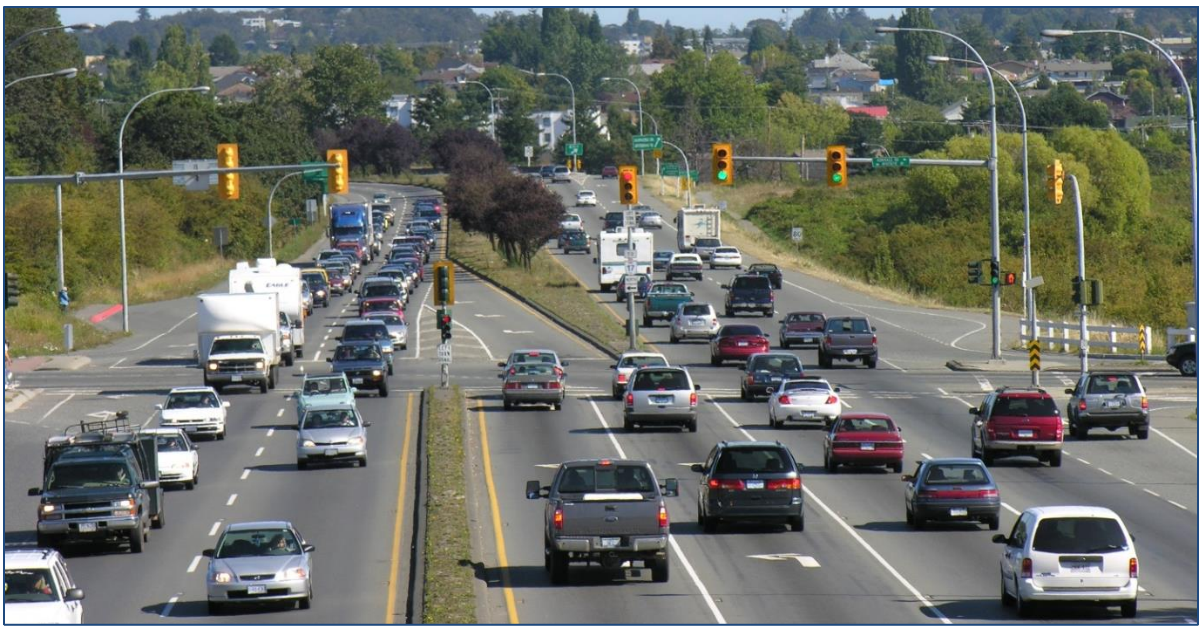
www.vtpi.org
Info@vtpi.org
250-508-5150

Not So Fast

Better Speed Valuation for Transportation Planning

16 December 2024

Todd Litman
Victoria Transport Policy Institute



Conventional planning practices exaggerate the benefits and understate the costs of faster travel. This favors faster modes and higher design speeds over slower but more affordable and resource-efficient options.

Summary
Planning decisions often involve trade-offs between travel speed and other goals. It is important to consider all of these impacts when evaluating those decisions. This report examines why and how to do that. It identifies various benefits and costs of faster travel, describes how speed valuation affects planning decisions, and provides guidance for comprehensive analysis of these impacts. Conventional planning tends to exaggerate the benefits and understate the costs of higher speeds. This favors faster modes, such as automobile travel, over slower but more affordable and resource-efficient modes such as walking, bicycling and public transit; favors higher roadway design speeds; and favors sprawl over compact development. Increasing the speed of slower modes tends to provide more benefits than increasing the speed of faster modes. Because people tend to maintain fixed travel time budgets, higher speeds generally increase the distances that people travel rather than saving time. Changing consumer demands and community goals are increasing the value of slower modes. Serving these demands requires more comprehensive analysis of speed-related trade-offs.

Key Findings

- Transportation planning often involves trade-offs between speed and other goals. It is important to consider all speed-related impacts in a planning process.
- Higher speeds are inherently costly. Faster modes require more expensive vehicles and infrastructure, more space and energy, and impose greater health risks and environmental damages. Because travel speeds tend to increase with wealth, speed-prioritizing planning tends to be inequitable; it increases costs that affluent travellers impose on disadvantaged groups.
- Planners often assume that faster travel provides time savings, but people tend to maintain fixed travel time budgets, they devote about the same number of daily minutes to personal travel regardless of speed. As a result, faster travel increases travel distances rather than saving time. This causes *mobility inflation*, it ratchets up the amount of travel people require to meet their needs, which is costly to communities and unfair to people with limited mobility.
- Current planning practices tend to exaggerate the benefits, underestimate the costs, and ignore the inequities of faster travel. Current planning generally recognizes trade-offs between speed and safety, but overlooks other impacts such as reduced affordability, public health, and mobility for non-drivers. This results in overinvest in faster modes and higher roadway design speeds, which over the long run increases total vehicle travel and sprawl.
- Higher travel speeds do not necessarily support economic development. Faster travel can increase productivity if it increases overall accessibility, but those benefits are often offset by its additional costs. Many economically successful communities have low travel speeds but high accessibility.
- The inefficiency and inequity of speed-prioritizing planning are evident if transport performance is evaluated using *effective speed*, defined as travel distance divided by the time spent travelling *and* earning money to pay travel expenses. Measured this way, automobile travel is often slower than bicycling and public transit, and is regressive because it benefits affluent motorists who value time more than money, but harms lower-income people who prefer lower-cost modes.
- Faster travel is not *bad*, but it is costly and often unfair. Current planning overlooks many of these impacts. More comprehensive analysis tends to justify favoring affordable, inclusive and resource-efficient modes over faster, costly modes, and traffic speeds set to optimize community livability. Travel time savings for slower modes should be weighted higher than time savings to faster modes.
- To their credit, many policy makers and planning practitioners support slower modes and traffic speed reductions more than their economic models justify; they realize intuitively that slower modes play important roles in an efficient and equitable transportation system, and so deserve public support. However, this occurs *despite* rather than *supported by* standard analysis practices. Reforming these practices can justify much more support for slower modes.
- More comprehensive speed analysis is likely to result in less investment in urban highways, more investments in active and public transport modes, lower roadway design speeds, more planning to improve travel comfort and convenience rather than speed.
- Of course, every traveller has unique needs and preferences. Many choose faster modes, such as automobiles, despite their higher costs, for convenience and status sake. However, current demographic and economic trends – aging population, increasing urbanization, plus growing affordability, health and environmental concerns – are increasing demand for slower modes and multimodal neighborhoods. Given better options, many people would choose slower modes for many trips. Everybody benefits if planning practices respond to these demands.

"Haste makes waste."

Contents

Introduction

People often make trade-offs between speed and other goals such as comfort, affordability and safety. For example, travellers often choose between slower but cheaper modes, such as walking, bicycling and public transit, or faster but more expensive modes such as driving and air travel. They can sometimes pay a premium for faster options, such as an express train or tollroad. Motorists choose between faster sportscars, or more affordable or luxurious vehicles.

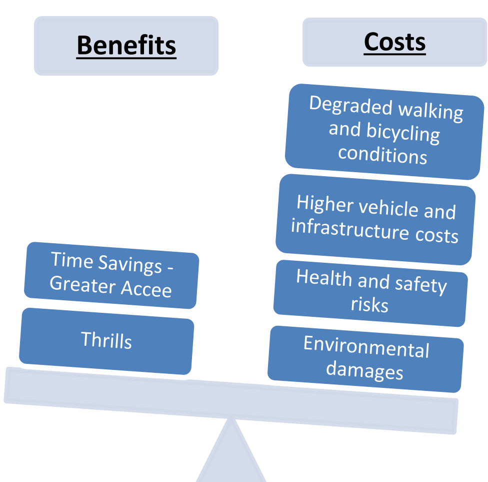
Similarly, planning decisions also involve trade-offs between speeds and other community goals. Transportation agencies can invest in faster modes, such as automobile and aviation, or in slower but more affordable and resource-efficient modes such as walking, bicycling and public transit. Roads can be designed to maximize traffic speeds, or as complete streets with more priority for slower modes and lower design speeds for comfort, safety and environmental quality. The question explored in this report is whether current planning accurately reflect traveller and community preferences in such trade-offs.

Certainly, higher speeds provide benefits. All else being equal, higher speeds increase the distances people can travel in a given time period, and travellers sometimes enjoy the thrill of speed. Many productive activities and lifestyles require the higher speeds provide by automobiles. For example, automobiles provide efficient goods delivery, expand workers' job options and employers' pool of potential workers, and allow more recreation and social opportunities would not otherwise be feasible.

However, higher speeds increase costs and can make people worse off overall. For example, because automobiles are expensive their *effective speeds* (travel distance divided by time spent travelling plus time spent earning money to pay travel expenses) is often lower than more affordable modes, particularly for lower-wage workers. Urban travel would be faster if more travellers used space-efficient modes, but for individuals, driving is generally faster so automobile-oriented planning makes most travellers slower overall (Meira, et al. 2020; Mogridge 1997; Verkade and Brömmelstroet 2020). Similarly, although urban highways increase traffic speeds they encourage sprawled development which increases the total amount of time residents spend travelling.

Figure 1 illustrates these trade-offs. Table 1 provides a more detailed list of these benefits and costs.

Figure 1 **Balancing Goals**



Transportation planning decisions must balance speed with other goals such as affordability, multimodal accessibility, public safety and health, and environmental protection. This report examines whether current planning practices accurately reflect these trade-offs as valued by individual travellers and communities.

Table 1 Typical Benefits and Costs of Speed

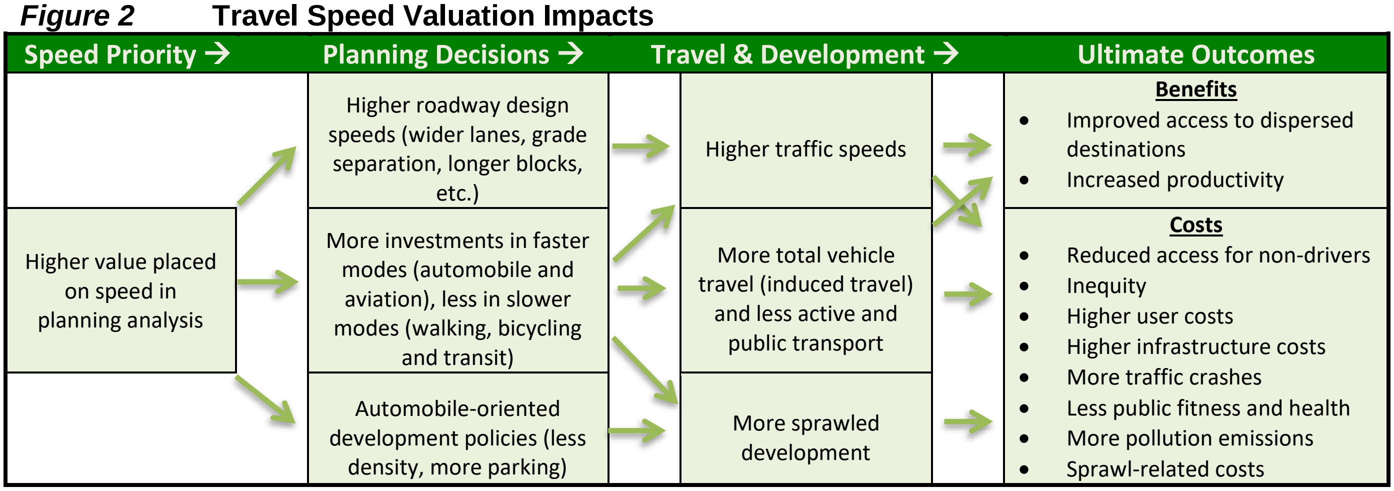
Benefits	Costs
	• Reduced travel comfort and increased driver stress.
	• Increased user costs and reduced affordability.
	• Increased traffic congestion and barrier effects.
	• Increased road and parking infrastructure cost.
	• Increased crash risk, particularly for vulnerable modes.
	• Increased energy consumption, noise and pollution emissions.
• Short-term travel time savings.	• Degraded public realm and community livability.
• Increased accessibility.	• More automobile dependency and sprawl.
• People sometimes enjoy the thrill of speed.	• Increased disparities between motorists and non-motorists.

Higher speeds provide user benefits and increase various user and community costs.

Conventional planning assumes that higher speeds provide time savings, but these tend to be offset over the long run by increased travel distances and sprawl. This occurs because people tend to maintain fixed travel time budgets. Extensive research indicates that most people devote 60-90 daily minutes to travel, called *Marchetti's Constant* (Marchetti 1994). For example, if a road improvement increases traffic speeds by 30%, affected motorists tend to drive about 30% more vehicle-miles. As social philosopher Andreas Gorz argued in his 1973 essay *The Social Ideology of the Motorcar*, "In the final analysis, the car wastes more time than it saves and creates more distance than it overcomes. Of course, you can get yourself to work doing 60 mph, but that's because you live 30 miles from your job and are willing to give half an hour to the last 6 miles" (Gordon 2023). Although the additional mobility provides user benefits, it increases external costs such as roadway costs, congestion, crash risk, and pollution.

The value placed on speed significantly affects planning decisions, and therefore various benefits and costs, as illustrated in Figure 1. Conventional planning considers some of these impacts but often overlooks or undervalues others, particularly long-term effects if they increase sprawled development. To the degree that planning exaggerates the benefits or undervalues costs of speed, it results in faster traffic, more vehicle-miles, and higher total costs than travellers and communities actually want.

Figure 2 Travel Speed Valuation Impacts



Higher values placed on speed favors faster modes, higher traffic speeds and dispersed development, which reduces non-auto modes, and increases total vehicle travel and sprawl.

Transportation planning often involves trade-offs between different forms of access. For example, expanded roads and parking facilities increase automobile travel speeds but degrade walking and bicycling access, reduce public transit service quality, and encourage sprawled development, which increases the distances that people must travel to reach destinations, which increases total transportation costs, and reduces non-auto accessibility, making non-drivers worse off. This reduces effective speeds for most lower-income motorists – their travel time savings are more than offset by the additional work hours needed to own and operate their automobiles – and non-drivers are far worse off due to reduced non-auto accessibility.

Fair and efficient transportation planning would offer travellers affordable accessibility options: good walking and bicycling conditions and efficient public transit for travelling on busy corridors, and affordable housing in walkable urban neighborhoods. Conventional planning fails to do this. It favors faster modes and higher traffic speeds over slower but more affordable, comfortable and resource-efficient alternatives in many ways. Consider these examples.

1. In a typical community, 10-20% of trips are made by slower modes (walking, bicycling and public transit), 20-50% of residents rely on these modes at least three times per week, surveys indicate that many travellers want to use slower modes more, and accommodating these demands helps achieve many economic, social and environmental goals. Yet, most communities devote much less than 10% of transportation funds and road rights-of-way to these modes, less than their mode shares.
2. Most urban streets have design speeds and speed limits over 30 miles per hour (mph), although research indicates that this is excessive for the safety and comfort of walking and bicycling.
3. During the last century many high-accessibility urban neighborhoods were displaced by freeways. This improved suburban motorists' access to city jobs and services, but degraded urban neighborhoods and reduced non-auto access.
4. Traffic engineers often design roads for speeds that are 5-15 mph higher than their posted speed limits, and those speed limits are adjusted based on the 85th percentile rule (speed limits are based on the speeds exceeded by 15% of vehicles), creating a self-reinforcing cycle of speed increases.

There are many reasons why speed-prioritizing planning is common. It may reflect consumerist assumptions that automobile travel is better than slower modes and suburbs are better than cities; the political influence of vehicle and petroleum industries; the biased experiences of decision-makers who themselves lead automobile-dependent lifestyles; and racist assumptions that consider urban neighborhoods "blight" to be displaced. These are all legitimate critiques. However, the *mechanism* that causes planning processes to favor faster modes over slower modes and sprawl over compact development is the high value placed on travel time savings, plus the tendency to overlook many external costs of faster modes and traffic. Planning that emphasizes affordability, health, equity or resource-efficiency tends to give speed less priority than current practices.

This report investigates these issues. It identifies various benefits and costs of speed (Figure 2), how they are valued, how this valuation affects planning decisions, and the resulting impacts on people and communities. This should be of interest to policy makers, planning professionals, advocates of slower modes, and anybody who wants more equitable and efficient transportation.

The Demand for Speed

Travel demand refers to the type and amount of travel that people would choose in a particular situation. A key question in this analysis is the degree that consumers demand speed relative to other goals, and the degree that planning reflects these preferences.

Of course, people are sometimes willing to pay a high price for faster travel, for example, in an emergency on when delivering valuable, time-sensitive goods, but travellers often have other priorities. For example, motorists often choose slower but more scenic routes, and commuters sometimes choose to bike or ride transit for affordability, health or enjoyment sake.

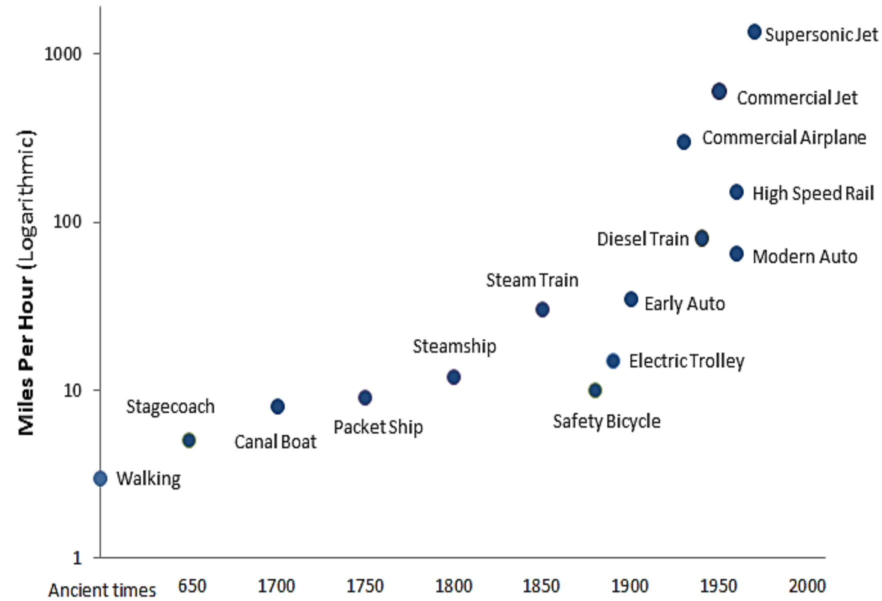
Some highways have tolled express lanes that test motorists' demand for faster travel. They indicate that, although some motorists are willing to pay cost-recovery tolls (tolls sufficient to finance highway expansions), most would rather save money than time (Howard and Williams-Derry 2012; Parsons Brinckerhoff 2012; Prozzi 2009). For example, on the Katy Freeway, only about 10% of motorists are willing to pay tolls to avoid congestion delays, indicating that 90% of motorists value their time at less than $8 per hour (Burris 2016). In other words, motorists want faster travel if it is subsidized, but will often choose slower options they must pay the costs.

In addition, many communities recognize new planning goals such as affordability (cost burdens on lower-income households), equity (impacts on disadvantaged groups), public health, community livability, and environmental quality, which slower modes and traffic speeds tend to support.

A Short History of Speed

Until recently, transportation progress consisted of faster modes, from walking to horse travel, sailing ships, bicycles, trains, automobiles, airplanes, to supersonic jets, as illustrated in Figure 3.

Figure 3 **New Modes' Initial Availability and Typical Operating Speed** (Various Sources)

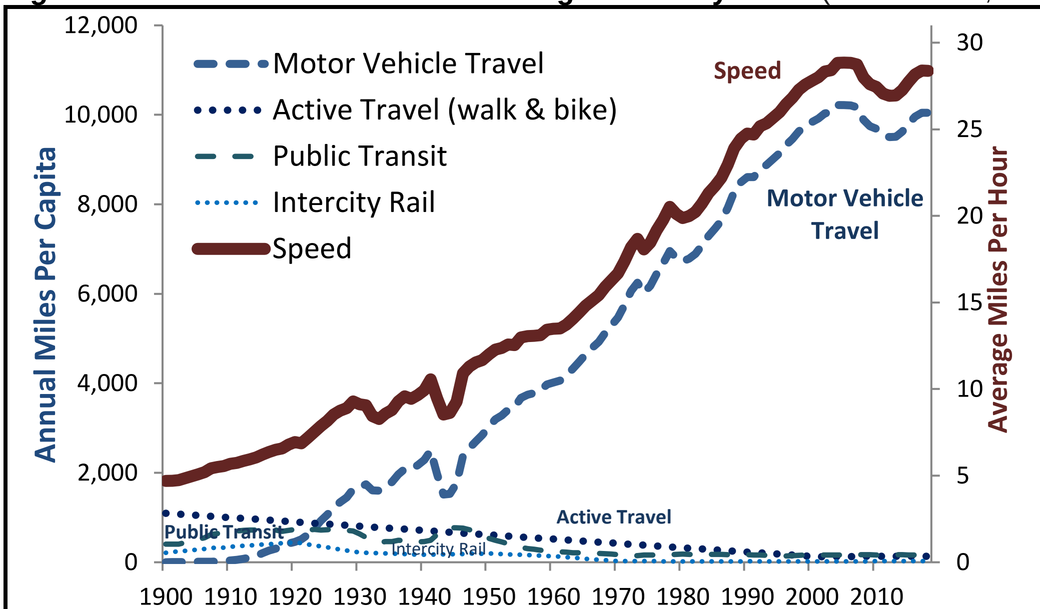


For most of history, transportation progress consisted of the development of faster modes. Increased travel speeds provided many benefits, but also imposed many costs.

Note that speed is indicated on a logarithmic scale so small increases in height indicate large increases in speed.

Motorization significantly increased people's average speed and distance, as illustrated below. During the Twentieth Century, motorization increased average travel speeds from about 4 to 30 mph, and per capita travel from about 1,000 to 10,000 annual miles or 12,000 annual miles per motor vehicle.

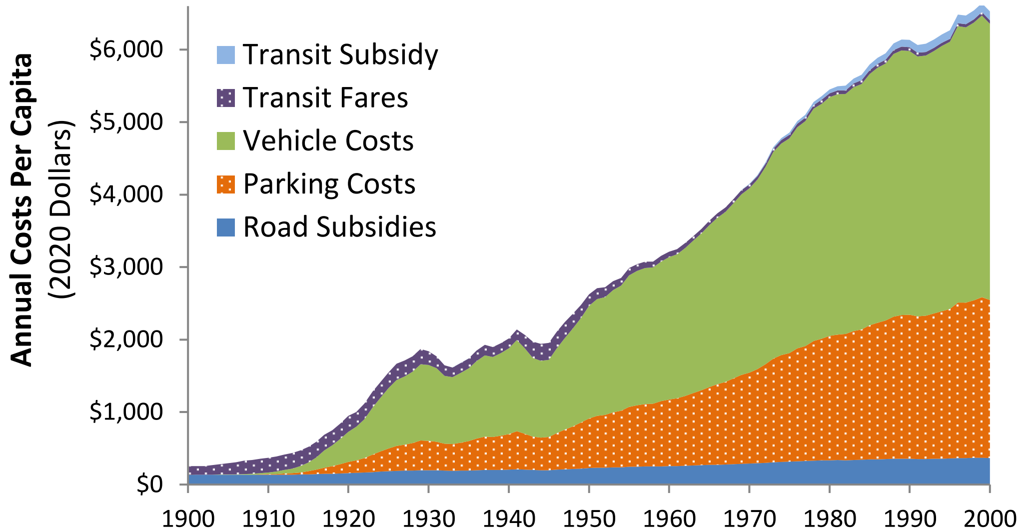
Figure 4 **Estimated Annual Passenger-Miles by Mode** (Litman 2020, Exhibit 8)



Before 1900 travel people travelled primarily of walking, with occasional bike and rail trips. During the Twentieth Century, motor vehicle travel grew. This increased average speeds from about 3 to 30 mph, mobility from about 1,000 to 10,000 annual miles per capita, and reduced travel by other modes.

Increased motor vehicle travel increased various costs, as illustrated below.

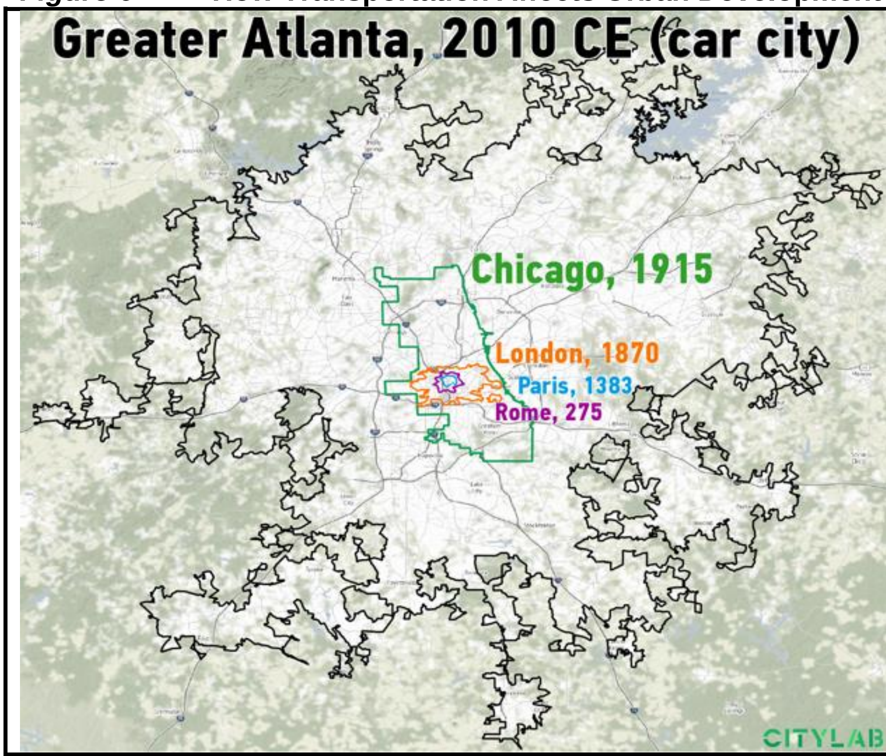
Figure 5 **Estimated Vehicle and Infrastructure Costs** (Litman 2020, Exhibit 36)



As vehicle travel increased during the Twentieth Century, transportation costs increased significantly. Per capita inflation-adjusted expenses are estimated to have increased from less than $200 in 1900 to more than $6,000 dollars in 2000.

Increased vehicle traffic degraded urban areas and faster vehicle travel encouraged sprawled development, illustrated in Figure 6.

Figure 6 **How Transportation Affects Urban Development** (English 2019; Mouzon 2012)



Ancient Rome and Paris were compact walking cities. London and Chicago expanded along rail lines to create transit-oriented suburbs. Greater Atlanta is a sprawled, automobile dependent city where it is difficult to get around without a car.

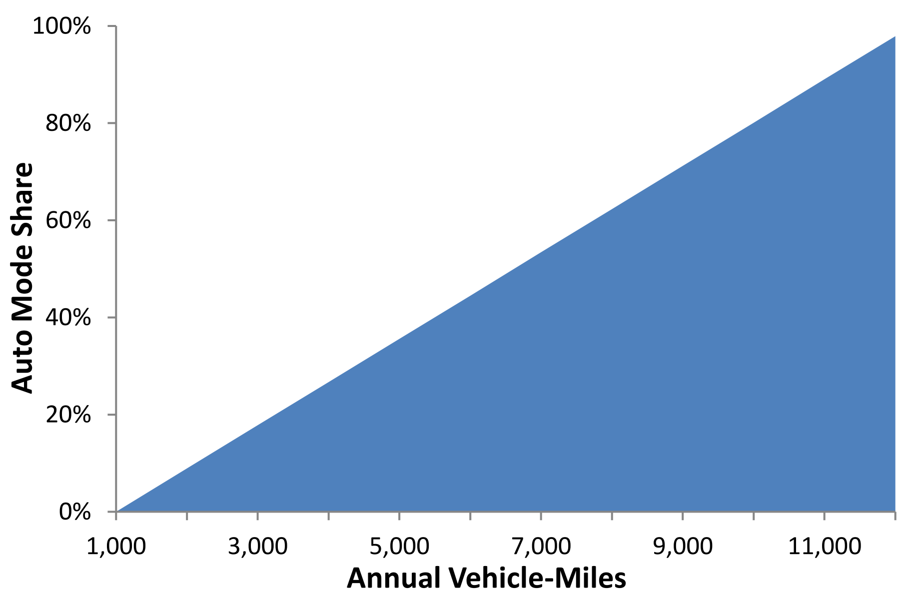
These examples illustrate how faster travel encourages urban dispersion – sprawl – which increases the travel distances required for a given level of accessibility, and reduces non-auto access. As a result, speed increases do not usually provide travel time savings; over the long run they generally cause people to travel more.

Over the long run people tend to maintain fixed travel time budgets: most people devote about 70 daily minutes to out-of-home personal travel (Ahmed and Stopher 2014), called *Marchetti's Constant* (Marchetti 1994). Of course, there are many exceptions, some people devote much more or less time to travel, but this pattern is common at most times and places around the world.

Travel time budgets tend to maintain equilibrium because people have only 24 hours per day of which some is devoted to sleep, personal activities and work, so the time available for travel is limited. Most people enjoy a certain amount of travel, so if they spend too little they find reasons to travel more, and if they spend too much, they find ways to travel less. For example, when searching for a home or job, workers usually look for commutes up to 30 minutes, and shoppers generally choose stores accessible in less than 15 minutes. If traffic speeds increase, commuters and shoppers expand their destinations, and over time this encourages more sprawled development patterns which increase vehicle travel. Similarly, when employees work at home, they generally make additional out of home trips to perform errands that they otherwise would have made while commuting to worksites.

Fixed travel time budgets mean that over the long run, faster travel tends to increase the distances people travel rather than providing travel time savings. The previous chapter showed how this occurred during the last century: in 1900 people typically travelled about 1,000 annual miles, primarily by walking and bicycling, and occasionally by train or boat; now people typically travel about 10,000 annual miles, primarily by private automobile and occasional walking, bicycling and public transport trips. The figure below illustrates this effect. Since motor vehicles travel five to ten times faster than walking, bicycling and public transport, each mile shifted from auto to non-auto modes typically reduces five to ten motor vehicle-miles (Litman 2022).

Figure 7 **Vehicle-Miles Versus Automobile Mode Share**



This figure illustrates the increase in annual vehicle-mileage that results as automobile mode shares increase, assuming that people who never drive generate about 1,000 annual miles of travel by freight and service vehicles, and people who rely entirely on automobile travel generate 12,000 annual vehicle-miles.

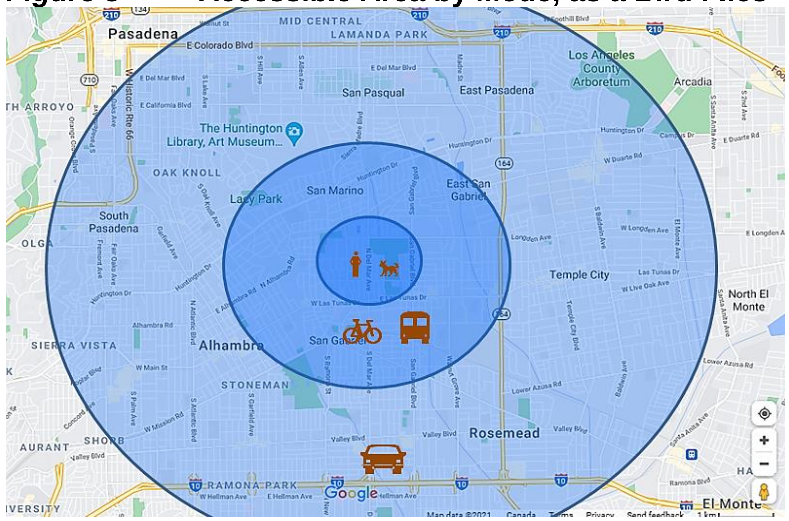
Speed Benefits and Costs

This section examines various benefits and costs of increased travel speed.

Increased Access

Faster travel expands the area that people can access. In 20-minutes a pedestrian can typically reach an area of about 3 square miles, a bicyclist or transit passenger about 30 square miles, and a motorist averaging 30 mph about 300 square miles as illustrated to the right

Figure 8 **Accessible Area by Mode, as a Bird Flies**

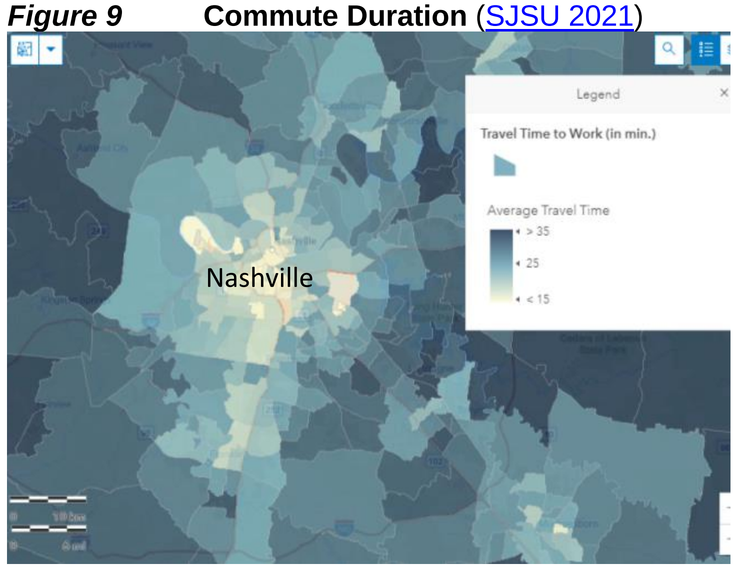


In 20-minutes a 3 mph pedestrian can reach about 3 square miles of area, a 10-15 mph bicyclist or transit passenger about 30 square miles, a 30 mph motorist about 300 square miles, as the crow flies.

However, vehicle speeds are just one of many factors that affect accessibility; others include the quality of non-auto travel, network connectivity, development density and mix, and mobility substitutes such as telecommunications (Levinson, Marshall and Axhausen 2018). Development density tends to affect accessibility more than vehicle travel speed (Levine, et al. 2012). There are often trade-offs between these factors: money and road space invested in faster modes are unavailable investment in slower modes, designing roadways for maximize traffic speeds tends to reduce their connectivity and local accessibility, and highway-oriented sprawl increases the distances between destinations.

New accessibility models can evaluate these factors (Sundquist, McCahill and Brenneis 2021). For example, the [*Metropolitan Chicago Accessibility Explorer*] indicates that central neighborhood residents can access more jobs by bicycle or transit than most suburban motorists can reach in the same amount of time, and their access to local services, such as stores and schools, is even better. This indicates that urban non-drivers often have better access overall than suburban and rural motorists.

Figure 9 **Commute Duration** ([SJSU 2021])



This map of the Nashville region shows that commute duration tends to be lower in central areas than outer suburbs, because their lower traffic speeds are offset by shorter trips distances.

In fact, despite greater use of slower modes and lower traffic speed, urban residents spend less time commuting than suburban residents, as illustrated in Figure 8. This indicates that proximity affects accessibility more than by travel speeds, so compact development can provide more time savings than congestion reductions.

Travel Time Savings

Planners often assume that higher travel speeds save time, and typically value these savings at 35% to 60% of wages ("Travel Time," Litman 2018; USDOT 2016). Their value can vary significantly depending on preferences and conditions: under favorable conditions, time spent travelling has positive value, while under unpleasant conditions it has high unit costs (Mokhtarian 2005). Rowland and McLeod (2017) found that motorists tend to overestimate the time savings provided by high travel speeds.

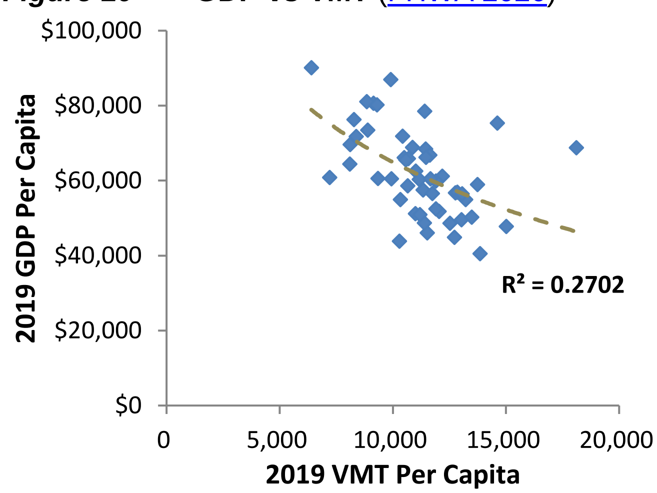
As previously mentioned, people tend to maintain fixed travel time budgets (Ahmed and Stopher 2014); most people around the world devote 60-80 daily minutes to personal travel, so over the long run, faster travel usually increases travel distance rather than saving time. If traffic speeds increase, commuters and shoppers expand their destinations, and development patterns become more sprawled, increasing travel distances rather than saving time. The resulting benefits tend to be modest since the increased mobility consists of vehicle-miles that travellers most willing forego if their time costs increase. Dam, et al (2022), found that commute time savings when people work at home are devoted to a combination of increased working, sleeping and leisure, including in out-of-home activities that often increase travel.

This has important implications for speed valuation (Metz 2015; Standen 2018). For example, although speed gains sometimes provide large benefits (motorists would pay a lot to save a few minutes), other factors, such as affordability and comfort are also important (Burris, et al. 2016). In many situations, travellers will choose slower modes if they are cheaper or more enjoyable, and improving travel comfort, for example, by reducing transit crowding or building nicer stations, may provide greater user benefits than increasing travel speed (Litman 2017).

Economic Productivity and Opportunity

Faster travel can sometimes increase economic productivity and opportunity, for example, by allowing field workers to reach more destinations per shift, expanding the pool of workers available to employers, and the jobs and services available to residents (Ewing, et al. 2016; Smart and Klein 2015). However, other accessibility options often provide similar productivity gains with lower total costs, for example, if non-auto improvements and more compact development improve accessibility and support agglomeration efficiencies. Since faster modes, increased vehicle traffic, and sprawl increase many costs, it is unsurprising that productivity tends to decline as per capita vehicle travel increases, as shown in the figure to the right. This suggests that improvements to slower modes and Smart Growth development policies often increase economic development more than automobile-oriented improvements (Chatman and Noland 2013).

Figure 10 **GDP vs VMT** (FHWA 2020)



Per capita Gross Domestic Product (GDP) declines with vehicle travel, indicating that faster driving does not increase economic development. (Each dot is a state.)

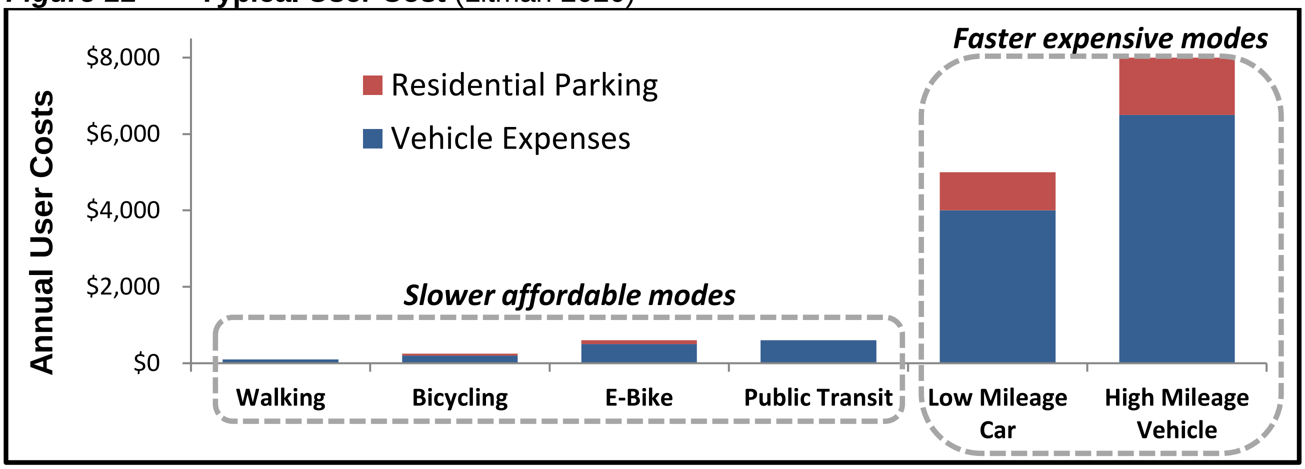
Traveller Stress and Discomfort

Although travellers sometimes enjoy the thrill of speed, faster travel generally increases driver stress and reduces passenger comfort. Motorists often choose slower roads, such as tree-lined city streets and scenic byways, over higher speed roads. Commuters who drive long distances tend to be less satisfied and more stressed than those who walk, bike, use comfortable public transit, or have shorter car trips (Wei 2015). Lowe and Mosby (2016) find that lower-income travellers are particularly sensitive to travel unreliability, discomfort and dependency. This suggests that conventional planning may overvalue speed relative to qualitative factors such as convenience and comfort. This could justify more investments in active and public transport, plus lower roadway design speeds and more streetscaping.

User Expenses

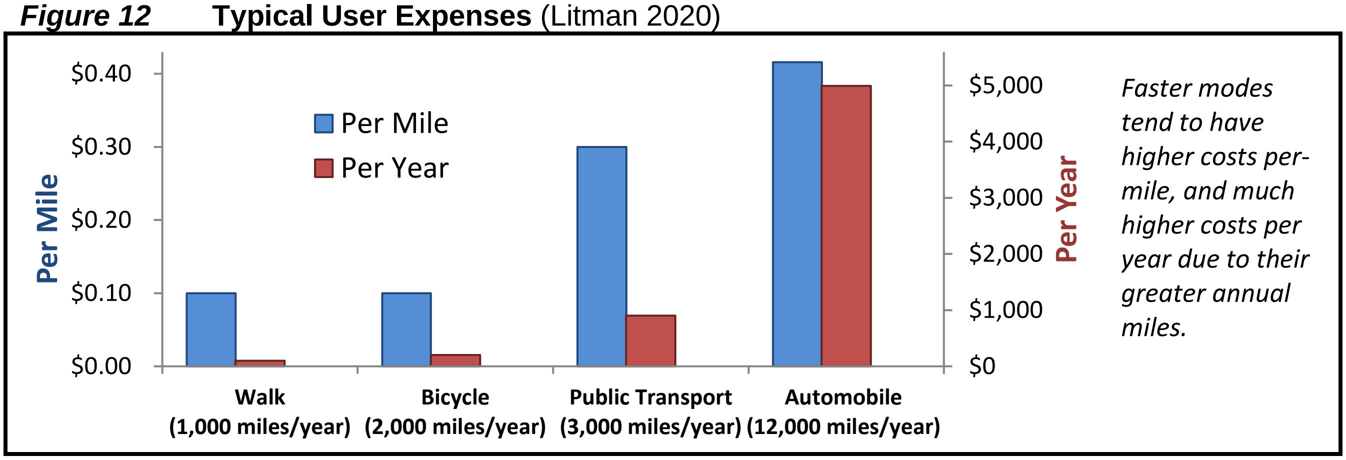
Faster travel tends to increase user expenses. A typical pedestrian spends an extra $100 per year on shoes to walk about 1,000 miles; a typical bicyclist spends $200 extra per year to ride 2,000 miles; a typical transit user spends $600 on fares to ride 3,000 annual miles; and a typical motorist spends about $5,000 to $8,000 annually on vehicles and residential parking to drive 5,000 to 15,000 annual miles.

Figure 11 **Typical User Cost** (Litman 2020)



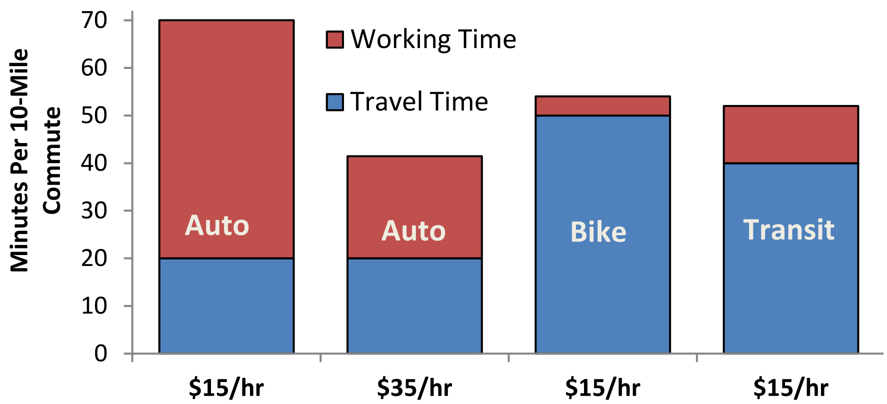
Slower modes cost much less than faster modes, as shown in Figure 10 (annual user costs) and Figure 11 (cost per mile and per year).

Figure 12 **Typical User Expenses** (Litman 2020)



These costs can be evaluated using *effective speed*, which measures distance travelled divided by time spent traveling *and* earning money to pay travel expenses (Meira, et al. 2020; Tranter 2010), illustrated below. Blue shows time spent travelling and red shows time spent earning travel expenses.

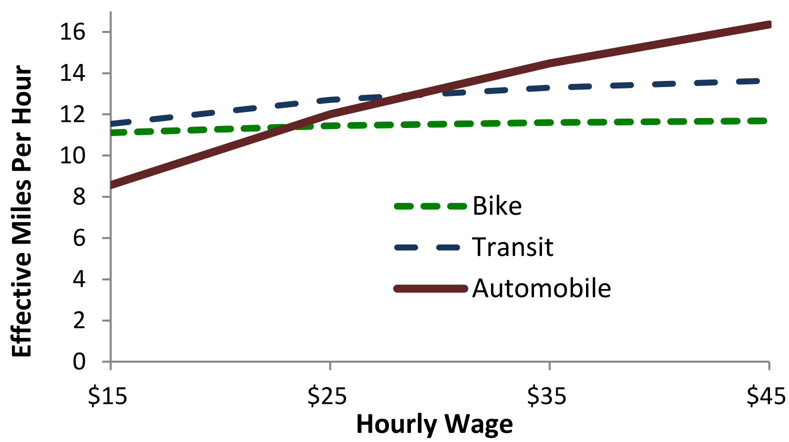
Figure 13 **Effective Speed by Income and Mode** (Litman 2020)



Measured by effective speed (time spent travelling and earning money to pay travel expenses), bicycling and transit are often faster than driving, particularly for lower-wage workers. (Assumes bicycling 12 mph, 10₵/mile; Public Transit 15 mph, 30₵/mile; Auto 25 mph, $5,000 and 4,000 annual miles for $15/hr. motorists and $7,000 and 12,000 annual miles for $35/hr. motorists.)

Since lower-wage workers must spend more time earning their travel expenses and drive fewer average annual miles, effective speeds increase with income, as illustrated below. Measured this way, automobile travel is regressive, and improvements to slower modes increase affordability and equity.

Figure 14 **Effective Speed by Income**



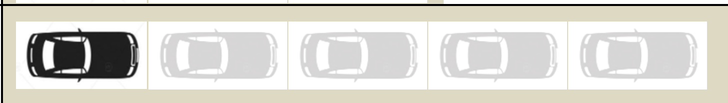
Effective speed considers time spent traveling and working to pay travel expenses. It therefore increases with income. For lower-wage workers, bicycling and public transit are often faster than driving.

As a result, planning practices that favor automobile travel over more affordable modes are regressive, they favor higher-income over lower-income travellers.

Infrastructure Costs

Faster modes, higher travel speeds, and the additional vehicle travel they generate increase the size and costs of transportation infrastructure (Mouzon 2012). Building and maintaining sidewalk and bikeways typically costs $20-50 annual per capita, public transit services typically cost $50-100 annual per capita, while public road cost about $800 and off-street parking facilities $2,000 to $4,000 annual per capita (FHWA 2018, Table HF10; Litman 2018). Higher speeds require more *shy distance* (clearance between vehicles and other objects), which requires more and wider traffic lanes, and more complicated intersections. For example, at 20 mph a car requires approximately 500 square feet (sf) of road space, but at 60 mph requires about 1,500 sf, as illustrated below.

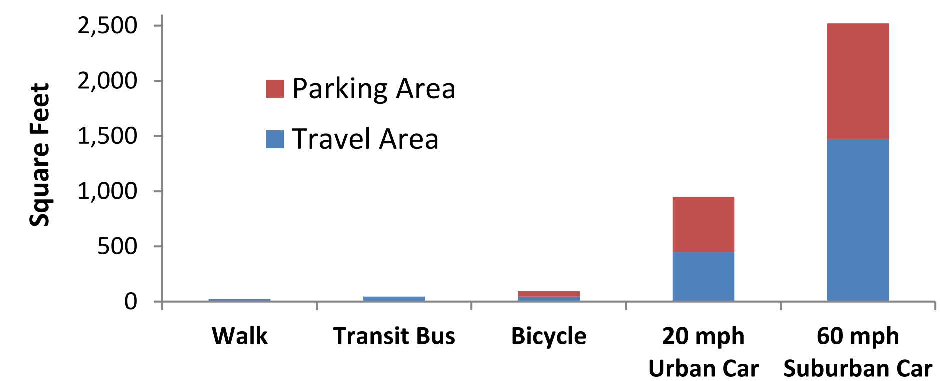
Figure 15 **Road Space Requirements by Vehicle Speeds**

MPH	Road Space Required	
20		15’ x 3 x 11’ = **490** sf
40		15’ x 5 x 12’ = **900** sf
60		15’ x 7 x 14’ = **1,470** sf

As traffic speeds increase vehicles require more shy distance (clearance from other objects) ahead and to the side. An increase from 20 to 60 mph approximately triples a vehicle’s road space requirements (sf = square feet).

The figure below illustrates the additional road and parking space required by faster travel.

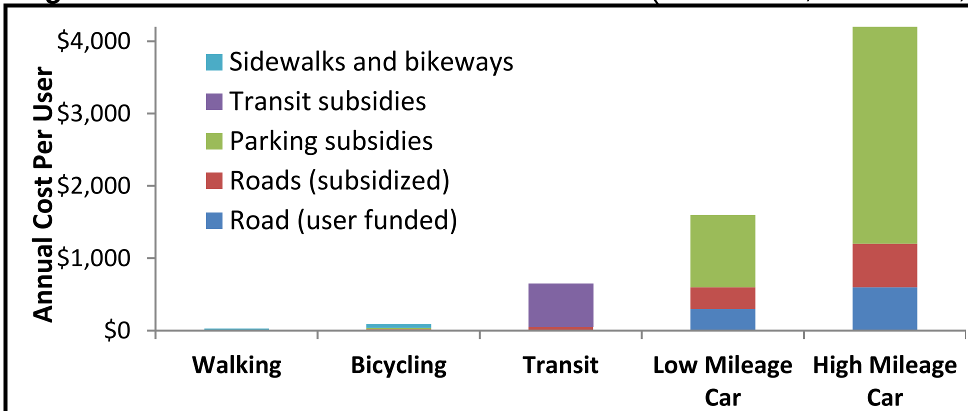
Figure 16 **Road and Parking Space Required by Travel Modes**



Faster modes and higher speeds require more space for travel and parking.

Faster modes and higher traffic speeds require larger roads and parking facilities, more complex intersections, more road maintenance, and more traffic safety programs. As a result, higher speeds increase infrastructure costs, as illustrated below.

Figure 17 **Estimated Infrastructure Costs** (Kockelman, et al. 2013; Litman 2019)

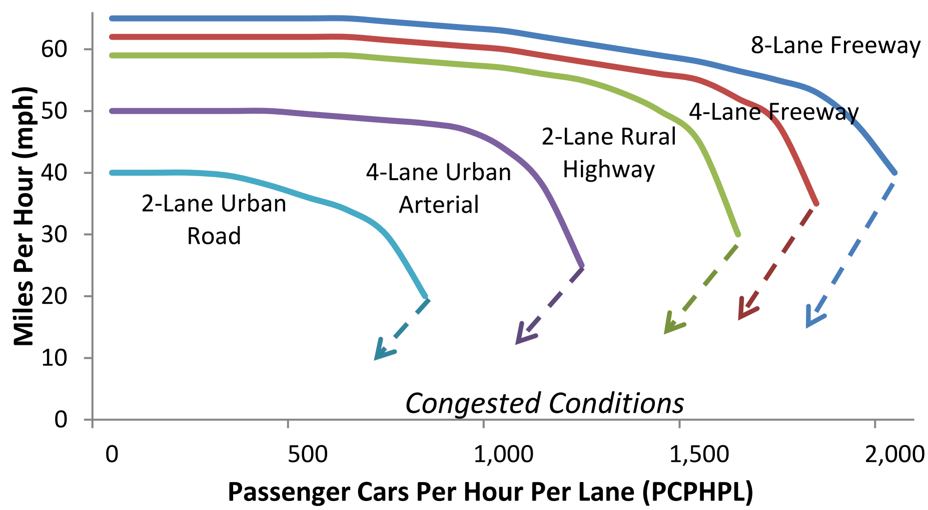


Walking and bicycling have low infrastructure costs. Transit travel requires a few hundred dollars in annual subsidies. Automobile travel requires a few thousand dollars a year in road and parking facility costs, most of which are funded indirectly through general taxes, rents and the prices of other goods.

Congestion and Barrier Effect Costs

As previously mentioned, automobiles require more travel space per passenger-mile than slower modes, and their space requirements increase with speed. Roadway capacity, the number of vehicles a road can carry per hour, tends to peak at 30-50 mph on highways and less on surface streets, as illustrated below. Wider roads and increased traffic speeds also increase the delay and risk imposed on walkers and bicyclists, called the *barrier effect* (Litman 2018; SGA 2023). This harms active travellers and causes shifts to motorized modes, which increases traffic problems. As a result, higher speeds increase the congestion costs a vehicle imposes on other road users.

Figure 18 **Speed Flow Curves** (based on Hall 1994)



Although details vary depending on roadway design and conditions, traffic capacity (vehicles per hour) is maximized, and therefore traffic congestion is minimized, at moderate traffic speeds, typically 20-40 miles per hour.

As a result, speed reductions tend to increase peak-period roadway capacity and reduce congestion.

Crash Risk

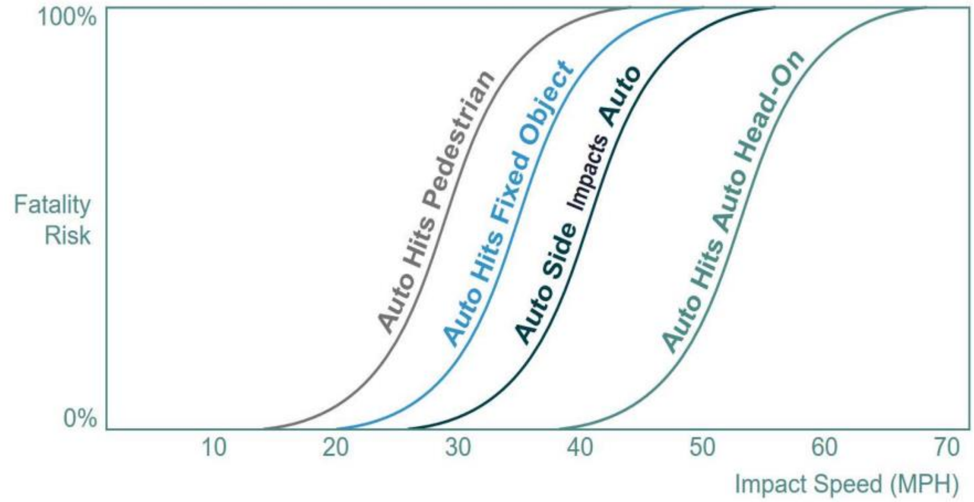
Crash risk increases with speed for reasons described in the box to the right. Most traffic safety studies only categorize crashes as "speed related" if drivers exceed legal speed limits, which overlooks the additional crashes caused by higher posted speeds.

Crash frequency and severity increase exponentially with traffic speeds: a 1% increase in traffic speeds increases injury crash frequency 2%, severe crash frequency 3% and fatal crash frequency 4% (Elvik 2009; ITF 2018). Reducing speed limits to 30 km/h in 40 European cities reduced average road crash, fatality, and injury rates by 23%, 37%, and 38% respectively (Yannis and Michelaraki 2024). Urban traffic speed reductions provide particularly large reductions in pedestrian and bicyclist casualties (Brenneis 2021). Redelmeier and Bayoumi (2010) find that the travel time savings provided by higher speeds are more than offset by reduced longevity and increased crash delays. One major study concluded that speed management can reduce more casualties than any other traffic safety strategy; optimal speeds could save about 347,258 lives globally annually, about three times the potential saving provided by seatbelt, seven times by helmet, and twenty times by anti-drunk driving interventions (Vecino-Ortiz, et al. 2022).

Traffic Risks (NACTO 2020; NHTSA 2023)
Higher speeds increase crash risk in these ways:

1. Reduces drivers' field of vision, reducing their chance of seeing and avoiding hazards.
2. Increase reaction and braking distances, reducing the chance of avoiding crashes.
3. Increase crash severity. For example, pedestrian crash survival rates decline from 90% at 20 mph to just 10% at 40 mph.
4. Increases total vehicle travel and therefore total risk exposure.
5. Automobile dependency and sprawl reduce traffic safety program effectiveness. For example, anti-impaired driving programs are more effective in multimodal communities where drinkers have alternatives to driving.

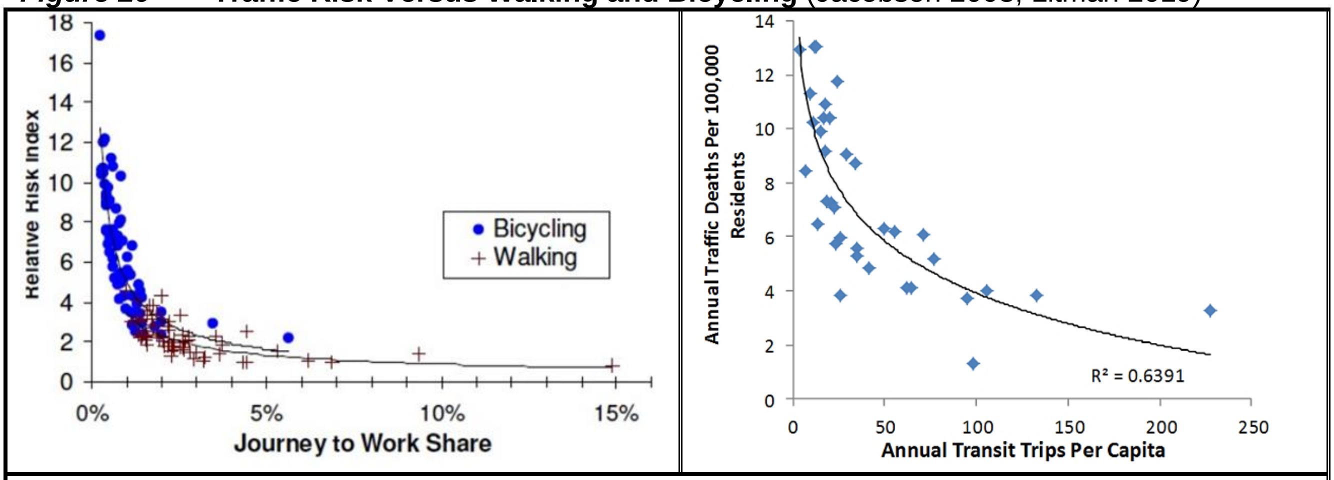
Figure 19 **Speed Flow Curves** (based on Australian Road and Traffic Authority research)



All types of road users become safer as traffic speeds decline.

Total traffic casualty rates tend to decline with more compact development, reduced vehicle travel, lower traffic speeds, and, more active and public transit travel (Ewing and Hamidi 2017; Larson 2018; Welle, et al. 2018), as illustrated below. To optimize safety, experts recommend 30 km/h speed limits in urban areas with mixed motorized and non-motorized traffic; 50 km/h in areas with intersections; and 70 km/h on rural roads without median barriers to prevent head-on collisions (ITF 2018; NACTO 2020). Reductions in traffic speed translate into insurance cost savings. For example, vehicle damage claims fell 20% after Wales reduced urban speed limits to 20mph (Butler 2024).

Figure 20 **Traffic Risk Versus Walking and Bicycling** (Jacobson 2003; Litman 2019)

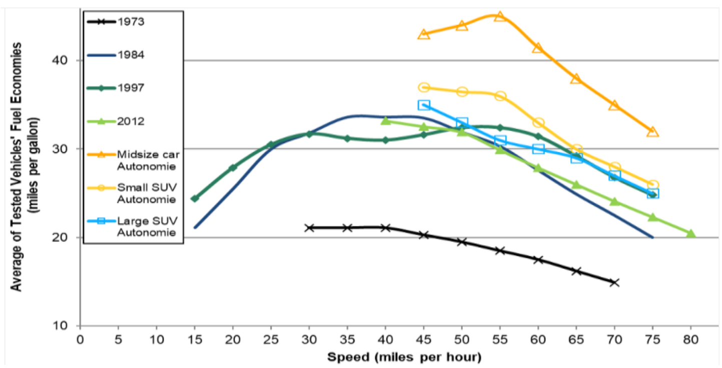


Total (all mode) crash rates tend to increase as traffic speeds and total vehicle-miles increase, and decline as walking, bicycling and public transit mode shares increase in a community, an effect called "safety in numbers."

Energy Consumption and Pollution Emissions

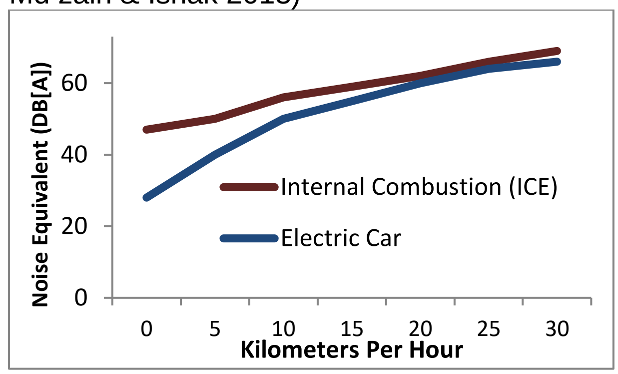
Motor vehicles operate most efficiently at 50 to 80 kilometers per hour (30 to 50 mph), and less under stop-and-go conditions (Figure 20). Raising Michigan roadway speed limits from 70 to 75 mph for light vehicles and 60 to 65 mph for heavy trucks was estimated to increase fuel consumption 11% (Chakraborty, Mahmud and Gates 2023). Rasing Chinese expressway speed limits from 80 to 120 km/h was found to increase average traffic speeds increased 21–27%, which increased fuel consumption and carbon emissions approximately 33–38% (Gao et al. 2024). A European study estimates that reducing highway traffic speeds from 120 to 110 km/h could reduce fuel consumption and related emissions by gasoline cars by 18% and diesel cars by 12% (EEA 2020). Reducing speed limits in European cities reduces average emissions 18%, noise 2.5 dB and fuel consumption 7% (Yannis and Michelaraki 2024).

Figure 21 **MPG Versus Speed** (Oak Ridge 2022)



Under typical highway conditions, fuel economy peaks between 50 and 80 kph (30 to 50 mph). Electric and hybrid cars use less energy but have similar efficiency curves

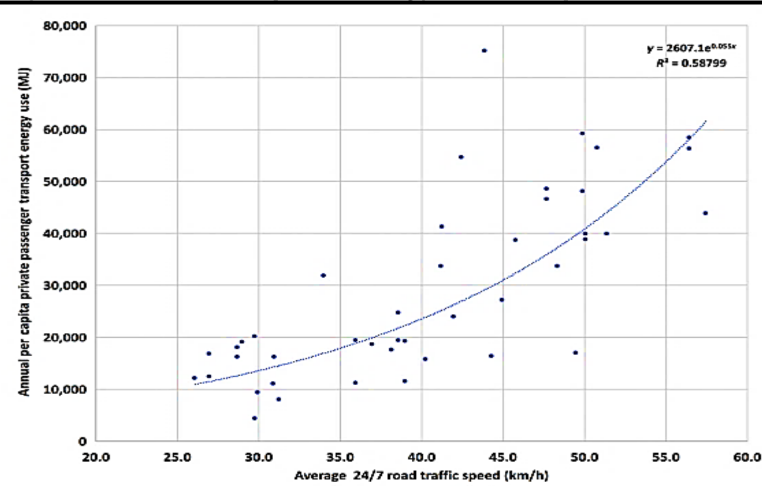
Figure 22 **Noise Versus Speeds** (Salleh, Md zain & Ishak 2013)



Vehicle noise increases with speed. Although electric cars produce less noise than internal combustion engines (ICEs), the differences decline with speed.

Motor vehicle noise also increases with speed (Figure 22). Although electric cars produce less noise than internal combustion engines at low speeds, the differences decline at speeds over 20 kph, as tire and wind noises increase. The figure below from a study of 44 global cities indicates that energy consumption tends to increase with higher average vehicle traffic speeds.

Figure 23 **Transport Energy Consumption Versus Traffic Speeds** (Kenworthy 2018)



Transportation energy consumption and climate emissions tend to increase with urban traffic speeds. This reflects the increased energy required to achieve higher speeds, particularly in stop-and-go traffic, plus fixed travel time budgets which causes higher travel speeds to result in more travel distance and therefore more automobile-dependent, sprawled development patterns.

(Each dot represents a global city)

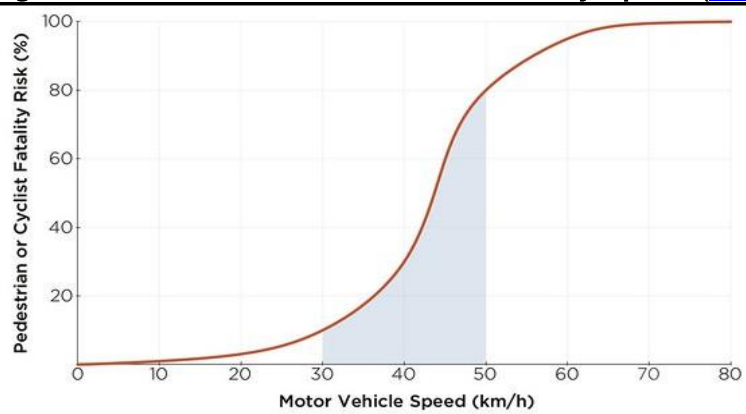
This probably reflects several factors. Higher travel speeds require more energy, particularly in stop-and-go urban traffic conditions where vehicles must frequently accelerate. In addition, higher traffic speeds encourage residents to travel farther and choose more dispersed, urban fringe locations, reflecting their fixed travel time budgets. In addition, higher urban traffic speeds indicate that a city is investing more money and land in urban highways, leaving less for energy efficient modes, making them less convenient, comfortable and safe relative to driving.

Walkability and Bikability

As motor vehicle traffic speeds increase, active mode (walking and bicycling) conditions tend to degrade due to increased noise, dust, risk and delay. On roads with speeds under 20 mph, pedestrian, bicycle and motor vehicle traffic can mix, which is sometimes described as *share space* or *open street*s (FHWA 2017). Above 20 mph, walking and bicycling become less comfortable, requiring sidewalks, bikelanes, paths and crosswalks, with more separation between motorized and non-motorized travel required as traffic speeds increase. This is sometimes quantified using pedestrian and bicycle levels-of-service (LOS) ratings, from A (best walking and bicycling conditions) to F (worst) (TRB 2008).

Pedestrian and bicyclist injury risk increases exponentially with speed: the chance of a severe injury is 10% at 16 mph, 50% at 31 mph, and 90% at 46 mph; and the risk of death is 10% at 23 mph, 50% at 42 mph, and 90% at 58 mph, as illustrated below.

Figure 24 **Active Mode Crash Deaths by Speed** (Krueger 2012)

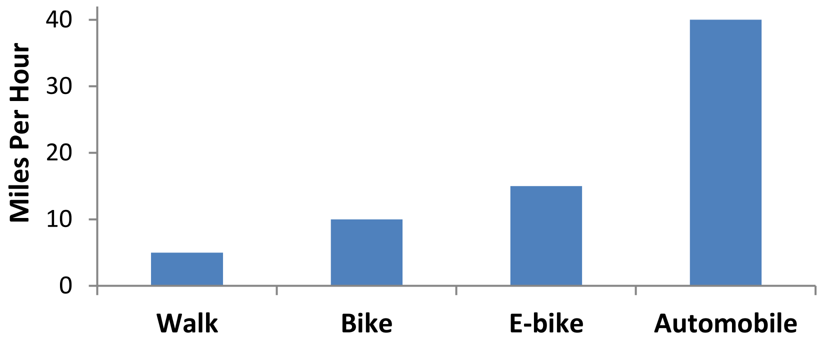


As crash speeds increases the chance of a pedestrian or bicyclists death increases exponentially; from about 10% at 16 mph up to 90% at 58 mph. The risk and unpleasantness imposed by higher traffic speeds delays pedestrians and bicyclists, called the "barrier effect," which often causes travellers to shift from active to motorized modes.

The increased risk and delay that higher traffic speeds cause to active modes is called *severance* or the *barrier effect* (Wallwork 2018; Litman 2020). This imposes several costs on travellers and communities:

- It reduces active travellers' comfort and enjoyment.
- It caused delays and detours, for example, when bicyclists and pedestrians must travel must wait for a break in traffic or travel further to cross a street.
- It causes shifts from active to motorized modes, for example, when parents are obliged to chauffeur children to school or other destinations because high-speed traffic makes walking and bicycling unpleasant and dangerous. This imposes health and vehicle costs on travellers, chauffeuring costs on drivers, and various external costs on communities as people walk and bicycle less, and drive more, even for local trips that could easily be made by active modes.

Figure 25 **Maximum Traffic Speeds for by Mode**



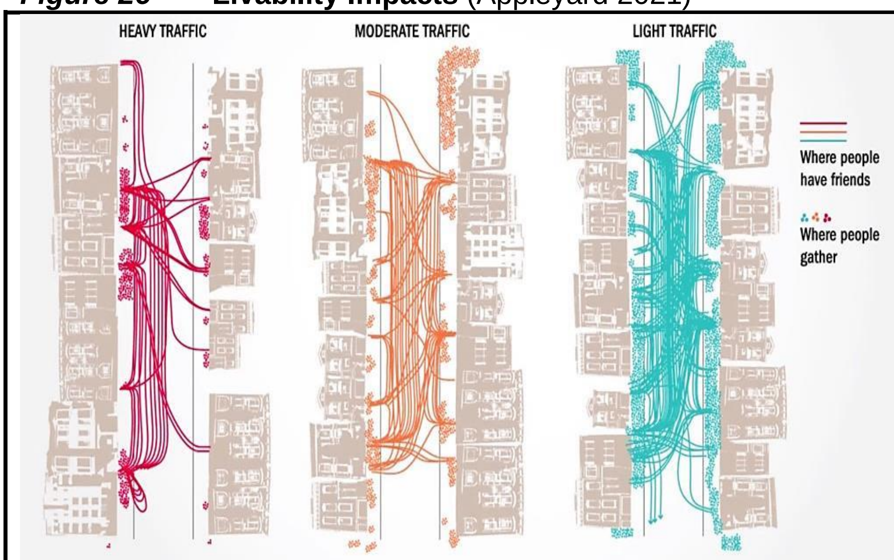
To feel safe, pedestrians require low traffic speeds. Bicyclists and e-bikes can operate at moderate speeds, but are still discouraged by traffic speeds over about 20 miles per hour. As a result, higher roadway design speeds tend to exclude most active travellers.

To improve walking and bicycling safety, comfort and use, many organizations recommend urban traffic speed reductions including the American Association of Retired Persons (AARP and CNU 2021), the Governor's Highway Safety Association (GHSA 2019), the International Transport Forum (ITF 2020) and the National Association of City Transportation Officials (NACTO 2020).

Community Livability and Cohesion

Higher traffic speeds tend to degrade the public realm (public spaces where people interact, such as streets and parks) which reduces *community livability*, local environmental qualities such as safety, quiet, air quality, and attractiveness (AARP and CNU 2021), and *community cohesion*, the quality of interactions among residents in a neighborhood, as illustrated to the right. Higher travel speeds offer fewer opportunities for social interaction, such as unplanned conversations that occur among residents, businesses, pedestrians and transit passengers. Cortright (2017) found a negative correlation between travel speeds and transportation system satisfaction: residents in lower speed regions tend to be more satisfied than those in higher-speed regions.

Figure 26 **Livability Impacts** (Appleyard 2021)

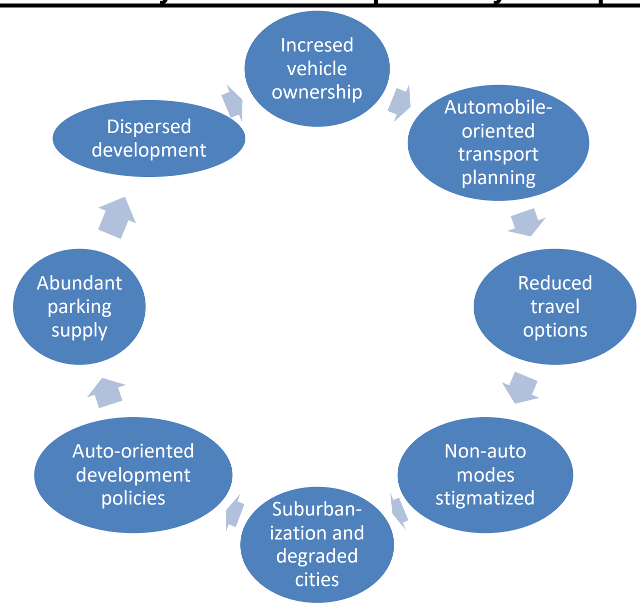


As traffic speed and volumes increase, livability features such as safety, quiet, air quality, attractiveness and neighborhood social interactions tend to decline.

Automobile Dependency and Sprawl

Speed-prioritized planning contributes to a self-reinforcing cycle of automobile dependency and sprawl, as illustrated to the right. For example, speed oriented planning justifies expanding roads and parking facilities, which discourage compact development, and degrade walking, bicycling and public transit travel. It justifies building urban highways in order to increase traffic speeds for suburban motorists, which displace compact, multimodal communities where it is easy to get around without a car.

Figure 27 Cycle of Auto Dependency and Sprawl



Planning that prioritizes speed over other planning goals creates automobile dependent, sprawled communities.

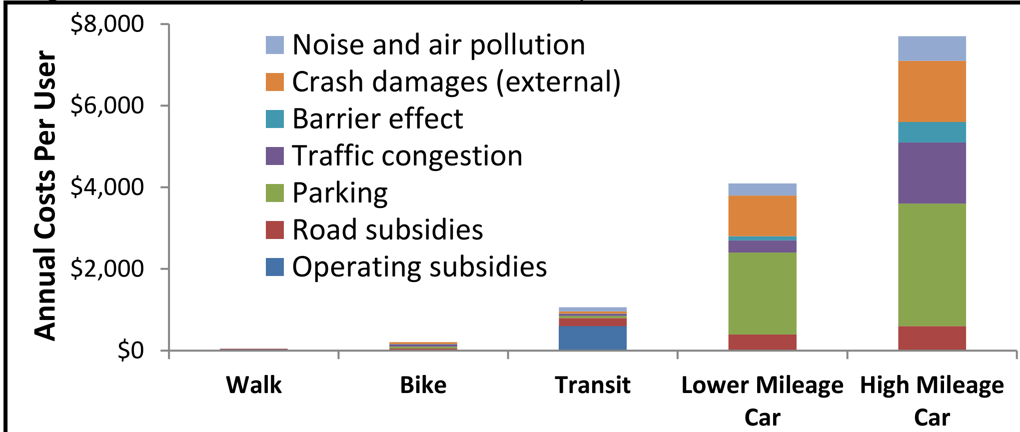
People who live or work in automobile-dependent, sprawled areas must drive more, spend more money on transportation, require more costly infrastructure, and spend more time travelling than residents of compact, multimodal neighborhoods (Brinkman and Lin 2019; Ewing and Hamidi 2017; Shill 2020). This tends to be costly (Grabar 2021; Handy 2020). These additional costs can be considered indirect, long-term impacts of speed-prioritizing planning.

Social Equity Impacts

Social equity refers to the distribution of impacts (benefits and costs) and the degree that those are considered fair and appropriate. Travel speed valuation can have the following equity impacts:

- Speed-prioritizing planning favors motorists over other travellers. It results in far more public spending per motorist than on users of slower modes, as illustrated in Figure 17. This is unfair, and, since vehicle travel tends to increase with income, it is regressive.
- Faster modes and higher speeds increase external costs, as illustrated below. This is inequitable. For example, it is unfair that walkers and bicyclists bear excessive risks imposed by automobiles, and urban residents bear noise and air pollution caused by suburban commuters. Since physically, economically and socially disadvantaged groups tend to rely on non-auto modes and live in urban neighborhoods, these impacts tend to be regressive.

Figure 28 **Estimated External Costs** (Kockelman, et al. 2013; Litman 2019)



Faster modes require more space, impose more risk and produce more noise and air pollution, and so have significantly higher external costs (costs imposed on other people) than slower modes.

- Over the long run, speed-prioritized planning tends to create automobile-dependent, sprawled communities where it is difficult to get around without a car. This increases the disparity in economic opportunities and quality of life between drivers and non-drivers (Frederick and Gilderbloom 2018).

Planning often assumes that everybody benefits from higher travel speeds, but in practice, speed-prioritized planning harms many people, as indicated in the table below, including disadvantaged groups who tend to rely on slower modes and are harmed by external traffic costs (Severen and Holden 2023).

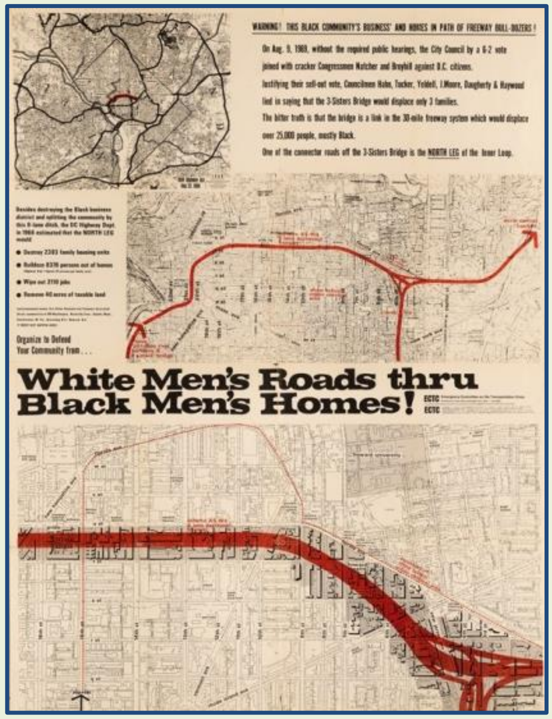
Table 2 **Speed-Prioritizing Planning Equity Impacts**

Who Benefits	Who is Harmed
• Wealthier suburban motorists • Automobile industries and suburban developers	• People who cannot drive. • People who prefer slower modes. • Lower income households that spend more on vehicles than is affordable. • Urban residents harmed by wide roads and increased vehicle traffic.

Speed-prioritizing planning tends to benefit suburban motorists, but harms many physically, economically and socially disadvantaged groups. Comprehensive analysis recognizes these inequities.

Equity Analysis of Speed Prioritization: Lessons from Urban Highways

During the Twentieth Century highways displaced many low-income, largely minority urban neighborhoods. The article, *Interstate Injustice: Plowing Highways Through Minority Neighborhoods* (Problogic 2018) identifies more than fifty examples. This shows how speed-prioritizing planning can lead to unfair outcomes.



Those highways harmed communities and reduced accessibility, as described in a Federal Reserve Bank study, *Freeway Revolts!* (Brinkman and Lin 2019). High-speed highways are not really needed in urban areas: many cities function well with moderate-speed surface streets, and the displaced neighborhoods generally had much better access than the suburbs those highways were built to serve.

The planning process that created these highways was classist and racist, as described in *White Men's Roads Through Black Men's Homes': Advancing Racial Equity Through Highway Reconstruction (*Archer 2020). Urban planners described low-income and minority community as *blight* to be displaced when possible. For example, a Transportation Research Board report, *Beneficial Effects Associated with Freeway Construction* (Gamble and Davinroy 1978) stated that *"Old housing of low quality occupied by poor people often serves as a reason for the destruction of that housing for freeway rights of way."* It claimed that freeways improve safety, environmental quality, economic productivity and aesthetics:

> "Blighted or substandard housing, junkyards, dumps, and other sources of ugliness may be eliminated through condemnation, eminent domain, out-right purchase, and other procedures. The effect is a reduction in visual discontinuity to the highway viewer and a possible improvement in the entire visual quality of the affected area and the community."

The *motivation* may have been classism and racism, but the *mechanism* through which transportation agencies displaced urban neighborhoods was a planning process which placed a high value on vehicle travel time savings and ignored the reduction in access by other modes, and other costs to urban residents. If considered at all, harms to urban communities were described as *intangibles*, with the implication that they are difficult to quantify and not very important. Federal and state governments offered large and generous grants for urban highways but virtually no support for affordable and resource-efficient modes.

The article, "Paved with Good Intentions: Fiscal Politics, Freeways, and the 20th Century American City" (Brown, Morris and Taylor 2009) concluded that these highways were not cost effective. Consider an example. A six-lane (three lanes each direction) city-to-suburb freeway typically serves 5,000 to 10,000 automobile commuters, assuming 2,000 vehicles per lane-hour during one to three peak hours, a third of which are local trips. The freeway corridor is five-miles long and 600 feet wide, with 30 average residents per acre, it displaced about 10,000 residents. By reducing the supply of affordable homes in high-accessibility neighborhoods the project forced many households to shift from multimodal to automobile-dependent communities. In addition, urban freeways create barriers to local travel, particularly for non-drivers, making trips that could previously be made by a short and pleasant walk or bike ride longer and less pleasant, and imposing noise and air pollution on urban neighborhoods.

By measuring the mobility benefits of faster traffic but ignoring the accessibility value of compact, multimodal neighborhoods this planning process favored motorists over non-drivers, wealthy over lower-income residents, and suburban over urban communities. To be more equitable, planning must correct these structural biases.

Summary of Impacts

Table 3 summarizes these impacts. Many of these effects are exponential, so modest increases in speed can cause large increases in congestion, crash risk, noise and air pollution costs.

Table 3 **Speed Impacts**

Impact Category	Effects of Higher Speeds
Accessibility	Increases the area that motorists can reach in a given time period.
Travel time costs	Allows travellers to save time, although over the long run they usually travel farther.
Economic development and opportunity	Increases productivity and opportunity in some ways but reduces it in others. Automobile dependency and sprawl tend to reduce productivity overall.
Traveler comfort and driver stress	Generally reduces comfort and increase stress.
Vehicle costs	Faster modes and speeds usually increase vehicle costs.
Infrastructure costs	Faster modes require much more costly roads and parking facilities.
Congestion and barrier effect	Requires more road space, which increases congestion delays.
Crash costs	Significantly increases crash frequency, severity and exposure.
Energy consumption and pollution emissions	Beyond optimal speeds (30 to 50 mph on highways and less on surface streets) increased speed increases energy consumption, noise and pollution emissions.
Reduced walk- and bike-ability	Beyond 20 mph, higher traffic speeds degrade walking and bicycling conditions.
Community livability	Faster traffic tends to degrade the public realm and reduce community livability.
Automobile dependency and sprawl	Contributes to a cycle of automobile dependency and sprawl, which increases driving, reduces non-auto modes, and disperses destinations.
Social equity	Tends to be unfair and regressive (favors wealthier people who use faster modes).

Higher speeds have various impacts on travellers and communities.

Conventional planning tends to overlook or undervalue many of these impacts (van Goeverden 2022). It evaluates road performance using indicators of mobility, such as roadway Level of Service (LOS) and the Travel Time Index (TTI), which assume that faster is always better. Transportation planning and funding often prioritize traffic speed improvements. The *Manual on Uniform Traffic Control Devices* applies the "85th Percentile Rule," which means that speed limits are often set by the 15% of drivers who exceed posted limits (Bronin and Shill 2021; Zipper 2021). The Transportation Research Board's *Development of a Posted Speed Limit Setting Procedure and Tool* (TRB 2021), considers trade-offs between travel time and crash risk, but overlooks other impacts and goals (Frith 2012; OECD 2020; Standen 2018). Common data sources, such as census and travel surveys, tend to undercount, and therefore undervalue, slower modes. Most models overlook or undervalue induced travel impacts, and so exaggerate the benefits and underestimate the full costs of highway expansions and higher traffic speeds (Sundquist 2020).

Conventional planning tends to ignore the inequities that result from speed-prioritizing planning. It seldom analyzes the allocation of public resources between drivers and non-drivers, and ignores the external costs that vehicle travel imposes on other people, and the harms that automobile dependency and sprawl impose on physically, economically and socially disadvantaged groups.

Table 4 summarizes the degree that various impacts are considered in transportation planning.

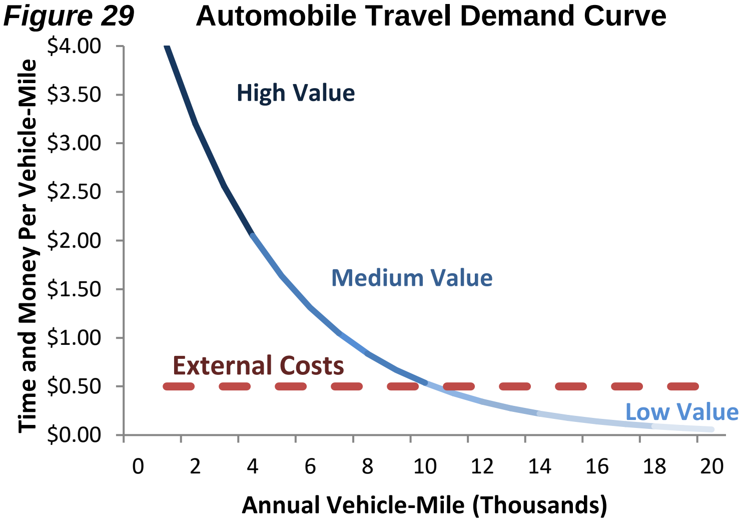
Table 4 **Consideration of Speed Impacts in Conventional Planning**

Impacts of Higher Speeds	Consideration in Conventional Planning
Increased motorist access	Often described and sometimes quantified.
Travel time savings	Often quantified. Is generally the largest impact considered.
Economic development and opportunity	Often exaggerates the benefits and overlooks the costs of speed, and underestimates the economic benefits provided by slower modes.
Reduced traveler comfort and increased driver stress	Generally ignored. Seldom considers the discomfort and stress of higher speeds.
Increased vehicle costs	Generally ignores the increased user costs of faster modes and traffic.
Increased infrastructure costs	Considers direct costs but not the added costs from induced travel and sprawl.
Congestion and barrier effect	Congestion costs are considered but barrier effect costs are generally ignored.
Crash costs	Considers how speed changes affect distance-based crash rates, but generally ignores the increased per capita crash rates caused by induced travel.
Energy consumption and pollution emissions	Considers how speed changes affect fuel consumption and emission rates, but generally ignores the impacts of induced vehicle travel and sprawl.
Degraded walk- and bike-ability	Sometimes considered in specific situations.
Community livability and cohesion	Generally ignored. Seldom considers qualitative factors.
Automobile dependency and sprawl	Generally ignored. Integrated transportation and land use models can predict these impacts, but they are seldom used for individual project evaluations.
Social equity	There is little analysis of the fairness of investments in faster vs. slower modes.

Conventional evaluation tends to describe and quantify the direct user benefits of increased speeds but overlooks or undervalues many costs, particularly the indirect and long-term costs of induced vehicle travel and sprawl.

The demand for mobility is virtually unlimited: as travel becomes faster and cheaper people travel more, although their marginal benefits decline. For example, if electric self-driving cars make vehicle travel cheaper and more convenient, people will choose longer distant commutes and more cross-country trips. The increased vehicle travel provides small user benefits but imposes large external costs. As a result, as vehicle speeds increase a growing portion of vehicle travel is economically inefficient; its benefits are smaller than its total costs, including external costs such as infrastructure, congestion, crash and pollution costs, as illustrated to in Figure 29.

Figure 29 **Automobile Travel Demand Curve**



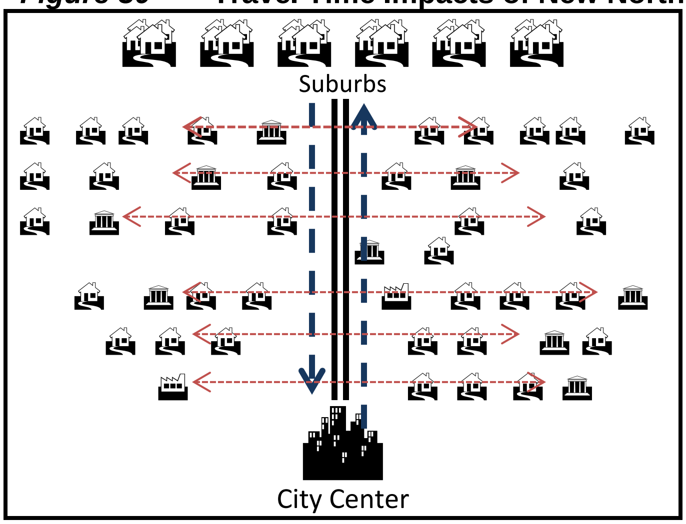
As driving becomes cheaper people tend to drive farther even if the additional vehicle-miles provide minimal user benefits that are less than their external costs (dashed line).

Examples

There are many ways that incomplete speed and travel time valuation can bias planning decisions to favor faster modes and higher speed roadway designs over slower modes and slower traffic speeds. Conventional transportation evaluation values the time savings from faster travel, but tends to undervalue many of the costs, such as higher users' costs, barrier effects, increased crashes, increased energy consumption and pollution emissions, plus increased automobile dependency and sprawl.

Consider, for example, the evaluation of a proposed urban highway that would connect a city with northern suburbs. With current evaluation practices, the increased travel speeds would be valued based on north-south travel time savings (blue arrows), but the highway would delay many east-west trips, forcing travellers to detour to reach the limited number of crossings and degrading walking and bicycling conditions (green arrows). What may seem like a small increase, for example, increasing the travel distance for a typical east-west trip from a half-mile to a one-mile, is actually a larger increase in walking trip travel times, adding ten minutes per trip. These additional travel distances are likely to cause many east-west trips to shift from walking and bicycling to automobile travel.

Figure 30 **Travel Time Impacts of New North-South Highway**



In this example, a transportation agency would value the travel time savings provided by a north-south highway that connects a city with suburbs (vertical blue arrows) but ignore the delays imposed on east-west travellers (horizontal red arrows), since those are short, non-commute trips. The expanded highway, with a limited number of safe crossing points, will make many east-west walking and bicycling trips longer, causing some travellers to shift from non-motorized to motorized modes, increasing user costs and traffic problems. The result is inefficient and unfair to non-drivers.

To the degree that highway project evaluation undercounts motorized trips, overlooks delay and risk that wider roads impose on non-auto travel, or exaggerates congestion-reduction benefits by underestimating induced vehicle travel, it will underinvest in active mode improvements and overinvest in urban highway expansions, increasing automobile dependency and sprawl. More comprehensive analysis considers all these factors. As a result, more comprehensive analysis tends to support slower modes, lower traffic speeds, and more emphasis on compact development which reduces travel distances and the portion of trips made by motorized modes.

Analysis in the article, "Effective Speed: Factors That Influence the Attractiveness of Cost Effective and Sustainable Modes of Transport in Cities," (Schnieder 2023) indicates that if travellers choose travel options with the highest effective speeds they would drive less and rely more on slower but more affordable and resource-efficient modes, reducing emissions up to 14.7% and external costs up to 11.6%.

Changing Demands and Goals

Vehicle speeds and per capita vehicle travel increased steadily during the Twentieth Century, but have peeked in most developed countries (Figure 4, OECD 2012), indicating that the demand for mobility is saturating, and many current demographic and economic trends support slower traffic speeds (Boarnet 2013). Aging population, rising poverty, increased urbanization and increasing health and environmental concerns are increasing the demand for active and public transport. New technologies, such as e-bikes and telework, improve alternatives to vehicle travel. Although few motorists want to give up driving altogether, surveys indicate that many want to drive less, use slower modes, and reduce their vehicle costs. The National Association of Realtors' *Community Preference Survey* (NAR 2021) found that 80% of respondents enjoy walking and 53% enjoy bicycling, 58% report driving because they lack alternatives, and most respondents prefer walkable neighborhoods over automobile-oriented areas.

During the 1950s through the 1970s, U.S. motorists paid about four times current fuel taxes per vehicle-mile in inflation-adjusted dollars to finance faster highways, but there is no longer political support for such projects, indicating declining demand for speed. Traffic speeds *could* increase if citizens were willing to pay more taxes or tolls but there appears to be little support. Few citizens demand, "Raise my taxes to finance urban roadway expansions!"

In addition, community values are changing in ways that reduce the value of traffic speed. Planning increasingly evaluates transport system performance based on *accessibility*, not just *mobility*, which places a higher value on slower modes, lower traffic speeds and compact development (Levinson and King 2020; Litman 2013). Wang and Levinson (2022) found that major public transit projects that are not justified based on travel time savings are justified when evaluated based on their accessibility gains that increase local property values. Many communities have goals to increase affordability, equity, public health, traffic safety, livability, and environmental protection, which justify more support for slower, more efficient travel options. The table below compares the range of benefits provided by various speed-related planning decisions indicating that slower modes and lower roadway design speeds tend to support a broad range of community goals. As a result, many jurisdictions have targets to increase walking, bicycling and public transit travel, and reduce vehicle travel (ACEEE 2019; Litman 2021).

Table 5 **Comparing Transportation Improvement Options**

Community Goals	Improve Auto Travel	Expand Roadways	Improve Slower Modes	Reduce Road Design Speeds
Total Vehicle Travel	*Increased*	*Increased*	*Reduced*	*Reduced*
Increase motorists' speed and access	✓	✓	✓/×	×
Increase non-drivers' speed and access	×	×	✓	✓
Consumer savings and affordability	×	×	✓	✓
Traffic safety	×	×	✓	✓
Physical fitness and health	×	×	✓	✓
Road and parking cost savings	×	×	✓	✓
Energy conservation reduced pollution	×	×	✓	✓
Community livability and cohesion	×	×	✓	✓
Reduce sprawl-related costs	×	×	✓	✓

Improving automobile travel and expanding roadways increases motorists speed and access, but tends to contradict other community goals. Improving slower modes (walking, bicycling and public transit) and reducing traffic speeds improves non-drivers' access, and by improving affordable and resource-efficient mobility and reducing total vehicle travel, these help achieve a wide range of goals. (✓= supports goal. ×= contradicts goal.)

How Planning Overvalues Speed

Surveys indicate that many people want to drive less and rely more on walking, bicycling and public transit, and will do so if their conditions improve (NAR 2021). Current planning does a poor job of responding to these demands. It is biased in various ways that overvalue faster modes and higher roadway design speeds to the detriment of slower options. The results are inefficient and unfair.

For example, conventional planning quantifies and monetizes travel speed increases, which are generally the dominant factor in transportation investment decisions, but ignores other goals such as consumer savings and affordability, basic mobility for non-drivers and social equity, the comfort and safety of non-auto travel, public fitness and health, and parking costs.

Travel surveys often undercount and undervalue non-auto travel. Many surveys ignore shorter trips, non-commute trips, recreational travel, travel by children and the walking and bicycling links of motorized trips. For example, a *bike-bus-walk* trip is usually categorized as a *transit* trip, and walking trips between parked vehicles and destinations are ignored even if they involve several blocks of travel on public roads. Although commute mode share statistics imply that less than 4% of trips are by active modes, more comprehensive surveys indicate that active modes currently serve 12% of trips, and their use increases if their conditions are improved, so their potential mode share is much higher.

Travel time costs vary significantly, and sometimes have positive values. Studies find that most people prefer travelling 30 to 60 minutes daily (Cornet, et al. 2021). Travellers often choose slower options if they are convenient, comfortable and affordable, such as walk and bicycle for enjoyment and exercise, and public transit if they can relax or work during their trip. Under those circumstances, travel time has low or negative costs. Conventional planning ignores these factors; it assigns the same cost to all travel time regardless of conditions, and so recognizes no benefit from improving traveller comfort, for example, by making walking and bicycling less stressful or reducing public transit crowding.

Conventional planning tends to evaluate transportation system performance based primarily on indicators traffic and delay such as roadway level of service, average traffic speeds, and hours of delay. This prioritizes speed over other goals, and roadway expansions over other transportation improvements such as active and public transit projects, and TDM programs. A new planning paradigm evaluates transportation system performance based on *accessibility* (people's ability to reach desired services and activities), recognizing various factors that affect it including mobility, non-auto travel conditions, geographic proximity (and therefore development density and mix), and affordability (Sundquist, McCahill and Brenneis 2021). Accessibility-based analysis recognizes ways that wider roads and increased traffic speeds can reduce accessibility, for example by degrading active mode conditions and increasing sprawl. It recognizes the important roles that slower modes and proximity can play in providing accessibility, for example, if walking and bicycling improvements increase public transit access, and if reduced automobile traffic and parking demands allow more compact urban development. In these ways, accessibility-based planning supports slower modes and lower traffic speeds.

Proponents claim that roadway expansions reduce congestion and provide travel time savings, but such claims are often inaccurate. Traffic congestion tends to maintain equilibrium: it increases to the point that delay discourages some potential peak-period trips. As a result, within a few years the additional roadway capacity tends to fill with induced vehicle traffic. Congestion costs return and the additional vehicle-miles increase external costs including downstream congestion, crashes and pollution emissions.

Transportation agencies typically value personal travel time at 35% to 80% of average wages, but when tested with optional tolls that allow motorists to avoid congestion delay, average willingness to pay is generally much less, indicating that most travellers prefer to save money rather than time. Highway improvement projects that are justified by excessive time values are economically inefficient; their benefits are less than their costs. Most transportation agencies have dedicated funds for highways, and local governments require property owners to provide off-street parking, but non-auto facilities must compete for scarce local funds, favoring investments in automobile infrastructure over other modes.

Transportation planning seldom analyzes travel speed equity impacts, for example, the harms that higher traffic speeds impose on non-drivers and urban residents. The study, *The Economic Cost of a 130 kph Speed Limit in Germany* (Gössling, et al. 2023) concluded that the lack of a speed limit on Germany's autobahnen highways increases infrastructure, crash and pollution external costs, which represents a subsidy for faster drivers to the detriment of other road users and the environment.

Table 6 summarizes common planning biases that favor speed over other goals and corrections for better analysis of speed impacts. This indicates that more comprehensive and objective planning would invest more in slower modes, create complete streets with lower design speeds, and favor more compact, multimodal community development to improve accessibility overall.

Table 6 **Common Planning Biases Favoring Speed** (Litman 2023; Metz 2021)

Bias	Corrections
Undercounting and undervaluing walking and bicycling. Often-used commute mode share statistics count less than a third of their trips.	Use more comprehensive surveys and data sources.
Ignoring or overlooking latent demand for non-auto travel.	Targeted studies to identify latent demands.
Mobility-based rather than *accessibility-based* planning. Ignores the accessibility provided by slower modes and compact development.	Apply accessibility-based planning analysis.
Assumes abundant free parking, which increases automobile travel and sprawl to the detriment of non-auto modes.	Efficiently price parking. Analyze non-auto demands based on priced parking.
Overvalues time savings compared with other goals. Ignores travellers' preferences for slower but more affordable options.	Apply realistic travel time valuation.
Ignores induced vehicle travel and sprawl impacts. This exaggerates the benefits and underestimates the costs of roadway expansions.	Account for induced travel impacts and costs.
Overlooks and undervalues non-auto mode benefits, including consumer savings and affordability, social equity, community livability and environmental quality.	Apply more comprehensive benefit analysis.
Dedicated funding for roads and parking facilities. This encourages decision-makers to invest in automobile infrastructure to the detriment of non-auto modes.	Apply more multimodal, least-cost funding.
Elite bias (most decision-makers lead auto dependent lives).	Involve non-drivers in planning and encourage decision-makers to experience non-auto modes.

Conventional planning is biased in ways that favor faster modes and higher roadway design speeds. More comprehensive and objective planning supports slower modes and lower traffic speeds.

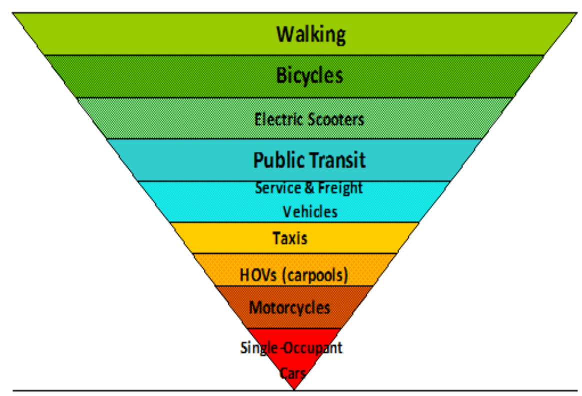
Recommendations

To be efficient and fair, transportation planning should consider all impacts when evaluating decisions that affect travel speeds, including external and long-term effects. Impact analysis should account for induced vehicle travel and the additional external costs – increased downstream congestion, infrastructure costs, crashes and pollution emissions – that result. Impacts should be described, and if possible, quantified and monetized.

Travel speed and mobility should not be considered ends in themselves; planning decisions should be evaluated based on how they affect overall accessibility, recognizing the various ways that wider roads, faster traffic and more sprawled development can reduce accessibility, for example, by creating barriers to walking and bicycling, reducing roadway connectivity, and increasing travel distances.

Analysis should recognize the diversity of travel demands, including the needs of people who cannot, should not, or prefer not to drive. Analysis should recognize the high costs of automobile travel and the often unmet demands for slower modes by travellers who want to save money, avoid driving stress, or exercise more. Because slower, resource-efficient modes are so constrained, small increases in their speed can provide large benefits. For example, pedestrian and bicycle shortcuts can benefit users directly and eliminate the need for longer vehicle trips.

Figure 31 Sustainable Transport Hierarchy



A sustainable transportation hierarchy prioritizes resource-efficient modes and higher value trips.

Planning should consider social equity impacts. Speed-prioritizing planning devotes most transportation funding and road space to automobile facilities, to the detriment of walking, bicycling and public transit. Analysis should evaluate whether travellers who use slower modes receive a fair share of investments and bear excessive external costs, including delay, risk and pollution exposure imposed by faster modes and higher roadway design speeds (Culver 2018; Zipper 2021).

If communities have goals to increase affordability, equity, public health and safety, and reduce pollution, planners should apply a sustainable transportation hierarchy, as illustrated to the right. This justifies policies that favor more efficient modes and higher value trips. New tools can help evaluate speed impacts. For example, integrated models can predict how wider roads and increased traffic speeds affect multimodal accessibility, travel activity and development patterns (Levinson and King 2020).

This analysis indicates that traffic speeds are often higher than optimal, particularly in urban areas where higher speeds impose the largest external costs (Lopez-Aparicio, et al. 2020). Table 7 illustrates maximum traffic speeds optimized for safety and livability. These are lower than what is commonly used, reflecting often-overlooked benefits of reduced vehicle speeds and travel.

Table 7 Maximum Traffic Speeds

Facility	Maximum Traffic Speeds
Suburban arterial	40 mph (64 kph)
Urban arterial	30 mph (50 kph)
Residential street	20 mph (30 kph)
Mixed traffic street	10 mph (15 kph)

Lower traffic speeds tend to optimize safety and livability.

Conclusions

Planning decisions often involve trade-offs between speed and other goals such as travel comfort, affordability, mobility for non-drivers, public health and safety, and local environmental quality. Faster modes and higher traffic speeds directly benefit suburban drivers but impose numerous costs on other travellers and communities. Conventional planning tends to recognize the benefits of speed but overlooks and undervalues other impacts, resulting in a less efficient, affordable, safe, healthy, or equitable transportation system than is optimal.

Certainly, people sometimes enjoy the thrill of speed, and drivers often exceed legal speed limits, but when offered a choice, travellers often choose comfort and affordability over speed. Increases in development density and mix tend to increase accessibility more than increases in speed. Planning decisions that increase traffic speeds, such as urban highway expansions, can increase accessibility for some groups, such as suburban motorists, but reduce accessibility for others, such as pedestrians and bicyclists, and by encouraging sprawl, reduce overall accessibility. Seemingly small increases in speed for slower modes, such as reduced pedestrian delays or bus priority in traffic, often provide more time savings, accessibility gains and total benefits than increases in automobile traffic speeds.

Conventional planning often assumes that higher speeds provide time savings, but over the long run people tend to maintain a fixed travel time budget so higher speeds increase travel distance rather than save time: a 10% speed increase generally increases affected travellers' mileage by 10% over the long run. This causes *mobility inflation*, which ratchets up the distances everyone must travel to meet their needs, and contributes to automobile-dependency and sprawl. This is unfair to travellers who use slower modes, and increases total transportation costs.

During the last century, motorized travel increased people's average travel speeds and distance by an order of magnitude, which increased transportation costs by similar amounts. In 1900, most people travelled about one thousand annual miles and spent negligible money on transport. Now, a typical motorist drives more than 10,000 annual miles, but to do so must devote about 20% of their income, and therefore about 20% of their workday, to paying vehicle expenses. When evaluated by *effective speed*, defined as travel distance divided by the time spent travelling and earning money to pay travel expenses, automobile travel is often slower overall than bicycling and public transit, and it is regressive because effective speeds are low for low-wage workers and increase with income.

In various ways, conventional planning tends to exaggerate the benefits and overlook many costs of faster travel. This has the following results:

- More investment in faster modes (particularly automobile and air travel) and roads designed for higher speeds, and less investment in slower modes (walking, bicycling and public transit).
- Communities become more automobile-dependent and sprawled. More vehicle travel is required to access services and activities.
- More expensive and resource-efficient transportation system. People must spend more on travel, governments must spend more on roads, businesses must spend more on off-street parking, and communities must bear more crash risk and environmental costs.
- A major portion of this additional vehicle travel is economically-inefficient; the incremental user benefits are less than incremental external costs.
- Faster modes receive a greater share of public investments. This is unfair and, since people with disabilities and low incomes tend to rely on slower modes, it is regressive.

Planning that prioritizes speed over affordability forces many lower-income travellers to spend more than is rational on motor vehicles; they spend an hour of work to pay for a half-hour of travel time saving. They would be better off overall with slower but more affordable travel options; better walking, bicycling and public transit services, and more compact communities where it is easy to get around without driving.

Conventional planning assumes that travellers place a high value on speed but, when faced with trade-offs, travellers often choose slower options for affordability, health, enjoyment and livability sake. For some trips, such as urgent errands or deliveries, travel speed can have high values, but for many trips users prefer to save money rather than time. As a result, transportation systems become more efficient and equitable if they prioritize higher-value trips and more space-efficient modes over lower-value trips and space-intensive modes using road pricing and priority lanes.

Table 7 **Often-Overlooked Costs of Speed**

- Increased driver stress and reduced passenger comfort.
- Increased users' costs and reduced affordability.
- Increased infrastructure costs.
- Additional crashes caused by induced vehicle travel.
- Inequity if excessive speed valuation leads to overinvestment in faster modes and roadways, and underinvestment in slower modes and complete streets road design.
- Inequity if higher traffic speeds harms non-drivers.
- Increased energy consumption and pollution emissions.
- Barrier effect (degraded walking and biking conditions).
- Reduced community livability.
- Increased automobile dependency and sprawl.

Conventional planning tends to overlook and undervalue many costs of speed, which is inefficient and unfair.

To their credit, many decision-makers support slower modes and traffic speed reductions more than justified by their economic analysis; they realize that walking, bicycling and public transit are important and deserve more investment. However, this occurs *despite* rather than *supported by* standard planning methods. Reforming these practices can justify much more support for slower modes. More comprehensive analysis of speed impacts results in less investment in urban highways, more investments in active and public transport modes, lower roadway design speeds and more effort to improve travel comfort and convenience than what currently occurs.

Of course, every traveller has unique needs and preferences. Many will choose faster modes, despite their higher costs. However, current demographic and economic trends – aging population, increasing urbanization, plus growing concerns about affordability, public health and environmental quality – are increasing demand for slower modes and more livable neighborhoods. More comprehensive valuation of travel speeds can better respond to consumer demands and community goals.

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