Are Vehicle Travel Reduction Targets Justified?  
Why and How to Reduce Excessive Automobile Travel  
4 August 2023

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Many current planning practices result in economically-excessive vehicle travel. Vehicle travel reduction targets can guide planning decisions to create more accessible, multi-modal communities where people can meet their needs with less driving.

Abstract
Automobile travel grew steadily during the Twentieth Century so during that time it made sense to invest significant resources in automobile infrastructure. This created a self-reinforcing cycle of more driving, more automobile-oriented planning, and fewer travel options that results in economically excessive vehicle travel; more driving than people would choose if they had better options and efficient incentives. Per capita vehicle travel has peaked and current demographic and economic trends are increasing non-auto travel demands. This is a good time to reform planning practices in response to changing needs. To guide these reforms, some jurisdictions establish vehicle travel reduction targets. These can help align individual planning decisions to support strategic goals. This report investigates why and how to implement these targets. It describes examples of targets, examines why and how communities establish them, describes ways to determine the amount of vehicle travel that is optimal, identifies effective vehicle travel reduction strategies, and evaluates criticisms.
An efficient and equitable transportation system must be diverse in order to serve diverse demands, including the needs of travellers who cannot, should not, or prefer not to drive. Vehicle travel reduction targets help align planning decisions to support efficiency and equity goals.

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Introduction

Motor vehicles make wonderful servants but terrible masters. Automobiles can provide many benefits but also impose large costs on users and communities, and they tend to squeeze out other travel options. To be efficient and equitable, public policies should optimize motor vehicle travel: not too little but not too much. What policies can make that happen?

Figure 1  Vehicle Travel Trends (FHWA various years)

Automobile travel grew steadily during the Twentieth Century but peaked about 2005, as illustrated above. During the growth period it made sense to invest in road and parking facility expansion, but priorities should respond to changing demands. Many common planning practices favor automobile travel over other modes. For example, most transportation funding is devoted to automobile infrastructure, roads are designed for maximize traffic speeds with little consideration to walking and bicycling conditions, and most jurisdictions impose parking minimums that subsidize automobile travel and encourage sprawl. These practices encouraged automobile dependency and sprawl, as illustrated below.

Figure 2  From “Predict and Provide” to “Decide and Deliver” Planning

“Predict and provide” transportation planning expands 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.
Because automobile travel and sprawl are resource-intensive (they require more energy and land than other modes and development patterns), they increase various economic, social and environmental costs, as summarized below.

**Costs of Automobile Dependency and Sprawl (Ewing and Hamidi 2014; Litman 2014b)**
Compared with compact neighborhoods residents of sprawled, auto-dependent areas typically have:
- 30-50% higher transportation expenses.
- Longer duration commutes and more total time spent travelling.
- Higher road and parking facility costs.
- 3-5 times higher traffic fatality rates.
- Less access to economic opportunities (education, jobs, and services) by non-drivers.
- Less exercise, more obesity and chronic illnesses, and shorter average lifespans.
- Two to three times higher pollution emissions.
- More land used per capita for housing, parking and roads, displacing openspace.

The figure below illustrates how vehicle and infrastructure costs grew with increased automobile travel. A 1901 survey of workingmen’s families’ expenditures had no category for transportation, indicating that mobility costs were insignificant for most moderate-income families, whereas now an average moderate-income household devotes about 20% of its income to automobiles and residential parking facilities (Litman 2021).

**Figure 3 Estimated Per Capita Vehicle and Infrastructure Costs** (Litman 2021)

Conventional transportation planning tends to undervalue of these impacts. It evaluates transportation system quality based on driving conditions, assuming that the goal is to maximize vehicle traffic (Lyons 2020). A new planning paradigm is more multimodal and comprehensive; it recognizes the important roles that walking, bicycling and public transit play in an efficient and equitable transportation system. Current demographic and economic trends – aging population, urbanization, changing preferences, rising fuel prices, plus growing concerns about affordability, public health and environmental protection – are increasing non-auto travel demands.
Now is a good time to reassess planning practices to ensure that they respond to changing needs. The new paradigm shifts from automobile-oriented to multimodal planning, and allows some areas, such as city centers, campuses and resorts, to be car-free, as summarized below.

<table>
<thead>
<tr>
<th>Table 1: Types of Transportation Planning</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Automobile-oriented</strong></td>
</tr>
<tr>
<td><strong>Description</strong></td>
</tr>
<tr>
<td><strong>Modes considered</strong></td>
</tr>
<tr>
<td><strong>Motor vehicle ownership and use</strong></td>
</tr>
</tbody>
</table>

Conventional planning is automobile-oriented. Newer planning is more multimodal, and sometimes car-free.

To encourage more efficient and multimodal planning many jurisdictions are establishing vehicle travel reduction (often called vehicle miles travelled or VMT reduction) targets; typically to reduce per capita vehicle-miles 15-25% over one or two decades. These targets help align individual, short-term decisions with strategic, long-term goals to create more diverse and efficient transportation systems. For example, many governments are making investing in non-auto modes; to maximize the benefits of these projects communities must change contradictory policies that encourage driving such as high parking minimums and sprawl-oriented development policies. VMT reduction targets identify such conflicts. They support integrated programs that include multimodal planning, Transportation Demand Management (TDM) incentives, and Smart Growth development policies. This is important because these policies often have synergistic effects: they become more effective and cost effective if implemented together. Vehicle travel reduction targets provide a guide to these reforms.

VMT reductions are not necessarily the most effective way of achieving any single goal, but are often cost effective considering all impacts. More comprehensive analysis, which considers diverse consumer demands, emerging planning goals and new technologies tends to justify vehicle travel reduction targets. Analysis in this report suggests that the optimal level of vehicle travel is significantly less than what occurs in most North American communities.

Critics argue that vehicle travel reduction targets are misguided. Highway and motorist advocacy groups claim that vehicle travel reduction policies are costly, unfair, and harmful to consumers and the economy, and constitute a “war on cars.” Some environmental advocates argue that clean vehicle technologies, such as hybrid and electric vehicles, are more effective at reducing emissions (Curry 2022). Robert Poole (2009) called VMT reduction goals a “terrible idea” and challenges proponents to prove they are cost effective. This study responds to that challenge.

This report investigates these issues. It describes examples of vehicle travel reduction targets, examines why and how communities establish such targets, evaluates criticisms, describes ways to optimize vehicle travel, and identifies effective vehicle travel reduction policies. This should be of interest to policy makers, practitioners (engineers, planners and analysts) and anybody who wants a more diverse, responsive, affordable and efficient transportation system.
Examples of Targets
Many jurisdictions have targets to reduce vehicle travel, increase non-auto travel, and create more compact communities (ACEEE 2019; Klein 2020; Thorwaldson 2020). Professional organizations are developing resources and tools to achieve these targets (ABAG 2021; Caltrans 2020; F&P 2022; ITE SB 743 Task Force 2021; Tomer and George 2023). Below are examples.

Countries, States and Provinces
- **United Kingdom**: half of all urban journeys will be by active modes by 2030 (DfT 2020).
- **United States**: reduce greenhouse gas pollution 52% from 2005 levels in 2030 (White House).
- **New Zealand**: reduce light-duty vehicle travel 20% by 2035 (NZMoE 2022).
- **Scotland**: reduce vehicle travel by 20% by 2030 (Reid 2020).
- **Israel**: cut car travel in half (Zagrizak 2022).
- **British Columbia**: reduce light-duty vehicle travel 25% and approximately double walking, bicycling and public transit trips by 2030 (CleanBC 2021).
- **Quebec**: reduce solo car trips 20% by 2023 (MdT 2018).
- **California**: achieve carbon neutrality by 2045, reduce per capita light-duty vehicle miles traveled 25% by 2030 and 30% by 2045 (Newsom 2022).
- **Colorado**: major projects must support emission reduction targets (Degood and Zonta 2022).
- **Minnesota**: reduce vehicle travel 14% by 2040 and 20% by 2050 (Bellis 2021).
- **North Carolina**: Implement various TDM strategies to reduce traffic problems.
- **Washington State**: 30% reductions by 2035 and 50% by 2050 (WSL 2008).

Regions and Cities
- **Boston**: Locate every home within 10 minutes of public transit, bike-, and car-share by 2050.
- **Columbus**: Create “smart mobility hubs,” to help residents travel without a car.
- **Minneapolis**: reduce VMT 40% by 2040 through walking, bicycling, public transit and compact development.
- **Orlando**: most local trips are done on foot, bike, carpooling, or transit.
- **Phoenix**: 90% of residents are within a half-mile of transit and 40% commute by non-auto modes.
- **Portland**: reduce vehicle travel and associated emissions by 45%.
- **San Antonio**: reduce average daily vehicle-miles per capita from 24 now to 19 by 2040.

The targets’ stated goals vary. Older vehicle travel reduction programs were intended to reduce local traffic congestion and air pollution emissions. Many recent programs are primarily intended to reduce climate emissions. Some are intended to correct past policies that resulted in automobile dependency and sprawl, and support more multimodal transportation planning in order to help achieve multiple economic, social and environmental goals.
Vehicle Travel Variability
For this analysis it is useful to consider factors that affect the amount that people drive. The figure below shows variations in per capita vehicle travel among U.S. urban regions; this ranges from less than 20 to more than 40 average daily vehicle-miles per person.

Figure 4 Per Capita Vehicle Travel in Selected Urban Regions (FHWA 2018)

Vehicle travel ranges from less than 20 to more than 40 daily vehicle-miles per capita.

Similar variations occur within regions (Salon 2014). Daily vehicle-miles are two to three times higher in suburban and rural areas than in compact, multimodal neighborhoods, as illustrated below.

Figure 5 Geographic Variation in Household VMT (CNT 2022)

This heatmap shows how average annual motor vehicle miles per household vary in a typical urban region, Nashville, Tennessee. Households in central neighborhoods average less than 16,000 annual vehicle-miles, about half the amounts in automobile-dependent, sprawled areas.

This shows how compact, multimodal development can reduce vehicle travel.
The table below summarizes factors that affect vehicle travel. This information can help identify appropriate vehicle travel reduction strategies. These factors often have synergistic effects. For example, transit improvements may have little effect alone but cause large vehicle travel reductions if implemented with TDM incentives and transit-oriented development policies.

### Table 2  
Factors Affecting Vehicle Travel (Litman 2023a; CARB 2015)

<table>
<thead>
<tr>
<th>Factor</th>
<th>Definition</th>
<th>Travel Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demographics</td>
<td>Age, gender, income, employment and caregiving responsibilities.</td>
<td>Vehicle travel tends to peak at about 50 years of age, is higher for men than women, increases from low to moderate incomes, increases with employment and family responsibilities.</td>
</tr>
<tr>
<td>Regional accessibility and centricity</td>
<td>Location relative to regional urban center. Portion of jobs in city centers.</td>
<td>More central area residents typically drive 10-40% less than at the urban fringe. City center commuters drive less and rely more on walking, bicycling and public transit.</td>
</tr>
<tr>
<td>Density</td>
<td>People or jobs per unit of land area (acre or hectare).</td>
<td>Reduces vehicle ownership and travel, and increases alternative modes use. A 10% increase typically reduces VMT 0.5-1%.</td>
</tr>
<tr>
<td>Mix</td>
<td>Proximity between different land uses (housing, commercial, institutional)</td>
<td>Tends to reduce vehicle travel and increase use of alternative modes, particularly walking. Mixed-use areas typically have 5-15% less vehicle travel.</td>
</tr>
<tr>
<td>Roadway design</td>
<td>Street scale, design and management.</td>
<td>Multi-modal street design and lower traffic speed reduce VMT and increase non-motorized travel.</td>
</tr>
<tr>
<td>Quality of non-auto travel options</td>
<td>Quantity, quality and safety of sidewalks, crosswalks, paths, bike lanes, public transit, carsharing, and telework.</td>
<td>Improving non-auto modes tends to increase their use and reduce automobile travel. Multimodal neighborhood residents tend to own 10-30% fewer vehicles, drive 10-30% fewer miles, and use non-auto modes more than in auto-oriented areas.</td>
</tr>
<tr>
<td>Parking supply and management</td>
<td>Number of parking spaces per building unit or acre, and how parking is managed and priced.</td>
<td>Tends to reduce vehicle ownership and use, and increase the use of alternative modes. Cost-recovery pricing (users finance parking facilities) typically reduces automobile trips 10-30%.</td>
</tr>
<tr>
<td>Transportation prices</td>
<td>Vehicle, fuel, parking and road prices.</td>
<td>Vehicle travel tends to decline as prices increase. A 10% fuel price increase typically reduces vehicle travel 1% in the short-run and 3% over the long run. Cost recovery road tolls and parking fees typically reduce affected vehicle travel 10-30%.</td>
</tr>
<tr>
<td>TDM incentives</td>
<td>Policies and programs that encourage efficient travel.</td>
<td>Tends to reduce vehicle ownership and use, and increase use of alternative modes. Impacts vary depending on specific factors.</td>
</tr>
<tr>
<td>Convenience</td>
<td>Ease of obtaining information and using non-auto modes.</td>
<td>If non-auto modes are more convenient their use tends to increase and auto travel declines.</td>
</tr>
<tr>
<td>Perception</td>
<td>Social status of non-auto modes and urban locations.</td>
<td>Travellers may be more reluctant to use non-auto modes that are stigmatized or live in neighborhoods considered inferior.</td>
</tr>
</tbody>
</table>

This table describes various factors that can affect travel behavior.

People sometimes assume that vehicle travel reductions are only feasible in dense urban areas that have high quality public transit services, but many TDM and Smart Growth strategies are also effective in suburban and rural areas (Morton, Huegy, and Poros 2014).
The Changing Planning Paradigm

*New planning practices emphasize accessibility over mobility, resulting in less vehicle travel.*

Transportation planning is undergoing a paradigm shift, that is, a fundamental change in the way that transportation problems are defined and potential solutions are evaluated (Boarnet 2013; Litman 2013). The old paradigm evaluated transportation system performance based primarily on vehicle travel speed and distance. The new paradigm evaluates performance based on accessibility, the time and money required to access services and activities (Sundquist, McCahill and Brenneis 2021). The table below compares these different approaches.

**Table 3** Changing Transportation Planning Paradigm (Litman 2013)

<table>
<thead>
<tr>
<th>Definition of Transportation</th>
<th>Old Paradigm</th>
<th>New Paradigm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mobility (physical travel), mainly automobile travel.</td>
<td>Accessibility (people’s overall ability to reach services and activities).</td>
<td></td>
</tr>
<tr>
<td>Modes considered</td>
<td>Automobile travel is considered better due to its speed.</td>
<td>Multi-modal: Walking, cycling, public transport, automobile, telework and delivery services.</td>
</tr>
<tr>
<td>Objectives</td>
<td>Congestion reduction; roadway cost savings; vehicle cost savings; and reduced crash and emission rates per vehicle-kilometer.</td>
<td>Congestion reduction; affordability; accessibility for non-drivers; public fitness and health; energy conservation and emission reductions; and efficient land use (reduced sprawl).</td>
</tr>
<tr>
<td>Performance indicators</td>
<td>Vehicle traffic speeds, roadway Level-of-Service (LOS), distance-based crash and emission rates.</td>
<td>Quality of accessibility for various groups. Multi-modal LOS. Various economic, social and environmental impacts.</td>
</tr>
</tbody>
</table>

The old planning paradigm favored automobile-oriented transportation improvements. The new paradigm expands the range of objectives, impacts and options considered in a planning process.

This has important implications for planning. The old, automobile-oriented paradigm assumed that the planning goal is to maximize motor vehicle travel speed and distances, and that vehicle travel reductions are harmful. The new, paradigm recognizes that the ultimate planning goal is to maximize access, and that many factors affect accessibility including the speed and affordability of various modes, plus land use factors such as development density and mix. The new paradigm recognizes that it is possible to increase accessibility while reducing vehicle travel by improving non-auto modes and creating more compact communities. It also recognizes the reduction in accessibility that results from automobile dependency and sprawl.

The old planning paradigm evaluated transportation system performance based on roadway level of service (LOS) ratings, which rate traffic flow from A (best) to F (worst). This approach is criticized because it only considers automobile travel conditions, ignoring other travel modes and other accessibility factors. The new paradigm is more multimodal and recognizes additional accessibility factors such as development density and mix (SSTI 2018). To apply the new paradigm, many jurisdictions are shifting from trying to maximize LOS to minimizing VMT (vehicle miles travelled) (Lee and Handy 2018). Using this approach, proposed projects are approved if they reduce per capita vehicle-miles travelled, and rejected or mitigated if it increases vehicle travel (CAPCOA 2021). This supports multimodal planning and compact development, and rejects or mitigates projects that increase sprawl.
How Much Vehicle Travel is Optimal? What is Excessive?
The following economic principles can help determine the amount of vehicle travel that is optimal, and the portion that can be considered excessive.

1. Fair Share Planning
Basic fairness requires that travellers receive similar shares of public resources unless there are specific reasons to do otherwise. This suggests, for example, that communities should spend at least as much on sidewalks, crosswalks, paths and crossing guards to allow children to walk and bicycle to school as would be spent on roads and parking facilities to allow parents to chauffeur them. This suggests that non-auto modes’ share of funding should at least equal their share of trips or users; for example, if walking and bicycling have 15% mode share they receive at least 15% of transportation infrastructure funding. Currently, non-auto modes receive far less than their potential mode shares in most North American communities, as illustrated below.

Figure 6 Non-auto Spending Versus Demand (Litman 2022)

2. Consumer Sovereignty
Consumer sovereignty means that planning decisions respond to consumer demands. This suggests that demographic and economic trends are increasing demands for non-auto travel. Based on this principle, the optimal amount of vehicle travel is what travellers would choose if transportation planning responded to non-auto travel demands. Current demographic and economic trends – aging population, rising fuel prices, changing consumer preferences, increased health and environmental concern – are increasing non-auto demands. The COVID pandemic demonstrated that telecommunications and delivery services can substitute for many vehicle trips, studies suggest that e-bikes could substitute for 10-30% of local trips, and new navigation and payment apps can make non-auto travel more convenient.

Experience in many communities indicates that walking, bicycling and public transit travel increase and automobile travel declines if planning invests more in non-auto modes. Evidence described later in this report indicates that walking, bicycling and public transit travel is usually much higher and automobile travel lower in communities that make significant investments in non-auto modes. This indicates that more responsive planning is likely to reduce vehicle travel.
3. **Efficient ("Use Pays") Pricing**

Another basic principle is that, for efficiency and fairness sake, the prices that users pay should reflect the costs of producing goods unless there are specific reasons to do otherwise. This tests users’ willingness to pay and prevents unjustified subsidies. For example, if a vehicle trip imposes $2 in roadway costs and $3 parking facility costs, the transportation system becomes more efficient and equitable if motorists are charged tolls and fees of those amounts. This ensures that society does not spend $5 worth of resources on a trip that users value less, and prevents non-drivers from being forced to subsidize motorists. Trips that motorists take if driving is underpriced but not if they are charged for their costs, are economically inefficient; the trip’s costs exceed their benefits, making society worse off overall.

Automobile travel is currently significantly underpriced; North American motorists only pay directly about half of their roadway costs, only a small portion of their parking costs, and little for the congestion, risk and pollution costs they impose on others (Cui and Levinson 2018; ICF 2021; Litman 2009). In addition, some vehicle charges, such as insurance premiums, taxes and registration fees, are fixed, unrelated to the amount that a vehicle is driven, although the costs they represent do increase with annual mileage, resulting in cross-subsidies from motorists who drive less than average to those who drive more than average.

**Figure 7** Vehicle Costs

![Figure 7 Vehicle Costs](image)

- **About a quarter of vehicle costs are fixed** (purchase taxes, financing, insurance, registration fees), and about a quarter are external (road and parking costs not paid directly by users, congestion, crash risk and pollution damages imposed on other people). This price structure is inefficient and unfair; it forces people who drive less than average to cross-subsidize others who drive more than average.

- More efficient pricing would reduce automobile travel by 30-50%, consisting of lower-value trips worth less than the total costs they impose.

Efficient pricing could significantly reduce vehicle-travel. For example, cost recovery parking fees typically reduce driving by 10-30% compared with unpriced parking; U.S. fuel taxes would need to increase about 40¢ per gallon to fully pay for roadways, which would increase fuel prices about 10% and reduce long-run vehicle travel about 5%; a $50 per tonne carbon tax would add about 50¢ per gallon of gasoline, which would reduce driving about 6%; and distance-based vehicle insurance could reduce vehicle travel about 10% (Litman 2020). This suggests that efficient pricing would reduce vehicle travel 30-50% (Butner and Noll 2020; Litman 2014).
4. Comprehensive Analysis
A fourth principle is that planning analysis should consider all significant goals and impacts, and individual short-term decisions should support strategic, long-term goals. For example, when deciding between expanding a roadway or improving public transit service, the analysis should consider how they affect strategic goals such as increasing affordability, improving public health, and reducing pollution emissions, not just traffic speeds. Conventional planning often overlooks important goals and impacts, as listed below.

<table>
<thead>
<tr>
<th>Usually Considered</th>
<th>Often Overlooked</th>
</tr>
</thead>
<tbody>
<tr>
<td>Travel speeds and congestion delays</td>
<td>Affordability (savings to lower-income households)</td>
</tr>
<tr>
<td>Parking convenience</td>
<td>Independent mobility for non-drivers</td>
</tr>
<tr>
<td>Vehicle operating costs</td>
<td>Chauffeuring costs</td>
</tr>
<tr>
<td>Crash rates</td>
<td>Induced vehicle travel</td>
</tr>
<tr>
<td>Pollution emission</td>
<td>Public fitness and health</td>
</tr>
<tr>
<td></td>
<td>Barrier effects (traffic delay imposed on non-drivers)</td>
</tr>
<tr>
<td></td>
<td>Sprawl costs (infrastructure costs, habitat loss, etc.)</td>
</tr>
</tbody>
</table>

Conventional transportation project evaluation considers some impacts but often overlooks others.

Demographic and geographic factors affect optimal levels of vehicle travel. Affluent suburbs and rural areas can have higher automobile mode shares, but as incomes decline and densities increase planning should be more multimodal and favor affordable modes, as illustrated below.

In affluent rural areas and suburbs it may be appropriate to plan for high levels of automobile travel, but optimal auto mode shares decline as densities increase and incomes decline, and should be less than 30% in most urban neighborhoods. Conventional planning ignores these factors, resulting in more auto-oriented planning than is efficient and fair.

To the degree that planning overlooks strategic goals it tends to overinvest in automobile facilities and underinvests in affordable and resource-efficient modes than is optimal, resulting in excessive motor vehicle travel (Butner and Noll 2020; Shill 2019). This is particularly true in cities and lower-income communities, or in any community that places a high value on social equity and environmental protection.
Summary
The table below summarizes common planning biases that violate these economic principles, resulting in excessive motor vehicle travel.

<table>
<thead>
<tr>
<th>Type of Distortion</th>
<th>Effects</th>
<th>Reforms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elite bias. Policy makers and planners favor automobile travel and undervalue other modes.</td>
<td>Prioritizes automobile travel over other modes in policy, planning and investments.</td>
<td>Better analysis, guidance and tolls for multimodal planning. Include non-drivers in planning.</td>
</tr>
<tr>
<td>Undercounting non-auto travel (in surveys) and undervaluing non-auto travel demands.</td>
<td>Underinvests in non-auto modes relative to their demands (including latent demands) and potential benefits.</td>
<td>More comprehensive travel data, including latent demands. Recognize data biases.</td>
</tr>
<tr>
<td>Incomplete impact analysis. Little consideration of affordability, social equity, safety, public health, and environmental goals.</td>
<td>Favors automobiles over more affordable, inclusive and resource-efficient modes, and higher speed roadways over complete streets.</td>
<td>More comprehensive impact analysis, additional performance targets and more multimodal planning.</td>
</tr>
<tr>
<td>Mobility-based performance indicators (e.g., roadway level-of-service and travel time index).</td>
<td>Favors faster modes, higher roadway design speeds, and sprawl over compact development.</td>
<td>Consider other planning goals beside speed. Apply accessibility-based planning.</td>
</tr>
<tr>
<td>Overvaluing travel time savings. Valuing speed over other goals such as affordability, health and livability.</td>
<td>Favors faster modes and higher roadway design speeds over slower modes and complete streets.</td>
<td>Use realistic travel time values. Account for the costs higher traffic speeds.</td>
</tr>
<tr>
<td>Ignoring induced travel impacts. Overvalues road expansion benefits.</td>
<td>Overinvests in roadway expansions and underinvests in alternatives.</td>
<td>Account for induced vehicle traffic in planning analysis.</td>
</tr>
<tr>
<td>Dedicated road and parking funds, but not for other modes.</td>
<td>Favors automobile infrastructure over investments in other modes.</td>
<td>Least-cost transportation planning. Multimodal planning.</td>
</tr>
<tr>
<td>Automobile underpricing (unpriced roads, parking, risk, pollution, etc.)</td>
<td>Increases automobile travel and reduces non-auto travel demands.</td>
<td>More efficient pricing and more investments in non-auto modes.</td>
</tr>
<tr>
<td>Parking minimums. Local mandates for off-street parking.</td>
<td>Increases automobile ownership and use, degrades walking conditions, and encourages sprawled development.</td>
<td>Reduce or eliminate parking mandates. More efficient parking management.</td>
</tr>
<tr>
<td>Sprawl-oriented development policies. Density restrictions and parking minimums.</td>
<td>Creates dispersed communities that increase travel distances and provide poor non-auto access.</td>
<td>Smart Growth policies that create more compact, multimodal communities.</td>
</tr>
</tbody>
</table>

Many common policies and planning biases result in economically excessive vehicle travel.

In a survey of 2,157 UK adults, Walker, Tapp and Davis (2022) found biases in favor of automobile travel which they label “motonormativity.” For example, 75% of respondents agree that, "People shouldn't smoke in highly populated areas where other people have to breathe in the cigarette fumes" but only 17% agreed that “People shouldn't drive in highly populated areas where other people have to breathe in the car fumes.” This bias leads to automobile-oriented planning, social acceptance of illegal activities such as excessive vehicle noise, risky driving and ignoring parking rules, and automobile-oriented planning.
Although travellers sometimes benefit from biases favoring automobile travel, it imposes indirect costs that harm most people overall. For example, driving is often faster than bus travel but the resulting shift from transit to driving increase congestion reducing everyone’s speeds.

These impacts are cumulative and synergistic. For example, underpricing road space not only increases traffic congestion, it also increases parking costs and pollution emissions, while underpriced parking not only increases parking facility costs, it also increases traffic congestion and crashes. These planning distortions reinforce the cycle of increased automobile dependency, reduced travel options, increased sprawl, and increased total costs.

The table below summarizes the four planning principles, the reforms needed to apply them to transportation planning, and their impacts on travel activity. This can help determine the amount of vehicle travel that is truly optimal and therefore vehicle travel reduction targets.

**Table 6 Economic Principles for Optimizing Vehicle Travel**

<table>
<thead>
<tr>
<th>Principle</th>
<th>Description</th>
<th>Current Practices</th>
<th>Reforms Needed</th>
<th>Travel Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fair share planning</td>
<td>Each traveller should receive comparable shares of public resources.</td>
<td>In most communities motorists receive more public resources than non-auto mode users.</td>
<td>Invest in non-auto modes at least equal to their share of trips or travellers. More integrated planning.</td>
<td>Would significantly improve and increase non-auto travel and reduce auto travel.</td>
</tr>
<tr>
<td>Consumer sovereignty</td>
<td>Planning responds to latent and changing consumer demands.</td>
<td>Planning tends to undercount, undervalue and underinvest in non-auto travel.</td>
<td>Improved data on non-auto travel activity and demands. Planning that responds to non-auto demands.</td>
<td>Would significantly improve and increase non-auto travel, and reduce auto travel.</td>
</tr>
<tr>
<td>Efficient pricing</td>
<td>Users pay directly for facilities and external impacts such as congestion, crash and pollution damages.</td>
<td>Vehicle travel is significantly underpriced; most costs are fixed or external.</td>
<td>Cost-recovery road tolls and parking fees, plus charges for congestion, crash and pollution damages.</td>
<td>Would increase the price of driving, reducing vehicle travel, particularly under urban-peak conditions.</td>
</tr>
<tr>
<td>Strategic planning</td>
<td>Individual, short-term decisions should support strategic, long-term goals.</td>
<td>Current planning gives little consideration to many goals.</td>
<td>Considers affordability, mobility for non-drivers, equity, health and environmental goals.</td>
<td>Would increase support for affordable and resource-efficient modes.</td>
</tr>
</tbody>
</table>

These four principles can help guide planning decisions and determine optimal vehicle travel targets.

Fair share planning, consumer sovereignty and strategic planning all tend to justify more multimodal planning, TDM incentives and Smart Growth development policies to create compact, multimodal communities, and these become more successful with efficient transportation pricing. The optimal amount of vehicle travel is what people would choose if these reforms were fully implemented.

Implementing these reforms tends to significantly reduce per capita automobile travel, increase use of non-auto modes, and create more compact, multimodal communities. This suggests that the economically optimal level of vehicle travel is significantly lower than what currently exists,
particularly in North America. This justifies the establishment of vehicle travel reduction targets as a way to guide policy decisions to support travel optimization reforms.
Vehicle Travel Reduction Savings and Benefits
Well-planned vehicle travel reduction policies can provide various benefits to users and communities.

Consumer Savings and Affordability
Automobiles are expensive to own and operate. Residents of compact, multimodal communities save thousands of dollars annually compared with more automobile-oriented areas.

Figure 9 Household Transportation Expenses (CNT 2022)

Residents of compact, multimodal neighborhoods spend far less money on transportation (yellow in this map) than in automobile-dependent, urban fringe areas (red).

Improved Accessibility and Travel Time Savings
More compact, multimodal communities provide more independent mobility for non-drivers, and improve overall accessibility due to better travel options and shorter travel distances. As a result, residents spend less time travelling and have less chauffeuring responsibilities than in automobile-dependent, urban fringe areas, as illustrated below. Chauffeuring trips tend to be particularly inefficient because they often require empty backhauls, so transporting a passenger five miles generates ten vehicle-miles of travel and requires twice as much time.

Figure 10 Commute Duration (Mineta Institute Commute Duration Mapping System)

Average commute duration (minutes per commute) are much lower in central neighborhoods than in automobile-dependent, urban fringe areas.

This figure shows this effect in Nashville, Tennessee. Similar patterns are seen in most cities.
Infrastructure Savings
Reducing vehicle ownership and trips and more compact development can provide large savings to governments and businesses by reducing road and parking facility costs, and reducing the costs of providing water, sewage, emergency services and schools.

Other Savings and Benefits
Residents of more compact, multimodal communities tend to have better economic opportunities, lower crash rates, better fitness and health, and cause less environmental damage due to better access, less driving and more reliance on non-auto modes. The table below summarizes these impacts.

**Table 7** Typical Benefits of Vehicle Travel Reduction Policies *(Litman 2021)*

<table>
<thead>
<tr>
<th>Economic</th>
<th>Social</th>
<th>Environmental</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roadway savings.</td>
<td>Improved public health and safety.</td>
<td>Reduced traffic noise.</td>
</tr>
<tr>
<td>Parking facility savings.</td>
<td>Improved community livability.</td>
<td>Reduced pavement.</td>
</tr>
<tr>
<td>Reduced crash damages.</td>
<td></td>
<td>Habitat preservation.</td>
</tr>
</tbody>
</table>

Vehicle travel reduction policies tend to provide many benefits to individuals and communities.

Summary
The table below compares the planning objectives supported by three types of transportation improvements. While roadway expansions can reduce traffic congestion, and efficient and alternative fuel vehicles can conserve fuel and reduce pollution, both induce additional vehicle travel which can exacerbate other traffic problems, such as downstream congestion, road and parking facility costs, crashes, and sprawl-related costs. In contrast, by reducing total vehicle travel and creating more compact communities, TDM and Smart Growth policies help achieve virtually all objectives, and so can be considered win-win solutions.

**Table 8** Comparing Strategies *(Litman 2020)*

<table>
<thead>
<tr>
<th>Planning Objective</th>
<th>Roadway Expansion</th>
<th>Efficient/Alt. Fuel Vehicles</th>
<th>TDM and Smart Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor Vehicle Travel</td>
<td>Increased</td>
<td>Increased</td>
<td>Reduced</td>
</tr>
<tr>
<td>Congestion reduction</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Road and parking cost savings</td>
<td>×</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Consumer savings and affordability</td>
<td></td>
<td>Mixed</td>
<td>✓</td>
</tr>
<tr>
<td>Independent mobility for non-drivers</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Traffic safety</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Energy conservation</td>
<td>Mixed</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Pollution reduction</td>
<td>×</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Physical fitness &amp; health</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Sprawl-related costs</td>
<td>×</td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>

(✓ = Achieve objectives. × = Contradicts objective.) Roadway expansions and more fuel efficient vehicles provide a limited range of benefits, and by increasing total vehicle travel they can exacerbate other problems such as congestion, accidents and sprawl. Vehicle travel reduction strategies help achieve many planning objectives and so tend to be cost effective, considering all impacts.
Vehicle Travel Reduction Strategies

Various strategies have proven to be effective at increasing transportation system efficiency and reducing vehicle travel (TfA and SGA 2020; TTI 2022). Table 1 lists examples.

### Table 9  Vehicle Travel Reduction Strategies (ICAT 2020; ITF 2022; VTPI 2020)

<table>
<thead>
<tr>
<th>Improved Options</th>
<th>TDM Incentives</th>
<th>Smart Growth Policies</th>
<th>Programs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transit improvements</td>
<td>Road space reallocation</td>
<td>Complete streets</td>
<td>Commute trip reduction programs</td>
</tr>
<tr>
<td>Walking and cycling improvements</td>
<td>Congestion pricing</td>
<td>Smart growth/New urbanism</td>
<td>School and campus transport management</td>
</tr>
<tr>
<td>Rideshare programs</td>
<td>Distance-based fees</td>
<td>Transit oriented development</td>
<td>Freight transport management</td>
</tr>
<tr>
<td>Flextime</td>
<td>Parking cash out</td>
<td>Parking management</td>
<td></td>
</tr>
<tr>
<td>Telework</td>
<td>Parking pricing</td>
<td>VMT developer fees</td>
<td>Garbage management</td>
</tr>
<tr>
<td>Carsharing</td>
<td>Fuel or carbon tax increases</td>
<td>Car-free planning</td>
<td>TDM marketing</td>
</tr>
</tbody>
</table>

Various strategies can help reduce vehicle travel. These tend to have synergistic effects, so the most effective programs include a combination of positive and negative incentives to reduce driving.

Some jurisdictions now evaluate road project travel impacts and change those that increase VMT (Bellis 2021; DeGood and Zonta 2022). California’s Vehicle Miles Traveled-Focused Transportation Impact Study Guide (Caltrans 2020). GreenTRIP Connect (connect.greentrip.org) calculates how smart location and TDM strategies can reduce driving, parking facility costs and emissions in residential developments. The Brookings Institute’s Building for Proximity: The Role of Activity Centers in Reducing Total Miles Traveled (Tomer and George 2023) indicates how per capita VMT varies by U.S. location. The Cool Climate Network (coolclimate.berkeley.edu) produces interactive heat maps showing where infill development can reduce household emissions. The San Francisco TDM Tool (www.sftdmtool.org), provide guidance for predicting vehicle travel impacts and how to achieve VMT reduction targets. This analysis recognizes that roadway expansions tend to induce more vehicle travel. Many proposed road building projects have been halted or revised to avoid increasing traffic and emissions (Morris 2023).

Vehicle travel reduction programs tend to be most effective if implemented as an integrated program that includes both positive and negative incentives (STTI 2018). Various examples described later in this report indicate that cost-effective programs can typically reduce affected vehicle travel by 5-15% if they only include positive incentives (improved travel options and encouragement campaigns); 10-30% if they include financial incentives (road tolls, parking fees, and distance-based vehicle insurance pricing), and 20-60% if they also include Smart Growth development policies (compact, multimodal neighborhoods with reduced parking supply).

Some cities have achieved significant traffic reductions. In Paris, bicycle mode share increased tenfold, public transit travel increased 30%, and automobile mode share declined about 45% by implementing policies that prioritize pedestrians, bicyclists and transit, reducing motorists’ access to major streets, expanding green areas, and promoting non-auto travel (Yeung 2022). In Washington State’s Puget Sound region, an integrated program that includes significant improvements to non-auto modes, commute trip reduction requirements, and development policies that create more compact, multimodal communities significantly increased walking, bicycling and public transit, and reduced per capita vehicle travel about 5%, and central city automobile commute mode shares by a quarter (PSRC 2019; SDOT 2020).
The table below summarizes the impact of various vehicle travel reduction strategies. They tend to become more effective and cost effective if implemented as an integrated program.

**Table 10  Travel Reduction Strategies** *(CARB 2015, Kuss & Nicholas 2022, VTPI 2020)*

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Description</th>
<th>Typical Travel Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Efficient parking pricing and management</strong></td>
<td>Charge cost-recovery parking fees with rates that vary by demand. Cash out and unbundle parking. Eliminate parking mandates.</td>
<td>5-15% reduction in vehicle ownership and 10-30% reduction in affected vehicle trips.</td>
</tr>
<tr>
<td><strong>Active and micro modes (walking, bicycling, e-bikes and variants)</strong></td>
<td>Improve walking and bicycling conditions, and encourage use of these modes. Create more compact, walkable neighborhoods.</td>
<td>Infrastructure improvements increase active and micro mode travel 50-100% and reduce driving 5-15%. Compact, walkable communities reduce driving 20-40%.</td>
</tr>
<tr>
<td><strong>High quality public transit</strong></td>
<td>Frequent, fast, convenient, comfortable transit services. Amenities such as free wifi, and improved payment systems.</td>
<td>Service improvements increase affected transit travel 20-50%, and reduce auto travel 5-15%, and sometimes more.</td>
</tr>
<tr>
<td><strong>Smart Growth, New Urbanism, Transit-oriented development</strong></td>
<td>Develop compact, mixed-use neighborhoods around high quality public transit.</td>
<td>Residents tend to walk, bike and use public transit 20-100% more, and drive 20-60% fewer annual miles.</td>
</tr>
<tr>
<td><strong>Commute, school and campus transport management programs</strong></td>
<td>Improve non-auto travel options and encourage their use with financial incentives (parking pricing and cash out).</td>
<td>Programs that only use persuasion reduce driving 5-15%, those that provide financial incentives reduce auto trips 10-30%.</td>
</tr>
<tr>
<td><strong>Roadway redesigns to favor sustainable modes</strong></td>
<td>Improve sidewalks, add bike- and bus lanes, and reduce traffic speeds. Apply complete streets policies</td>
<td>Non-auto travel typically increases 20-100%, and auto travel declines 10-30%. Reducing traffic speeds reduces VMT.</td>
</tr>
<tr>
<td><strong>Efficient road pricing</strong></td>
<td>Motorists pay cost-recovery tolls on urban highways and fees to enter city centers</td>
<td>10-30% reduction in affected road traffic volumes.</td>
</tr>
<tr>
<td><strong>Distance-based pricing</strong></td>
<td>Vehicle insurance and registration fees are prorated by average annual mileage.</td>
<td>Up to 15% if total insurance premiums and registration fees are prorated.</td>
</tr>
<tr>
<td><strong>Vehicle sharing</strong></td>
<td>Provide car- and bikesharing services in urban neighborhoods.</td>
<td>12-15 private cars replaced by each shared car.</td>
</tr>
<tr>
<td><strong>Freight transport management</strong></td>
<td>Require or encourage shippers to use efficient vehicles and logistics.</td>
<td>Can reduce freight vehicle travel and emissions 10-30%.</td>
</tr>
<tr>
<td><strong>Limited traffic zone</strong></td>
<td>Limit vehicle trips to central city areas.</td>
<td>10-20% reduction in city-centre cars.</td>
</tr>
<tr>
<td><strong>Personalized travel planning</strong></td>
<td>Residents encouraged to use non-auto modes. Transit fare discounts.</td>
<td>6-12% reduction in car use by participants.</td>
</tr>
<tr>
<td><strong>Sustainable mobility apps</strong></td>
<td>Mobile apps provide user information, payments and rewards for reduced driving.</td>
<td>73% of app users reduce their vehicle travel.</td>
</tr>
</tbody>
</table>

*Vehicle travel reduction strategies can significantly increase non-auto travel and reduce driving. Impacts vary depending on design and conditions. These strategies tend to have synergistic effects: they become more effective if implemented as an integrated program that includes a combination of resource-efficient mode improvements, automobile travel disincentives (efficient road, parking and vehicle insurance pricing in particular), and development policy reforms to create more compact, multimodal neighborhoods.*
Evaluating Criticisms

This section evaluates various criticisms of vehicle travel reduction targets and programs.

Harms Motorists

Critics argue that vehicle travel reduction policies are “social engineering” and a “war on cars” that arbitrarily deprive motorists of desired mobility and reduce their freedom (Fix 2017; Greenhut 2019). On the other hand, current policies that favor automobile travel over other modes and encourage sprawl can be considered social engineering that reduces non-drivers’ freedom. For example, wider roads with higher traffic speeds degrade walking and bicycling conditions, underinvestment in non-auto modes leave non-drivers with limited mobility, and parking mandates force non-drivers to pay for costly parking facilities they don’t need, reducing their housing affordability. As Professor Mark Hallenbeck explains, “All transportation planning is social engineering. We’ve spent 100 years making it easy to drive. We’ve spent 100 years making it really hard to [walk, bicycle or] take a bus. So people drive, because it makes sense.”

Vehicle travel reduction programs include both positive and negative incentives, as summarized below. Positive incentives that directly benefit users are more numerous, and even negative incentives benefit motorists by reducing their congestion and crash risk. It is therefore inaccurate to claim that vehicle travel reduction programs harm motorists overall; their impacts are variable and mixed, and most travellers benefit overall, considering all impacts.

<table>
<thead>
<tr>
<th>Positive Incentives</th>
<th>Mixed</th>
<th>Negative Incentives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public transit improvements</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walking and bicycling improvements</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rideshare and carshare programs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flextime and telework</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pay-As-You-Drive pricing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parking cash out and unbundling</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smart growth</td>
<td></td>
<td></td>
</tr>
<tr>
<td>New urbanism</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parking management</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transit oriented development</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Car-free planning</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Traffic calming</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Road tolls</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parking pricing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fuel tax increases</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vehicle travel restrictions</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Many VMT reduction strategies provide positive incentives, and even negative incentives, such as road tolls and parking fees, can benefit most travellers overall by reducing their congestion and crash risks.

Unfair to Motorists

Critics argue that it is unfair to use road user revenues, such as fuel taxes and road tolls, to finance non-auto modes, which they call these diversions (Feigenbaum and Hillman 2020). However, if it is unfair for motorists to fund non-auto infrastructure it is more unfair for non-drivers to fund public roads and government-mandated parking facilities, since those subsidies are larger, and since automobile travel increases with income, tend to be regressive (Litman 2022). One public opinion survey found that most Oregon voters favor redirecting a portion of fuel tax funding to vehicle travel reduction programs, such as public transit and affordable housing near transit (Quirke 2018). The OECD report, Distributional Effects of Urban Transport Policies to Discourage Car Use (Lindsey, Tikoudis and Hassett 2023) investigates the social equity impacts of vehicle travel reduction policies such as cordon tolls, distance-based charges, fuel taxes, parking measures and public transport subsidies. It evaluates their distributional effects and discusses ways to design such policies to support more equitable outcomes.
All Travel Imposes External Costs and is Subsidized

Critics argue that all travel imposes external costs so it is unfair to focus only on motorists, and public transit receives larger subsidies than automobile travel (O’Toole 2019), but their analysis is faulty (Litman 2018; Walker 2016). Critics only consider a limited set of costs, and measure them per mile which ignores motorists’ much higher annual mileage. Walking and bicycling require low cost facilities and impose minimal wear, congestion, crash or pollution costs. Transit has higher external costs but operates in dense urban areas where automobile use imposes high external costs, so transit costs are generally lower. Studies that compare these impacts find that automobile travel imposes higher costs per mile than other modes, and since motorists travel high annual miles their per capita costs and subsidies are generally much higher than non-drivers (Gössling, et al. 2018; Litman 2009; Schröder, et al. 2022).

Harms the Economy

Critics sometimes argue that because most economic activities involve motor vehicle travel, vehicle travel reductions reduce economic productivity (Pozdena 2009). That is generally untrue. Of course, motor vehicle travel supports goods delivery, commuting and access to goods and services, but it also imposes significant economic costs. Policies that reduce the vehicle travel required to serve these needs reduce costs and increase economic efficiency. For example, TDM strategies that reduce traffic congestion allow commercial vehicles to make more deliveries per day, increasing their productivity. More efficient parking management which reduces the number of parking spaces that a building needs can increase development productivity. Walking, bicycling and public transit improvements can increase the number of workers and customers that can access businesses, often at lower costs than would be required for automobile access (Wu, et al. 2021). Businesses tend to be more productive if located in compact, multimodal areas where less vehicle travel is needed to deliver goods or attract employees and customers; what economists call agglomeration efficiencies (Melo, Graham and Noland 2009).

Recent studies find that the relationship between mobility and productivity is strong among lower-income economies, so increased motor vehicle travel can increase economic productivity, but these effects decline and eventually become negative at high levels, as external costs and inefficiencies increase (Ecola and Wach 2012; Kooshian and Winkelman 2011; McMullen and Eckstein 2011). During the Twentieth Century, vehicle travel and gross domestic product (GDP) grew together, but decoupled after 1995, as illustrated below.

Figure 11 Per Capita GDP Versus VMT (DOE 2021)

Vehicle travel and economic productivity decoupled: since 2000 productivity increased about 40% while total vehicle travel increased less than 5% less than population growth. This and other research indicate that modern economies require less mobility to produce goods and services, in part because of new technologies that substitute for physical travel.
Within developed countries there tends to be a negative relationship between vehicle travel and economic productivity (Kooshian 2011; Zheng, et al. 2011). This makes sense, since once travellers satisfy their most valuable trips, the marginal benefits of additional travel decline, while economic costs (vehicle expenses, infrastructure costs, congestion, crashes and pollution damages, etc.) increase. As a result, an increase from low to moderate levels of per capita VMT is likely to increase productivity, but an increase from moderate to high levels is likely to have negative net benefits (it’s costs exceed its benefits) and reduces productivity overall.

The following figure shows this negative relationship among U.S. states.

**Figure 12** Per Capita GDP and VMT for U.S. States *(FHWA 2019)*

Per capita economic productivity tends to increase as vehicle travel declines. (Each dot is a U.S. state.)

This suggests that more compact and multimodal urban regions tend to be more economically productive than sprawled, automobile dependent regions.

**Reduces Travel Efficiency and Freedom**

Critics argue that automobile travel is more efficient and provides more independence and freedom than other modes, citing examples of trips that would be much slower by walking, bicycling or public transit. However, the fact that some trips are most efficient by automobile does not mean that this is true of all trips and that vehicle travel cannot be efficiently reduced. Some of the perceived efficiency of automobile travel is an illusion. For example, much of the time savings provided by faster automobile travel is offset by the additional working hours required to own and operate a vehicle. When measured as effective speed (defined as travel distance divided by time spent travelling plus time spent earning money to pay travel expenses), non-auto travel is often faster than driving, particularly for lower-income workers (Tranter 2010). Automobile dependency and sprawl increase traffic congestion, chauffeuring burdens and the distances between destinations, resulting in residents spending more total time travelling.

Automobiles can increase some freedoms, allowing motorists to travel to any destination at any time, but by reducing non-auto travel options and increasing sprawl, automobile-oriented planning reduces non-drivers’ independence, increases drivers’ chauffeuring burdens, and by increasing road and parking facility costs, it reduces everybody’s financial freedom.
Table 11  Auto Travel Impacts on Freedom

<table>
<thead>
<tr>
<th>Freedoms Increased</th>
<th>Freedoms Reduced</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Independent travel by non-drivers.</td>
</tr>
<tr>
<td></td>
<td>• Drivers’ freedom from chauffeuring burdens</td>
</tr>
<tr>
<td></td>
<td>• Motorists’ financial freedom.</td>
</tr>
<tr>
<td></td>
<td>• Non-drivers’ financial freedom.</td>
</tr>
</tbody>
</table>

Automobile travel increases motorists’ freedom of movement, and reduces other types of freedom.

Not Cost Effective

Critics argue that reducing vehicle travel is a difficult and inefficient way to achieve specific goals such as reducing pollution emissions (Poole 2009). This might be true if emission reductions were the only benefit, but vehicle travel reduction strategies generally provide large co-benefits and so tend to be very cost effective considering all impacts (Alarfaj, Griffin and Samaras 2021).

Although electric and hydrogen vehicles are often called “zero emissions,” they actually produce significant emissions during vehicle, energy and infrastructure production. Hybrids typically reduce lifecycle emissions by a third and electric cars by two-thirds compared with comparable fossil fuel vehicles. Recent studies conclude that vehicle travel reductions are needed to achieve emission reduction targets (Manjoo 2021; McCahill 2021; Vaughan 2019). For example, “Electrification of Light-Duty Vehicle Fleet Alone Will Not Meet Mitigation Targets,” (Milovanoff, Posen and MacLean 2020) concludes that fleet electrification is an inefficient way to achieve emission reductions due to slow fleet turnover and their various external costs.

Some studies compare the cost-efficiency of various emission reduction strategies, including Environmental Defense’s Marginal Abatement Cost Curves for U.S. Net-Zero Energy Systems (Farbes, Haley and Jones 2021) and The Economics of Climate Change: A Primer (Hatzius, et al. 2020). They generally find that, considering all benefits and costs, clean vehicle emission reductions are relatively expensive, usually costing more than $50 per tonne and often much more (NCE 2015). In contrast, vehicle travel reduction strategies often have negative costs; their total benefits are greater than their total costs. The figure below shows results from one study.

Figure 13  Emission Abatement Cost Curve (Liimatainen, Pöllänen and Viri 2018)

This study concluded that vehicle travel reduction strategies, such as car- and ride-sharing incentives and more compact urban form, have negative costs (they provide net savings) due to their large co-benefits, while alternative fuels and alternative energy and more energy efficient cars tend to have relatively high costs, over 100€ per tonne.
Harms Disadvantaged Groups
Critics sometimes argue that because some people with disabilities and low incomes use motor vehicles, vehicle travel reduction policies must harm them. However, this is generally untrue. Most vehicle travel reduction strategies tend to benefit disadvantaged groups overall, and programs can be designed to support specific equity goals.

The table below summarizes these effects. Most vehicle travel reduction strategies directly benefit disadvantaged non-drivers by improving affordable travel options, creating more accessible communities, and reducing the external costs they bear. For example, parking unbundling (renting parking separately from housing) typically reduces apartment rents by $100 to $300 per month. Low income drivers can be harmed directly by higher fuel taxes, fees and tolls, but their ultimate impacts depend on how revenues are used; if invested in affordable modes or used to reduce regressive taxes, low-income drivers can benefit overall. Higher income motorists benefit from parking fees and road tolls that reduce their congestion.

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Non-drivers</th>
<th>Low-Income Drivers</th>
<th>High-Income Drivers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transit and ridesharing improvements</td>
<td>Flextime and telework</td>
<td>Parking cash out</td>
<td>Flextime and telework</td>
</tr>
<tr>
<td>Active and micro mode improvements</td>
<td></td>
<td></td>
<td>Parking management</td>
</tr>
<tr>
<td>Flextime and telework</td>
<td></td>
<td></td>
<td>Parking fees</td>
</tr>
<tr>
<td>Smart Growth and complete streets</td>
<td></td>
<td></td>
<td>Parking fees</td>
</tr>
<tr>
<td>Parking unbundling &amp; cash out</td>
<td></td>
<td></td>
<td>Road space reallocation</td>
</tr>
<tr>
<td>Road tolls and fuel taxes</td>
<td></td>
<td></td>
<td>Road tolls &amp; congestion pricing</td>
</tr>
<tr>
<td>Reduced travel as a vehicle passenger</td>
<td>Fuel or carbon tax increases*</td>
<td>Road tolls *</td>
<td>Road space reallocation</td>
</tr>
<tr>
<td></td>
<td>Parking fees*</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Road space reallocation</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Most vehicle travel reduction strategies directly benefit non-drivers by improving non-auto modes, creating more accessible communities, and reducing roadway subsidy costs. Low income drivers are harmed directly by higher prices but their ultimate impacts depend on how revenues are used (indicated by *). Higher income motorists benefit from road tolls and parking fees that reduce their congestion.

Critics claim that disadvantaged workers can earn more if they have an automobile (Pisarski 2009), but that is often untrue. Smart and Klein (2015) found that the higher costs of automobile commuting exceed their additional income, making them financially worse off overall. In addition, automobile travel increases crash risk and reduces physical fitness, and imposes external costs on disadvantaged communities (Lens 2021). Improving non-auto modes increases low-income worker incomes and benefits all income groups (CTS 2010; Gao and Johnston 2009). Studies indicate that transportation pricing reforms tend to benefit disadvantaged groups overall since few drive under congested conditions and they bear many external costs (Manville and Goldman 2018). Parking cash out and parking unbundling are particularly progressive since they can provide large financial benefits to non-drivers.

This indicates that although some disadvantaged people benefit from pro-automobile policies, they generally benefit much more from vehicle travel reduction strategies that improve affordable modes, provide financial savings to non-drivers, create more compact neighborhoods, and reduce external costs (Alexander, Alfonzo and Lee 2021).
Bikeway Inefficiencies and Inequities
Critics argue that bikeways are expensive, unnecessary and underused, and therefore wasteful and unfair, particularly if they displace traffic and parking lanes. Bikeway programs often seem expensive because they require new public funding, in contrast to roads that have dedicated funds, and parking facilities that are mandated but not funded by governments. However, their per capita annual costs are generally small compared with roadway and parking expenditures.

Critics generally cite the low bicycle mode share values from commute surveys and ignore the higher values reported in comprehensive surveys. Although bikeways may initially have low traffic, their use usually increases as networks expand and bicycling becomes more common. Most communities that develop comprehensive, high quality bike networks experience large increases in bicycling and reductions in car trips (Buehler 2016; Yang, et al. 2021).

Although bikeways often displace vehicle parking, this loss is generally more than offset by improved bicycle access and reduced automobile trips. For example, if a bikelane displaces 100 parking spaces but causes 101 commuters to bicycle rather than drive, it increases parking supply overall. Shifts from driving to bicycling also tend to create more attractive shopping streets by reducing traffic noise and air pollution. Recent studies using objective data find that local commercial activity tends to increase after bikeways are constructed, indicating that economic benefits exceed their costs (Arancibia, et al. 2019).

Critics argue that bikeway investments are unfair to motorists who pay fuel taxes, but this is inaccurate. Fuel taxes only finance about half of total roadway costs, the remainder is financed by general taxes that people pay regardless of how they travel, and most bikeways are built on local streets that are funded primarily by local taxes. Bicycle facilities have relatively low costs per trip, and bicycling imposes lower external costs. As a result, people who drive less than average tend to cross-subsidize the infrastructure costs of those who drive more than average (Litman 2022). As a result, bikeway investments ensure that bicyclists receive their fair share of transportation funding and road space.

Maximizing Efficiency and Equity
Some vehicle travel reduction strategies can be inefficient and unfair. For example, strategies that simply prohibit driving at certain times or locations, such as “no drive days,” may prevent some high value trips and fail to reduce low-value trips. It may be inefficient to spend a lot of money on alternative modes (walking and cycling facilities, public transit service improvements, etc.) without sufficient incentives to encourage their use. Vehicle travel reduction targets may be nothing more than aspirations. It is important that these targets lead to positive and rational change. To be effective, vehicle travel reduction programs require public support.

This suggests that most legitimate criticisms reflect poor planning and implementation of specific projects rather than a fundamental failure of the concept. To be effective, vehicle travel reduction programs should involve an integrated set of policies that reflect basic economic principles: consumer sovereignty, efficient pricing and strategic planning, with comprehensive analysis of impacts, and community involvement to build support. However, if first-best strategies are infeasible (for example, if it is impossible to price urban highways efficiently), second-best strategies (such as driving restrictions or increased parking fees) may be justified.
Examples

Below are examples of successful vehicle travel reduction programs. For more information see “TDM Success Stories: Examples of Effective Transportation Demand Management Policies and Programs, and Keys to Their Success” ([www.vtpi.org/tdmss.pdf](http://www.vtpi.org/tdmss.pdf)).

Active Transportation Improvements

Many studies find that appropriate improvements significantly increase walking and bicycling activity (CPSTF 2017). For example, after the Federal Highway Administration’s four-year Nonmotorized Transportation Pilot Program invested about $100 per capita in pedestrian and bicycling improvements in four typical communities (Columbia, MO; Marin County, CA; Minneapolis area, MN; and Sheboygan County, WI), walking trips increased 23%, bicycling trips increased 48%, and automobile travel declined 3% (FHWA 2014).

A recent U.S. study found that a 10% increase in per capita bikeway-miles increases bicycle commute mode shares 2.5%, and a 10% increase in protected bicycle lanes increases bicycle mode shares 4% (Yang, et al. 2021). Cities with extensive active mode networks, such has Davis, California; Eugene, Oregon; and Boulder, Colorado have more than 15% active commute mode shares, five times the national average, plus under 20 daily vehicle miles travelled per capita, 20% less than the national average (Buehler 2016).

TDM Program Effectiveness

The article, Don’t Underestimate Your Property: Forecasting Trips and Managing Density over the Long Term (Galdes and Schor 2022) summarizes experience with TDM programs in suburban Fairfax County, particularly Tyson’s Corner. It found that residential and commercial developments that had comprehensive but cost-effective TDM programs actually generate 49% fewer trips than predicted by ITE trip generation models. This reduces parking and roadway costs, and allows more development to occur on available land. As one traffic engineer explained,

> “Underestimating trip generation can have deleterious effects on a neighborhood because trip generation is so closely linked to the amount of square footage that a property is allowed. More than any other feature of a development, vehicle trip generation estimates determine density limits and impacts.” (Mike Workosky, traffic engineer and President of Wells + Associates)

Similarly, a detailed study, Travel Demand Management: An Analysis of the Effectiveness of TDM Plans in Reducing Traffic and Parking (Spack and Finkelstein 2014) measured trip generation at various office buildings in the Minneapolis-St. Paul metropolitan region. It found that, compared with Institute of Transportation Engineers’ average trip generation rates, office buildings that implemented TDM Plans generate, on average, 34% to 37% less traffic and need 17% to 24% fewer on-site parking spaces.

Regional Vehicle Travel Reduction Programs

Some North American urban regions have implemented integrated vehicle travel reduction programs that significantly reduce per capita vehicle travel. For example, during the last two decades the city of Portland shifted highway expansion funding to improve regional bus and rail transit services, implemented TDM programs, reformed its parking policies, and implemented Smart Growth policies that encourage more compact development. As a result, per capita vehicle travel declined in that region while it increased nationally, resulting in average per capita vehicle travel nearly 30% lower than the U.S. average, as illustrated in the following graph.
Figure 14  Portland, Oregon Travel Trends  (Metro 2021)

Portland, Oregon’s integrated TDM and Smart Growth policies reduced average vehicle travel in both the city and its urban region (which includes the Vancouver, Washington suburb), while driving increased elsewhere in the U.S.

Similarly, analysis described in, “Sustainable Transportation Infrastructure Investments and Mode Share Changes: A 20-Year Background of Boulder, Colorado,” (Henao, et al. 2015) shows that after the city increased non-auto mode investments, use of those modes increased and automobile mode share declined, as illustrated below.

Figure 15  Non-Auto Funding and Mode Share, Boulder (Henao, et al. 2015)

After Boulder increased non-auto investments to about $100 annual per capita (left) their mode shares increased to about a third of all trips and single occupant vehicle (SOV) shares declined about 17%.

California SB 743
California has targets and plans to achieve carbon neutrality by 2045, in part by reducing per capita light-duty vehicle travel 25% by 2030 and 30% by 2045. To achieve these targets California law requires that transportation projects be evaluated based on their vehicle travel impacts (Lee and Handy 2018). The California State Transportation Agency (CalSTA 2021) and the Northern California Institute of Transportation Engineers (ITE SB 743 Task Force 2021) developed guidelines for applying these policies to transportation planning decisions. These practices reflect a shift from mobility-based to accessibility-based planning (STTI 2018).
Campus Transportation Management Programs
Many colleges and universities are implementing transportation demand management programs in order to reduce traffic and parking problems, increase affordability and better serve students, staff and visitors. These typically include active and public transit service improvements, u-pass (the campus purchases highly-discounted transit service for all students), efficient parking pricing, bike- and car-sharing, and more accessible campus design. These typically reduce automobile trips to campus by 20-50%.

For example, Stanford University implemented its comprehensive TDM program in an agreement with the local government to eliminate the requirement for traffic impact studies and mitigation for campus development (more classrooms, laboratories, research institutes and housing) provided there is no net increase in total vehicle trips. As a result drive alone rates declined from 72% to 46% for staff, and just 39% for total commuters, including students, drive. This allowed construction of millions of square feet of additional building space that accommodate more students and staff without expanding roads and parking facilities.

Scottish Planning Rules (BBC 2023)
Scotland established new planning rules intended to support “transformational reduction in private car use” by creating “20-minute neighbourhoods” where all services are within walking or bicycling distance, improving public transit services, and reducing out-of-town shopping malls and drive-throughs. This will help achieve national targets to reduce car trips 20% by 2023.

Rural Community Multimodal Planning (Lynott 2014)
Some rural communities are implementing multimodal planning to improve affordable and healthy travel options and help reduce vehicle-travel. For example, Washington State’s Rural Mobility Grant Program and a Travel Washington Intercity Bus Program supports public transit services in rural counties. As a result, it is possible to travel around the Olympic Peninsula using the Olympic Transit Loop, which consists of six coordinated local public transit agencies.

European Sustainable Urban Mobility Plans (Elitis 2021 and EU 2021)
The European Union’s new Urban Mobility Framework requires municipal governments to develop Sustainable Urban Mobility Plans (SUMPs) by 2025 (EU 2021). This is intended to help solve air pollution, congestion, accessibility, traffic safety, growth of e-commerce, and other urban mobility challenges. SUMPs are multifaceted and tailored to each region’s unique needs and abilities. They typically include a combination of active and public transport improvements, roadway and parking design changes, efficient road and parking pricing, development policy reforms, regulatory reforms, improved data collection and program evaluation, and targetted mobility management programs to improve both personal and freight transport efficiency.

To support these plans the European Union sponsors the Urban Mobility Observatory, managed by Elitis, a network of research organizations that provides extensive, practical guidance on SUMP development (Elitis 2021). These resources include the Planner’s Guide to Sustainable Urban Mobility Management (SUMP) a Toolbox for Mobility Management, and the Elitis Case Study Database which describes in detail numerous, diverse examples from the European Local Transport Information Service. Elitis also provides tailored training on all aspects of the SUMP process and its implementation, improved data collection and evaluation tools, and financial support for implementing and testing innovation.
Conclusions
Automobile travel grew during the Twentieth Century, which justified automobile-oriented planning. Many planning practices established during that period favored driving over other modes and sprawl over compact, multimodal development. This created a self-fulfilling prophecy of more driving and more automobile-oriented planning. The results harm non-drivers directly; harm drivers indirectly by increasing congestion, crash risk and chauffeuring burdens; and increase various costs to consumers, businesses and governments. If resources are invested instead in other modes and communities are designed for multimodal access, people drive significantly less. Good planning therefore starts with a clear vision of desired outcomes in order to guide short-term planning decisions.

Per capita vehicle travel has peaked and current trends are increasing non-auto travel demands. New technologies and services, such as telework, delivery services and e-bikes, can substitute for automobile travel. Everybody can benefit from planning that responds to these new demands. This creates a more diverse and efficient transportation system which encourages travellers to use the best option for each trip: walking and bicycling to local destinations, public transit on busy corridors, and automobiles when they are truly most cost effective considering all impacts. This is therefore a good time to reassess planning practices to ensure that they are heading in the right direction, so our future transportation system will serve our future needs.

Many decisions affect the amount that people drive. Some are by individuals and others are by communities, some are short-term and others are long-term. The table below summarizes these. Comprehensive vehicle travel reduction plans help coordinate all of these decisions.

<table>
<thead>
<tr>
<th>Table 13</th>
<th>Vehicle Travel Reduction Decisions</th>
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<tbody>
<tr>
<td></td>
<td><strong>Short Term (&lt; 1 year)</strong></td>
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<tr>
<td><strong>Individual</strong></td>
<td></td>
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<tr>
<td>Choose non-auto modes.</td>
<td>Encourage employers to support telework and CTR programs.</td>
</tr>
<tr>
<td>Telework instead of physical travel.</td>
<td>Improve personal telecommunications services.</td>
</tr>
<tr>
<td>Choose local services.</td>
<td>Purchase a bike or e-bike.</td>
</tr>
<tr>
<td>Choose closer holiday destinations.</td>
<td>Reduce car ownership.</td>
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<tr>
<td><strong>Community</strong></td>
<td></td>
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<tr>
<td>Develop vehicle sharing and Mobility as a Service.</td>
<td>Develop bus rapid transit.</td>
</tr>
<tr>
<td>Implement commute trip reduction programs.</td>
<td>Establish VMT reduction targets.</td>
</tr>
<tr>
<td>Efficient parking pricing.</td>
<td>Develop parking and transport management programs</td>
</tr>
</tbody>
</table>

There are many possible ways to reduce vehicle travel. Their impacts tend to increase over time.

Although many of these decisions only affect a small portion of total trips, their cumulative effects can be large. A person can typically reduce driving 5-15% over the short term by choosing non-auto modes and closer destinations when feasible, and 10-30% over the long run by reducing their vehicle ownership and relying on carsharing, purchasing a utilitarian bike or e-bike, and choosing a home in a walkable neighborhood. A community can approximately double these reductions by applying more multimodal planning, providing TDM incentives, and implementing Smart Growth policies that create more compact, multimodal communities.
Many jurisdictions are establishing targets to reduce vehicle-miles and increase non-auto travel, and planning reforms to help achieve them. There are several justifications for such policies. The table below summarizes four principles that can help determine the optimal amount of vehicle travel and guide planning decisions. Many current policies violate these principles, resulting in economically excessive driving; vehicle travel with costs that exceed benefits.

**Table 14  Economic Principles for Optimizing Vehicle Travel**

<table>
<thead>
<tr>
<th>Principle</th>
<th>Description</th>
<th>Travel Impacts</th>
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</thead>
<tbody>
<tr>
<td>Fair share planning</td>
<td>Each traveller should receive comparable shares of public resources.</td>
<td>Would significantly improve and increase non-auto travel, and reduce auto travel.</td>
</tr>
<tr>
<td>Consumer sovereignty</td>
<td>Planning responds to latent and changing consumer demands.</td>
<td>Would significantly improve and increase non-auto travel, and reduce auto travel.</td>
</tr>
<tr>
<td>Efficient pricing</td>
<td>Users pay directly for facilities and external impacts such as congestion, crash and pollution damages.</td>
<td>Would increase the price of driving, reducing vehicle travel, particularly under urban-peak conditions.</td>
</tr>
<tr>
<td>Strategic planning</td>
<td>Individual, short-term decisions should support strategic, long-term goals.</td>
<td>Would increase support for affordable, healthy and resource-efficient modes.</td>
</tr>
</tbody>
</table>

*These four principles can help guide planning decisions and determine optimal vehicle travel. They tend to reduce automobile travel, increase non-auto travel, and create more compact, multimodal communities.*

Analysis in this report indicates that applying these principles would significantly reduce vehicle travel, typically by 30-60%, while increasing non-auto travel, reducing costs, increasing fairness, and making most people better off overall. This suggests that vehicle travel reduction targets of 20-30% are reasonable, resulting in the lower-bound of optimal vehicle mileage. Such targets can help guide decision-making. For example, many jurisdictions invest in non-auto modes while applying contradictory policies that encourage driving and sprawl, such as highway expansions and parking mandates. Vehicle travel reduction targets can identify such conflicts and support reforms so individual, short-term decisions support strategic, long-term goals.

Although vehicle travel reductions are not necessarily the most cost effective way to achieve a single objective, such as reducing congestion, crashes or emissions, they help achieve multiple objectives, and so tend to be cost effective considering all impacts. Because they can provide diverse benefits, they are win-win solutions that can gain broad public support.

Critics argue that vehicle travel reduction targets are inefficient and unfair, sometimes described as a “war on cars,” but their arguments cannot stand scrutiny. Their criticisms reflect an older planning paradigm which assumed that automobile travel is superior to other modes, and that planning can ignore many costs of automobile travel and benefits of non-auto travel. This research indicates that vehicle travel can be reduced in ways that benefit most travellers, enhance freedom, are cost effective, increase economic productivity, and support social equity.
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