table 1. As more planning objectives are considered the value of transit investments tend to increase.

Table 1 **Transit Benefits** (Litman, 2005)

Benefits	Description
Congestion Reduction	Reduced traffic congestion.
Facility cost savings	Reduced road and parking facility costs.
Consumer savings	Reduced consumer transportation costs.
Transport diversity	Improved transportation options, particularly for non-drives.
Road safety	Reduced per capita traffic crash rates.
Environmental quality	Reduced pollution emissions and habitat degradation.
Efficient land use	More compact development, reduced sprawl.
Economic development	Efficiencies of agglomeration, increases productivity and wealth.
Community cohesion	Positive interactions among people in a community.
Public health	More physical activity (particularly walking) increases fitness and health.

Rail transit tends to reduce per capita vehicle ownership and use, and encourage more compact, walkable development patterns, which can provide a variety of benefits to society.

For example, comparing U.S. cities according to their rail transit service quality found that those with large rail transit systems have (Litman, 2004):

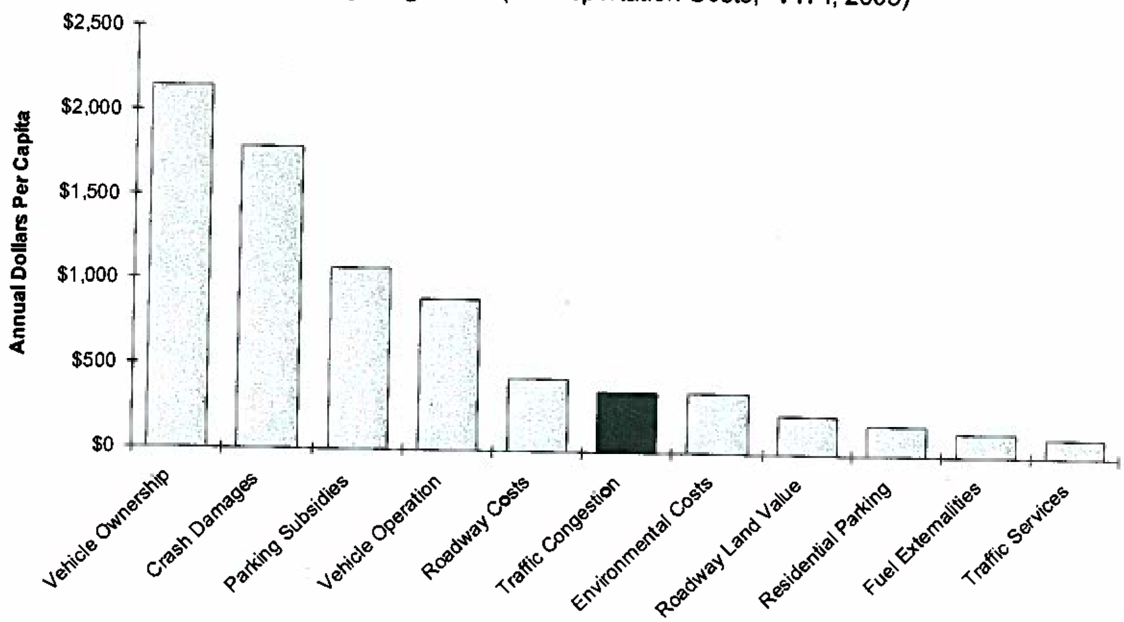
- 400% higher per capita transit ridership (589 versus 118 annual passenger-miles).
- 21% lower per capita motor vehicle mileage (1,958 fewer annual miles).
- 887% higher transit commute mode split (13.4% versus 2.7%).
- 36% lower per capita traffic fatalities (7.5 versus 11.7 annual deaths per 100,000 residents).
- 14% lower per capita consumer transportation expenditures ($448 average annual savings).

- 19% smaller portion of household budgets devoted to transportation (12.0% versus 14.9%).
- 33% lower transit operating costs per passenger-mile (42¢ versus 63¢).
- 58% higher transit service cost recovery (38% versus 24%).
- Transit-oriented development residents are more likely to achieve recommended levels of physical activity through daily walking than residents of automobile-oriented communities.

From a household's perspective, rail transit provides a positive return on investment. Quality rail transit requires on average about $100 annually per capita in additional tax funding but provides about $500 annually per capita in direct consumer transport cost savings. In addition, rail transit tends to increase regional employment, business activity and productivity, plus it improves mobility for non-drivers, reduces the need for motorists to chauffeur non-drivers, improves community livability and improves public health.

Figure 2 illustrates the estimated magnitude of various automobile costs, including vehicle ownership and operation costs, road and parking facilities, traffic services, accidents, environmental damages, and congestion. Congestion costs are relatively modest overall. It would not be cost effective to implement a policy that reduces traffic congestion costs by 10% if it increased other transportation costs, such as vehicle expenses, roadway expanses, crashes or environmental damages, by just 3% each. On the other hand, a congestion reduction strategy provides far more benefit to society if it helps reduce these other costs, even by a small amount.

Figure 2 **Costs Ranked by Magnitude** ("Transportation Costs," VTPI, 2005)



This figure shows Average Car costs per vehicle mile, ranked by magnitude.

Alternative Transportation Improvement Strategies

Of course, critics can legitimately suggest that other strategies may be more cost effective than high-quality rail transit investments. Depending on ideology they may recommend roadway capacity expansion, bus transit improvements, road pricing, or some type of mobility management program to encourage more efficient travel options, including cycling, ridesharing, public transit, telework and flextime. These are all legitimate ways of reducing congestion, but are often poor substitutes for improving public transit service.

Roadway expansion can reduce traffic congestion in the short-run, but these benefit tends to decline over time due to generated traffic, and the additional vehicle travel tends to increase other costs such as downstream traffic congestion and parking demand, total accidents, energy consumption and pollution emissions (Litman, 2006b). Advocates generally exaggerate the benefits and underestimate the full costs of highway expansion.

A major study evaluated congestion reduction options for the Puget Sound region in Washington State (WSDOT, 2006). It concluded that neither highway expansion nor transit improvements alone are cost effective, considering just congestion reduction benefits, but both become cost effective if implemented with roadway pricing.

Table 2 compares the estimated congestion reduction benefits and project costs calculated in the study. Both highway expansion and transit improvements have Benefit/Cost Ratios less than 1.0. Highway expansion ranks somewhat higher than bus improvements, considering just congestion reduction benefits. But, as previously described, highway expansion tends to impose other costs, while transit improvements provide other benefits to users and society. As a result, when all of these impacts are considered transit is often most cost effective.

Table 2 **Congestion Reduction Economic Analysis** (WSDOT, 2006)

	Benefits	Costs	Ratio
Highway Expansion	$1,850	$3,100	0.60
Transit Improvements	$605	$1,350	0.45

This table indicates the midpoint estimated highway and transit congestion reduction benefits and costs, in millions of annualized dollars. Neither approach provides congestion-reduction benefits that exceed costs, but transit provides many additional benefits.

Although, bus transit is excellent for serving dispersed destinations, on major urban corridors rail tends to be more effective at attracting riders (Henry and Litman, 2006), since trains tend to offer a more comfortable ride, are propelled by electric motors rather than internal combustion engines (so train stations tend to be more pleasant than large bus stations), and more cost effective because they carry more passengers per operator. Light rail service has lower operating costs compared to buses with as few as 1,200 peak-period passengers on a corridor, and is particularly appropriate for destinations with more than about 2,000 peak period passenger arrivals to avoid the unpleasant impacts from large congregations of buses at a station (Pushkarev, 1982; Vuchic, 2005).

Critics often claim that bus service is cheaper than rail, but as performance and comfort features are added (grade separation, larger seats, better stations, alternative fuels, etc.), bus system capital costs increase and approach those of rail, and may be offset over the long run by rail's lower operating costs. Operating costs are lower and cost recovery is higher in U.S. cities with large rail transit than those with little or no rail service, due to higher load factors and greater operating efficiency (Vuchic 2005; Henry and Litman 2006). Rail stations are far more effective than bus stations at creating TOD and therefore providing the additional benefits associated with improved neighborhood accessibility and reduced per capita vehicle travel. For these reasons, where ridership volumes are high and transit oriented development is a planning objective, rail may be justified despite higher initial costs.

Road pricing can reduce urban traffic congestion and eliminate the need for grade separated busways, but most cities that have implemented urban road pricing (Singapore, London and Stockholm) have rail transit to accommodate the large numbers of transit passengers that pricing creates. By providing an attractive travel alternative, rail transit reduces the price needed to reduce traffic congestion, benefiting motorists and making rail transit a complement to congestion pricing.

High Occupant Toll (HOT) lanes are *High Occupant Vehicle* (HOV, which include carpools, vanpools and buses) lanes that also allow use by a limited number of low occupancy vehicles that pay a toll. Proponents argue that these toll can finance significant highway expansion and therefore support High Occupant Vehicle use (Poole, 2003), but in practice such revenues can generally cover only a minor portion of project costs without spoiling the lane's travel time advantage ("HOV Priority," VTPI, 2006).

To attract travelers from automobiles, HOV traffic must flow uncongested, maintaining *Level Of Service* (LOS) A or B, which means less than about 1,000 vehicles per hour on a grade-separated highway. Buses and vans typically impose about two *Passenger Car Equivalents* (PCEs) and vans about 1.2. Thus, if during peak hour there are 100 buses and 100 vans causing 320 total PCEs, there will only be space for 680 automobiles. At 25¢ per vehicle-mile this only provides about $100,000 annual revenue ($0.25/veh-mile x 680 vehicles x 2 daily peak-hours x 300 days per year), at best a third of the full cost. All too often HOV and HOT lane optimal capacity is exceeded due to political intervention or a desire to maximize revenues, degrading their quality of service and reducing shifts from driving to high occupant vehicles. It is therefore important that HOT lanes be managed to optimize HOV performance rather than to accommodate other classes of vehicles or maximize revenues.

Mobility management programs that encourage use of alternative modes can be quite effective and beneficial, but they require high quality travel options to be effective (VTPI, 2006). For example, a mobility management marketing programs that encourages travelers to try public transit will fail if the transit service is slow, uncomfortable, unsafe or stigmatized. As a result, mobility management programs are complements rather than substitutes for transit investments.

Qualitative Improvements

Conventional transport modeling measures total hours of travel and congestion delay, but often overlooks important qualitative factors related to transit convenience, comfort, security and reliability, and so tends to undervalue transit service improvements.

For example, many travelers consider time spent on a comfortable train or bus (with padded seats, safe and comfortable stations) to cost less per minute than time spent as a driver in congested traffic (Litman, 2007b). On the other hand, transit travelers tend to assign a high cost to waiting for a transit vehicle, to unreliable service, and to long walking distances between transit stations and destinations. As a result, transit service quality improvements can reduce travel time costs even if they do not reduce the amount of time spent traveling, because costs per minute of travel are reduced. This suggests that it could be more cost effective to shift resources currently devoted to reducing motorists' traffic congestion delays to improving public transit service quality, for example, by increasing transit frequency, providing more comfortable vehicles, providing better user information (such as real time information on transit vehicle arrival times), nicer stations, improved security and better walking conditions around stations (Litman, 2007c).

Conclusions

High quality public transit reduces traffic congestion by attracting travelers who would otherwise drive. As public transit service improves on a corridor (including improved speed, convenience, comfort and affordability), congestion levels on parallel roadways tends to decline. Grade-separated rail transit tends to reduce congestion directly and help create more accessible communities where there are good travel options and travel distances are shorter, which reduces per capita congestion costs.

Many peak period travelers would prefer to drive less and rely more on alternative modes, provided they are convenient, comfortable, flexible, safe, affordable and prestigious. Since transit travel times and travel time costs vary depending on attributes such as comfort, reliability and access, transit service quality improvements can be considered equivalent to traffic congestion reductions. For example, increasing train and bus service frequency, which reduces the waiting times and crowding, or locating more worksites closer to transit stations reduces travel time costs, even if there is no increase in transit vehicle speeds.

Below is the general ranking of strategies, considering only their ability to reduce traffic congestion reduction (not considering other impacts and objectives):

1. Congestion pricing (higher road and parking fees during peak periods).
2. Other mobility management strategies (commute trip reduction programs).
3. High quality public transit (particularly grade separated transit).
4. Highway capacity expansion.
5. Smart growth land use policies.

Transit investments by themselves are not usually the most cost effective way to reduce roadway congestion. However, they become more cost effective at reducing congestion if implemented with complementary road pricing, mobility management strategies and smart growth land use policies. Conversely, transit service improvements support road pricing, mobility management and smart growth, making these more effective and politically acceptable. Congestion reduction is just one of many benefits provided by transit improvements. Other benefits provided by public transit, such as road and parking cost savings, consumer cost savings, accident reductions and improved mobility for non-drivers, are of equal or greater value than congestion reductions. When all impacts are considered, transit investments are often cost effective.

Conventional transportation economic evaluation practices tend to undervalue transit investments by ignoring many benefits including downstream traffic reduction, user savings and benefits, improved mobility for non-drivers, and support for strategic land use objectives. This is not to say that every transit project is optimal or that transit investments alone will solve every transport problem. However, various studies indicate that considering all impacts and planning objectives, transit improvements are often cost effective investments.

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Common Urban Myths About Transport

Myth: Freeways relieve traffic congestion

Fact: They may provide some short-term relief, but within a short time the extra road capacity generates more traffic than there was before. In the long term freeways just allow congestion to grow further: they don't reduce it.

> LIFE WILL CERTAINLY IMPROVE ONCE WE HAVE A TRIPLE BY-PASS
> The major arteries leading to the very heart of our city are becoming increasingly clogged.... Fortunately, there is a remedy. It will come from having a $1.5 billion by-pass operation that will link and upgrade Melbourne's three major arteries - the Tullamarine Freeway, the Westgate Freeway and (via the Domain Tunnel) the South Eastern Arterial.... Traffic will again flow freely in and around the Central Activities District, because there will be far less through traffic using our inner city streets. Travel times will be substantially reduced.
> ---Melbourne City Link Authority advertisement, May 1995
>
> It was hailed as a solution to some of Melbourne's worst traffic problems. Now, four years after it opened, the CityLink tollway is the focus of a new traffic nightmare - worsening peak-hour congestion on the roads that feed into it.
> ---*The Age*, 11 November 2004
>
> The Western Ring Road has been an outstanding success since it was built in the 1990s. However, the ring road is now experiencing high levels of congestion, particularly in peak periods, and it is time for its capacity to be significantly enhanced.
> ---Roads Minister Tim Pallas, *Laverton Star*, 10 July 2007

Road planners often promise that freeway building will relieve traffic congestion, especially on the arterial roads that freeways bypass. But the promised relief, if it arrives at all, is usually only temporary.

Official acknowledgement that freeways do not relieve traffic congestion is found in numerous places. For example, in April 2005 VicRoads told a planning panel examining new road construction in central Geelong that the $400 million Geelong Bypass will not, as popularly supposed, relieve traffic congestion on major roads like Latrobe Terrace. Supporting the proposed removal of a heritage overlay to allow a left turn slip lane to be built, VicRoads submitted that

> there is likely to be a reduction in traffic volumes of up to 17% in Latrobe Terrace.... immediately on completion of the Geelong Bypass. However the natural growth of traffic (approx 2% per year), as well as a redistribution of traffic from other north/south routes, is expected to result in traffic volumes.... returning to their pre-Bypass volumes in a relatively short period of time.

Similarly, a 2004 report by traffic consultants Parsons Brinkerhoff for the City of Whitehorse confirmed that building the Mitcham-Frankston Freeway (MFF) will do nothing to relieve traffic congestion at the intersection of Springvale Road and Whitehorse Road. Even the road lobby themselves now concede Eastlink will not relieve congestion in the worst 'red spots' on Springvale Road.

> [T]he analysis demonstrates that in future years the existing arrangement and [proposed] intersection treatments result in the Springvale / Whitehorse intersection operating either at or over capacity for traffic scenarios which assume the MFF to be operating (tolled or otherwise). This is an important conclusion as it indicates that the Springvale / Whitehorse intersection will operate overcapacity in future years, even in a traffic scenario which assumes MFF is to be built i.e. solely relying on the traffic redistribution effects of the MFF is unlikely to provide a long term solution to the problems of the Springvale / Whitehorse intersection.
> ---*Springvale Road Traffic Improvements Feasibility Project Stage 2: Final Option Review*, August 2004, p.25

> EASTLINK will not ease traffic congestion in Whitehorse, with the long-term outlook for roads "hopeless", a Whitehorse councillor says. Cr Chris Aubrey said the heavy congestion on roads such as Springvale Road in Nunawading would not be eased in the long term by EastLink. "In the first year of the freeway [EastLink], traffic will be reduced by 20 per cent but every year there is a 7 per cent increase in traffic. So in two to three years it will cancel out."
> ---"Traffic Trouble", *Whitehorse Weekly*, 8 March 2006

> The notorious Nunawading intersection is a prime example. Despite repeated calls from the public to fix it there has been continued inaction by the State Government.... Eastlink was never going to solve the problem.
> ---Peter Daly (RACV), *Herald Sun*, 15 September 2008

But the best known official debunking of this myth is the report of Britain's Standing Advisory Committee on Trunk Road Assessment (SACTRA) in 1994. This states:

> Increases in traffic on improved roads are, in general, not offset by equivalent reductions in traffic on unimproved alternative routes.

The first reason freeways fail to relieve congestion is that freeway traffic still has to go somewhere before and after it uses the freeway. Prior to the construction of CityLink, VicRoads published figures showing that many roads allegedly 'relieved' by CityLink would actually be carrying *more* traffic after City Link opened than before. Some of this would be through toll avoidance: thus VicRoads predicted that traffic in Mount Alexander Road would more than double, a prediction that has since come to pass. But they also predicted an 80 per cent increase in traffic in Gatehouse Street, a 65 per cent increase in Peel Street, and even an increase on Punt Road at the freeway junction. These increases had nothing to do with people avoiding tolls, but rather the effect of drivers changing routes once CityLink was in place.

The second reason is that *new roads create new traffic*. Thus, even the Vicroads figures above have actually proved to be too low. Indeed, VicRoads and other road lobby consultants have consistently underestimated the traffic consequences of new roads in their traffic studies, such as for the Mulgrave-South Eastern Freeway link in the 1980s and the Eastern Freeway extension in the 1990s. This is because their computer models assume that improved roads don't generate any additional traffic.

This isn't through lack of understanding. Even car company executives back in the 1920s understood that new roads quickly fill up with new traffic:

> Since the advent of the automobile.... the amount of traffic carried by a main thoroughfare seems to be dependent largely upon how many the thoroughfare can carry. Increasing the width of roadway and making

> possible an additional lane of travel each way will in many cases find the added capacity entirely taken up within a few months, either by diversion from other less favorable routes or by actual increase in the use of cars by those living in and passing through the city in question.
> ---Alvan Macauley (president, Packard Motor Car Company), in a pamphlet produced in 1925

Even as recently as 2006, the Bracks Government touted a consultants' report claiming the EastLink tollway would bring $15 billion of economic benefits to Victoria. Yet the report's authors admit that the figure was obtained by assuming not one extra car trip would be made as a result of the road being built.

> The analysis assumes that the projected demand is from vehicles that would have otherwise used the existing arterial roads, such as Springvale Road and Stud Road. In other words, it assumes that all vehicles travelling on EastLink will incur time savings because they would have otherwise driven on arterial roads. If some of the vehicle journeys are actually 'induced' by EastLink, meaning that they would not have occurred if EastLink did not exist, then the time savings counted in our analysis is an overestimate because 'induced' vehicle journeys do not result in time savings. It is not possible to obtain an estimate of the number of vehicle journeys induced by EastLink; however, we believe the number would be small.
> ---Allen Consulting Group, *Economic Effects of Eastlink*, 2006, page 11

The evidence, both statistical and anecdotal, shows otherwise. Though new roads do temporarily reduce traffic flows on parallel routes, this relief is almost completely wiped out after a few years. Take for example the link between the Mulgrave and South Eastern Freeways built in 1988:

Traffic Flows on Roads Parallel to Monash Freeway (vehicles per day)

Year	Waverley Road	High Street Road
1982	31,000	
1983		28,000
1986	32,500	
1988	32,000	22,000
	(Mulgrave - South Eastern link opens)	
1989	13,900	17,500
1996	28,000	23,000

Source: ARRB Transport Research, Report No. 299

> Three days after [the freeway] opened, I went to check out Waverley Road in the morning peak....it was dead quiet. Not a car hardly. Freeways are great, I concluded. The freeway has removed all this traffic.
> Step forward roughly 13 years and we are living elsewhere and I suggested to R that a good way to work was Waverley Road. He said no. It is too busy. Step forward a few months and I had an occasion to see Waverley Road in the morning peak and I was astonished that it was just a long line of stop and start cars.
> What changed? The number of cars grew because the ease of travel grew.
> ---Andrew of the High Riser blog

> Has no one asked why the Monash tollway is still 40 minutes outbound in peak hour, just like in the old days of the South-Eastern 'car park'?
> ---David Bowker, letter to *The Age*, 14 June 2005

> When they put in the Hallam bypass a few years ago traffic conditions improved noticably for a little while but the volume of traffic went up noticably shortly after and all benefits were obliterated.
> ---Post to *melb.general* newsgroup, September 2006

While all that new traffic was flocking on to the Monash Freeway and the roads parallel to it, the road lobby was building CityLink, whose marketing material proclaimed it to be a lasting solution to Melbourne's traffic problems such as those caused by the 'dead-ending' of the Monash Freeway at the city end. Cold reality has proved otherwise: barely five years after CityLink opened in late 2000, the Monash Freeway was called "the worst freeway for traffic delays" by the outgoing CEO of VicRoads. In 2006 the road lobby succeeded in getting more lanes added to this freeway in order to encourage even more traffic, but this hasn't stopped the RACV calling the barely-five-year-old CityLink "slow and congested" and a source of "frustrating delays", which they say can only be fixed by building *another* freeway - this time through the Yarra Valley.

Meanwhile, the parallel King Street route through the CBD is still classified as a major freight route by the road engineers at Melbourne City Council, and this is given as a reason why more priority can't be given to trams on the cross streets. Needless to say, things would be very different if CityLink had really taken all the trucks off King Street, the way it was supposed to do. But while car and truck trips *have* shifted from King Street to CityLink, just as many entirely new car and truck trips have appeared to take their place.

The story is the same in Sydney. In 1992 the Sydney Harbour Tunnel opened amid promises that it would fix traffic congestion on the Harbour Bridge forever. The truth is quite different, as the traffic counts show:

Traffic Flows on Sydney Harbour Bridge (vehicles per day)	
Year	**Average Flow**
1970	129,000
1980	159,000
1987	180,366
1989	182,024
1991	181,878
(Harbour tunnel opens)	
1992	138,400
1995	150,889
2000	161,000
2005	180,000 (est.)

After remaining steady over the five-year period from 1987 to 1991, traffic levels both on the bridge and in the tunnel increased throughout the 1990s as Sydney swapped a congested bridge for a congested bridge-and-tunnel. The final cost of the tunnel was $738 million in 1992 dollars; a high price to pay for just a few years of reduced congestion. Traffic levels in the tunnel have now reached 80,000 per day, meaning that its effect has been not to reduce congestion but instead to increase the number of cars crossing the harbour by nearly 30 per cent - despite no similar increase in the size of the central Sydney workforce.

In the 1950s, American transport planners used to claim that roads respond to traffic, but don't cause it. This is nonsense, of course. Road engineers used to be the only business people who thought that if they improved their produce, they wouldn't get more customers! VicRoads planners are still stuck in the 1950s, denying that road building will produce additional traffic.

> **Gordon Price:** I simply ask people: show me the example where this has worked. All I want is for a working example of a city that has built its way out of congestion simply by building more roads, and then is that the place you want to be? I don't get an answer to A or B.
> **Peter Mares:** You mean, there's never been a city that's managed to fix congestion by building more freeways or more roads?
> **Gordon Price:** You might argue that Houston, Texas has. They throw about $1-billion a year into it, they do keep the traffic moving. Do people want to be like Houston? Can you be like Houston? Are you prepared to spend that amount of money and is that really the kind of city that you want in the end? And they have to run as fast as they can just to keep where they are. And they're looking at transit too!
> ---Gordon Price (Transport Planner, Vancouver, Canada), ABC radio interview, February 2007

> I spent the first 30+ years of my existence in the Houston area. I was in my early-teens during the 'boomtown' period in the early-80s, so have watched the city grow.... Houston's road frenzy has not eased congestion one iota. I have observed this build-up of congestion and sprawl on brand new highways firsthand.
> Not only are the GHG emissions bad, [Houston] is also at or near the top in ozone emissions, too. This is thanks to the endless sprawl - the cars, the freeways - and the miserable climate. Not only that, for a while at least, [Houston] was noted as 'The Fattest' city in the US. A dubious honor if there ever was one.
> ---From a blog discussion on Houston

Outside the cut-and-thrust of political lobbying, the new traffic created by new roads is tacitly acknowledged in official circles. The Australian Institution of Engineers, the professional body representing road builders, says in its policy material:

> New urban roads always attract traffic....the two main sources are induced traffic (trips that would not otherwise have been made had the road not been built) and diverted traffic (trips that would otherwise have followed some alternative route).
> ---*Australian Institution of Engineers, 1990*

And very occasionally, the new traffic 'induced' by new or bigger roads will be acknowledged by the government, sometimes even in the same breath as they call for even more new or bigger roads in order to *reduce* traffic congestion. Thus, the following statements are juxtaposed on the same page of a State Government brochure, apparently without irony:

> Some 48km of the Princes Highway between Melbourne and Geelong has been widened and interchanges have been upgraded... There has been about a 16 per cent increase in the volume of traffic travelling along the upgraded section of Geelong Road.
> The Geelong Bypass will provide a 22km freeway-standard road from the Princes Freeway in Corio to the Princes Highway in Waurn Ponds. The bypass will reduce traffic congestion and delays within Geelong's road network....
> ---*Building One Victoria*, Victorian Government, 2005, page 20.

Meanwhile, the Eastlink tollway is likely to increase rather than reduce traffic congestion in the City of Manningham, according to the road planners:

> [N]umber crunchers predict Manningham Rd will be bombarded with up to 20 per cent more traffic when EastLink opens, which could be in June. The sharp rise was forecast by the Southern and Eastern Integrated Transport Authority (SEITA) - the State Government body overseeing EastLink's delivery.
> The authority's report....also said EastLink's opening would reduce amenity for residents living on Manningham Rd. Koonung Ward councillor Warren Welsh said Manningham Rd was destined to become "a traffic sewer" if commuters used Manningham as their route to EastLink.
> ---"Eastlink's traffic sewer", *Manningham Leader*, 15 January 2008

Be prepared for the same road planners to 'solve' this problem with another freeway - just as Eastlink was supposed to 'solve' congestion problems in the eastern suburbs. Proponents of the westward extension of the Eastern Freeway have likewise tried to have their cake and eat it too, citing as a benefit

> Reduced road congestion at the city-end of the Eastern Freeway and the inner north generally, which will be exacerbated in 2008 on completion of the East-link project. The [east-west freeway] would enable easier movement by local traffic, tram, bike and foot and improved amenity between the CBD and the inner northern suburbs.
> ---VECCI Infrastructure Task Force, November 2005

In other words: yes, building Eastlink will increase congestion, but don't worry, *this* new freeway will reduce it again!

One can also find figures in Vicroads' own annual report demonstrating that building freeways hasn't reduced the level of congestion. In fact, the overall level of congestion (as measured by the average delay to traffic) has remained steady over at least the last decade, with reductions in congestion in some locations evenly balanced by increases in congestion elsewhere. What is even more clear is that freeway-building has increased the amount of car travel by 13 per cent over 10 years, faster than the increase in Victoria's population (even when offset by a slight decrease in 2006 due to higher petrol prices).

Traffic Levels and Congestion (At urban monitored locations, all times)		
Financial Year	**Vehicle kilometres**	**Traffic delay (min/km)**
1997-98	78,318	0.53
1998-99	80,785	0.50
1999-00	82,803	0.50
2000-01	85,030	0.51
2001-02	86,412	0.55
2002-03	86,460	0.53
2003-04	88,301	0.52
2004-05	88,688	0.57
2005-06	88,041	0.53

Source: VicRoads, *Annual Report 2006*, page 57.

Transport expert Nicholas Low comments on the lack of evidence for time savings thus:

> It is a rather strange fact that despite many billions of dollars being committed to road building on the basis of aggregate time savings, there has not been a single study of whether time has actually been saved as a result of a particular road, or any other form of transport infrastructure, or whether that time is actually spent productively.
> ---Prof Nicholas Low, University of Melbourne, October 2008

The final verdict - that freeways in the long term increase traffic congestion, rather than reducing it - came in 1994 with the release of the SACTRA report mentioned above. The British Department of Transport's own expert team concluded that new roads can and do generate traffic.

> Travellers must, as a matter of logic, be assumed to respond to reductions in travel time brought about by road improvements by travelling more or further.
> ---*Standing Advisory Committee on Trunk Road Assessment, UK, 1994*

> Any transport policy must balance the additional economic activity generated by new roads against the self-defeating gridlock that results. [The SACTRA] report, for the first time, takes into account those drivers who switch from one route to another because of a new road, those who change their destination to take advantage of increased accessibility, those who previously used public transport, those whose journeys were caused by a change in land use and those who previously did not travel.
> ---*The Times (Editorial), London, 20th December 1994*

The latest research confirms that this effect works the other way as well: closing roads, or reducing road capacity through traffic calming, can actually cause traffic to disappear!

> Who'd have guessed you could shut down a third of [Seattle's] most congested freeway and not paralyze the region in epic traffic jams? Oliver Downs, that's who.... A few days before the state began what it was calling the most disruptive road project in local history, Downs put out a contrary view. He forecast no extreme clogs anywhere - not on I-5, nor on alternate routes such as Highway 99 or 599. So far he's been right about that. Then he crazily suggested that one of our chronically jammed roads, the I-405 S-curves in Renton, would actually be better off than normal. Which it has been.
> Downs wasn't dead on. Even his optimistic view was too pessimistic. A stunning 50,000 fewer cars are using northbound I-5 some days. It's slow going in the work zone. But in many places, driving has been smoother than before....
> In 1998, British researchers studied what happened to traffic in more than 100 highway and bridge shutdowns in Europe and the U.S. They found that on average 25 percent of all car trips simply evaporated.... "Drivers are not stupid," Downs says. "They change schedules. They don't take some trips, or they delay them. The net effect of all these little decisions can be dramatic."
> ---"Math whiz had I-5's number", *Seattle Times*, 22 August 2007

The car works best as a form of travel when few people use it: increasing traffic leads to congestion, making driving less attractive. By contrast, public transport service improves as patronage increases, as frequent services and express runs become more viable. Where public transport and roads are in competition, as in Melbourne, expanding road capacity is a two-way loser. It attracts additional traffic, making road conditions worse, and reduces public transport patronage, making public transport less attractive as well!

Conversely, improving public transport can make life easier for both public transport and road users. Vancouver in Canada has built no freeways for decades, and has invested in public transport instead. In the last decade, average travel times to work have reduced as a result.

This paradox is widely recognised by transport planners overseas, and even has an official name: the Downs-Thompson Paradox. One doesn't have to look hard to find examples of this principle in action.

Case Study No.1:

The extension of the Eastern Freeway to Springvale Road, built in the mid-1990s, parallels and competes with the Lilydale/Belgrave rail line. Currently, the rail line is Melbourne's busiest, carrying around 15,000 passengers in the morning peak hour, just under half its capacity. Although much wider than the rail line, the Eastern Freeway before it was extended carried only about half this volume (8,000 passengers) but even they strained the road's capacity, with traffic banked up at the City end of the freeway for three or four kilometres. Now that the freeway has been extended, the traffic jams have grown to twice as long, and commuters who drive into the city from Templestowe regularly complain about the longer delays due to increased traffic!

(The further extension of this freeway to Frankston is predicted to dump an extra 28,000 cars a day at the City end - many of which would be escapees from neglected public transport services.)

Case Study No.2:

Within weeks of the South Eastern Arterial link opening in 1988, 20% of peak passengers on the Glen Waverley train line shifted to the freeway. Services on the rail line were reduced as a result: in 1987 there were seven peak period expresses on the Glen Waverley line; ten years later there were only two. This has pushed still more passengers onto the freeway, setting up a vicious spiral. Since there are many more rail passengers than freeway users, improvements to the freeway will be cancelled out even if a minority of rail passengers shift their mode of travel. The overall result is that, after the expenditure of hundreds of millions of dollars and the destruction of areas of great scenic beauty, we have worse conditions for both road users and public transport passengers!

Case Study No.3:

With the Environment Effects Statement for the Scoresby Freeway in 1997, we finally got official confirmation in Melbourne that public transport can be a more effective treatment for congestion than new freeways. The government's consultants wrote:

> each percentage point increase in PT mode share is estimated to reduce road user costs by about $165 million in 2011....[and there would be] estimated savings in road user costs in 2011 of about $190 million if the Scoresby Freeway is built and public transport mode share is kept unchanged.
> ---*Scoresby Transport Corridor EES Working Papers No.2: Addendum, p.24*

In other words, the same savings in road user costs would result from increasing public transport mode share by just 1.15 per cent, as from building the freeway. (In the latter case the savings would of course be only short-term, as traffic levels would soon build up until there is just as much congestion as before.) As soon as it was realised that it might damage the case for the Scoresby Freeway, this finding was buried in an obscure supplement to the EES, and no more detailed investigation of any public transport alternative to the freeway ever took place.

Case Study No.4:

In 2005 the road lobby began agitating for a new freeway parallel to the West Gate Bridge, pointing out that between 1994 and 2004 peak-hour travel time over the bridge had more than doubled, from 11 to 25 minutes. But it turns out that this 240% increase in travel time has resulted from only an 18% increase in traffic volume - from 17,600 cars to 21,800 between 6am and 9am. Public transport in the western and northern suburbs is truly woeful, with trains running only every 20 minutes in peak hour and buses even less often; meanwhile construction of the $630 million Western Ring Road has fed induced traffic onto the bridge. If public transport were improved tomorrow so as to attract one in six journeys away from car travel, traffic on the West Gate Bridge would revert to its relatively free-flowing conditions of 1994. On the other hand, building a second West Gate Bridge is likely to only give us two congested bridges in place of one.

Conclusion

In the heyday of freeway building in the 1950s, the well-known architect and urbanist Lewis Mumford warned that trying to cure traffic congestion with more road capacity was like trying to cure obesity by loosening your belt. The result of too much belt-loosening can be seen throughout the USA, where 'suburban gridlock' is endemic. We are not yet at such an advanced stage of urban decay; we can avoid it entirely if we want to.

> Congestion, it turns out, is an inevitable consequence when the private sector produces an unlimited number of vehicles and expects the public sector to spend limited resources to build an unlimited amount of space for them to run on.
> ---Gordon Price, Transport Planner and former City Councillor, Vancouver

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