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Congestion Costing Critique

Critical Evaluation of the "Urban Mobility Report"
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Summary

The *Urban Mobility Report* (UMR) is a widely-cited study that quantifies and monetizes (measures in monetary units) traffic congestion costs in U.S. metropolitan regions. This report critically examines the UMR's assumptions and methods. The UMR reflects an older planning paradigm which assumes that "transportation" means automobile travel, and so evaluates transport system performance based primarily on automobile travel speeds; it ignores other modes, other planning objectives and other impacts. The UMR methodology overestimates congestion costs and roadway expansion benefits by using higher baseline speeds and travel time unit cost values than most experts recommend, by ignoring induced travel impacts, and using an inaccurate speed-emission curve. Its estimates represent upper-bound values and are two- to four times higher than result from more realistic assumptions. The UMR claims that congestion costs are "massive," although they increase total travel time and fuel consumption by 2% at most. It exaggerates future congestion problems by ignoring evidence of peaking vehicle travel and changing travel demands. The UMR ignores basic research principles: it fails to identify best current practices, explain assumptions, document sources, incorporate peer review, or respond to criticisms.

Key Findings

- The *Urban Mobility Report* (UMR) is a widely cited source of U.S. congestion cost estimates.
- The UMR is produced by the Texas Transportation Institute with funding from the US Department of Transportation's University Transportation Center Program and other government agencies.
- The UMR's costing methods do not reflect best current practices recommended by economists.
- The UMR tends to overestimate congestion costs and roadway expansion benefits.
- Congestion is a modest cost overall, increasing total travel time and fuel costs at most by 2%.
- The UMR ignores standard research principles such as providing context, explaining assumptions, citing sources, indicating potential sources of bias, and acknowledging legitimate criticisms.

Introduction

Traffic congestion refers to incremental costs resulting from interactions among road users that reduce traffic speeds and increase driver stress, vehicle operating costs and pollution emission rates. There are important and interesting debates concerning how it should be defined and measured, and how potential congestion reduction strategies should be evaluated.

The Texas Transportation Institute's annual *Urban Mobility Report* (UMR) is a commonly cited source of congestion cost estimates. Its conclusions and recommendations are used in policy and planning studies, repeated by professional organizations and government agencies (USDOT 2013), and widely reported by popular media. Despite this wide use, the UMR's analysis methods have received little peer scrutiny. Yet, many of its analysis methods and assumptions do not reflect the practices recommended by experts. The UMR violates standard research practices: it fails to review existing literature, explain key assumptions, cite sources or apply independent peer review. Few transportation professionals, decision-makers or journalists who use UMR results seem aware of its omissions and biases.

This has important policy implications. To the degree that congestion costs and roadway expansion benefits are overestimated, transportation agencies tend to overinvest in roadway capacity expansion and under-invest in alternative solutions which often provide a wider range of benefits.

This report investigates these issues. It discusses current congestion costing best practices, examines the UMR's methodologies and assumptions, discusses its omissions and biases, and ways that its analysis could be improved. This should be of interest to transport planners, economists, decision makers, journalists, and the general public who want to better understand congestion problems and potential solutions.

Defining Congestion

The *Urban Mobility Report* defines congestion as "the result of an imbalance between travel demand and the supply of transportation capacity." This is an engineering perspective which treats vehicle traffic as a fluid to be pumped through the road system. This perspective ignores other modes, accessibility factors and facets of travel demands. Congestion can be defined in other ways that lead to very different conclusions about the problem and possible solutions (Grant-Muller and Laird 2007; Litman 2009; TC 2006; Wallis and Lupton 2013).

- *Transport and land use planners* evaluate transport system based on *accessibility* rather than just *mobility,* and consider vehicle travel speeds only one factor that affects overall accessibility. This perspective considers impacts on the overall transport system, rather than just one mode or link, and so recognizes, for example, that roadway expansion to improve traffic speeds may reduce other accessibility factors by reducing walkability and stimulating sprawl. This perspective recognizes that inadequate transport options, poor transport network connectivity and sprawled development, can contribute to traffic congestion. This perspective recognizes other planning objectives and strives to identify optimal, "win-win" solutions, which provide multiple benefits.

- *Economists* consider congestion a symptom of underpricing (prices below marginal costs), and evaluate solutions based on overall cost efficiency and users' willingness-to-pay for faster travel. Economists favor congestion reduction solutions which reflect economic principles, including consumer sovereignty (which means that consumers can choose between suitable options, such as between driving and other travel modes, and between free-but-congested lanes and uncongested-but-priced lanes) and efficient pricing (road user fees that reflects marginal costs, including the space required by each vehicle, and therefore its contribution toward congestion). This perspective recognizes that if vehicle travel is underpriced, roadway capacity will do little to reduce congestion over the long run, and can exacerbate other external costs such as parking congestion, traffic crashes and pollution emissions.

- *Urban economists* recognize congestion as a cost of proximity and density: as more people and activities locate closer together to improve accessibility vehicle travel speeds tend to decline. They recognize that traffic congestion tends to maintain equilibrium: it increases to the point that delays discourage additional peak-period vehicle trips. From this perspective, traffic congestion is a modest problem provided that overall accessibility is optimized through local transport options (good walking, cycling, public transit, delivery services, etc.), transport network connectivity, land use proximity, and efficient pricing.

- *Strategic planners* emphasize the need for comprehensive and integrated evaluation in order to identify truly optimal solutions, and insure that individual, short-term decisions support strategic, long-term goals. They emphasize the value of integrated, long-term transport planning that coordinates multiple modes, transportation and land use policies, and considers all significant objectives, impacts and options.

The *UMR* does not discuss these various perspectives. It includes no literature review that summarizes current congestion costing theory and practices, no comparison of potential congestion cost definitions and evaluation methods, and no explanation of why its selected perspective and methods were chosen. It assumes that urban transportation performance can be evaluated based only on peak-period traffic speeds, ignoring other modes, impacts and objectives. Practitioners, public officials and citizens increasingly favor more comprehensive, multi-modal evaluation based on economic principles, as discussed in the following section.

Changing Transportation Planning Practices

Transportation planning is experiencing a paradigm shift, a change in the way problems are defined and solutions evaluated (LaPlante 2010; Litman Forthcoming). The old paradigm assumed that *transportation* refers only to vehicle travel, evaluates transport system performance based on vehicle travel speed and operating costs, and crash and emission rates, using indicators such as roadway level-of-service, traffic speeds and congestion delays (Markow 2012).

The new planning paradigm recognizes that the ultimate goal of most travel activity is *access* to services and activities (CTS 2010; Kockelman, Chen and Nichols 2013), and that many factors affect this including mobility (physical travel), the quality of transport options available, transport network connectivity, and geographic proximity. The new paradigm is more multi-modal[1] and comprehensive. It recognizes the important roles that walking, cycling and public transport play in an efficient and equitable transport system, and considers various planning objectives, impacts and options. The new paradigm recognizes the tradeoffs that often exist between accessibility factors. For example, if roadway expansions reduce traffic congestion while creating barriers to pedestrian access and stimulating sprawl (Litman 2013). Transportation professionals increasingly apply the new paradigm (Poorman 2005). For example, the new *Highway Capacity Manual* (TRB 2010), the primary reference guide for highway planning and evaluation, now includes multi-modal performance indicators.

Table 1 **Changing Transport Planning Paradigm**

	Old Paradigm	New Paradigm
Definition of *Transportation*	*Mobility* (physical travel)	*Accessibility* (people's overall ability to reach services and activities)
Modes considered	Mainly automobile	Multiple: Walking, cycling, public transit, automobile, telework, delivery services, etc.
Planning objectives	Maximize mobility, minimize operating costs, crash and emission rates.	Maximize overall accessibility, affordability, safety, resource efficiency, environmental quality, public fitness and health.
Impacts considered	Travel speeds and congestion delays, vehicle operating costs and fares, crash and emission rates.	Various economic, social and environmental impacts, including mobility, accessibility and indirect impacts.
Performance indicators	Vehicle traffic speeds, roadway Level-of-Service (LOS), distance-based crash and emission rates.	Multi-modal LOS. Multi-faceted accessibility modeling which calculates total money and time required to reach services and activities.
Favored transport improvements	Roadway capacity expansion.	Improve transport options. Transportation demand management. More accessible development.
Planning scope	Limited. Transport is poorly integrated with other planning.	Integrated and strategic planning.

The new paradigm expands the range of modes, objectives, impacts and options considered in planning.

[1] *Multi-modal* refers to a transport system that provides a high level of access to both motorists and non-drivers, including factors such as network connectivity and geographic proximity, and so reflects overall accessibility.

The *Urban Mobility Report* reflects the old paradigm. Its title is inaccurate: it should be named the *Motor Vehicle Traffic Congestion Report* since it ignores other travel modes and impacts. The UMR uses the terms *commuter* when the analysis only considers *automobile commuters*, ignoring other modes. This significantly skews the report's results. For example, according to the report, Washington DC's *automobile commuters* experienced 67 average annual delay hours, but since that region has only 43% automobile commute mode share, this averages just 29 hours per *commuter* overall. In contrast, Houston's *automobile commuters* experience a somewhat lower 52 annual delay hours, but since it has a 88% auto mode share this averages 46 hours per *commuter*, much higher than in Washington DC. The UMR only values walking, cycling and public transit to the degree they reduce vehicle congestion; it assigns no benefit to the congestion avoided by the travelers who shift modes.

Recent research improves our understanding of how congestion affects overall accessibility. For example, a major study by Levine, et al (2012) indicates that a change in development density affects the number of jobs and services available within a given travel time about ten times more than a proportional change in traffic speed. Kuzmyak (2012) found that roads in more compact neighborhoods experience considerably less traffic congestion than roads in less compact, suburban neighborhoods due to shorter trip distances, more connected streets, and better travel options which more than offset the higher trip generation rates per square mile. Levinson (2013) measured the number of jobs that could be reached by automobile within certain time periods for the 51 largest US metropolitan areas, and found that the five cities that the UMR ranks *worst* (Washington DC, Los Angeles, San Francisco, New York, Boston, and Houston) are among the *best* for automobile employment access, because their lower traffic speeds is more than offset by their shorter commute distances. Cortright (2010) shows how roadway expansion that stimulates sprawl increases residents' total time spent traveling, because increased traffic speeds are more than offset by increased travel distances. These studies illustrate how the Urban Mobility Report's methodology fails to reflect overall accessibility.

Understanding these factors is critical for identifying truly optimal solutions, since some congestion strategies increase traffic speeds but reduce other types of access. For example, adding traffic lanes and reducing cross streets on urban arterials can increase traffic speeds, which improves automobile access but creates barriers to walking and cycling ("Barrier Effect," Litman 2009), reduces roadway connectivity, and stimulates more dispersed development patterns which increase the distances that must be traveled to reach destinations. It is important that decision-makers understand these trade-offs. The *UMR* ignores these issues; it advocates highway expansions without discussing possible negative impacts they may have on overall accessibility and total travel costs.

Congestion Costing Methods

There are many possible ways to quantify and *monetize* (measure in monetary units) congestion costs, and considerable debate among experts as to which is best (Litman 2009; Grant-Muller and Laird 2007; TC 2006; Wallis and Lupton 2013). A key issue is the *baseline* (also called *threshold*) speed below which congestion delays are calculated. For example, if the baseline speed is 60 miles per hour (MPH), and peak-period traffic speeds are 50 MPH, the 10 mph speed reduction is considered a congestion delay. There are several possible ways to define baseline speeds:

- Actual off-peak (free-flow) traffic speeds.
- Traffic speed limits.
- Traffic speeds that maximize roadway capacity and fuel efficiency.
- Economically-optimal speeds, based on motorists' willingness-to-pay for faster peak-period travel.

Free-flow speeds do not maximize roadway capacity because faster traffic requires more *shy distance* between vehicles. For example, a highway lane can carry about twice as many at 45-55 MPH as at 60 MPH (Table 2). As a result, maintaining freeflow traffic speeds during peak periods would be extremely expensive, far more costly than most motorists are willing to pay, and therefore economically excessive. Lower speeds, 44-55 MPH, also tend to maximize fuel economy and minimize pollution emissions (Barth and Boriboonsomin 2009).

Table 2 **Typical Highway Level-Of-Service (LOS) Ratings**[2]

LOS	Description	Speed (mph)	Flow (veh./hour/lane)	Density (veh./mile)
A	Traffic flows at or above posted speed limit. Motorists have complete mobility between lanes.	Over 60	Under 700	Under 12
B	Slightly congested, with some reduced maneuverability.	57-60	700-1,100	12-20
C	Ability to pass or change lanes constrained. Posted speeds maintained but roads are close to capacity. Target LOS for most urban highways.	54-57	1,100-1,550	20-30
D	Speeds somewhat reduced, vehicle maneuverability limited. Typical urban peak-period highway conditions.	46-54	1,550-1,850	30-42
E	Irregular flow, speeds vary and rarely reach the posted limit. Considered a system failure.	30-46	1,850-2,200	42-67
F	Flow is forced, with frequent drops in speed to nearly zero mph. Travel time is unpredictable.	Under 30	Unstable	67-Maximum

This table summarizes roadway Level of Service (LOS) ratings, an indicator of congestion intensity.

For these reasons, most transport economists recommend capacity-optimizing rather than freeflow baseline speeds (TC 2006; Wallis and Lupton 2013). One leading economist explains,

> "The most widely quoted [congestion cost] studies may not be very useful for practical purposes, since they rely, essentially, on comparing the existing traffic conditions against a notional 'base' in which the traffic volumes are at the same high levels, but all vehicles are deemed to travel at completely congestion-free speeds. This situation could never exist in reality, nor (in my view) is it reasonable to encourage public opinion to imagine that this is an achievable aim of transport policy." (Goodwin 2003)

[2] "Level of Service," *Wikipedia*, http://en.wikipedia.org/wiki/Level_of_service.

For a baseline, the *UMR* uses actual off-peak traffic speeds, which often exceed legal speed limits. For example, in Madison, Wisconsin the freeflow speeds are 62.3 MPH on freeways and 40.6 MPH on arterial streets (*UMR* Appendix A, page A-18), although speed limits are 55 MPH on urban freeways 35 MPH or lower on most urban arterials. As a result, the UMR's congestion cost values reflect an assumption that motorists should be able to exceed legal speed limits.

There is no universal agreement on how to calculate congestion costs. However, it seems unlikely that most people would agree that reducing traffic speeds to the legal limit should be considered a "cost" imposed on motorists, yet the *UMR* make this assumption and uses it to calculate congestion costs. It seems likely that most people would choose baseline speeds that reflect either legal speed limits or capacity optimizing speeds. One study specifically criticizes the *UMR*'s use of freeflow baseline speeds, as quoted in the box below:

Selecting Baseline Speeds (TC 2006, p. 7)
Some have expressed concern that the TTI method suggests that free-flow speed is the desired objective; meaning in turn that the appropriate infrastructure is needed to meet this objective. However, such levels of capacity are neither environmentally sustainable nor economically efficient. This is because:

a) Maximum traffic flow (i.e., capacity flow) occurs only at speeds lower than free-flow (as shown in standard speed-flow relationships);
b) Capacity expansion is "lumpy" and expensive. The life cycle of an investment typically involves an initial period with excess capacity and free-flow speeds. The initial period is followed by traffic growth and increasing congestion until additional expansion is warranted. This life cycle means that the average condition will involve some congestion;
c) Economically efficient congestion pricing would eliminate only the external part of the congestion costs, leaving a substantial amount of congestion,; and
d) Drivers expect a certain level of quality of service from the road network, but the level expected depends upon the real and perceived cost of road use in congested conditions. Most drivers may accept a certain level of congestion as long as any given trip could be completed safely, within a reasonable and predictable time and with minimum interruption.

Most other congestion cost studies use lower baseline speeds (Wallis and Lupton 2013). For example, Transport Canada uses 50%, 60% and 70% of free-flow speeds (Table 3), reflecting what their researchers consider an optimal range of urban-peak traffic speeds.

Table 3 **Total Costs of Congestion** (TC 2006, Table 5)

Urban Area	Base Year	at 50% Threshold	at 60% Threshold	at 70% Threshold
Vancouver	2003	$402.8	$516.8	$628.7
Edmonton	2000	$49.4	$62.1	$74.1
Calgary	2001	$94.6	$112.4	$121.4
Winnipeg	1992	$48.4	$77.2	$104.0
Hamilton	2001	$6.6	$11.3	$16.9
Toronto	2001	$889.6	$1.267.3	$1.631.7
Ottawa-Gatineau	1995	$39.6	$61.5	$88.6
Montréal	1998	$701.9	$854.0	$986.9
Québec City	2001	$37.5	$52.3	$68.4
Total. all available urban areas		$2.270.2	$3.015.0	$3.720.6

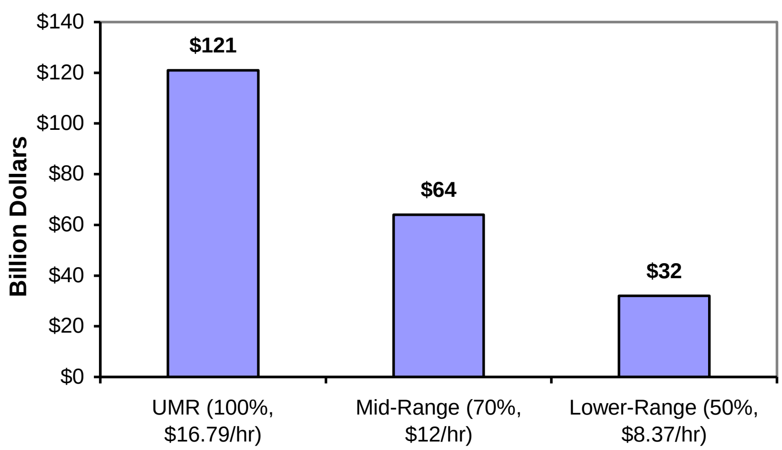
Besides the Urban Mobility Report, most traffic congestion costing studies use baseline speeds considerably less than free-flow since that maximizes system capacity and fuel efficiency.

Another key factor is the value assigned delay, which should reflect users' willingness to pay. Some motorists are willing to pay a lot for faster travel, but most travelers are price sensitive (Howard and Williams-Derry 2012; NCHRP 2006). The U.S. Department of Transportation recommends valuing personal travel time at 35% to 60% of prevailing incomes, or $8.37 to $14.34 per hour (USDOT 2011). The *UMR* uses $16.79 per hour (Exhibit A-7, although it also cites $8 per hour on page 24, and $16 on pages 25-31), 33% more than the USDOT's $12 per hour default value, more than its $14.34 upper-bound value, and probably more than average peak-period motorists would willingly pay for time savings. Some economists recommend using relatively high travel time unit costs for driving under highly congested conditions (LOS D or worse) to reflect driver stress ("Travel Time Costs," Litman 2009), but this only applies to a portion of the *UMR*'s total congestion delay estimate.

The *UMR* includes no review of current congestion costing theory and methods, does not explain why it chose baseline and travel time cost values significantly higher than most experts and government agencies recommend, fails to discuss possible biases, and provides no sensitivity analysis to indicate how different assumptions would affect results. It directs readers to a *Resources* (http://mobility.tamu.edu/resources) page for information on the study's methods, but that contains no literature review or explanation of assumptions. The 2012 *UMR* ignores previous criticisms for inadequate documentation (Cortright 2011).

The *UMR*'s congestion cost estimates should be considered upper-bound values. Figure 1 compares the *Report's* $121 billion upper-bound cost estimate based on a free-flow speed baseline and $16.79 per hour time costs with a middle-range value based on 70% baseline and $12 per hour value, and a lower-range value based on a 50% baseline and $8.37 per hour, which can be considered to indicate reasonable mid-range and lower-range values.[3]

Figure 1 **Reasonable Congestion Cost Ranges**



The Urban Mobility Report uses upper-bound baseline speeds and travel time unit costs. Most economists recommend lower values. The lower-bound estimate is based on Transport Canada's lower baseline speed and the U.S. Department of Transportation's lower travel time unit costs, reflecting reasonable lower-bound values published by major organizations.

[3] Similarly, Wallis and Lupton (2013) estimated Auckland's annual congestion costs at $1,250 million using a free-flow baseline and $250 million for maximum roadway capacity.

Analysis Scope

As previously described, mobility is seldom an end in itself. The ultimate goal of most transport activity is *accessibility*, that is, peoples' ability to reach services and activities. Several factors affect accessibility including vehicle travel speeds (called *mobility*), the quality of other modes (called *transport diversity*), transport network connectivity, and geographic proximity (the distances between activities, affected by land use density and mix). Conventional, mobility-based planning assumes that travel distances are fixed so speed is the only travel time variable; accessibility-based planning recognizes travel distances are also variable. It is important to consider all accessibility factors because planning decisions, such as roadway design and development locations, often involve tradeoffs between them.

Analysis scope also applies to the range of impacts (costs and benefits) considered. Conventional planning tends to consider travel speeds, vehicle operating costs, as well per-mile accident and emission rates. Other impacts are sometimes considered at other steps in the planning process, but are seldom quantified or monetized. These include vehicle ownership costs, the quality of mobility for non-drivers, parking costs, land use impacts (such as whether a planning decision is likely to stimulate sprawl) and impacts on the amount of walking and cycling that occurs in a community, and therefore public fitness and health

Table 4 illustrates the accessibility factors and impacts considered in the *UMR*. It focuses on automobile travel speeds (dark blue), gives limited consideration to a few other impacts (light blue), and ignores other factors and impacts (white).

Table 4 **Scope of Conventional Planning Accessibility Factors and Impacts**

		← Accessibility Factors →				
		Mobility (Auto Travel)	**Transit Quality**	**Non-motorized Quality**	**Roadway Connectivity**	**Land Use Proximity**
← Impacts →	Travel speed and delay					
	Safety					
	User costs and affordability					
	Mobility for non-drivers					
	User comfort					
	Parking costs					
	Energy consumption					
	Pollution emissions					
	Land use impacts					
	Public fitness and health					

The Urban Mobility Report considers a limited scope of accessibility factors and impacts. It focuses on automobile travel speeds (dark blue) and considers to a lesser degree other impacts (light blue).

Table 5 describes various congestion indicators, many included in the *UMR*, and indicates whether they are comprehensive, that is, whether they reflect accessibility factors besides vehicle traffic speeds. Few are comprehensive and therefore suitable for multi-modal or accessibility-based analysis. For example, denser urban areas that rate poorly according to roadway level-of-service or the travel time index often have less total delay and better overall accessibility than more sprawled, automobile-dependent areas which have poor transport options (inadequate walking, cycling and public transport facilities), poor roadway connectivity, and reduced geographic proximity which result in longer travel distances. The most comprehensive accessibility indicator is *total per capita travel time*, with the portion consisting of congestion delays indicated to reflect the extra stress of driving in congested conditions (CTS 2010). Other congestion indicators can be useful for specific applications, such as traffic trend analysis or corridor planning, but not for evaluating overall transport system performance.

Table 5 **Roadway Congestion Indicators** ("Congestion Costs," Litman 2009)

Indicator	Description	Comprehensive?
Roadway Level Of Service (LOS)	Congestion intensity at a particular road or intersection, rated from A (uncongested) to F (most congested).	No
Travel Time Rate	Ratio of peak period to free-flow travel times, considering only recurring congestion delays.	No
Travel Time Index	The ratio of peak period to free-flow travel times, considering both recurring 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 for vehicles, yes for people
Congested Road Miles	Portion of roadway miles congested during peak periods.	No
Congested Time	Duration of congested "rush hour."	No
Congested Lane Miles	The number of peak-period lane miles with congested travel.	No
Annual Hours Of Delay	Hours of extra travel time due to congestion.	No for vehicles, yes 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	Monetized value of extra travel time and fuel costs.	Yes
Congestion Cost Per Capita	Additional travel time costs divided by area population	Yes
Congestion Burden Index (CBI)	Travel rate index multiplied by automobile mode share.	Yes
Planning Time Index (PTI)	Earlier departure required to insure timely arrival during peaks	No
Total Peak Period Travel Time	Total amount of time motorists spend during peak periods	No
Avg. Traffic Speed	Average peak-period vehicle travel speeds.	No
Avg. Commute Travel Time	Average commute trip time.	Yes for commuting
Avg. Per Capita Travel Time	Average total time devoted to travel.	Yes

There are many possible congestion cost indicators. Some only consider impacts on motorists and so are unsuited for multi-modal or accessibility-based transport planning.

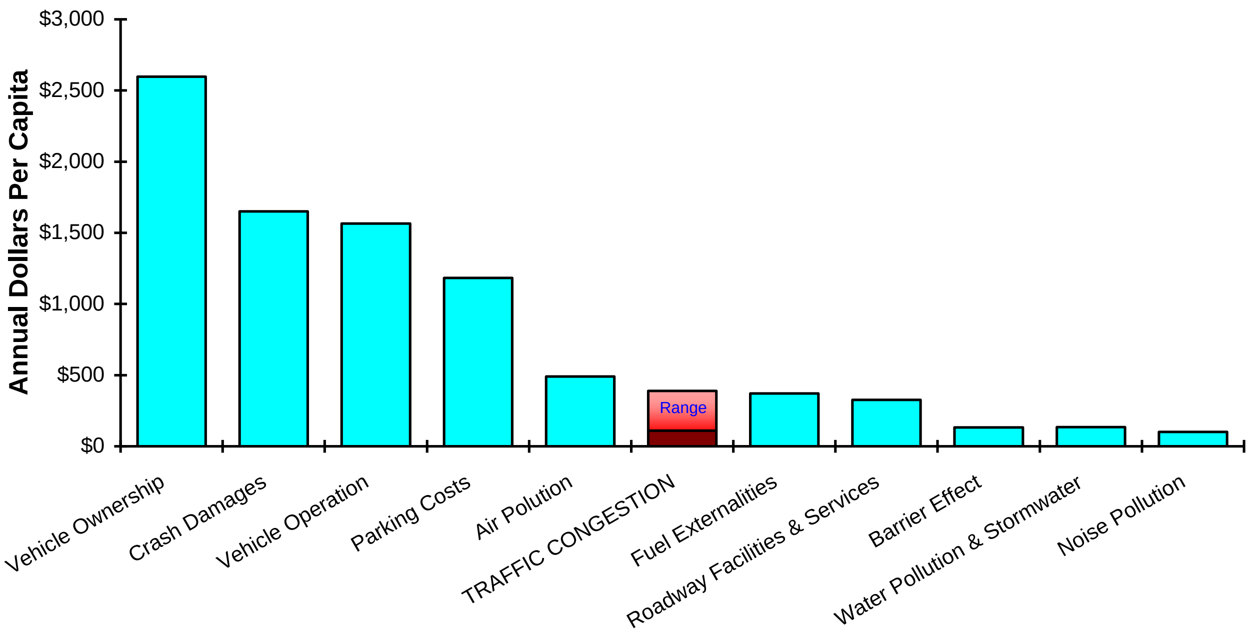
The *UMR*'s indicators can create a self-fulfilling prophecy by directing all resources to roadway expansion, resulting in automobile-dependent transport systems, less connected roadway networks, and sprawled development patterns which increase total travel time, congestion delay and transport costs (Cortright 2010; Kuzmyak 2012; Levine, et al 2012). These long-term system effects result from interactions among various accessibility factors, and so are invisible to analyses that only measure congestion delay on individual links. More comprehensive evaluation expands the range of transport improvement options considered in a planning process to help identify the set that is most optimal overall, taking into account a broad range of planning objectives and improvement options.

Comparing Congestion With Other Costs

The *UMR* claims that traffic congestion wastes "massive" amounts of time and money, estimated at 5.5 billion hours and 2.9 billion gallons of fuel, worth an estimated $121 billion. Described this way the costs seem very large, but measured per capita they appear more modest: 17 hours, 9 gallons and $388 per year, or less than three minutes, 0.03 gallons and $1.06 per day. These represent less than 2% of total travel time and fuel costs, which is small compared with other factors that affect per capita travel time and fuel consumption costs.[4]

Several studies have monetized transport costs (CE, INFRAS, ISI 2011; Delucchi 2005; Kockelman, Chen and Nichols 2013; Litman 2009; TC 2008). Figure 2 compares these cost estimates. Congestion cost estimates range from $110 (50% baseline speeds and $8.37 per hour time costs) up to $388 (the UMR's estimate) annual per capita, compared with approximately $2,600 in vehicle ownership costs, $1,500 in crash damages, $1,200 in parking costs, $500 in pollution damage costs, and $325 in roadway costs. This indicates that congestion is overall a modest cost, larger than some but smaller than others.

Figure 2 **Costs Ranked by Magnitude** (Litman 2009)[5]



U.S. traffic congestion cost estimates range between about $110 and $340 annual per capita, depending on assumptions. These are modest compared with other transportation costs.

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[4] According to Table 1.12 in the *Transportation Energy Book 30*, transportation consumes 13 million barrels per day of petroleum, which totals (13 x 365/year x 55 gallons/barrel) 261 billion gallons. This is an upper-bound estimate since the *UMR* uses an unrealistic free-flow baseline speed and assumes that fuel efficiency increases at higher speeds, and so ignores the possibility that modest congestion may reduce fuel consumption, as other researchers conclude (Barth and Boriboonsomin 2009).

[5] Using the *Transportation Cost Analysis Spreadsheet* (www.vtpi.org/tca/tca.xls), incorporating 8% 2007 to 2011 inflation, and assuming 9,548 average annual vehicle-miles per capita, based on ORNL 2001, Table 8.2.

Because congestion is just one of many costs, it is inappropriate to evaluate congestion reduction strategies in isolation. A congestion reduction strategy is worth far less overall if it increases other costs, and is worth far more if it provides other benefits. For example, a particular roadway expansion may seem cost effective considering congestion impacts alone, but not if it induces additional vehicle travel which increases other external costs such as downstream traffic and parking congestion, accident risk, pollution emissions. Conversely, improving alternative modes may not be cost effective based only on their congestion reductions, but are cost effective overall when co-benefits (parking cost savings, traffic safety, or improved mobility for non-drivers, etc.) are also considered.

Responding to Consumer Demands

A key principle in the fields of economics and planning is that, as much as possible, public policies and planning should respond to consumer demands. The *Urban Mobility Report* can claim that it reflects consumer demands since most people dislike congestion. However, the *UMR* does not respond to consumer demands that involve prioritizing transport problems, willingness to pay for congestion reductions, or trade-offs between different congestion reduction and accessibility improvement strategies.

According to the 2009 *National Household Travel Survey*, transport system users rank congestion as a mid-level issue, below affordability ("price of travel") and availability of public transit, about equal to safety and distracted driving, and a little higher than lack of walkways (Mattson 2012). The relatively low value consumers place on congestion is also reflected in their reluctance to pay for congestion reductions, either individually through road tolls, or through fuel tax increases to finance roadway expansions. Recent experience indicates that only a minority of motorists are willing to pay significant tolls to avoid congestion (Howard and Williams-Derry 2012; NCHRP 2006), and real (inflation-adjusted) transport funding is about half as much per vehicle-mile as it was during the 1960s and 70s, indicating that citizens do not consider congestion problems sufficient to justify major investments.

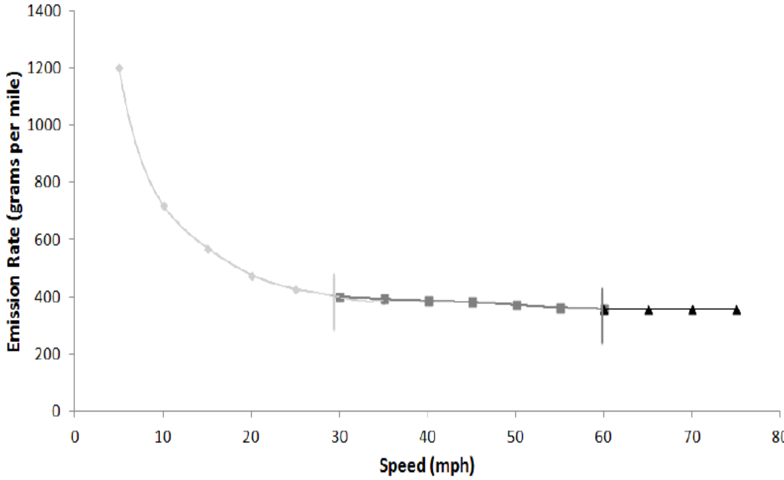
Conventional planning often evaluates transport system performance based primarily on travel speed, and so assumes that walking, cycling and public transit travel are inferior to driving. However, there are many situations in which travelers can rationally choose slower modes, for example, due to walking and cycling enjoyment and health benefits, because public transit commuters can work or rest while traveling, or because financial savings offset incremental time costs ("Travel Time Costs," Litman 2009).

New demographic and economic trends (aging population, rising fuel prices, increasing urbanization, improving transport options, increasing health and environmental concerns, and changing consumer travel and housing preferences) reduce vehicle travel growth and increase demand for alternative modes (Polzin, Chu and Toole-Holt 2003; Litman 2006; Silver 2009). This suggests that congestion reduction strategies which improve transport options (better walking, cycling, public transport, telework, delivery services, etc.), and help achieve other planning objectives such as increased affordability, safety health, community livability and environmental quality, are more responsive to transport system user preferences than automobile-oriented solutions which may reduce traffic congestion but fail to support, or even contradict, other planning objectives.

Environmental and Safety Impacts

The *Urban Mobility Report* analysis exaggerates congestion environmental impacts and roadway expansion benefits. It uses a constantly declining speed-emission curve (Figure 3) which assumes that any traffic speed increase reduces per-mile/kilometer fuel consumption and emission rates.

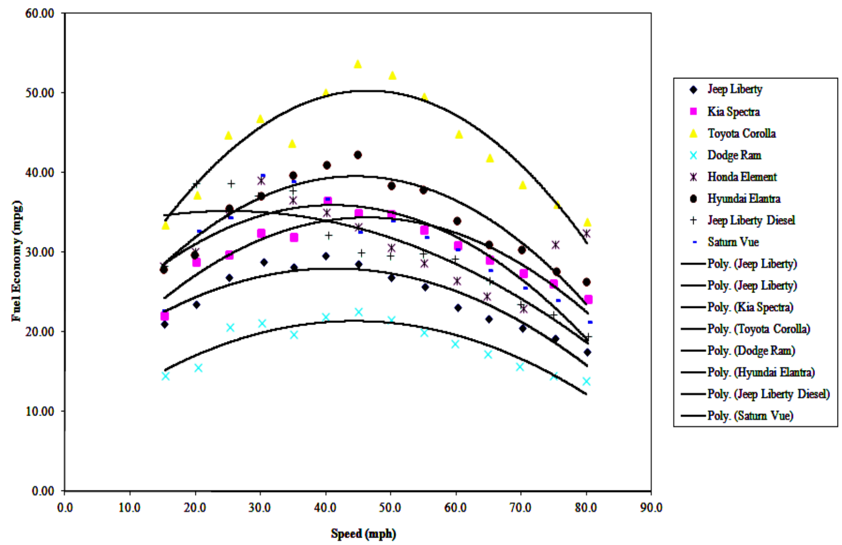
Figure 3 **Speed-Fuel Efficiency Curves** (UMR 2012, Exhibit A-11)



This graph from the Urban Mobility Report's Technical Appendix, assumes that any increase in traffic speeds reduces fuel consumption and emission rates, so reducing congestion provides large environmental benefits.

Virtually all other studies indicate that fuel consumption and emission rates are lowest at 40-50 miles per hour (MPH), and increase above 55 MPH.[6] The *UMR* authors claimed that their constantly-declining fuel consumption and emission curves are based on the USEPA's MOVES model, but in fact, the USEPA data actually indicates otherwise (Figure 4).

Figure 4 **Speed Versus Fuel Efficiency** (USEPA Data)



This USEPA graph shows that vehicle fuel economy tends to peak at 40-50 miles per hour (MPH) and declines above 55 MPH. This contradicts the Urban Mobility Report's claims.

6 The 2011 *UMR* was criticized for inadequate documentation of this assumption (Cortright 2011), but the 2012 edition contains no additional information.

The *UMR's* analysis assumes that congestion always increases fuel consumption and pollution emissions, so any congestion reduction provides large environmental benefits. Other researchers conclude otherwise (Bigazzi and Figliozzi 2012; Noland and Quddus 2006; TØI 2009). They find that moderate traffic congestion can actually reduce fuel consumption and emissions. Although reducing extreme congestion (LOS E or F) is likely to reduce energy consumption and pollution emissions, shifting from moderate congestion to free-flow speeds (for example, from LOS C or D to LOS A or B) often increases fuel consumption and pollution emission rates per vehicle-mile, and induces additional vehicle travel that increases total fuel consumption and emissions. Barth and Boriboonsomin (2009) explain, "If moderate congestion brings average speeds down from a free-flow speed over 70 mph to a slower speed of 45 to 55 mph, this moderate congestion can *reduce* CO2 emissions. If congestion mitigation raises average traffic speed to above about 65 miles per hour, it can increase CO2 emissions. And, of course, speeds above 65 or 70 also make the roadway more dangerous."

The *UMR* ignores this last point, that congestion reductions can increase traffic risks, although it is much discussed by traffic safety researchers (Kockelman 2011; Marchesini and Weijermars 2010). Crash rates tend to be lowest on moderately congested roads (V/C=0.6), and increase at lower and higher congestion levels, while fatalities decline at high levels of congestion, indicating a tradeoff between congestion and safety (Zhou and Sisiopiku 1997). Per capita traffic deaths tend to increase with per capita vehicle travel, so roadway expansions that induce additional vehicle travel tends to increase traffic casualties (Luoma and Sivak 2012).

The UMR claims that Exhibit 13 proves significantly expanding roadway capacity can reduce congestion, but the graph actually shows that during the last five years all types of cities experience reduced congestion, and since the cities which significantly expanded capacity tend to be smaller, rapidly-expanding urban regions which differ in various ways from other city types, the analysis does not really prove the point (Dutzik 2011). More detailed analysis would be needed to reach this conclusion.

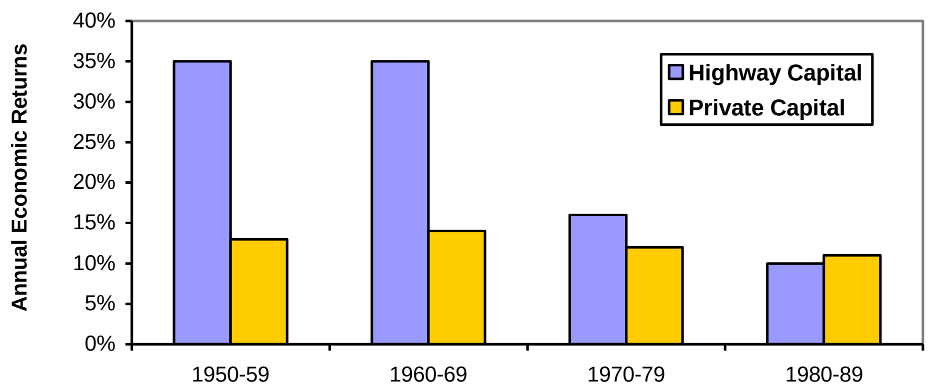
These factors can significantly affect the evaluation of potential congestion reduction strategies. Even using the *UMR's* estimates, which represent upper-bound values, congestion costs are a modest portion of total transportation costs. For example, a 10% congestion cost reduction is probably not cost effective if it increases accident and pollution damages by 5%. This highlights the importance of comprehensive analysis that considers all economic, social and environmental impacts, particularly the additional costs that often result from urban roadway expansions and the co-benefits of a more diverse and economically efficient transport system.

Economic Development Impacts

The *Urban Mobility Report* estimates that in 2011 congestion cost industries $22 billion, and average auto commuters $818, and so argues that congestion reductions can provide substantial productivity gains and consumer savings. However, it exaggerates net benefits. As previously discussed, traffic congestion is a modest cost overall, increasing total travel time and fuel consumption by 2% at most. Many congestion reduction strategies, particularly roadway expansions, increase other transport costs by reducing other forms of accessibility, inducing vehicle travel and stimulating sprawl. It is important to account for these costs as well as benefits.

In mature transport systems, highway expansions tend to provide modest productivity gains, which may be offset by incremental costs (Boarnet and Haughwout 2000; Iacono and Levinson 2013). Nadiri and Mamuneas (2006) found that highway investments had high economic returns during the 1950s and 60s, but these subsequently declined after the most cost effective projects were implemented, as indicated in Figure 5. Newer technologies, such as real-time traffic information and mobile telecommunications, further reduce congestion productivity costs by allowing businesses to anticipate, avoid and respond to delays.

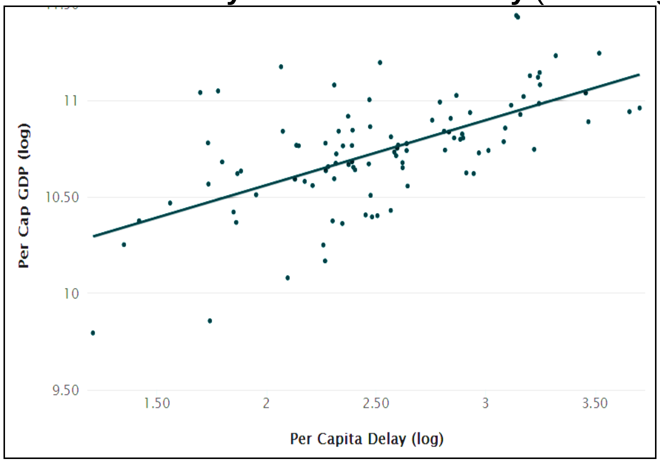
Figure 5 **Annual Highway Rate of Return** (Nadiri and Mamuneas 2006)



Highway investments provided high economic returns during the 1950s and 60s when the U.S. Interstate system was first developed, but have since declined, suggesting that highway expansion is now an inefficient investment.

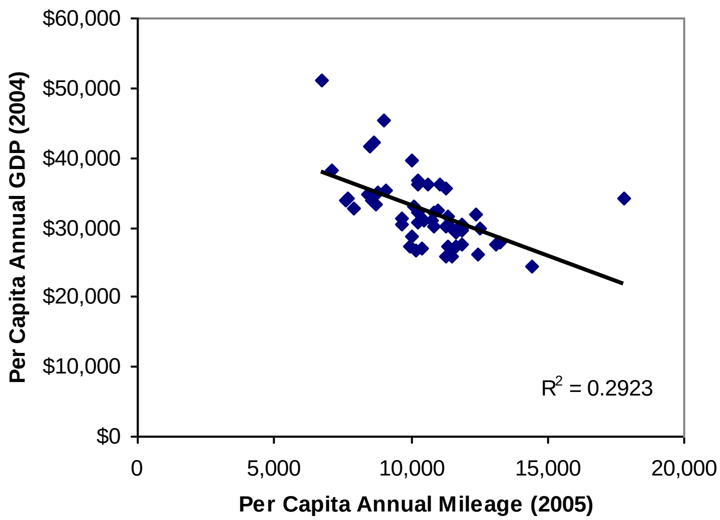
Dumbaugh (2012) and Litman (2010) find negative relationships between regional vehicle travel or roadway supply and economic productivity, and positive relationships between traffic congestion and productivity (figures 6-8). This does not mean that congestion actually causes productivity to increase, rather, it suggests that congestion costs are small compared with other accessibility factors such as density and mix, and that transport policies that stimulate vehicle travel, including roadway expansions, inexpensive fuel and parking, and dispersed development patterns, can be economically harmful. Such policies can also increase per capita consumer transport costs, which explains why households located in compact, multi-modal communities spend a smaller portion of their budgets on transport than comparable households located in automobile-dependent areas (CTOD and CNT 2006; Litman 2011).

Figure 6 **Traffic Delay Versus Productivity** (Dumbaugh 2012)



The relationship between per capita traffic congestion delay and economic productivity tends to be positive overall. (Each dot is a U.S. metropolitan region.) Line represents statistical trend.

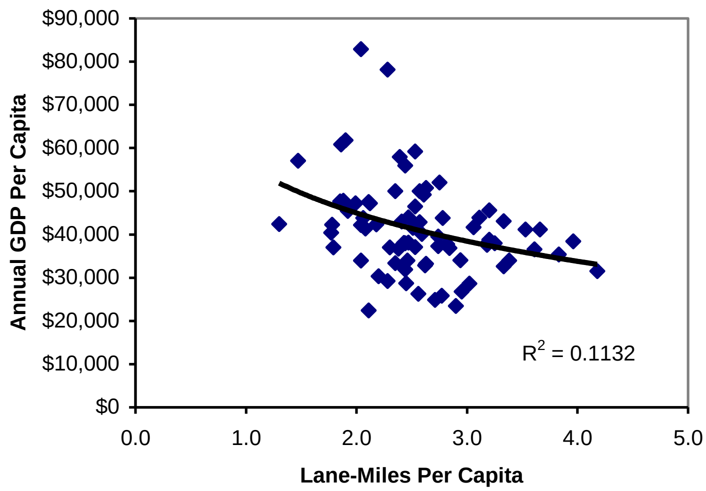
Figure 7 **Vehicle Travel Versus Productivity** (VTPI 2009)



The relationship between per capita vehicle travel and regional economic productivity tends to be negative overall. (Each dot is a U.S. state.)

Data from the FHWA "Highway Statistics Report" the "Urban Mobility Report" and the Bureau of Economic Account's "Gross Domestic Product By Metropolitan Area."

Figure 8 **Roadway Supply Versus Productivity** (VTPI 2009)



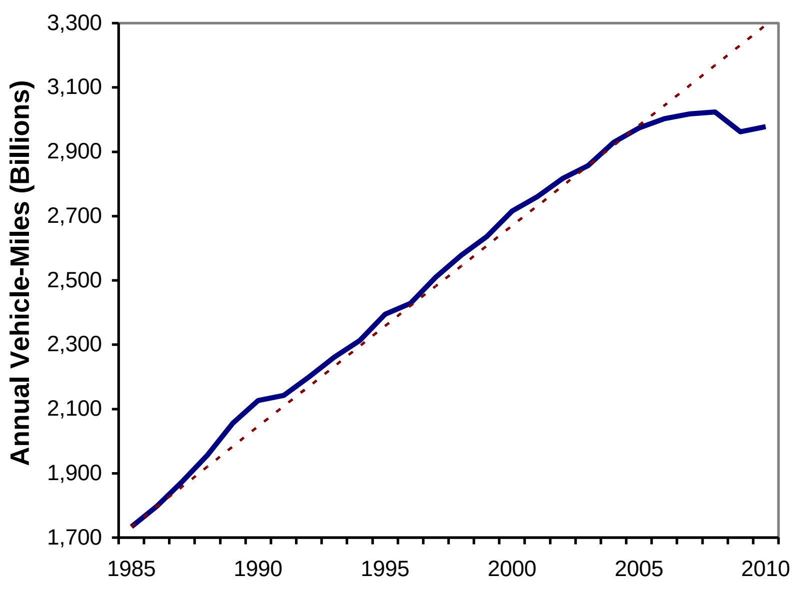
The relationship between roadway supply and regional economic productivity tends to be negative overall. (Each dot is a U.S. urban region.)

Exaggerating Future Congestion Problems

The *Urban Mobility Report's* press release headline, "As traffic jams worsen, commuters allow extra time for urgent trips…", and its projections of future congestion costs imply that congestion problems are increasing, but the analysis actually indicates that total congestion delays have declined in recent years, from 43 average hours of delay per automobile commuter in 2005 down to 38 hours in 2011. In addition, information services such as real-time traffic condition reports allow motorists to anticipate and avoid congestion, nearly ubiquitous mobile telephones allow motorists to warn colleagues and family members when they are delayed, and improved transport options allow more travelers to avoid traffic congestion altogether. The *UMR* should celebrate, or at lease acknowledge, these positive trends.

The *UMR* assumes that recent declines in congestion are temporary, resulting from an economic recession, and so predicts severe congestion in the near future. It assumes that traffic volumes will grow in the future at the same rate that occurred during the last half-century. Most experts disagree (Polzin, Chu and Toole-Holt 2003; Litman 2006; Silver 2009). They recognize demographic and economic trends (aging population, rising fuel prices, increasing health and environmental concerns, improving transport options, changing consumer preferences) affect travel demands in ways that reduce automobile travel growth and increase demand for alternatives, causing vehicle travel to peak (Figure 9). Because of these trends, traffic congestion problems are unlikely to increase significantly on most roads. Congestion may increase on some corridors with significant population and economic growth, and automobile-dependent planning, but decline on other corridors, particularly if transport planning improves transport options and implements appropriate demand management strategies. The ignores these issues; it simply extrapolates high pre-2006 traffic growth rates into the future without accounting for underlying demographic and economic factors that affect travel demands.

Figure 9 **U.S. Annual Vehicles Mileage Trends** (USDOT Data)



The UMR predicts that traffic congestion costs will increase significantly in the future, based on extrapolating high pre-2006 traffic growth rates (dashed line) into the future. This ignores current demographic and economic trends that most experts predict will significantly reduce future traffic growth.

Evaluation Practices

The *Urban Mobility Report* lists various possible congestion reduction strategies, but provides no useful guidance for evaluating them, and contains several striking omissions:

- It ignores pricing reforms as a congestion reduction and economic efficiency strategy. The *UMR* recognizes the high costs that congestion delay imposes on businesses and the relative travel time unit costs for commercial travel compared with personal travel. Yet, its discussion of freight congestion reduction strategies does not mention efficient road pricing which would allow higher value trips to outbid lower value trips for scarce road space (p. 15). The report mentions tolling as a way to finance roadway but not as a way to manage existing capacity. This is a critical omission to economists who define congestion as an outcome of underpricing, and recognize that expanding underpriced systems can reduce, rather than increase, economic productivity.

- It does not discuss conflicts between roadway expansion and other forms of accessibility. It ignores the tendency of wider roads and increased traffic speeds to create barriers to non-motorized travel, and the tendency of roadway expansion to induce additional vehicle travel. To be fair, in the following, nearly incomprehensible paragraph, it acknowledges the possibility that roadway expansion can induce vehicle travel, but dismisses this concern, although other experts consider it significant (Barth and Boriboonsomin 2009; Bigazzi and Figliozzi 2012).

> "Some may note that if the congestion were not present, speeds would be higher, throughput would increase, and this would generally result in lower fuel consumption and CO_2 emissions – thus the methodology could be seen as overestimating the wasted fuel and additional CO_2 produced due to congestion. Similarly, if there is substantial induced demand due to the lack of congestion, it is possible that more CO_2 could be present than during congested conditions because of more cars traveling at free-flow. While these are notable considerations and may be true for specific corridors, the UMR analysis is at the areawide level for all principal arterials and freeways and the assumption is that overestimating and underestimating will approximately balance out over the urban area. Therefore, the methodology provides a credible method for consistent and replicable analysis across 498 urban areas." (p. A-31)

- It fails to consider other transport planning objectives. Identifying truly optimal congestion reduction strategies requires comprehensive and multi-modal evaluation which accounts for indirect costs and co-benefits provided by some strategies (Litman 2013; Poorman 2005). Table 6 illustrates a basic framework for multi-objective evaluation.

Table 6 **Comparing Congestion Reduction Strategies** (Litman 2012)

Planning Objectives	Roadway Expansion	Improve Alt. Modes	Pricing Reforms	Smart Growth
Congestion reduction	✓	✓	✓	Mixed
Roadway cost savings		✓	✓	✓
Parking savings		✓	✓	✓
Consumer cost savings	✓	✓	Mixed	✓
Transport diversity		✓	✓	✓
Improved traffic safety		✓	✓	✓
Reduced pollution		✓	✓	✓
Energy conservation		✓	✓	✓
Efficient land use		✓	✓	✓
Improved fitness and health		✓	✓	✓

Roadway expansion helps reduce congestion and vehicle operating costs. Other congestion reduction strategies provide additional co-benefits which should be considered when evaluating options.

Context and Criticisms

Research is a dynamic process: each study builds on existing knowledge. It is therefore important that research reports include literature reviews that summarize current understanding of an issue to provide context. It is also important to acknowledge and specifically respond to criticisms. The *Urban Mobility Report* fails to do this.

Several recent studies have investigated best congestion costing practices:

- *You Are the Traffic Jam: An Examination of Congestion Measures* (Bertini 2006). Reviews congestion cost definitions and measurement methods. Of 480 transportation practitioners who responded to a survey approximately half indicted that current congestion evaluation methods are inadequate and more comprehensive methods are needed.

- *Driven Apart: How Sprawl is Lengthening Our Commutes and Why Misleading Mobility Measures are Making Things Worse* (Cortright 2010). Discusses various ways to measure urban transport system performance and criticizes the *UMR* for applying mobility-based evaluation which ignores other accessibility factors. *UMR Remains a Flawed and Misleading Guide to Urban Transportation* (Cortright 2011) criticizes the *UMR* for failing to respond to criticisms.

- *International Literature Review of the Costs of Road Traffic Congestion* (Grant-Muller and Laird 2007). Provides an extensive review of congestion costing definitions and measurement methods. Discusses criticisms of the *total cost of congestion approach* (the *UMR*'s method), including the arbitrariness of baseline values and its tendency to ignore induced travel impacts. It discusses other congestion costing methods, including the *excess burden of congestion approach* which measures road users' willingness-to-pay for reduced congestion, which generally results in substantially lower congestion cost estimates than the total cost of congestion approach.

- *The Costs Of Congestion Reappraised* (Wallis and Lupton 2013). Evaluates congestion definitions and costing methods for use in New Zealand. It discusses the differences between engineering-based methods (as used in the *UMR*), and economic-based methods which measure incremental travel costs based on users' willingness-to-pay for faster travel. It recommends the economic method, and to simplify analysis chooses this functional definition, "The cost of congestion is the difference between the observed cost of travel and the cost of travel when the road is operating at capacity." Estimates Auckland's annual congestion costs to total $250 million using its recommended methodology, compared with $1,250 million based on freeflow speeds.

- *Transportation Cost and Benefit Analysis; Techniques, Estimates and Implications* (Litman 2009). Comprehensive study of various transportation costs, including congestion. It discusses and compares various congestion cost definitions and summarizes various congestion cost estimates. *Smart Congestion Relief: Comprehensive Analysis Of Traffic Congestion Costs and Congestion Reduction Benefits* (Litman 2012). Uses a comprehensive framework to evaluate various congestion reduction strategies.

- *The Cost Of Urban Congestion In Canada* (TC 2006). Develops congestion cost indicators for Canadian urban areas. Reviews relevant literature and discusses differences between *engineering* and *economic* methods. It selects the engineering approach as most practical but argues that freeflow baseline speeds are arbitrary and excessive, and so calculate congestion costs based on 50%, 60% and 70% of free-flow. Its fuel and emission curves increase at high traffic speeds.

- *Does the travel-time index really reflect performance?* (Sundquist and Holloway 2013). Finds no significant statistical relationship between changes in the *UMR*'s travel time index and changes in average commute times for 100 U.S. urban regions. Recommends alternative performance.

These studies criticize the *Urban Mobility Report's* methodologies and assumptions. Most experts favor *economic* definitions and methodologies, which measure the value of travel based on users' willingness-to-pay, over *engineering* methodologies which only measure traffic speeds. Most experts recommend more comprehensive, multi-modal urban transport performance indicators.

The *UMR* fails to explain assumptions or cite sources. It lacks a literature review, does not discuss or incorporate other definitions or evaluation methods, contains unexplained discrepancies, for example, its transit-passenger-miles differ from official data in the *National Transit Database* (Ewing, et al. Forthcoming). It does not acknowledge or respond to peer criticism. The *UMR* authors might challenge this last statement, for example, they might claim that their new indicator, *Total Peak Period Travel Time*, responds to Cortright's 2010 and 2011 criticism, but that is not really true; although the new indicator is called "*Total* Peak Period Travel Time," it only reflects automobile travel times, and so ignores the congestion avoided by travelers who shift modes, and fails to account for off-peak travel times that increase with more dispersed development. It therefore does not respond to Cortright's criticism.

Similarly, the *UMR*'s authors might point to their 2010 paper, *Incorporating Sustainability Factors Into The Urban Mobility Report*" as evidence that they are considering more comprehensive analysis, but that paper simply attempts to apply the *UMR*'s engineering-based evaluation methods to other modes It does not reflect accessibility or more comprehensive evaluation, such as accounting for the impacts that wider roads have on alternative modes, nor does it reflect current sustainability evaluation practices which require indicators that reflect economic, social and environmental objectives, not just travel speed (Litman 2013; TRB 2010).

To be fair, the authors could argue that the *UMR*'s mobility-based indicators are justified because they are more practical and easier to understand than accessibility-based and economic-based indicators, and because there are two decades of data that can be used for trend analysis, but those arguments *increase* rather than *reduce* the importance of putting those indicators into a larger context, and the responsibility to discuss potential biases and their impacts on results.

To reflect research principles the *UMR* must:

- Incorporate a comprehensive literature review concerning best current practices for defining and measuring congestion costs and evaluating congestion reduction strategies.
- Describe and compare potential definitions and methods, and explain why those used in this study were selected.
- Discuss possible sources of uncertainty and bias, and how that bias is likely to affect results.
- Report results as ranges rather than point values.
- Describe, discuss and respond in detail to legitimate criticism.
- Have a clearly-defined quality control program that includes independent peer review.

Summary of Biases and Their Impacts

Table 7 summarizes the *Urban Mobility Report's* major omissions and biases, and their impacts on planning decisions. Virtually all these tend to skew results toward overestimating congestion costs and roadway expansion benefits, and undervaluing other types of transport improvement strategies. The *UMR's* congestion cost estimates therefore represent upper-bound values and are probably much higher than most road users are actually willing to pay to reduce congestion.

Table 7 ***Urban Mobility Report* Omissions and Biases, And Their Impacts On Planning**

Omissions and Biases	Impacts on Planning Decisions
Lacks a current literature review and so fails to identify best current congestion evaluation practices.	Prevents readers from understanding the background and context of congestion costing.
Fails to explain its assumptions.	Prevents readers from understanding the study's methods or from replicating, critiquing and building on its analysis.
Assumes that *transportation* means automobile travel. Uses "commuter" when only automobile travel is measured.	Undervalues non-automotive modes. Skews planning decisions to favor roadway improvements over other types of transport improvements.
Ignores important accessibility factors and impacts, including the quality of non-automobile modes, transport network connectivity and land use proximity.	Skews planning decisions to favor roadway improvements over other accessibility improvements such as improving alternative modes, network connectivity and land use proximity.
Exaggerates congestion costs by using baseline speeds and travel time values higher than most economists recommend.	Exaggerates congestion costs relative to other economic impacts, and so can justify roadway expansions that may be economically inefficient considering all impacts.
Fails to consider ways that some congestion reduction strategies can reduce accessibility and increase costs.	Exaggerates roadway expansion benefits relative to other transportation improvement strategies.
Fails to compare congestion with other transport costs. Calls congestion costs "massive," although they increase travel time and fuel consumption 2% at most.	Exaggerates congestion costs relative to other economic impacts, and so can justify roadway expansions that may be economically inefficient considering all impacts.
Ignores induced travel impacts.	Exaggerates roadway expansion benefits relative to other transportation improvement strategies.
Uses a constantly declining speed-emission curve which assumes that increasing traffic speeds always reduces fuel consumption.	Exaggerates roadway expansion environmental benefits.
Ignores demographic and economic trends which are reducing motor vehicle traffic growth and increasing demand for alternative modes.	Exaggerates future congestion problems and long-term roadway expansion benefits.
Ignores positive trends, including recent declines in congestion, improved technologies and travel options that allow travelers to avoid congestion, and increasing effectiveness of demand management strategies.	Exaggerates current and future congestion problems and long-term roadway expansion benefits.
Lacks independent peer review.	Reduces the study's ability to identify and correct omissions and biases in analysis.
Ignores criticism.	Reduces the study's contribution to the profession's dialogue concerning best congestion costing practices.

The Urban Mobility Report contains various omissions and biases which affect planning decisions.

Table 8 describes potential solutions for making the Urban Mobility Report more accurate, comprehensive and useful.

Table 8 ***Impacts of* Omissions, Biases and Solutions**

Omissions and Biases	Potential Corrections
Lacks a current literature review.	Add a comprehensive literature review concerning best congestion costing methods.
Fails to explain its assumptions.	Clearly explain and document all assumptions.
Assumes that *transportation* means automobile travel. Uses "commuter" when only automobile travel is measured.	Specify whether all modes or just automobile travel conditions are considered in analysis. Report how results change when impacts are evaluated per capita or commuter rather than per peak-period motorist.
Ignores important accessibility factors and impacts, including the quality of non-automobile modes, transport network connectivity and land use proximity.	Account for all accessibility factors and all significant impacts, or indicate which are ignored and discuss how this affects analysis results.
Exaggerates congestion costs by using baseline speeds and travel time values higher than most economists recommend.	Discuss the assumptions used to select these values and how different values would affect results. Report ranges rather than just point values.
Fails to consider ways that some congestion reduction strategies can reduce accessibility and increase costs.	Discuss trade-offs between different types of accessibility, such as barrier effect of wider roads, and sprawl.
Fails to compare congestion with other transport costs. It calls congestion costs "massive," although they increase travel time and fuel consumption by 2% at most.	Compare congestion with other transport costs. Avoid hyperbole.
Exaggerates roadway expansion benefits by ignoring induced travel impacts.	Discuss induced traffic impacts, including smaller congestion reduction benefits and increased external costs.
Exaggerates environmental impacts by using a constantly declining speed-emission curve which assumes that increasing traffic speeds always reduces fuel consumption.	Justify or correct the speed-emission curve.
Ignores the increased crash severity associated with increased traffic speeds and therefore reduced congestion.	Discuss the trade-offs between traffic speed and safety.
Exaggerates future congestion problems by ignoring demographic and economic trends that are reducing vehicle traffic growth.	Discuss demographic and economic trends that affect vehicle traffic growth, and apply sensitivity analysis when predicting future congestion costs.
Ignores positive trends, including recent declines in congestion, improved technologies and travel options that allow travelers to avoid congestion, and increasing effectiveness of demand management strategies.	Provide more balanced and comprehensive discussion of congestion costs. Acknowledge and support newer congestion reduction strategies such as improved travel options, pricing reforms and other TDM strategies.
Lacks independent peer review.	Invite appropriate experts to provide advice on the study's research methods and review the reports.
Ignores criticism.	Acknowledge, discuss and respond in detail to legitimate criticisms.

The Urban Mobility Report's omissions and biases which should be corrected to make it more comprehensive, objective and accurate.

Conclusions and Recommendations

Traffic congestion reduces vehicle traffic speeds, can increase vehicle operating costs and frustrates motorists. Planners, decision-makers and the general public want comprehensive and objective information on congestion costs and the full benefits and costs of potential congestion reduction strategies. The *Urban Mobility Report* provides widely cited congestion cost estimates and provides recommendations for reducing congestion. However, its analysis is neither comprehensive nor objective. It contains various omissions and biases that tend to exaggerate congestion costs and roadway expansion benefits, and undervalues other transport system improvement strategies.

The *UMR* ignores basic research principles. It contains no literature review; fails to clearly explain its methodologies, assumptions and sources; does not discuss potential sources of bias; does not compare congestion with other transportation costs; includes no independent peer review and fails to acknowledge and respond to legitimate criticism. It fails to give readers the information they need to understand its results. For example, the *UMR* states that U.S. traffic congestion costs $121 billion annually, but never mentions that this is based on baseline travel speeds and travel time unit costs that are significantly higher than most experts recommend. Similarly, when it states that Washington DC and San Francisco rate worse than Houston and Atlanta, it does not mention that this reflects just one of many possible urban transport performance indicators, and that if evaluated per *commuter* rather than per *motorist*, or based on the number of jobs and services accessible within a given travel time, San Francisco and Washington DC rate better than Houston and Atlanta.

To their credit, the *UMR* authors have tried to improve their analysis. In recent years they added estimates of the congestion reduced by public transit and operational improvements, and a new indicator called *total peak-period travel time*. However, even these indicators are mono-modal: they only measure automobile travel impacts, they do not account for the congestion avoided by travelers who shift from driving to another mode. As a result, the report does not reflect current understanding of overall urban transportation system performance.

This is not to deny that traffic congestion is a problem and congestion reduction is an important planning objective. However, it is only one of several objectives that should be considered in the transportation planning process, and is not necessarily the most important. Planning decisions often involve tradeoffs between various costs and benefits. It is therefore important to apply comprehensive evaluation which considers congestion along with other impacts. This helps identify *win-win* solutions: congestion reduction strategies that help achieve other planning objectives and therefore maximize total benefits to society. The *UMR* fails to explore these issues. More comprehensive and objective analysis is needed to identify truly optimal solutions to congestion problems.

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