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Abstract

This chapter investigates the role that *mobility management* plays in an efficient transport system. It describes the basic principles that a transport system must reflect to optimize efficiency and maximize benefits, identifies various transport policy and planning distortions that result in economically-excessive motor vehicle travel, and describes various reforms that correct these distortions, resulting in more efficient transport patterns. These mobility management strategies include improvements to alternative modes, transport pricing reforms, and more neutral policies and planning practices. This favors higher value trips and more efficient modes, increasing overall transport system efficiency. Mobility management can provide multiple economic, social and environmental benefits, and so help achieve true sustainability. It also benefits disadvantaged people by improving affordable transport options. This analysis indicates that many commonly used transport policies and planning practices result in economically excessive motor vehicle travel, which is particularly harmful to lower income people and economies. This has important implications for developing countries which are still establishing their planning policies and practices.

Chapter 14
Mobility Management Solutions to Transport Problems Around the World

Todd Litman

Abstract This chapter investigates the role that *mobility management* plays in an efficient transport system. It describes the basic principles that a transport system must reflect to optimize efficiency and maximize benefits, identifies various transport policy and planning distortions that result in economically-excessive motor vehicle travel, and describes various reforms that correct these distortions, resulting in more efficient transport patterns. These mobility management strategies include improvements to alternative modes, transport pricing reforms, and more neutral policies and planning practices. This favors higher value trips and more efficient modes, increasing overall transport system efficiency. Mobility management can provide multiple economic, social and environmental benefits, and so help achieve true sustainability. It also benefits disadvantaged people by improving affordable transport options. This analysis indicates that many commonly used transport policies and planning practices result in economically excessive motor vehicle travel, which is particularly harmful to lower income people and economies. This has important implications for developing countries which are still establishing their planning policies and practices.

14.1 Introduction

Motor vehicle travel can provide large benefits but also imposes large costs. Because many vehicle costs are external (imposed on somebody other than the user), individuals tend to drive more than optimal from society's perspective. As a result, policies that reduce vehicle travel, generally called *mobility management* or *transportation demand management* (TDM), are often justified.

For example, from the perspective of an individual who can afford to purchase an automobile, driving often seems to be the best travel option since it is generally faster and more prestigious than other modes. However, as more travellers drive, problems such as traffic and parking congestion, traffic accidents and pollution increase, making all travellers worse off. As a result, everybody can benefit from policies that limit automobile travel and encourage use of efficient modes.

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Mobility management includes various strategies that improve efficient transport options (such as walking, cycling, public transport and telecommunications), incentives to choose the most efficient option for each trip (such as more efficient road, parking and fuel pricing), and policies that encourage more accessible land use development which reduces the distances people must travel to reach activities such as work, schools and stores. Mobility management is increasingly being implemented around the world, in both developed and developing countries, to help achieve a variety of planning objectives, including congestion reduction, road and parking facility cost savings, consumer savings, accident reductions, improved mobility for non-drivers, energy conservation, emission reductions, and improved public fitness and health (Broaddus et al. 2009). When all impacts are considered, mobility management strategies, such as those listed in Table 14.1, are often the most cost effective solution to transport problems.

However, to be implemented to the degree that is optimal mobility management requires changing the way we define transport problems and evaluate potential solutions. Conventional planning tends to overlook many mobility management benefits, so it is often undervalued in policy and planning analysis. Mobility management also faces institutional barriers, such as inadequate funding and support within the existing transport planning process.

This chapter investigates these issues. It asks, 'How much and what type of travel is overall optimal, considering all impacts, and what transport policies can help achieve that optimality.' It discusses the principles required for an efficient transport system, identifies existing transport market distortions that violate these principles, describes policy and planning reforms that correct these distortions, estimates how such reforms would affect transport activity, and discusses the economic, social and environmental benefits that would result. Although previous studies have evaluated most of these reforms individually, few consider their cumulative impacts.

Table 14.1 Mobility management strategies (VTPI 2010)

Improves transport options	Efficient incentives	Land use management
Transit improvements	Congestion pricing	Smart growth
Non-motorized improvements	Distance-based fees	Transit oriented development
Rideshare programs	Commuter financial incentives	Location-efficient development
HOV priority	Parking pricing	Parking management
Flextime	Parking regulations	Carfree planning
Carsharing	Fuel tax increases	Traffic calming
Telework	Transit encouragement	
Guaranteed ride home		

14.2 The New Transport Planning Paradigm

A *paradigm shift* (a fundamental change in the way problems are defined and solutions evaluated) is occurring in the transport planning field (Litman 1999, Leather 2009). The old transportation planning paradigm focused on *mobility*, that is, physical movement. With that paradigm, *transport* generally means motor vehicle travel, *transport problems* consist of excessive vehicle delay and cost, and *transport improvement* consists of strategies that increase motor vehicle traffic speeds and reduce driving costs. But mobility is seldom an end in itself, most transport is intended to achieving *accessibility*, which refers to the ability of people and businesses to reach desired goods, services and activities. Various factors affect accessibility, including the speed and affordability of mobility, land use factors that affect the distances between activities, and mobility substitutes, such as delivery services and telecommunications which can reduce the need for physical travel (Litman 2003, El-Geneidy and Levinson 2006).

Accessibility-based transport planning expands the range of solutions that can be applied to transport problems. For example, with mobility-based planning, the only solution to traffic congestion is to expand roadways. With accessibility-based planning, potential solutions also include improving alternative modes (better walking, cycling, ridesharing, public transport, and telecommunications), incentives to use alternatives (such as more efficient road and parking pricing, and commute trip reduction programs), and land use policies that reduce the need for residents to travel to access services and jobs.

Mobility-based planning tends to create a self-reinforcing cycle of automobile dependency and sprawl, as illustrated in Fig. 14.1. Although many planning decisions that support automobile dependency and sprawl may individually seem justified, their cumulative effect significantly increases economic, social and environmental costs. Residents of automobile dependent communities must spend more on vehicles, fuel, roads and parking facilities, have higher traffic fatality rates, produce more pollution, consume more land, and are less physically fit than if they lived in more multi-modal communities. In addition, non-drivers are worse off, which is unfair and regressive (it burdens lower-income people more than higher-income people). This is not to suggest that motor vehicle travel provides no benefits, but it does indicate that planning which is unintentionally biased in favor of automobile tends to result in sub-optimal transport patterns.

The new planning paradigm expands the range of impacts and options considered in transport planning. For example, under the old paradigm, transport planners were primarily concerned with reducing traffic delays. Under the new paradigm they also consider indirect and external costs and benefits (sometimes called *co-benefits*) which can help decision-makers identify the most efficient and equitable transport improvements available, taking into account all impacts.

There are many justifications for this paradigm shift. More comprehensive analysis and more multi-modal planning tend to increase overall transport system efficiency which provides multiple benefits, including congestion reduction, road and parking facility savings, consumer savings, improved mobility for non-drivers,

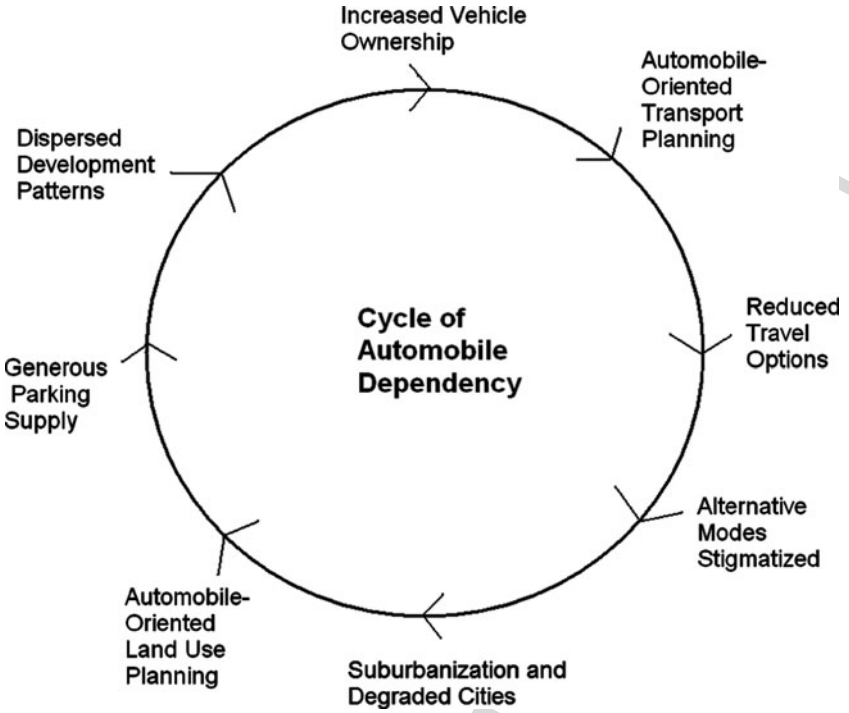

Fig. 14.1 Cycle of automobile dependency and sprawl

traffic safety, energy conservation, emission reductions, more efficient land use development, and improved public fitness and health. Although some people emphasize environmental benefits, it also tends to support economic development. In fact, mobility management tends to reflect basic market principles, and so tends to support economic development, as discussed in the following chapter.

14.3 Transport Market Principles, Distortions and Reforms

According to basic economic and planning theory, an efficient transport system must reflect the following principles (Litman 2006a):

1. *Diverse consumer options* (also called *consumer sovereignty*). Consumers must have a variety of travel modes, service quality, and price options so they can choose the bundle that best meets their needs and preferences.
2. *Efficient pricing.* Efficiency requires that prices (what consumers pay for a good) reflect the marginal costs of producing that good unless a subsidy is specifically justified. This means, for example, that users should pay directly for roads and parking facilities, with fees that reflect the congestion, accident risk and pollution

emissions imposed by each trip. This encourages consumers to choose lower-cost options, and insures that people do not impose $10.00 in total costs for travel that users only consider worth $5.00.

3. *Neutral public policy.* Public policies (laws and regulations, pricing and taxes, public infrastructure investments, etc.) should not arbitrarily favor one group or transport mode over others.

Many existing transport policies and planning practices violate these principles:

- Conventional travel surveys and statistics tend to undercount and therefore undervalue non-motorized travel. This skews planning to favor automobile-oriented improvements even when they degrade non-motorized travel conditions.
- A major share of transport funding is dedicated to roads and parking facilities, which encourages communities to favor automobile improvements even if other types of transport improvements provide greater total benefits.
- Roads and parking facilities are generally unpriced, funded indirectly rather than through direct user charges.
- Road tolls and parking fees that do apply do not generally vary to reflect marginal costs. For example, road tolls and parking fees do not generally vary by time or location to reflect congestion.
- Vehicle insurance and registration fees are generally fixed – they do not increase with annual mileage. This gives motorists an incentive to maximize their annual mileage, in order to get their money's worth.
- Some tax regulations encourage businesses to subsidize employee parking and vehicles.
- In most countries (excepting Europe and wealthy Asian countries) fuel taxes are too low to finance total roadway costs, or the full economic and environmental costs of producing and importing that fuel. Many countries subsidize vehicle fuel, either directly, or indirectly through policies such as biofuel subsidies.
- Zoning codes, development policies and infrastructure investments often favor sprawled land use over more compact, infill development.

These distortions tend to reduce transport system efficiency. Problems such as traffic and parking congestion are virtually unsolvable without planning and pricing reforms that encourage urban-peak travellers to use more space-efficient modes. Similarly, underpricing fuel encourages travellers to choose fuel intensive modes, which is economically harmful, particularly for lower-income countries that import petroleum, and increases pollution emissions.

These distortions tend to reduce transport system diversity. For example, planning practices that undervalue non-motorized travel reduce investments in sidewalks and paths; dedicated roadway funding results in wider highways that make walking more difficult; underpricing of roads and parking facilities reduces public transit demand, which over the long-term reduces transit service quality; development

policies that limit development density and mix increase the distances between destinations, making them difficult to reach except by automobile. This is particularly harmful to non-drivers, and so tends to be inequitable.

For example, in a typical developing country city only about 10% of households own an automobile. Most travel is by walking cycling, or public transport. However, because travel surveys undercount short trips, non-commute trips, travel by children, and non-motorized links of public transport and automobile trips, official statistics overlook most non-motorized trips, which exaggerates the importance of motorized travel.

According to standard international practices, transport planners evaluate the transport system quality based on vehicle travel speeds, which directs transport improvement resources to highway and parking facility expansion, and large public transport projects. Few resources are devoted to non-motorized or local public transit improvements. Since expanding urban roadways and increasing urban traffic volumes and speeds tends to degrade walking and cycling conditions, and increased vehicle traffic volumes congest urban streets which reduces bus transit performance, most residents, who rely on walking, cycling and bus transit, experience declining transport performance. This further encourages automobile dependency and sprawl, increasing economic, social and environmental costs.

Described more positively, various policy and planning reforms can correct these distortions. These mobility management strategies favor higher value trips and more efficient modes, increasing overall transport system efficiency. This can lead to reduced traffic congestion, road and parking facility cost savings, consumer savings, increased safety, improved mobility options for non-drivers, energy conservation, emission reductions, more efficient land use development, and improved public fitness and health. Transport planners generally classify these as mobility management strategies. Thus, mobility management is the general term for various reforms that economists and planners recommend for improving transport system efficiency and equity.

14.4 Mobility Management Strategies

Examples of mobility management strategies are described below. For more information see Cambridge Systematics (2009), Cairns et al. (2004), Litman (2007) and VTPI (2010).

14.4.1 Least Cost Transportation Planning (WSDOT 2009)

Least-cost transportation planning is a term for more comprehensive and neutral planning that:

- Considers all significant impacts (costs and benefits), including indirect effects.
- Considers demand management equally with facility capacity solutions.

For example, least cost planning means that funding for roads and parking facilities could be used to improve alternative modes or support mobility management programs if they are more cost effective at achieving transportation planning objectives, such as providing mobility and reducing congestion, considering all benefits and costs.

14.4.2 Commuter Financial Incentives (ICF and CUTR 2005)

Commuter Financial Incentives include several types of incentives that encourage alternative commute modes:

- *Parking Cash Out* means that commuters who are offered subsidized parking are also offered the cash equivalent if they use alternative travel modes. For example, an employee can choose between a free parking space or $75 per month if they use an alternative commute mode.
- *Travel allowances* are a financial payment provided to employees instead of parking subsidies. Commuters can use this money to pay for parking or for another travel mode.
- *Transit and rideshare benefits* are free or discounted transit fares provided to employees.
- *Reduced employee parking subsidies* means that commuters who drive must pay some or all of their parking costs.
- *Company travel reimbursement policies* that reimburse bicycle or transit mileage for business trips when these modes are comparable in speed to driving, rather than only reimbursing automobile mileage.

These strategies are more efficient and equitable than the common practice by businesses of subsidizing parking but offering no comparable benefit to employees who use alternative modes.

Commuter financial incentives can be prorated according to how much employees use alternative modes. For example, employees who drive twice a week would receive 60% of the full Parking Cash Out allowance.

14.4.3 Fuel Taxes – Tax Shifting (Clarke and Prentice 2009, Metschies 2005)

Since governments must tax something to raise revenue, many economists recommend shifting taxes from desirable activities to those that are harmful or risky, for example, reducing taxes on employment and commercial transactions, and increasing taxes on the consumption of polluting, non-renewable resources such as petroleum. Current fuel taxes are relatively low, particularly in the U.S. and many

developing countries. There are several specific justifications for increasing taxes on petroleum products in general and motor vehicle fuel in particular:

- To reflect inflation. Fuel taxes are generally unit based (cents per gallon or liter), as opposed to a percentage of the retail price, and so their real value declines with inflation. The real, inflation adjusted value of fuel taxes has declined significantly in many jurisdictions. Increasing taxes and indexing them to inflation is justified to maintain constant revenue.
- As a road user fee. Special fuel taxes are generally considered a road user fee, which should at least pay the costs of building and maintaining roadways, and perhaps more to recover other associated costs, such as traffic services. In many jurisdictions fuel taxes are too low to finance roadway costs, so increases are justified.
- To encourage energy conservation in order to reduce dependence on imported resources, increase economic efficiency, reduce pollution emissions (including climate change emissions) and to leave more petroleum for future generations (Litman 2007).
- To internalize petroleum production subsidies, external costs and tax exemptions.

14.4.4 Pay-As-You-Drive Pricing (USDOT 2010, Litman 1997)

Pay-As-You-Drive (PAYD) pricing (also called *Distance-Based* and *Mileage-Based pricing*) means that vehicle insurance or other fees are based directly on how much it the vehicle is driven. This can be done by changing the pricing unit (i.e., how fees are calculated) from the vehicle-year to the vehicle-mile, vehicle-kilometer or vehicle-minute. Existing pricing factors are incorporated so higher-risk motorists pay more per unit than lower-risk drivers. For example, a $375 annual insurance premium becomes 3¢ per mile, and a $1,250 annual premium becomes 10¢ per mile. An average U.S. motorist would pay about 7¢ per mile for PAYD insurance. Similarly, currently fixed vehicle taxes, registration, licensing and lease fees, and taxes can be converted to distance-based fees by dividing existing fees by average annual mileage for each vehicle class. For example, if a vehicle's annual registration fees are $300 and its class averages 12,000 annual miles, the distance-based fee is 2.5¢ per mile.

Pay-As-You-Drive pricing helps achieve several public policy goals including fairness, affordability, road safety, consumer savings and choice, and reduced traffic problems such as traffic congestion, road and parking facility costs, pollution emissions and sprawl. PAYD should reduce average annual mileage of affected vehicles by 10–15%, reduce crash rates by a greater amount, increase equity, and save consumers money. It reduces the need for cross-subsidies currently required to provide 'affordable' unlimited-mileage coverage to high-risk drivers. It can particularly benefit lower-income communities that currently pay excessive premiums. Some insurance companies now offer versions of PAYD pricing, but implementation is limited.

14.4.5 Efficient Road Pricing (FHWA 2009, Schwaab and Thielmann 2001)

Road Pricing means that motorists pay directly for driving on a particular roadway or in a particular area. *Congestion Pricing* (also called *Value Pricing*) refers to road pricing with variable fees designed to reduce traffic congestion. Transportation economists have long advocated road pricing as a way to fund transportation improvements and to reduce congestion problems. Road tolls are justified since many road and bridge projects would otherwise be funded trough general taxes, or by taxes paid by motorists who seldom or never use costly new facilities. Some roads include both priced and unpriced lanes, allowing motorists to choose between financial and time savings. Experience with road tolls and various types of congestion pricing indicate that motorists respond to such fees, shifting travel time, route, destination and mode, increasing overall transport system efficiency.

14.4.6 Parking Management (Litman 2006b, Shoup 2005, USEPA 2006)

Parking Management includes a variety of strategies that encourage more efficient use of existing parking facilities, as summarized in Table 14.2. In addition to reducing parking costs, some of these strategies also reduce total automobile travel and therefore costs such as congestion, accidents and pollution.

AQ1

14.4.7 Transit Service Improvements (EDF 2009, Wright 2007)

There are many ways to improve public transit services, and encourage transit use, including increased service area and frequency, increased transit speed and reliability (including use of transit priority systems that allow transit vehicles to bypass congestion), reduced crowding, more comfortable vehicles, nicer waiting areas (stations and stops), reduced and more convenient fares, improved rider information and marketing programs, transit oriented land use development, pedestrian and cycling improvements around transit stops, bike and transit integration (bike racks on buses, bicycle parking at stations, etc.), park-and-ride facilities, improved security for transit users and pedestrians, and transit services targeting particular needs such as express commuter buses and special event services. Marketing programs that raise the social status of transit travel can also be considered a type of service improvement.

14.4.8 Ridesharing (Ennis 2010, Evans and Pratt 2005)

Ridesharing refers to carpooling and vanpooling, in which vehicles carry multiple passengers. *Carpooling* uses participants' own automobiles, while *vanpools*

406 **Table 14.2** Parking management strategies (VTPI 2010)

Strategy	Description	Typical reduction	Traffic reduction
Shared Parking	Parking spaces serve multiple users and destinations.	10–30%	
Parking Regulations	Regulations to prioritize use of the most desirable parking spaces.	10–30%	
More Accurate and Flexible Standards	Adjust parking standards to more accurately reflect demand in a particular situation.	10–30%	
Parking Maximums	Establish maximum parking standards.	10–30%	
Remote Parking	Provide off-site or urban fringe parking facilities.	10–30%	
Smart Growth	Encourage more compact, mixed, multi-modal development to allow more parking sharing and use of alternative modes.	10–30%	√
Walking and Cycling Improvements	Improve walking and cycling conditions to expand the range of destinations serviced by a parking facility.	5–15%	√
Mobility Management	Use resources that would otherwise be devoted to parking facilities to encourage use of alternative modes.	10–30%	√
Parking Pricing	Charge motorists directly and efficiently for using parking facilities.	10–30%	√
Improve Pricing Methods	Use better charging techniques to make pricing more convenient and cost effective.	Varies	
Financial Incentives	Provide financial incentives to shift mode, such as parking cash out.	10–30%	√
Unbundle Parking	Rent or sell parking facilities separately from building space.	10–30%	√
Parking Tax Reform	Change tax policies to support parking management objectives.	5–15%	√
Bicycle Facilities	Provide bicycle storage and changing facilities.	5–15%	√
Improve User Information	Provide convenient and accurate information on parking availability and price.	5–15%	√
Overflow Parking	Establish plans to manage occasional peak parking demands.	Varies	

use a larger vehicle that is often leased for the purpose. Ridesharing has minimal incremental costs because it makes use of vehicle seats that would otherwise be unoccupied.

14.4.9 HOV Priority (Turnbull et al. 2006)

HOV Priority refers to strategies that give *High Occupant Vehicles* (buses, vanpools and carpools) priority over general traffic, such as dedicated lanes, queue-jumping intersection design, and priority parking. HOV priority measures can be justified as a more efficient and equitable allocation of road space (travellers who share a vehicle and therefore *impose* less congestion on other road users, are rewarded by *bearing* less congestion delay), an efficient use of road capacity (they can carry more people than a general use lane), and as an incentive to shift to more efficient modes.

14.4.10 Walking and Cycling Improvements (Cairns et al. 2004, Pucher et al. 2010)

Walking and cycling travel can substitute for some motor vehicle trips directly, and support other alternative modes such as public transit and ridesharing. Residents of communities with good walking and cycling conditions drive less and use transit and rideshare more. There are many ways to improve these modes:

- Improve sidewalks, crosswalks, paths and bike lanes.
- Increase road and path connectivity, with special shortcuts for nonmotorized modes.
- Pedestrian oriented land use and building design.
- Traffic calming, speed reductions and vehicle restrictions, to reduce conflicts between motorized and nonmotorized traffic.
- Safety education, law enforcement and encouragement programs.
- Convenient and secure bicycle parking.
- Address security concerns of pedestrians and cyclists.

14.4.11 Smart Growth Land Use Policies (Ewing et al. 2007)

Current land use policies limit development density, disperse destinations and favor automobile access over alternative modes. *Smart growth* policies, such as those described below, reduce vehicle travel and provide other benefits.

- Encourage compact development with diverse housing types (single and multi-family).
- Create more complete, self-contained communities. For example, locating schools, parks and shops within neighborhoods.
- Encourage infill development, such as redevelopment of older buildings and neighborhoods.
- Concentrate commercial activities in compact centers or districts. Use access management to prevent arterial strip commercial development.

- Use development fees and utility pricing that reflects the higher costs of providing public services at lower-density sites.
- Develop a dense network of interconnected street. Keep streets as narrow as possible, particularly in residential areas and commercial centers.
- Design streets to accommodate walking and cycling. Create a maximum number of connections for non-motorized travel, such as trails that link dead-end streets.
- Apply parking management and reduce parking requirements.

14.4.12 Location Efficient Development (CNT 2008)

Location Efficient Development refers to building, neighborhood and community development that reflects Smart Growth principles. *Location Efficient Mortgages* recognize the savings that result in credit assessments, giving homebuyers more incentive to choose efficient locations.

14.4.13 Mobility Management Marketing (Sloman et al. 2010)

Mobility Management Marketing involves various activities to improve consumers' knowledge and acceptance of alternative modes, and to provide products that better meet travellers' needs and preferences. Given adequate resources, marketing programs can significantly increase use of alternative modes and reduce automobile travel.

14.4.14 Freight Transport Management (Hendrickson et al. 2006)

Freight Transport Management includes various strategies of increasing the efficiency of freight and commercial transport. This can include improving distribution practices so fewer vehicle trips are needed, shifting freight to more resource efficient modes (such as from air and truck to rail and marine), improving efficient modes such as marine, rail and bicycle; and by reducing the total volume of goods that need to be transported. Because freight vehicles tend to be large, energy-intensive and high polluting, a relatively small improvement in freight efficiency can provide large total benefits.

14.4.15 School and Campus Trip Management (Cairns et al. 2004, NTHP 2010)

These programs help overcome barriers to the use of alternative modes, and provide positive incentives for reduced driving to schools and college or university campuses. School trip management usually involves improving pedestrian and cycling access, promoting ridesharing, and encouraging parents to use alternatives when

possible. Campus trip management programs often include discounted transit fares, rideshare promotion, improved pedestrian and cycling facilities, and increased parking fees. These programs give students, parents and staff more travel choices, encourage exercise, and reduce parking and congestion problems.

14.4.16 Institution and Regulatory Reforms (Meakin 2004, Sakamoto 2010)

Mobility management requires institutional reforms to better support and finance demand management policies and programs, and regulatory reforms to allow innovation and competition. Private bus, jitney and taxi services are often restricted to favor existing service providers. Although there are reasons to regulate transportation services to maintain quality, predictability and safety, unnecessary regulations can be changed to address specific problems while encouraging competition, innovation and diversity.

14.4.17 Carsharing (Cairns et al. 2004, Cohen et al. 2008)

Carsharing provides affordable, short-term (hourly and daily rate) motor vehicle rentals in residential areas as an alternative to private ownership. Because it has lower fixed costs and higher variable costs than private vehicle ownership, carsharing tends to significantly reduce annual vehicle mileage by participants.

14.4.18 Streetscaping and Traffic Calming (ITE 2010)

Traffic calming includes various strategies to reduce traffic speeds and volumes on specific roads. Typical strategies include traffic circles at intersections, sidewalk bulbs that reduce intersection crossing distances, raised crosswalks, and partial street closures to discourage short-cut traffic through residential neighborhoods. This increases road safety and community livability, creates a more pedestrian- and bicycle-friendly environment, and can reduce automobile use.

14.5 Summary of Mobility Management Strategies

Table 14.3 summarizes these various Win-Win strategies. This analysis suggests that a well-coordinated program of Win-Win strategies implemented to the degree economically justified would probably reduce total vehicle travel 30–50% compared with current planning and pricing practices (Cambridge Systematics 2009, Ewing et al. 2007, Litman 2010).

This conclusion is supported by comparing the travel behavior and transport costs in different cities and countries with similar levels of economic development but

Table 14.3 Mobility management strategies (Litman 2007)

Name	Description	Transport impacts
Least-Cost Planning	More comprehensive and neutral planning and investment practices.	Increases investment and support for alternative modes and mobility management, improving transport options.
Commute Trip Reduction (CTR)	Programs by employers to encourage alternative commute options.	Reduces automobile commute travel.
Commuter Financial Incentives	Offers commuters financial incentives for using alternative modes.	Encourages use of alternative commute modes.
Fuel Taxes – Tax Shifting	Increases fuel taxes and other vehicle taxes.	Reduces vehicle fuel consumption and mileage.
Pay-As-You-Drive Pricing	Converts fixed vehicle charges into mileage-based fees.	Reduces vehicle mileage.
Road Pricing	Charges users directly for road use, with rates that reflect costs imposed.	Reduces vehicle mileage, particularly under congested conditions.
Parking Management	Various strategies that result in more efficient use of parking facilities.	Reduces parking demand and facility costs, and encourages use of alternative modes.
Parking Pricing	Charges users directly for parking facility use, often with variable rates.	Reduces parking demand and facility costs, and encourages use of alternative modes.
Transit and Rideshare Improvements	Improves transit and rideshare services.	Increases transit use, vanpooling and carpooling.
HOV Priority	Improves transit and rideshare speed and convenience.	Increases transit and rideshare use, particularly in congested conditions.
Walking and Cycling Improvements	Improves walking and cycling conditions.	Encourages use of nonmotorized modes, and supports transit and smart growth.
Smart Growth Policies	More accessible, multi-modal land use development patterns.	Reduces automobile use and trip distances, and increases use of alternative modes.
Location Efficient Housing and Mortgages	Encourage businesses and households to choose more accessible locations.	Reduces automobile use and trip distances, and increases use of alternative modes.
Mobility Management Marketing	Improved information and encouragement for transport options.	Encourages shifts to alternative modes.
Freight Transport Management	Encourage businesses to use more efficient transportation options.	Reduces truck transport.
School and Campus Trip Management	Encourage parents and students to use alternative modes for school commutes.	Reduces driving and increases use of alternative modes by parents and children.

Table 14.3 (continued)

Name	Description	Transport impacts
Regulatory Reforms	Reduced barriers to transportation and land use innovations.	Improves travel options.
Carsharing	Vehicle rental services that substitute for private automobile ownership.	Reduces automobile ownership and use.
Traffic Calming and Traffic Management	Roadway designs that reduce vehicle traffic volumes and speeds.	Reduces driving, improved walking and cycling conditions.

different transport policies and planning practices. For example, residents of wealthy European and Asian countries drive about half as much as in North America, spend much less on vehicles and fuel, and have much lower traffic fatality rates than in North America, due to different in fuel prices, transport investments and land use development policies (Ewing et al. 2007, Litman 2009).

14.6 Mobility Management Evaluation

Conventional planning tends to undervalue mobility management solutions. These strategies tend to provide multiple economic, social and environmental benefits (Cambridge Systematics 2009, Litman 2007). However, conventional planning is *reductionist*, meaning that each problem is assigned to a particular profession or agency with narrowly defined responsibilities. For example, transport agencies are responsible for traffic congestion and accident reductions, environmental agencies are responsible for emission reductions, social agencies are responsible for helping disadvantaged people, and public health agencies are responsible for encouraging public fitness. This approach tends to undervalue strategies that provide multiple benefits. For example, transport planning agencies tend to evaluate potential transport system improvements based primarily on their impacts on traffic congestion and accidents, they generally ignore impacts on parking costs, mobility for non-drivers, and public fitness and health. Similarly, environmental agencies tend to evaluate transport system improvements based on energy conservation and emission reductions, but generally ignore impacts on congestion and accidents.

Because their benefits are diverse, it is important to use comprehensive analysis when evaluating mobility management strategies. For example, expanding highways provides just one primary benefit, congestion reductions, and by inducing additional vehicle travel, over the long run it tends to exacerbate other problems such as traffic accidents, pollution emissions and sprawl (Litman 2005). Similarly, more efficient and alternative fuel vehicles tend to conserve energy and reduce pollution, but by reducing vehicle operating costs tends to increase total vehicle travel and therefore congestion, parking and accident problems. Mobility management tends to provide

Table 14.4 Comparing strategies (Litman 2007)

Planning objective	Roadway expansion	Efficient and alt-fuel vehicles	Mobility management
Total Vehicle Travel	Increased	Increased	Reduced
Congestion reduction	√	×	√
Roadway cost savings	×	×	√
Parking costs savings	×	×	√
Consumer costs savings	×		√
Traffic safety	×	×	√
Improved mobility options	×		√
Energy conservation	×	√	√
Pollution reduction	×	√	√
Efficient land use	×	×	√
Physical fitness & health	×		√

Note: Some transport improvement strategies help achieve one or two objectives (√), but by increasing total vehicle travel contradict others (×). Mobility management strategies reduce total motor vehicle travel and so can help achieve many planning objectives

a much larger range of benefits, as indicated in Table 14.4. When all impacts are considered, mobility management strategies often turn out to be the most cost effective and beneficial solutions to transport problems.

14.7 Implications for Developing Countries

Mobility management is particularly appropriate in developing countries for the following reasons:

- Most residents do not own automobiles. As a result, improvements to alternative modes provide greater direct user benefits, are more equitable, and do more to increase access to education, employment and services, than do automobile transport improvements.
- Policies that reduce automobile traffic reduce conflicts between motorized and non-motorized travellers, improving access and safety to the majority of travellers who rely on walking and bicycling.
- Developing countries have very limited resources to expand roads and parking facilities, or to provide public infrastructure for sprawled development. Mobility management reduces traffic and parking congestion, and therefore the need to expand roadways.
- By reducing the amount that consumers spend on vehicles and fuel, mobility management reduces the need to import these products, and in petroleum producing countries increases the amount of oil that can be exported, increasing export exchange and economic competitiveness. This will be increasingly beneficial in the future as international oil prices rise due to peak oil.

14.8 Examples and Case Studies[1]

14.8.1 Innovative Transportation Solutions in Curitiba, Brazil

Curitiba, capital of the Brazilian state Paraná 400 km south east of São Paulo, has over the last 30 years developed a high-quality, cost-effective public transport system. Today it stands as a model recognized internationally. Insightful, long term planning with several innovative solutions has provided the citizens with an effective system that gives priority to public instead of private transport. It has the highest user rates of all Brazilian state capitals, 75% of all weekday commuters. All this during a period of unprecedented city growth.

14.8.2 Bogota, Columbia Transport Initiatives (http://ecoplan.org/votebogota2000/vb2_index.htm)

The city of Bogota, Columbia has a diverse program to improve transportation choices and encourage non-automobile modes. They include:

- *TransMilenio*, a high-capacity public transportation system using articulated buses and convenient, magnetic ticketing.
- *Bikeways.* 120 existing and 180 planned kilometers of cycle paths.
- *Walkways.* Construction of sidewalks and shaded walkways ('alamedas') throughout the city.
- Increased parking fees.
- *Pico y Placa.* Restrictions on private automobile travel, based on each vehicle's license-plate number.
- *Car-Free Day.* An annual Car-Free day.

Because this program includes restrictions on automobile travel it was initially controversial. In October, 2000 a public referendum on the program received more than 62% yes votes indicating a high level of public support.

14.8.3 Africa Safe Routes to School (www.movingtheeconomy.ca/cs_tanzania.html)

The majority of Tanzania's urban dwellers face chronic mobility problems including: high proportions of family income needed for daily travel; long travel distances

[1] All Internet links in this section were last accessed in March 2011.

due to fast city growth; a poor route infrastructure network, especially for walking and cycling; and a high number of traffic accidents involving non-motorized transport users.

These problems are even worse for school children, who are sometimes denied access on private buses. Female students are sometimes forced to engage in relationships with male drivers or conductors to facilitate easy entry in the private buses and many children suffer from poor attendance and late arrival at school. The cost of transport also limits access to schools and disrupts education, especially of female pupils.

The Association for Advancing Low Cost Mobility (AALOCOM) was formed to address the mobility needs of Tanzania's urban dwellers, starting with school children. The Safe Routes to School Demonstration Project is in the planning stages at the time of writing, but it is a spectacular example of a community responding to a community problem in a manner that is participatory, broad-based and open. AALOCOM recognizes that the success of the project depends on the participation of the different parties responsible. Using a broad base of stakeholders (parents, teachers, police, NGOs, transportation officials and decision makers), AALOCOM's participatory approach creates a sense of ownership and responsibility around child, pedestrian and cycling safety issues.

The project will be piloted in a medium sized city with significant traffic problems, using schools with a high percentage of children residing 2–3 km away. It will focus on:

- Identifying walking and cycling routes to school where traffic safety is a major concern.
- Educating parents about child pedestrian safety issues and solutions;
- Developing traffic calming and infrastructure plans.
- Working with parents, community leaders and decision makers to reach agreement on what changes to make.
- Facilitating availability of affordable bicycles to teachers and pupils.

14.8.4 Rickshaw Trolley Community Solid Waste Collection (www.movingtheeconomy.ca/cs_rickshaw_trolley.html)

Before the Rickshaw Trolley Community Solid Waste Collection system was introduced, solid waste in most of Mirzapur, India was collected from neighborhood streets in handcarts and then dumped in heaps on bigger streets. From these heaps it was lifted onto bullock carts or tractor trolleys by shovel or a hydraulic loader. While being loaded, tractor trolleys blocked traffic on the narrow streets. This was inefficient, unsanitary and undependable since the city could not afford to keep the loader operating and the staff could not manage to lift more than a little bit of the city's garbage. Eventually garbage actually blocked many streets and drains, and

obstructed maintenance of the drainage and water supply systems. The public had lost confidence in the city services and there was little money available for new equipment.

Solid waste needed to be lifted from the street to tractor trolleys without hydraulic equipment. To do this the municipality in 1995 designed and introduced a loading platform with an access ramp for direct loading into parked tractor trolleys. Now 10 collection depots manage the city's daily solid waste. They use available space along street rights-of-way and do not interfere with traffic movement. To make operation of the depots feasible, the service area had to be increased. This was achieved through the introduction of a three-wheeled rickshaw trolley with a modified frame for easier pedalling, and a tilting bin for easy unloading, designed and built by local workshops. These easy to move rickshaw trolleys have twice the capacity of handcarts and double their service area to 400 meters.

This low-cost system has eliminated the need for hydraulic lifting throughout the city and dramatically reduced staff physical contact with solid waste. The improvement in city appearance has changed the public attitude toward the city. In addition, the municipality has even donated a rickshaw trolley for replication to the city of Aligarh, provided technical assistance to numerous municipalities from India and Nepal, and is exploring opportunities for private processing of compost.

14.8.5 Malaysian TDM Solutions (www.nctr.usf.edu/jpt/pdf/JPT11-3Kasipillai.pdf)

AQ2

Growing motor vehicle ownership and use are imposing significant costs on the Malaysian economy and environment. Kasipillai and Chan (2008) recommend a Transport Development Management-based approach to create more sustainable transportation:

1. Alteration of charges on road taxes and car insurance,
2. Elimination of fuel subsidies,
3. Imposition of fuel taxes and amendments in the bases for car taxation,
4. Congestion charging, particularly in Kuala Lumpur, and
5. National road pricing.

14.8.6 Manila Congestion Pricing (Roth and Villoria 2001)

A study of potential road pricing in Manila, Philippines calculates that an optimal congestion charge of 6–14 pesos per vehicle-km would reduce traffic volumes by 11–24% and increase traffic speeds 44–101%. Estimates total revenues of from congestion fees and a 40 peso per day charge for commercial parking could provide total revenues of 12.6–25.5 billion pesos annually to fund a regional transportation authority.

14.8.7 Ghana (www.ibike.org/ghana-women.htm)

In tackling transport and rural development issues, Ghana faces a host of common challenges: environmental degradation; urban gridlock; the cost of road repair and fuel; health problems for women from carrying heavy loads; and a shortage of foreign exchange for vehicles, parts and construction equipment. Fortunately, Ghana has chosen some innovative projects designed to address these issues in a way that meets the needs of the government, its citizens, and the environment. It is hoped that by improving rural quality-of-life, urbanization trends and the demand for expensive urban infrastructure can be reduced. Three current projects are briefly profiled here.

1. *New Road Design*. The Department of Roads and Highways is now designing rural roads using new standards taking into account the needs of the generally non-motor vehicle using population. One readily apparent result of the change is a 'single-blade' (4 m or 13 ft) compacted road. But the far more important products of the program are the change in the production process and the changes to social structure and the resource base and allocation – because of the changes in design standards, a road can be built most economically by labor intensive methods (costing 10–15% less than with mechanical methods), more rural employment is generated and there is growth in the local economy supplying the projects.

   The road program also includes a street-tree component, where citizens plant and maintain trees on both sides of the road, providing great relief to non-motorized travellers. Wells for safe drinking water are being drilled as part of the program.
2. *Transportation Rehabilitation Project*. One aspect of this project is the development and initial production of 250 bicycle trailers and promotion of bicycles for women. Surveys of women show that the equipment was readily accepted as a substitute for head-portage. Women have avidly taken to using the bicycle and trailer and there has been no cultural resistance to the change. The main problem identified is a lack of money or access to credit to buy the vehicles. This obstacle is being overcome by the purchase of the trailers by local NGO's, who then sell them to community members on instalment payback schemes.
3. *The Ministry Of Local Government's Bicycle Program*. Ghana is currently pursuing a decentralization and democratization process, but many of the 7,260 members and staff members of the new district assemblies have had trouble attending assembly and committee meetings and visiting constituents. The problem is most acute in the north where some areas are served by vehicles only once a week, roads are bad and bridges are weak. There are reports of assembly workers walking 50 km (31 miles) to perform assembly functions. However, the distances involved are moderate for bicycles, the terrain is flat and the weather lends itself to use of bicycles. Starting in 3 districts, the project is making bicycles available through a revolving fund on a hire-to-purchase plan. The program

is starting with 200 one speed roadster bikes with the goal of getting 1,000 bicycles.

The Transportation Rehabilitation program has met with good success and is now spurring employment by encouraging local entrepreneurs to produce trailers. The LG bicycle project is encouraging employment generation by training local youth to assemble, repair and maintain the bicycles. The road design program has so far trained 35 private contractors, employing over 3,000 people. The target is for 70% of the employees to be women and to combine the employment with nutrition education and vitamin and mineral supplement (iron was specifically mentioned for women.) Each employee works for about 3 months, receives food and vitamin/mineral subsidies, earns US$145 and has access to a savings plan to buy a bicycle to use on the new roads. The education and coordination of the program is provided by local NGO's, helping to strengthen these community organizations and insure their long term presence in the community.

14.8.8 Improving Urban Walkability in India (CSE 2009)

Table 14.5 indicates the mode split in Indian cities. The report *Footfalls: Obstacle Course To Livable Cities* (CSE 2009) evaluates walking conditions in Indian cities. Although walking is the dominant mode, representing 16% to 57% of urban trips, it receives little consideration in transport planning and investment: walking conditions are poor, with little investment, insufficient road space, and inadequate design and maintenance standards. The study argues that inadequate support for nonmotorized travel is inefficient and inequitable.

Table 14.5 Indian cities mode split, 2007

City category	City population	Walk	Bicycle	Motor-cycle	Public transport	Car	Auto rickshaw
Category-1a	<500,000, plain terrain	34	3	26	5	27	5
Category-1b	<500,000, hilly terrain	57	1	6	8	28	0
Category-2	500,000–1,000,000	32	20	24	9	12	3
Category-3	1,000,000–2,000,000	24	19	24	13	12	8
Category-4	2,000,000–4,000,000	25	18	29	10	12	6
Category-5	4,000,000–8,000,000	25	11	26	21	10	7
National		28	11	16	27	13	6

Wilbur Smith (2008)

The study developed a *Transport Performance Index* for evaluating urban transportation systems and prioritizing system improvements in Indian cities. It consists of the following factors:

- *Public Transport Accessibility Index* (the inverse of the average distance (in km) to the nearest bus stop/railway station (suburban/metro).
- *Service Accessibility Index* (% of Work trips accessible in 15 min time).
- *Congestion Index* (average peak-period journey speed relative to a target journey speed).
- *Walkability Index* (quantity and quality of walkways relative to roadway lengths).
- *City Bus Transport Supply Index* (bus service supply per capita).
- *Para-Transit Supply Index* (para-transit vehicle supply per capita).
- *Safety Index* (1/traffic fatalities per 100,000 residents).
- *Slow Moving Vehicle (Cycling) Index* (availability of cycling facilities and cycling mode share).
- *On-street Parking Interference Index* (1/(portion of major road length used for on-street parking + on-street parking demand).

14.8.9 Transport Policy Emission Impact Evaluation (www.asiandevbank.org/Documents/Evaluation/Knowledge-Briefs/REG/EKB-REG-2010-16.pdf)

The Asian Development Bank (ADB) is committed to assisting developing member countries (DMCs) in moving their economies onto low-carbon growth paths and to reduce their carbon emissions. The Bank has developed models for evaluating how specific transport policy decisions affect energy consumption and pollution emissions. It has expanded its policy and project economic evaluation to consider indirect impacts, including the effects of generated traffic, and co-benefits of demand management. This project has identified many cost effective and beneficial ways to improve overall transport system efficient and reduce emissions.

14.9 Criticisms

Mobility management may encounter the following criticisms (Litman 2008).

14.9.1 Costly and Dangerous

When evaluated using conventional transport economic analysis, individual mobility management strategies often seem cost ineffective. For example, individual pedestrian, cycling and public transit improvements often do little to reduce traffic

991 congestion, and because per-kilometer crash fatality rates are higher for pedestrians
992 and cyclists than for motor vehicle occupants, efforts to encourage non-motorized
993 travel may seem dangerous.

994 However, this reflects the inadequacies and biases of current transport economic
995 evaluation, which overlooks many mobility management benefits, and fails to recog-
996 nize the role that an individual strategy can play as part of a comprehensive mobility
997 management program (Litman 2008). Conventional evaluation overlooks many of
998 the costs of automobile dependency and sprawl, and many of the benefits of a more
999 diverse and efficient transport system. Although an individual strategy may appear
1000 to have modest impacts and benefits, an integrated program that includes improve-
1001 ments to alternative modes and incentives to use the most efficient option for each
1002 trip can have large impacts and benefits.
1003
1004
1005
1006 ### *14.9.2 Economically Harmful*
1007
1008 Critics sometimes argue that, because some economic activities are more efficient
1009 with motorized transport, and vehicle travel is associated with economic devel-
1010 opment and wealth, efforts to reduce vehicle travel reduce productivity and are
1011 economically harmful (Pozdena 2009). While it is true that a certain amount of
1012 motor vehicle travel can increase productivity, this does not mean that any increase
1013 in vehicle travel increases productivity or that any policy that reduces vehicle travel
1014 reduces economic development (Litman 2009). As discussed earlier, although motor
1015 vehicle travel can provide substantial benefits it also imposes substantial costs, so
1016 beyond an optimal level, increased vehicle travel is economically harmful. Mobility
1017 management strategies that reflect market and planning principles, such as more
1018 efficient pricing and more comprehensive evaluation, tend to increase productivity.

1019 Empirical evidence indicates that, among otherwise similar cities and countries,
1020 those that are more automobile dependent are less economically productive, while
1021 those that encourage use of alternative modes and have higher vehicle charges are
1022 more productive. For example, Fig. 14.2 shows that U.S. states with higher per
1023 capita vehicle travel tend to have lower average per capita gross domestic product
1024 (GDP).

1025 Figure 14.3 shows that per capita GDP tends to increase with public transit
1026 ridership in U.S. cities.

1027 Figure 14.4 shows that per capita economic productivity tends to increase with
1028 higher fuel prices, particularly among oil importing countries. This makes sense
1029 since higher fuel prices encourage efficient travel behavior and energy conser-
1030 vation, which reduces total transport costs (traffic congestion, road and parking
1031 facility costs, accident damages, pollution emissions, etc.), and reduces the export
1032 exchange that must be devoted to vehicle and fuel imports. This indicates that sub-
1033 stantial increases in vehicle fees can be achieved without reducing overall economic
1034 productivity.
1035

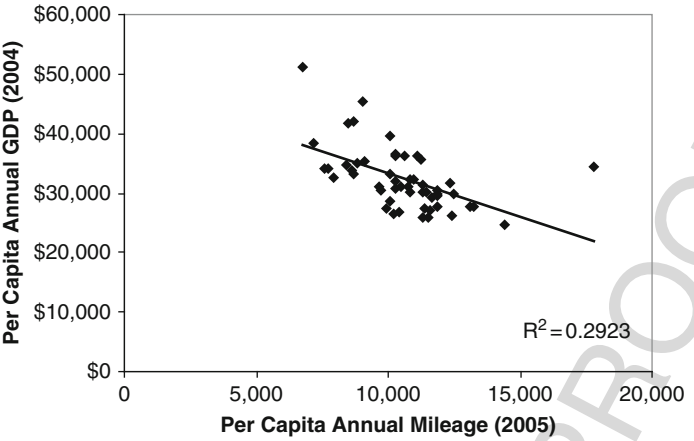

Fig. 14.2 U.S. state per capita GDP and VMT (VTPI 2009)
Note: Information in this and subsequent graphs is contained in the *2009 Urban Transportation Performance Spreadsheet* (www.vtpi.org/Transit2009.xls), based on data from the FHWA's *Highway Statistics*, the TTI's *Urban Mobility Report*, and the Bureau of Economic Account's *Gross Domestic Product By Metropolitan Area* (www.bea.gov/regional/gdpmetro)

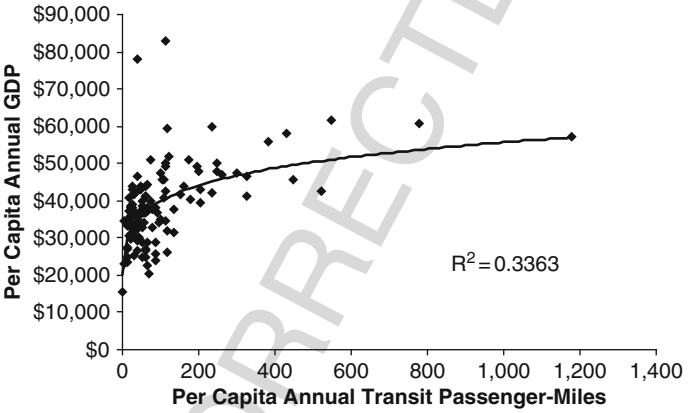

Fig. 14.3 Per capita GDP and transit ridership (VTPI 2009)

14.9.3 Unfair and Intrusive

Critics sometimes complain that a particular mobility management strategy is unfair or intrusive to a particular group. For example, if most roads and parking facilities are unpriced, road tolls and parking fees may seem unfair to urban motorists. Similarly, restrictions on vehicle travel, such as high occupant vehicle lanes or no-drive days may seem unfair. Yet, since automobile travel imposes significant

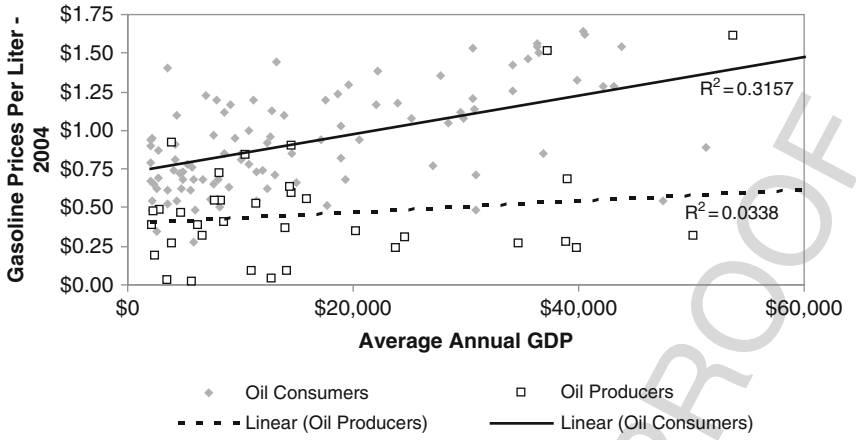

Fig. 14.4 GDP versus fuel prices, countries (Metschies 2005)
Note: Fuel price (www.internationalfuelprices.com), GDP (http://en.wikipedia.org/wiki/List_of_countries_by_GDP_(PPP)_per_capita) Petroleum production (http://en.wikipedia.org/wiki/Petroleum); excluding countries with average annual GDP under $2000

external costs, vehicle travel is unfair to other road users. For example, automobile travel is unfair to bus passengers, who are delayed by traffic congestion caused primarily by automobile travel which requires far more road space per passenger-kilometer, and to pedestrians and cyclists who bear excessive risk and pollution exposure. As a result, significantly higher user fees, and restrictions on vehicle use can be considered fairer overall.

14.10 Conclusions

Motor vehicle travel can provide significant benefits to individuals and society, but it also imposes significant costs. Although a certain amount of motor vehicle travel is efficient and beneficial overall, beyond an optimal level, the incremental costs exceed incremental benefits, resulting in vehicle travel with negative net value.

Many current policy and planning practices tend to favor mobility over accessibility and automobile travel over alternative modes. Many of these violate basic principles of good planning and efficient pricing, resulting in economically excessive motor vehicle travel. Correcting these distortions tends to reduce vehicle travel in ways that increase overall transport system efficiency. A general term for these reforms is *mobility management*, which includes various strategies that increase transport options (better walking, cycling, public transit, etc.), incentives to use more efficient transport options, and more accessible land use development patterns. This favors higher value trips and more efficient modes, increasing overall transport system efficiency.

Mobility management can provide many benefits including congestion reduction, road and parking facility savings, consumer savings, improved mobility for non-drivers, traffic safety, energy conservation, emission reductions, more efficient land use development, and improved public fitness and health. Where these strategies are implemented appropriately people tend to drive less, rely more on alternative modes, and are better off overall as a result. If fully implemented to the degree that is cost effective, mobility management strategies typically reduce motor vehicle travel by 30–50%, and even more in some situations, compared with what results from conventional policies and planning practices.

These reforms are particularly appropriate in developing countries to support economic development, social equity objectives, and to protect the environment for current and future generations.

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Chapter 14

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