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Fair Share Transportation Planning

Estimating Non-Auto Travel Demands and Optimal Infrastructure Investments

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In a typical community, 20-40% of travelers cannot, should not, or prefer not to drive, which is much larger than the portion of transportation infrastructure funding devoted to non-auto modes.

Summary

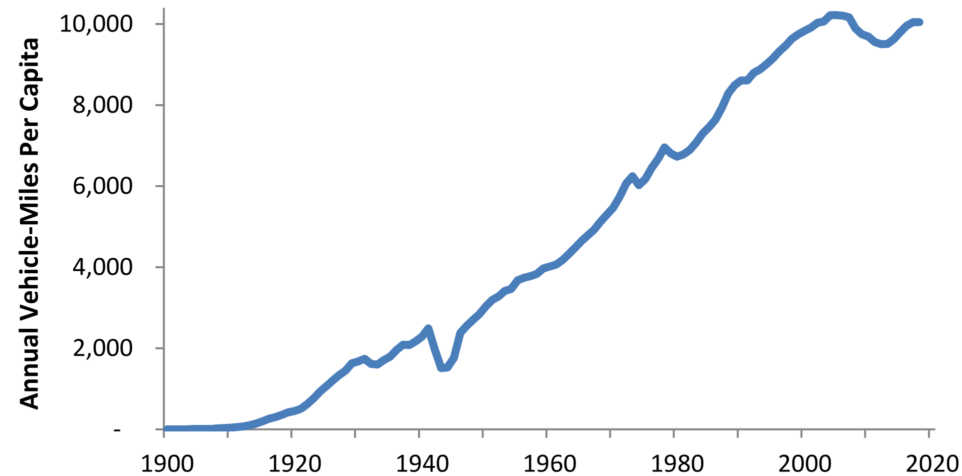
Efficient and equitable transportation planning should minimize disparities in *inputs* (funding, road space and priority) and *outcomes* (accessibility, safety and affordability) between different types of travellers and residents of different areas. This study examines how to determine the optimal portion of public resources to invest in different travel modes. It identifies principles to guide investment decisions including *fair share planning,* so all travelers receive comparable shares of public resources; *consumer sovereignty*, so planning responds to user demands; *social equity*, so disadvantaged travellers can achieve basic mobility; *cost efficiency*, so investments maximize user and community benefits; and *community goals*, so individual planning decisions support strategic goals. Current planning violates these principles. In a typical North American community 20% to 40% of travelers cannot, should not or prefer not to drive, and will use non-auto modes if they are convenient, comfortable and affordable. This is higher than generally recognized, and much higher than current non-auto mode investments. This study concludes that to be efficient and equitable, planning should invest in non-auto modes at least as much as their potential mode shares, and more to correct for past underinvestments and achieve strategic goals. This is more comprehensive than previous studies.

A summary of this report was presented at the 2023 *World Conference for Transportation Research* (http://wctr2023.ca), Montreal, Canada.

Introduction

Most communities have two transportation systems: an automobile-oriented system that includes higher speed roads and parking facilities, plus a non-auto system that includes sidewalks, paths, lower-speed roads that are safe for walking and bicycling, and public transit and taxi services. This study examines how determine the optimal balance of investments in these two systems.

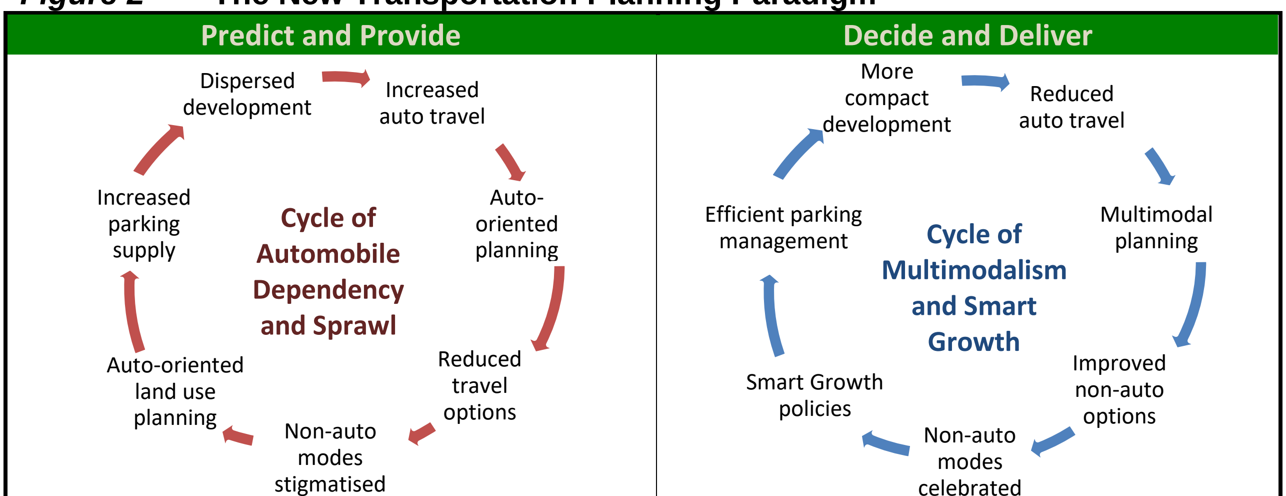
Figure 1 **Per Capita Vehicle Travel Trends** (FHWA various years)



Per capita vehicle travel grew steadily during the Twentieth Century but peaked about 2005, and current demographic and economic trends are increasing demands for non-auto travel. This report examines how planning practices should respond to these shifts.

During the Twentieth Century, motor vehicle travel grew steadily, but peaked about 2004, as illustrated in Figure 1. During that period it made sense to expand roadways to accommodate increasing demands. However, the "predict and provide" planning practices that developed during that period created a self-reinforcing cycle of automobile dependency and sprawl. A new paradigm supports "decide and deliver" planning to create more multimodal and compact communities, as illustrated below.

Figure 2 **The New Transportation Planning Paradigm**



"Predict and provide" transportation planning expanded roads and parking facilities in anticipation of future demands, creating a self-reinforcing cycle of automobile dependency and sprawl. "Decide and deliver" planning sets multimodal travel targets and implements policies to achieve them.

Automobile-oriented planning assumed that automobiles are superior to other modes and there is little demand for other modes. There are good reasons to question those assumptions. Common planning practices underestimated non-auto demands and benefits. Although automobile travel provides large benefits, it also imposes large costs and is unsuitable for many trips. Surveys indicate that many motorists would prefer to drive less and rely more on alternatives, provided they are convenient, comfortable and affordable (NAR 2023). Current demographic and economic trends—aging population, urbanization, increasing health and environmental concerns, changing preferences, and new options such as telework and e-bikes — are increasing non-auto travel demands. Improving non-auto modes helps achieve many strategic goals, and so can provide high economic returns. Virtually everybody benefits when planning responds to non-auto demands.

This study examines these issues. It investigates ways to determine the optimal level of investments in automobile and non-auto modes. It estimates the demands for non-auto modes, and the benefits of serving currently unmet demands. It identifies current planning distortions that favor automobile travel over other modes, and potential reforms for more efficient and equitable planning. This study provides guidance for multimodal planning. It should be of interest to policy makers, planning practitioners, advocates for non-auto mode, and anybody who wants more efficient and equitable transportation.

Valuing Multimodalism

To be efficient and fair, a transportation system must be multimodal in order to serve diverse demands, including the needs of travellers who cannot, should not, or prefer not to drive (López, Annema and van Wee 2022). This lets travellers choose the best option for each trip: walking and bicycling for local errands, public transit on busy corridors, and automobiles when they are truly most efficient overall. A diverse system ensures that non-drivers receive their fair share of public investments. Multimodal planning does not eliminate driving, it can include significant amounts of vehicle travel, in contrast to "car-free" planning. Table 1 compares these approaches.

Table 1 **Comparing Automobile-Dependent, Multimodal and Car-Free Planning**

	Auto-Dependent	Multimodal	Car-Free
Modal priorities	Automobile. Other modes are considered unimportant.	Walking, bicycling, transit, taxi/ridehailing, automobile and mobility substitutes.	Walking, bicycling, public transit, taxi/ridehailing and mobility substitutes.
Land use development	Dispersed. Development along highways.	Most development is compact and mixed.	All development is compact and mixed around transit.
Vehicle parking	Abundant and usually free.	Moderate and often priced.	Limited.
Vehicle ownership	High. Over 500 vehicles per 1,000 residents.	Moderate. 200-500 vehicles per 1,000 residents.	Low. Less than 200 vehicles per 1,000 residents.
Vehicle travel	High. Over 5,000 annual VMT per capita.	Moderate. 2,000-5,000 annual VMT per capita.	Low. Less than 2,000 annual VMT per capita.
Auto mode share	More than 80%.	20-80%.	Less than 20%.

Automobile-dependent, multimodal and car-free planning differ in many ways.

Principles for Optimal Public Resource Allocation

The following principles can be used to determine the optimal allocation of public resources (money, road space, traffic safety programs, etc.) between modes and groups.

1. *Fair share public resource allocation.* Basic fairness (horizontal equity) requires that each person receives a comparable share of public resources unless there are good reasons to favor one mode or group (Litman 2022). This implies that non-auto modes should receive investments at least proportional to their share of trips. For example, a mode that serves 10% of trips should receive about 10% of funds and road space. Since most non-drivers rely on multiple modes (walking and bicycling for local trips, and public transit for longer trips), this analysis can also compare the portion of travellers who cannot, should not, or prefer not to drive to the portion of transportation resources devoted to non-auto modes.

2. *Consumer sovereignty.* Consumer sovereignty means that planning decisions respond to consumer demands, including latent demands (additional trips that people would make if a mode was improved). For example, all else being equal, if investing 15% of resource would achieve 15% mode share, it should receive this portion of investments.

3. *Social justice.* Social justice (vertical equity) means that transportation systems should favor disadvantaged groups, ensure that everybody has basic mobility (ability to access essential services and activities), help, and correct for structural inequities such as racism. Disadvantaged travellers tend to rely more than average on non-auto modes, and may require universal design features that accommodate people with disabilities and other special needs, which add costs. This can justify additional resources for transportation that serves disadvantaged groups. This could include, for example, universal design requirements, additional funding for walkways and public transit services in lower-income areas, income-based fare discounts, and affirmative action policies.

4. *Cost efficiency.* Cost efficient means that investments should favor investments that minimize costs and maximize benefits, a concept called *least-cost planning* (Lindquist and Wendt 2012). For example, non-auto facilities and encouragement programs should receive investments if they provide mobility and access at a lower cost than automobile facilities, including costs to governments, businesses (for parking subsidies) and users.

5. *Community goals*. A basic principle of good planning is that individual, short-term decisions should be consistent with long-term strategic goals. Below are examples of typical strategic goals:

- Reduce congestion
- Reduce roadway costs
- Reduce parking costs
- Provide consumer savings and affordability
- Increase traffic safety
- Improve mobility for non-drivers
- Conserve resources (particularly fossil fuels)
- Reduce pollution
- Increase public fitness and health
- More compact development (reduce sprawl)
- Reduce total vehicle travel and increase non-auto travel (Litman 2023)

Non-auto modes should receive additional investments if they help achieve these goals. For example, public transit deserve more funding if it helps reduce traffic and parking congestion, and sidewalks and bike lane investments are justified if they support public health goals.

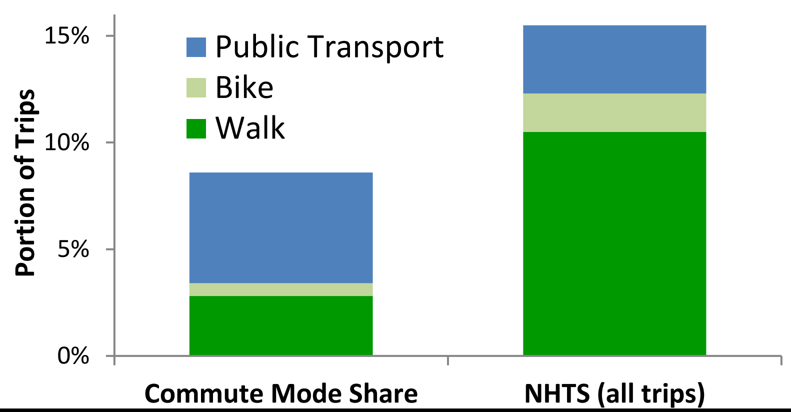
These principles are not mutually exclusive; to be efficient and equitable, multimodal planning should apply them all as much as possible. The following sections provide information on how to do that.

Non-Auto Travel Demands

Travel demand refers to the amount and type of travel that people would choose at a given quality and price. A mode's demands can be measured based on its *current mode shares* (portion of trips), *potential mode shares* if it were improved (latent demands), the *portion of travellers who currently use it* or the *portion travellers who would use it if it were improved* (latent users).

Non-auto modes include *active* transport (walking, bicycling and variations such as wheelchairs, e-bikes and scooters), public transport, and mobility substitutes such as telework and delivery services. Conventional travel data often undercounts and undervalues these modes. Planning often uses commute mode share data which ignores non-commute trips, adolescents' travel and many types of walking and bicycling trips. For example, a *bike-transit-walk* trip is often coded as a *transit* trip, and trips between parked vehicles and destinations are ignored even if they involve walking several blocks on public streets. This significantly undercounts non-auto trips which underestimates their demands and undervalues investments in those modes (Buehler and Pucher 2024; Wang and Renne 2023).

Figure 3 **Non-Auto Mode Shares** (U.S. Census, 2017 NHTS)



Commonly-cited statistics, such as census commute mode share data, tend to undercount non-auto modes, particularly walking and bicycling trips. More comprehensive sources, such as the National Household Travel Survey (NHTS) indicate that walking and bicycling trips are two to six times more common than indicated by commute mode share data.

Similarly, planning analysis is often based on vehicle ownership data. About 92% of North American households own at least one vehicle, implying that auto ownership is nearly universal. However, many vehicle-owning household residents cannot, should not or prefer not to drive and will use non-auto modes that are convenient and affordable (Zhao, et al. 2013). About 20% of U.S. households are car-deficit, meaning they have more drivers than vehicles (Blumenberg, Brown and Schouten 2020). About 15% of U.S. residents are adolescents, about 12% are seniors, and about 8% have mobility impairments (Brumbaugh 2021; US Census). The study, *The Multimodal Majority?* found that during a typical week 7% of Americans rely entirely on non-auto modes, about half of Americans use non-auto modes at least three times, and 25% use a non-auto mode seven or more times (Buehler and Hamre 2015). Non-auto travel tends to increase significantly after those modes are improved, indicating latent demands, as described later in this report.

Table 2 summarizes various non-auto travel demands and costs if they are not served. These factors overlap. For example, many youths, senior and people with disabilities also have high poverty rates and so many require travel options that are both accessible *and* affordable. This indicates that in a typical community 20-40% of travellers cannot, should not or prefer not to drive for a significant portion of trips, and would use non-auto modes if they are convenient, comfortable and affordable.

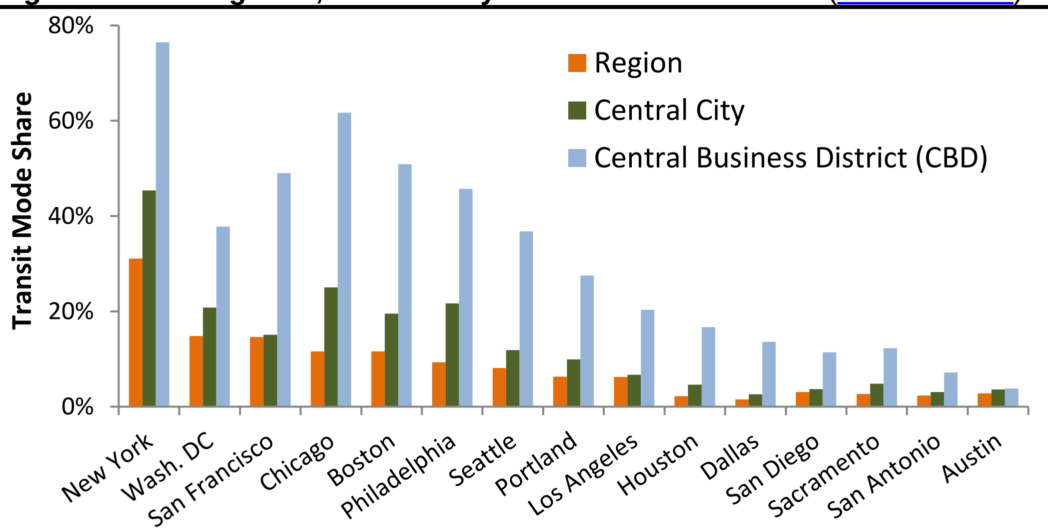
Table 2 **Non-Auto Travel Demands** (Brumbaugh 2021; Litman 2018; US Census 2021)

Type	Prevalence	Costs if not Served
Seniors who do not or should not drive.	5-10% of population.	Non-drivers lack mobility, require chauffeuring (special vehicle travel to transport a non-driver), must use higher-cost options (such as taxis and ridehailing) or move to another community with better transport options.
People with impairments.	5-10% of population.	
Adolescents (12-20 years).	10-20% of population.	
Drivers who share vehicles.	5-15% of motorists.	
Drivers who temporarily lack vehicles.	Varies.	
Lower-income households.	20-40% of households.	Lack mobility or bear excessive transport costs.
Tourists and visitors.	Varies.	Lack mobility or visit other areas.
People who do not drive for religious or cultural reasons.	0-3% of households.	Lack mobility during religious days or move to more walkable areas.
Impaired or distracted travelers.	Varies.	Impaired and distracted driving, increasing crashes.
People who walk and bike for health and enjoyment.	40-60% of residents.	Must spend time and money exercising at a gym or have insufficient exercise.
Families with pets to walk.	20% of households.	Pets lack exercise or owners drive to walking areas.
Motorists who benefit from better travel options for others.	Most motorists.	Motorists bear more congestion, risk and chauffeuring burdens.

In a typical community, 20-40% of travelers cannot, should not, or prefer not to drive for most trips, and will use non-auto modes if they are convenient, comfortable and affordable.

Non-auto mode shares tend to be high in central urban areas, as illustrated below. There traffic problems are particularly severe, so shifts to non-auto modes can provide large benefits.

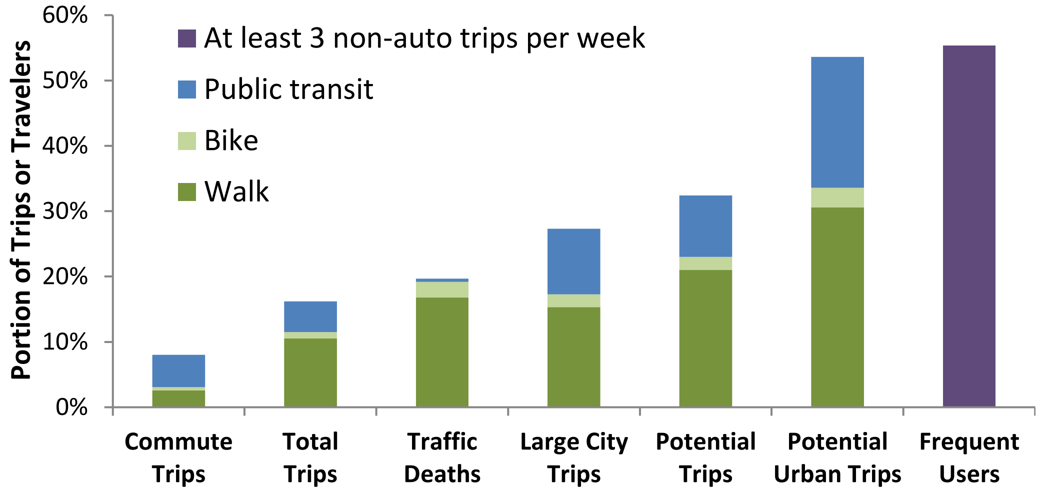
Figure 4 **Regional, Central City and CBD Mode Shares** (Pisarski 2006)



Non-auto mode shares are particularly high in central urban areas where traffic problems are severe, so small shifts to walking, bicycling or public transit can provide large benefits if concentrated on congested corridors.

The figure below shows indicators of non-auto travel demands. The first column shows commute mode shares. The second column shows *total* mode shares. The third column shows their shares of traffic deaths. The fourth shows mode shares in larger cities where traffic problems are most severe. The fifth and sixth columns show estimated potential non-auto mode shares if they received a proportionate share of investments. The seventh column indicates the portion of residents who make at least three weekly trips by non-auto modes. This suggests that non-auto modes, particularly walking, receive less than their fair share of investments.

Figure 5 **Non-Auto Demand Indicators** (2018 ACS, 2017 NHTS, Buehler & Hamre 2015)



Non-auto modes are 8% of commute trips, 16% of total personal trips, 27% of large city trips, 20% of traffic deaths, and a third to half of urban trips if their conditions are improved. About half of all travelers use non-auto modes at least three times per week.

Motorists also benefit from non-auto modes investments; they use non-auto modes when driving is difficult, dangerous or illegal (such as after drinking); to save money (to avoid high fuel prices, road tolls or parking fees); for enjoyment and health; to reduce their chauffeuring burdens; and because reductions in their neighbors' vehicle travel reduces their congestion, crash risk and pollution.

Experts recommend that households spend no more than 45% of their budgets on housing and transportation (CNT 2021), so a household that spends 30% on housing can spend up to 15% on transportation. This makes vehicle ownership and high-annual-mileage lifestyles unaffordable for many low- and moderate-income drivers (ITDP 2019). Of course, many lower-income people own cars, which leaves them vulnerable to financial stress when their vehicles have mechanical failures or crashes, or fuel prices increase, leading to financial and legal problems (Sanchez 2018). Rodriguez and Leinberger (2023) found that families and businesses willingly pay 35-45% higher prices for homes and commercial space in the most walkable neighborhoods, reflecting the savings and benefits they provide, and the shortage of such neighborhoods relative to demand.

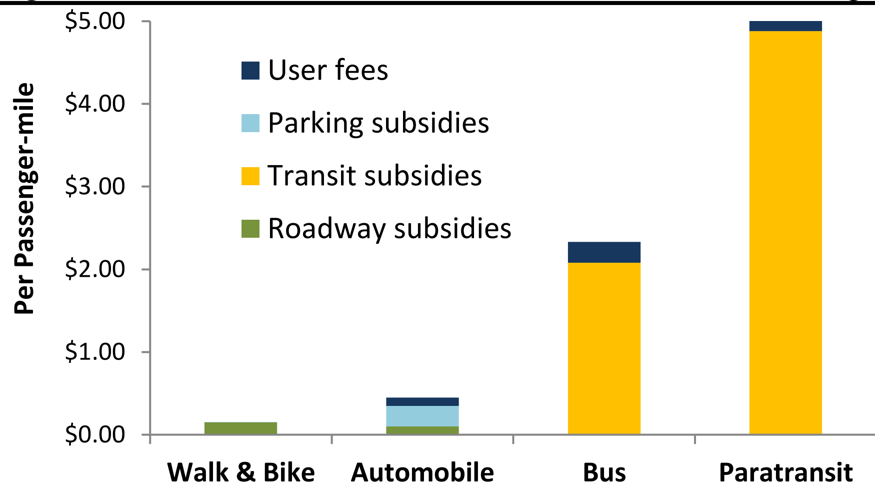
Although there is about one motor vehicle per adult in the U.S., they are unevenly distributed: the highest income quintile households have more vehicles than adults while the lowest income quintile has only 0.73, indicating that about half of lower-income adults lack or share vehicles (BLS 2011-2020). As a result, multimodal planning is progressive with respect to income: it tends to benefit lower-income households.

Units of Comparison

A key factor in equity analysis is the units used for comparisons. Benefits can include the supply and quality of infrastructure including sidewalks, paths, public transit services, roadways and parking facilities. Costs can include government infrastructure expenditures, total infrastructure expenditures (including government-mandated off-street parking facilities), and external traffic costs such as the congestion, traffic risk and pollution that a traveller imposes on other people. These can be measured as total costs or subsidies (costs minus user fees such as transit fares, special fuel taxes, road tolls and parking fees). They can be compared per trip, per distance (mile or kilometer), or annual per capita.

Consider the following comparisons. Walking and bicycling facilities cost about $50 annually per capita, or about $0.15 per mile walked and biked. Roads and traffic services cost about $0.10 per motor vehicle-mile, about half of which if funded by user fees and half by general taxes, and government-mandated off-street parking facility costs average about $0.30 per vehicle-mile of which about $0.05 is direct user paid. Paratransit services cost $5.17 per passenger-mile, of which $0.29 is paid by fares and $4.88 is subsidy. Conventional bus service costs average $2.33 per passenger-mile, of which $0.25 is paid by fares and $2.08 is by subsidy (APTA 2021).

Figure 6 **Infrastructure Costs and Subsidies Per Passenger-Mile**

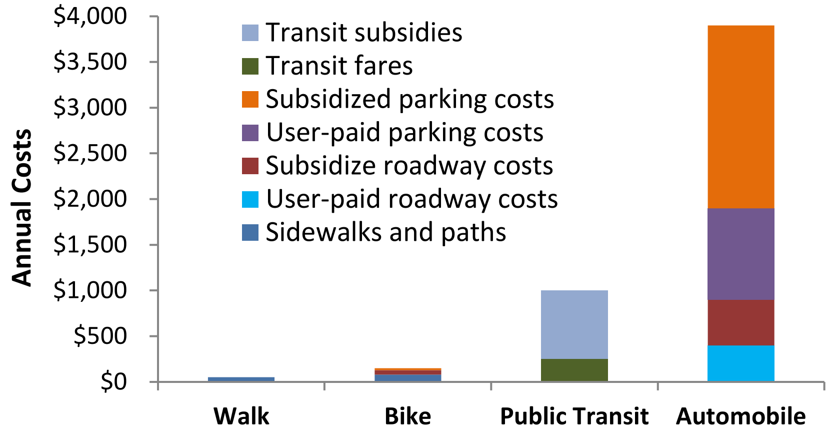


Measured per unit of travel (passenger-mile or kilometer), walking and bicycling have the smallest costs and subsidies. Automobiles have low roadway costs but significant parking costs. Buses have higher costs and subsidies, and paratransit the highest.

However, because equity is concerned with differences between *people*, equity analysis should generally compare impacts per capita. People's annual miles of travel, and therefore their annual infrastructure costs and subsidies, vary widely as illustrated in Figure 7. Those who rely primarily on walking and bicycling have the smallest annual costs and subsidies. A typical motorist who drives 12,000 annual miles has large costs and subsidies. A typical non-driver who travels 1,000 annual bus-miles (about four weekly trips), or a wheelchair user who travels 500 annual paratransit-miles (about two weekly trips), has moderate costs. A daily transit user who travels 2,500 annual bus miles has high costs, although these are generally lower than the full costs of driving in dense cities, where there road and parking facility costs are two or three times higher than average.

This indicates that people who drive less than average tend to subsidize the infrastructure costs others who travel more than average.

Figure 7 **Infrastructure Costs and Subsidies Per User**



People who walk and bicycle 2,000 annual miles have the smallest costs and subsidies. A transit user who travels 1,000 annual bus-miles, and a wheelchair user who travels 500 annual paratransit-miles, has moderate costs. A daily transit user who travels 2,500 annual bus miles has higher costs, although these are often lower than the full costs of driving in dense cities. A motorist who drives 12,000 annual miles has large costs and subsidies.

Infrastructure Investments Compared With Demands

This section compares estimated infrastructure spending with indicators of demand for non-auto modes.

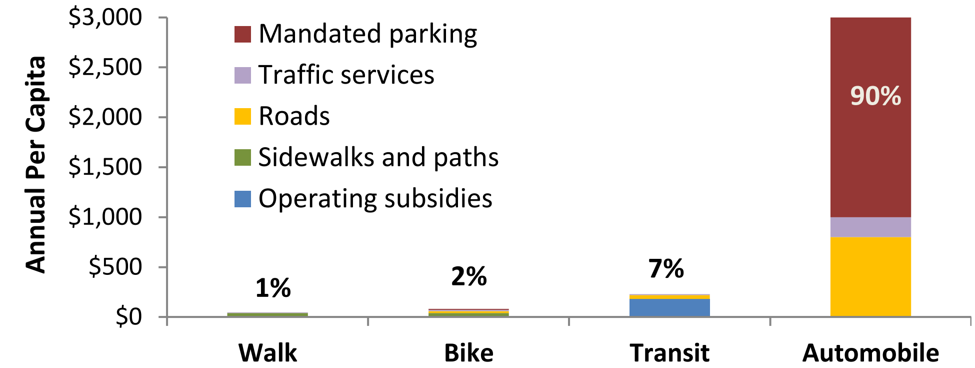
Municipal governments typically spend $30 to $60 annually per capita to build and maintain sidewalks ("Roadway Costs," Litman 2020), and those with ambitious bikeway programs, such as Davis, CA and Boulder, CO, spend similar amounts on bicycle facilities (Henao, et al. 2014; Jones 2021). State departments of transportation typically spend $1 to $3 annually per capita on active mode facilities (ABW 2018). Pedestrians and bicyclists also use roads but impose minimal costs due to their small size, light weight and low annual mileage, so they probably cost less than $20 annually. Governments spent about $180 annually per capita to subsidize public transit, and providing basic public transit, such as urban bus services, costs about $1,000 annually for a regular user (APTA 2020; Davis 2021).

In 2021 in the U.S., local, state and federal governments spent approximately $800 per capita on public roads, about half of which is funded through user fees, plus an estimated $200 annually per capita on traffic services such as policing, emergency response, and roadway stormwater management (FHWA 2021; "Roadway Costs," Litman 2021). In addition, government parking mandates result in two to six off-street parking spaces per capita, with total costs averaging $2,000 to $6,000 per capita (Litman 2025; Scharnhorst 2018). A recent study, *Closing the Climate Investment Gap* (NRDC 2023), found that of California's $22 billion in transportation infrastructure spending, 81% was allocated to maintain (72%) or expand (10%) roads, and only 19% funds non-auto projects such as sidewalks, bike lanes, transit and affordable housing. California planning is more multimodal than most other states (Caltrans 2020) and this analysis does not account for government-mandated parking costs, so the portion of total U.S. transportation infrastructure spending devoted to non-auto modes is much lower.

Similarly, the Australian federal government spends $714 annually per capita on roads but just $0.90 goes to walking, wheeling and bicycling (Mclaughlin, Ennis and McCue 2025).

The figure below compares these expenditures. This indicates that automobiles receive more than 90% of infrastructure spending. These are lower-bound estimates because they assume lower-bound parking costs and exclude the opportunity costs of land used for road rights-of-way, and environmental damages (stormwater management costs, heat island effects and habitat displacement) caused by these facilities. Including these would significantly increase total automobile costs.

Figure 8 **Estimated Transportation Infrastructure Spending** (Litman 2021)

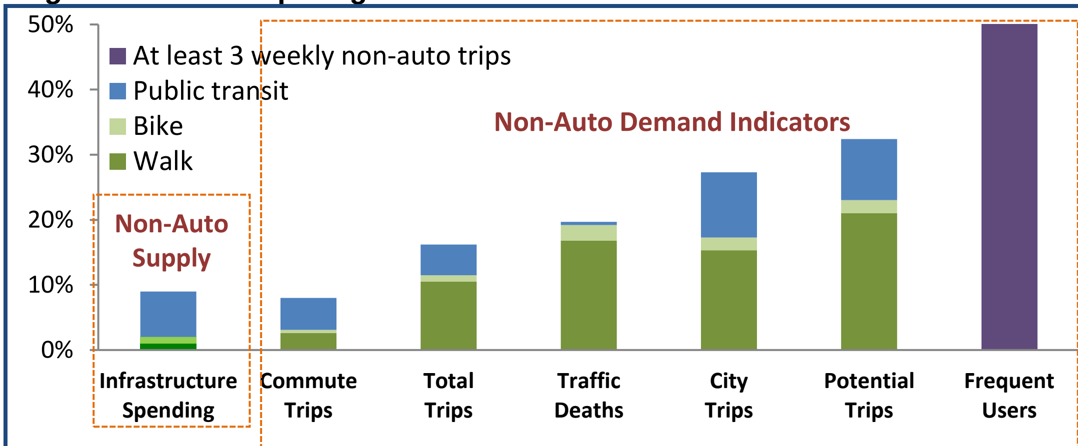


More than 90% of infrastructure spending is devoted to automobile travel, including roads, traffic services and government-mandated off-street parking.

Automobiles also receive the majority of road space for higher-speed traffic lanes and parking lanes (Creutzig, et al. 2020; Gössling, et al. 2016; Will, Cornet and Munshi 2020). Few roads have bike- or bus-lanes, or low traffic speeds for active mode safety. Typical urban streets have sidewalks that use 5-15% of rights-of-way (e.g., 4-8 feet of a 40-60 foot ROW), but sidewalk networks are incomplete, particularly in suburban and rural communities, so they probably use just 2-4% of total rights-of-way.

The figure below compares non-auto infrastructure spending with demand indicators. They currently receive less than 10% of investments which is comparable to non-auto commute mode shares but less than their shares of total trips, particularly in cities; their potential shares if their conditions improved; and far less than the portion of people who make at least three weekly non-auto trips.

Figure 9 **Comparing Non-Auto Infrastructure Investments with Demand Indicators**



Non-auto modes receive a smaller portion of infrastructure spending than their share of total trips, traffic deaths, potential trips, or frequent users (at least three weekly trips).

These discrepancies are particularly large for walking which accounts for more than 10% of trips and 17% of traffic deaths but receives less than 2% of investments. Bicycling investments are comparable to its current mode share but less than its potential share considering growing demands for e-bike travel. Public transit receives more funding than its mode share but it serves particularly costly travel including people with disabilities who need special facilities and services, travel by non-drivers who would otherwise require chauffeuring, and travel in dense urban areas where automobile infrastructure and traffic costs are very high. These high costs can justify the high portion of investments devoted to transit.

Determining Optimal Investments

The following principles can help determine optimal public investment levels in non-auto modes.

Fair Share Public Resource Allocation

This implies that non-auto mode investments should approximately equal their share of trips or users. As described in the section on travel demands, non-auto modes are 8% of commute trips, 16% of total personal trips, those shares typically double when non-auto modes receive more investments, indicating latent demands, and about half of all travelers use non-auto modes at least three times per week.

Walking and bicycling infrastructure costs $50 to $150 annually per user. Serving a daily public transit user typically cost about $750 in annual subsidies. Automobiles require about $1,000 in annual road and traffic service costs, plus at least $2,000 in parking facility costs. Although motorists pay more user fees, they also receive more total subsidies per capita than other mode users, due to their high costs. Fairness therefore requires higher investments in non-auto modes or higher road and parking fees, so all travellers receive comparable subsidies.

Automobile advocates sometimes argue that non-auto modes receive more than their fair share of public investments, citing fuel tax revenues "diverted" to non-auto uses (Feigenbaum and Hillman 2020), but their analysis is incomplete. If fairness requires that motorists "get what they pay for," it also requires that users "pay for what they get").

Although some local transportation agencies invest a significant portion of their budgets in non-auto modes, these are exceptions. Most transportation agencies, particularly state and provincial agencies, spend small portions of their budgets on non-auto modes (ABD 2018; Davis 2021). Since state and provincial agencies control about 70% of transportation budgets, the portion of funding spent on non-auto modes is relatively small ("Table HF-2" FHWA 2020). Although public transit requires greater subsidy than driving per passenger-mile (O'Toole 2017), motorists travel far more annual miles, so motorists receive more annual subsidies. Critics ignore the costs and subsidies of government-mandated parking facilities. This indicates that, because automobiles require more costly infrastructure and travel more annual miles than other modes, households that drive less than average tend to subsidize the infrastructure costs of other households that drive more than average.

Consumer Sovereignty

This requires that planning decisions respond to consumer demands, including latent demands (additional trips that people would make if a mode was improved). There is considerable evidence of latent demand for non-auto travel, demonstrated by consumer surveys (NAR 2019) and the increased walking, bicycling and transit travel that often occurs after their conditions improve. For example, the Nonmotorized Transportation Pilot Program, which invested about $100 per capita in active modes in four typical U.S. communities, increased walking trips 23% and bicycling trips 48% (FHWA 2014). A recent U.S. study found that a 10% increase in bikeway kilometers increases bicycle commute mode shares 2.5%, and 4% for protected bicycle lanes (Yang, et al. 2021). Cities that improved public transit service, such as Seattle, Phoenix and Houston, gained ridership, in contrast to declines elsewhere (Peterson 2017; Schmidt 2018). The elasticity of transit ridership to service is typically 0.6 to 1.0, meaning that a 10% increase in transit vehicle-miles usually increases ridership 6-10% (Pratt 2004). After Boulder, Colorado increased non-auto mode investments to about half of its transportation infrastructure spending, non-auto mode share increased 26% (from 38% to 48%), and automobile mode share decreased 16% (from 62% to 52%), the opposite of national trends (Henao, et al. 2014).

Comprehensive programs that include a combination of non-auto improvements and TDM incentives can substantially increase non-auto trips and reduce automobile travel (Kuss and Nicholas 2022). Cost-effective TDM programs reduce automobile trips by about half (Galdes and Schor 2022). Local property values tend to increase with non-auto improvements, indicating the value people place on multimodal transport (NAR 2023; Smith and Gihring 2021).

Current demographic and economic trends are causing automobile travel demand to peak and demands for non-auto travel to increase. These include aging population, increasing poverty and fuel prices, changing consumer preferences, plus growing social equity, public health and environmental concerns. In addition, new transportation technologies and services, such as micromodes (e-bikes and e-scooters) and integrated transportation information and payment apps, increase non-auto demands. As a result, non-auto mode investments can be justified to serve latent and future demands.

Social Equity

This means that policies should invest enough in non-auto modes to provide basic mobility to disadvantaged groups in order to ensure their economic and social opportunities (Ewing, et al. 2016; Oishi, Koo and Buttrick 2018). The table below illustrates disadvantaged groups' non-auto demands.

Table 3 **Non-Auto Demands by Disadvantaged Groups**

Group	Non-Auto Demands
People with disabilities	Many cannot drive or cannot afford an automobile and so rely on non-auto modes. Many need universal design features (ramps, lifts, etc.).
Low income households	Many cannot afford automobiles or own unreliable vehicles that require non-auto backups. They need convenient and affordable modes, and sometimes targetted discounts.
Minority communities	Many minority groups rely more than average on non-auto modes due to high poverty rates and urban locations. They also gain from active mode health benefits, and reductions in urban traffic risk and pollution provided by reduced auto traffic.

Disadvantaged groups tend to rely more than average on non-auto modes and require special design features and subsidies that add costs. This justifies more non-auto investments to support social equity goals.

Cost Efficiency

Non-auto modes tend to have lower public and user costs than automobile travel, so investments in their facilities can be very cost effective. For example, Portland, Oregon's $60 million bikeway investments, costing about $10 annual per capita, provides about $1.1 billion in total vehicle savings, plus infrastructure savings, health and environmental benefits (Cortright 2017; Kullgren 2011). Increasing urban transit service to optimal levels would cost about $65 billion annually or about $200 per capita, which is equivalent to about 7% of roads and parking facility costs or 4% of vehicle expenditures, so those investment would be repaid if they reduced vehicle costs just 3% (Freemark 2022). Boulder's non-auto mode investments, which average about $125 annual per capita, reduced auto mode share by 16% (Henao, et al. 2014); if vehicle and parking costs decline proportionately residents save more than ten dollars for each dollar invested.

Conventional planning tends to overlook and undervalue many costs of automobile travel and therefore the benefits of shifts to non-auto modes. For example, by tradition transportation project evaluation ignores vehicle ownership and parking costs, and so fails to account for the savings to households, businesses and governments that result when non-auto improvements reduce automobile ownership and use, and therefore parking facility costs. In addition, conventional planning tend to exaggerate highway expansion benefits by ignoring induced vehicle travel impacts (Volker, Amy and Handy 2020), and the full benefits provided by non-auto modes (Handy 2020). For example, transportation economic evaluations generally ignore vehicle ownership and parking costs, and therefore much of the savings provided by improvements to non-auto modes; the benefits of providing more independent mobility for non-drivers; and active transportation health benefits.

Community Goals

Because they are affordable, inclusive (they serve diverse users), healthy and resource-efficient, non-auto modes tend to support various community goals, particularly compared with auto infrastructure expansions. The table below evaluates these impacts. Roadway expansions may reduce traffic congestion in the short-run, but this declines over time as the added capacity induces more vehicle travel, which contradicts other goals. Non-auto improvements tend to achieve many community goals.

Table 4 **Comparing Auto and Non-Auto Investments** (Handy 2020; Litman 2019)

Community Goals	Expand Auto Infrastructure	Improve Non-Auto Modes
Vehicle Travel Impacts	*Increased*	*Reduced*
Reduce congestion	✓ (often declines over time)	✓
Reduce roadway costs	×	✓
Reduce parking costs	×	✓
Provide consumer savings and affordability	Higher purchase, lower operating	✓
Increase traffic safety	✓/× (declines if traffic increases)	✓
Improve mobility for non-drivers	×	✓
Conserve resources (particularly fossil fuels)	×	✓
Reduce pollution	×	✓
Increase public fitness and health	×	✓
More compact development (reduce sprawl)	×	✓

(✓= Achieve objectives. ×= Contradicts objective.) Automobile infrastructure expansions tend to reduce congestion and crashes in the short-run, but these benefits decline over time if they induce more vehicle travel. Improving non-auto modes tend to reduce congestion and crashes, and help achieve other community goals.

Summary

Applying these principles suggests that non-auto mode investments should:

- At least be proportional to their shares of trips or travellers. For example, if a mode serves 10% of trips or travellers it should receive at least 10% of funding, road space and safety programs. Increase if justified to correct for past underinvestment in non-auto modes.
- Respond to latent and future demands. Investments should increase if they would increase or serve future demand. For example, invest 15% of resources if that would achieve 15% future mode share.
- Increase where justified for social equity, such as providing basic mobility, affordability, public health or safety to physically, economically and socially disadvantaged groups.
- Invest in non-auto modes when they are cost effective, taking into account all impacts including costs and benefits to users, businesses (such as parking subsidies) and governments.
- Invest in non-auto modes to the degree that they help achieve strategic community goals.

This indicates that non-auto modes often deserve more investments. Critics sometimes challenge these conclusions. The table below responds to arguments often used to justify automobile-oriented planning.

Table 5 Responses to Arguments Favoring Auto-Oriented Planning

Argument	Response
The majority of households own cars and rely on automobile travel. Most people prefer driving. There is little demand for non-auto travel.	In most communities, 20-40% of travellers cannot, should not, or prefer not to drive and will use non-auto modes if they are convenient and affordable. About half of all travellers take at least three non-auto trips per week. Surveys indicate that many people want to drive less, rely more on non-auto modes, and live in more multimodal communities. Where non-auto modes are improved, travellers increase their use, indicating latent demands.
Automobile travel is more efficient and productive than other modes.	Automobiles are most appropriate for some trips, including urgent errands and goods transport, but automobile travel imposes large costs on users and communities. Many trips are most efficiently made by non-auto modes.
Highway improvements are needed for goods delivery and support economic development.	Although freight and service trips are important they represent a small portion (about 10%) of total traffic. Non-auto improvements and demand management strategies can improve goods delivery with lower total costs.
Everybody uses roads and benefits from roadway improvements, including bicyclists and bus passengers.	Motor vehicles require more costly facilities than other modes. Non-auto improvements are more cost effective than roadway expansions and benefit motorists by reducing congestion, risk, and chauffeuring burdens.
Motorists pay for their infrastructure; other modes are subsidized.	User fees only pay about half of roadway costs and a tiny portion of parking costs. Because motorists travel more average annual miles than non-drivers they receive far larger subsidies per capita.
New vehicle technologies (electric and self-driving) will eliminate problems.	New vehicle technologies are expensive, introduce new costs and risks, and will take decades to fully penetrate vehicle fleets.

This table evaluates various arguments used to justify underinvestment in non-auto modes.

Policy Reforms for More Multimodal Planning

This section describes common biases that undervalue non-auto modes, and policy reforms to correct them.

Conventional transportation planning tends to undercount non-auto travel and underestimate demands for these modes. For example, planning analysis often uses commute mode share data, which only counts about a third of walking and bicycling trips, and non-auto travel often increases significantly after those modes are improved, indicating latent demands. Comprehensive analysis indicates that 20-40% of travellers would use non-auto modes if they were convenient, comfortable and affordable.

Conventional planning evaluates transportation system performance using mobility-oriented indicators such as roadway level-of-service and congestion delay, rather than accessibility-oriented indicators that also consider geographic proximity. It also tends to ignore other planning goals such as affordability, inclusivity, social equity, public health, neighborhood livability and environmental protection (Levinson and King 2020). Older planning also underestimated induced vehicle travel and resulting increases in external costs (Volker, Lee and Handy 2020). These practices tend to overvalue faster modes, and undervalue slower, more affordable, safer and resource-efficient alternatives. More comprehensive planning tends to justify much more non-auto investments.

Table 6 **Scope of Transportation Impacts Considered in Planning** (Litman 2019)

Current Planning	Comprehensive Analysis
	• Parking costs and subsidies. • Consumer savings and affordability. • Non-auto traveller comfort and convenience. • Independent mobility and opportunity for non-drivers.
• Public infrastructure costs. • Traffic speed and delays. • Per-mile vehicle operating costs. • Per-mile crash risk. • Per-mile emission rates. • Road construction environmental impacts	• Realistic speed and travel time valuations. • Social equity goals. • Public fitness and health. • Safety for all modes. • Total environmental costs of roadways and vehicle travel. • Induced vehicle travel and sprawl-related costs.

The old planning paradigm considered a limited set of impacts. The new paradigm is more comprehensive, and so recognizes the additional benefits from improving non-auto modes.

Automobile travel is currently underpriced; most of their costs are either fixed or external. This price structure is economically inefficient – it fails to reflect the marginal cost of driving, resulting in economically excessive vehicle travel and sprawl, and suppresses demands for more resource-efficient modes and more compact development.

A major portion of transportation funding is dedicated to roadways and cannot be used for other modes or for TDM programs even if they are more cost effective and beneficial overall. Transportation funding is partly allocated based on vehicle-miles-travelled, which rewards jurisdictions for increasing vehicle travel and discourages vehicle-travel reduction strategies.

Planning decisions often reflect *elite bias*, which refers to decision-makers' tendency to evaluate problems and solutions based on their own experiences and preferences. Most policy makers and planning practitioners are busy professionals who seldom rely on non-auto modes and so tend to overlook and misunderstand non-auto travel demands.

The table below summarizes various planning distortions and reforms required for more efficient and equitable transportation planning.

Table 7 **Common Planning Distortions and Reforms** (Butner and Noll 2020; Litman 2006)

Distortion	Effects	Reforms
Undercounting non-auto travel demands, including latent demands.	Undervalues non-auto travel demands and improvements to non-auto modes.	More comprehensive travel data, including latent demands. Recognize data biases.
Incomplete analysis. Little consideration of affordability, social equity, safety, public health, and environmental protection goals.	Favors automobiles over more affordable, inclusive and resource-efficient modes, and higher speed roadways over complete streets.	More comprehensive analysis, more multimodal planning, and additional performance targets (affordability, health, etc.).
Mobility-based performance indicators (e.g., roadway level-of-service and travel time index).	Favors faster modes, higher roadway design speeds, and sprawl over compact development.	Consider other planning goals beside speed. Apply accessibility-based planning.
Overvaluing travel time savings.	Favors faster over slower modes, and higher roadway design speeds over complete streets.	Use realistic travel time values. Account for the costs higher traffic speeds.
Ignoring induced vehicle travel.	Overinvests in roadway expansions and underinvests in alternatives.	Account for induced vehicle traffic impacts.
Dedicated funds for roads and parking facilities, but not non-auto modes.	Favors automobile infrastructure over investments in other modes.	Least-cost transportation planning. Multimodal planning.
Automobile underpricing (unpriced roads, parking, risk, pollution, etc.)	Increases automobile travel and reduces non-auto travel demands.	More efficient pricing and more investments in non-auto modes.
Sprawl-oriented development policies, such as density restrictions and parking minimums.	Creates dispersed communities that provide poor non-auto access.	Smart Growth policies that create more compact, multimodal communities.
Elite bias (decision-makers have little experience with non-auto modes).	Favors automobile improvements over other modes, and sprawl over compact development.	Better information on non-auto travel demands, and more multimodal planning.

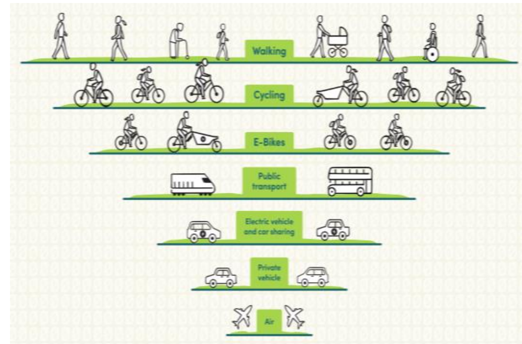
Many common transportation planning distortions favor automobile travel and sprawl over more affordable, inclusive and efficient modes, and sprawl over compact, multimodal development.

Although individually these distortions may seem modest and justified, their impacts are cumulative and synergistic. For example, underpriced parking not only increases parking demands and parking facility costs, it also increases total automobile ownership and use, which increases traffic congestion, crashes and pollution damages. Similarly, underinvestment in pedestrian facilities not only reduces walking trips, it also reduces public transit travel, since most transit trips include walking links. Described more positively, by creating more diverse and efficient transportation systems, these recommended policy reforms can provide diverse economic, social and environmental benefits.

Multimodal Planning Practices

This section describes specific planning practices for more optimal, multimodal planning.

Sustainable Transportation Hierarchy



To support strategic goals, some transportation organizations apply a sustainable transportation hierarchy that prioritizes more resource-efficient modes, as illustrated to the right. A variation is the Avoid-Shift-Improve hierarchy which prioritizes strategies that *avoid* unnecessary travel, followed by *shifts* to less carbon-intensive modes, followed by *improved* vehicle design such as more efficient and alternative fuels (SLOCAT 2021). These increase investments in non-auto modes and demand management programs.

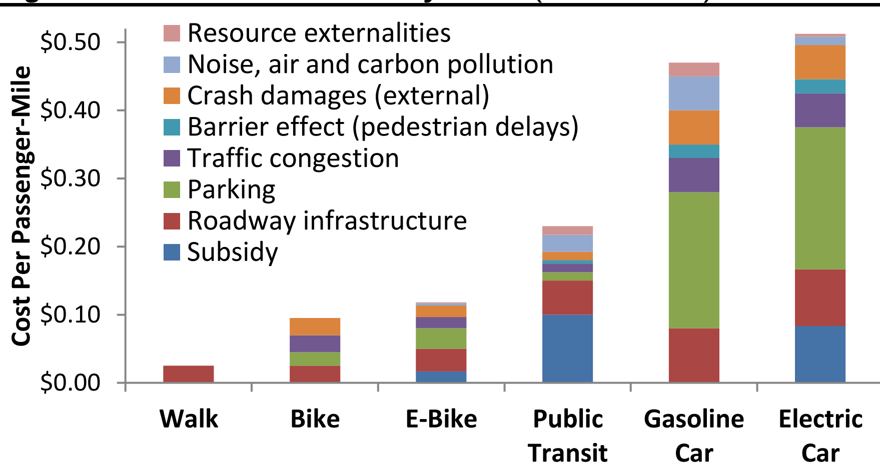
Comprehensive and Least Cost Planning

Comprehensive planning considers all impacts, including emerging planning goals such as affordability, social equity and public health. It also recognizes that roadway expansions tend to induce additional vehicle travel and sprawl, and accounts for the additional costs that result. Lease-cost planning considers all options and impacts, and invests public resources to maximize economic returns. This allows non-auto modes and TDM programs to be funded whenever they are more cost-effective than roadway and parking facility expansions. The table below compares conventional and emerging planning goals. Conventional goals tend to justify automobile-oriented investments. Emerging goals tend to justify more multimodal planning. As a result, comprehensive and least cost planning tends to reduce investments in automobile infrastructure and increase non-auto infrastructure investments.

Efficient Transportation Pricing

A basic economic principle is that prices (what users pay for a good) should reflect marginal costs (the incremental costs of producing it) unless subsidies are specifically justified. The figure below shows the external costs of various modes. These are inefficient and unfair. An efficient and equitable transport system charges users directly for these costs, giving travellers incentives to choose resource-efficient options and reduce external costs. Since automobiles impose relatively large costs, efficient pricing reduces costs that motorists impose on other people, increasing fairness.

Figure 10 **External Costs by Mode** (Litman 2021)



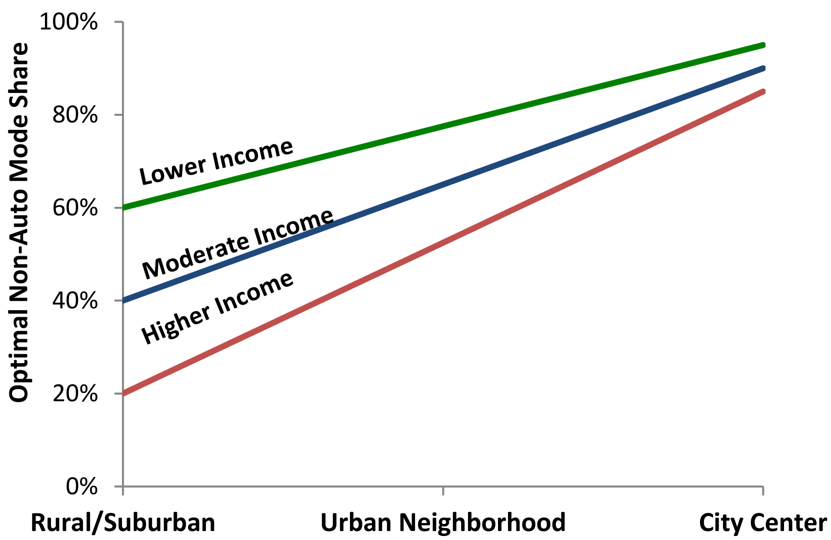
This figure compares the external costs of six modes. Efficient pricing charges users for these costs in order to encourage travellers to choose the most efficient option for each trip, and to reduce the external costs (congestion delays, risk, noise and air pollution, and infrastructure subsidies) that automobile travel imposes on non-auto travellers.

Vehicle Travel Reduction Targets

A growing number of jurisdictions have legal targets to reduce vehicle travel and increase non-auto travel. For example, Scotland has targets to reduce vehicle travel by 20% by 2030; New Zealand has targets to reduce light-duty vehicle travel 20% by 2035; California has targets to reduce per capita light-duty vehicle miles traveled 25% per capita by 2030 and 30% by 2045; and British Columbia has targets to reduce light-duty vehicle travel 25% and approximately double walking, bicycling and public transit trips by 2030 (Litman 2023). Their stated goals vary: older vehicle travel reduction programs were intended to reduce local traffic congestion and air pollution emissions, newer programs are intended to reduce climate emissions, but all recognize the many co-benefits provided by less vehicle traffic.

Optimal non-auto mode shares and investment levels vary by geographic and economic conditions. The figure below illustrates this concept. In affluent rural and suburban communities it may be appropriate for most trips to be made by automobile, so roads and parking facilities can receive most investments, but as an area becomes denser or poorer, optimal non-auto mode shares increase. In most moderate- and low-income urban neighborhoods, non-auto modes should serve more than half of all trips in order to respond to consumer demands and help achieve economic, social and environmental goals.

Figure 11 **Optimal Non-Auto Mode Shares by Location** (Litman 2017)



Optimal non-auto mode shares should increase with density and poverty. As a result, the portion of transportation resources devoted to non-auto modes should be much higher in urban neighborhoods, downtowns, and lower-income areas than in affluent suburbs.

Some of these jurisdictions have policies requiring that individual planning decisions support these targets and tools for evaluating those impacts (Lee and Handy 2018). For example, The California Department of Transportation's *Vehicle Miles Traveled-Focused Transportation Impact Study Guide* (Caltrans 2020) and the *San Francisco TDM Tool* (www.sftdmtool.org), provide technical analysis for predicting how specific policies and programs will affect vehicle travel and guidance on how to achieve travel reduction targets. The state of Colorado also requires that major projects must support emission reduction targets (Degood and Zonta 2022). Some jurisdictions require or encourage planners to account for induced vehicle travel, which reduces the justification for highway expansions (Volker, Lee and Handy 2020). These policies tend to significantly increase investment in non-auto modes, plus TDM incentives and Smart Growth policies that create more compact and multimodal communities.

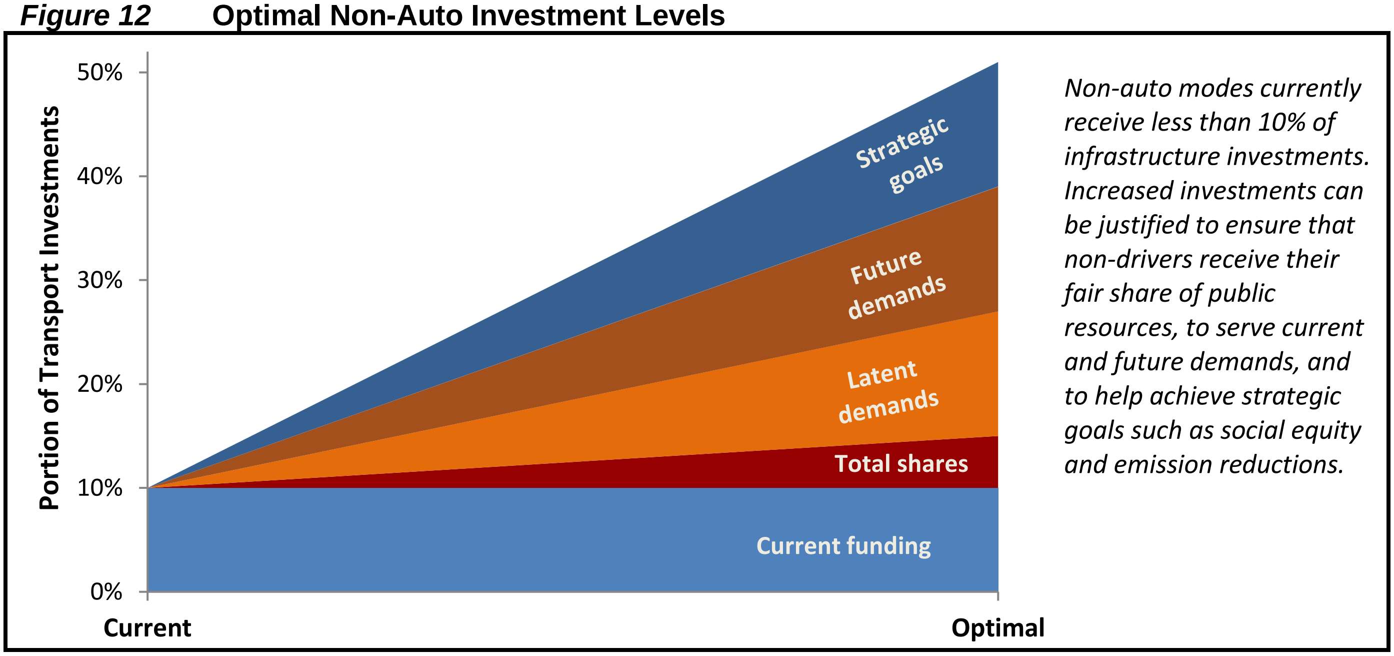
Conclusions

Efficient and equitable transportation planning should minimize disparities in *inputs* (funding, road space and priority) and *outcomes* (accessibility, safety and affordability) between types of travellers and residents of different areas. Current planning fails by these criteria. For most of the last century, transportation planning invested little in non-auto modes, which is unfair to travellers who cannot, should not or prefer not to drive, and unfair to residents of compact, multimodal, and lower-income neighborhoods where non-auto travel demands are greater.

This study examines why this happens, the problems that result and how to improve these practices. It identifies principles for efficient and equitable multimodal planning. These include *fair share planning,* so all travelers receive comparable shares of public resources; *consumer sovereignty*, so planning responds to user demands; *social equity*, so disadvantaged travellers receive sufficient investments to meet their basic needs; *cost efficiency*, so investments maximize user and community benefits; and *community goals*, so individual planning decisions support strategic goals. These principles are not mutually exclusive: planning should consider all of them when optimizing investments.

Non-auto travel demands are greater than commonly recognized. In typical North American communities, 10-20% of trips are currently by non-auto modes and 20-40% of travelers will use non-auto modes if they are convenient, comfortable, and affordable. Non-auto demands increase with density, diversity and poverty, and the justification to serve non-auto demands increase if communities are concerned about affordability, equity, public health, community livability and environmental quality. This suggests that communities should invest at least as much in non-auto infrastructure as their potential mode shares, and often more to correct for past underinvestments and achieve strategic goals. In most communities this would significantly increase non-auto investments, as illustrated below.

Figure 12 **Optimal Non-Auto Investment Levels**



This study concludes that current transportation planning overinvests in automobile infrastructure and underinvests in non-auto modes compared with what is efficient and equitable.

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