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"Efficiency - Equity - Clarity"

Potential Transportation Demand Management Strategies

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Abstract

Travel demand management (TDM) includes a variety of strategies to encourage more efficient use of existing transportation systems. This can provide multiple benefits, including reduced traffic congestion, road and parking facility cost savings, user financial savings, increased road safety, increased travel choice (especially for non-drivers), increased equity, reduced pollution, and energy savings. TDM includes strategies that increase the quantity of travel alternatives such as transit, ridesharing, walking, bicycling, telecommuting and delivery services; strategies that reduce the need for travel by creating more efficient land use; and strategies to reward consumers for using the travel option that is most cost effective overall. Although most TDM strategies only affect a small portion of total travel, their cumulative impacts can be significant. This paper provides an overview of available TDM strategies. More than three dozen TDM strategies are described, and references are provided to facilitate additional research. It is intended to provide a starting point for developing TDM programs that best suit a particular situation.

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Introduction

Transportation Demand Management (TDM) includes various strategies to encourage more efficient travel patterns. This can provide multiple benefits, including reduced traffic congestion, road and parking facility cost savings, user financial savings, increased road safety, increased travel choice (especially for non-drivers), increased equity, reduced pollution, and energy savings.[1] TDM does not require everybody to give up driving. Rather, it encourages consumers to use alternatives when appropriate. Although most TDM strategies only affect a small portion of total travel, their cumulative impacts can be significant. Travel reductions of 20-50% are possible.

TDM planning is still a relatively new concept (although many strategies are actually quite old). Too often, TDM planning focuses on just a few strategies that are familiar to the people involved. Perhaps one participant likes ridesharing, another is enthusiastic about rail transit, a third supports telecommuting, and another prefers road pricing. Effective TDM planning should start with a review of the full scope of potential strategies to insure that some appropriate options are not overlooked.

This report is intended to provide a summary of all possible TDM options. More than three dozen TDM strategies are described. Of course, only some of these options may be appropriate for application in a particular situation.

Access, Mobility, Traffic

Transportation is seldom an end in itself. Even recreational travel usually has a destination. The ultimate objective of most transportation is "access," the ability to reach desired goods, services and destinations.[2] It is important with any transportation planning to keep in mind that vehicle traffic is just once means of achieving access. This is particularly important when planning travel demand management, since TDM involves alternative approaches that provide access with reduced mobility and vehicle travel.

Vehicle flow is relatively easy to quantify, so many transportation plans focus largely on traffic volumes and speeds to measure of transportation quality. Mobility and access are more difficult to measure, so they are often ignored. This tends to skew planning decisions toward capacity expansion and away from management alternatives. As a wider range of options are considered, including TDM, more efficient solutions can be identified and selected. Efficient transportation planning therefore requires focusing on access rather than vehicle flow as the measure of transportation service quality.

[1] Todd Litman, *Guide to Calculating TDM Benefits*, VTPI (www.vtpi.org), 1997.
[2] *Mobility and Access; Transportation Statistics Annual Report 1997*, Bureau of Transportation Statistics, USDOT (Washington DC; www.bts.gov), 1997.

Potential TDM Strategies, Programs and Measures

TDM strategies are sometimes classified as "carrots," which provide positive incentives, and "sticks," which provide negative incentives, but the terms we prefer are "sweeteners" and "levelers." In most cases, disincentives to driving, such as charging for parking rather than providing it for free, simply eliminate a subsidy or advantage that is currently offered to motorists.

A. Enabling Programs

Enabling programs provide an overall institutional framework for implementing TDM.

1. Reform Transportation Institutions to Support TDM

Successful TDM implementation requires clear goals and objectives, long-term planning and data gathering, coordination among numerous participants, leadership to overcome problems, funding mechanisms, and ongoing management. This currently does not exist in many jurisdictions. Since TDM programs often bridge traditional institutional and jurisdictional boundaries, implementation requires overcoming existing barriers. For example, TDM may require coordination between transportation and land use decision making, innovative public-private partnerships, and funding for non-traditional transportation programs.[3] Specific actions include creating a regional TDM plan, and providing support for policies and programs to achieve the plan's stated objectives. The first step may be a plan which details goals, objectives and organization responsibilities. For example, the British government has produced guideliens for developing "Green Transport Plans" which emphasize transportation demand management strategies.[4]

2. Least-Cost Transportation Planning and Funding

Least-cost (or "integrated") planning means that strategies to reduce demand are considered equally with strategies to increase capacity, that all significant impacts are considered, and that the public is involved in developing and evaluating alternatives.[5] This reduces institutional bias toward facility construction, allowing demand management strategies to receive appropriate consideration.[6] In one case study researchers estimated that Sacramento regional governments could justify spending $37 million per year on TDM programs if doing so could delay the need for anticipated roadway capacity

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[3] Reid Ewing, *Transportation and Land Use Innovations; When You Can't Build Your Way Out of Congestion*, Planners Press (Chicago; www.planning.org), 1997.

[4] Department of the Environment, Transport and the Regions (www.local-transport.detr.gov.uk/gtp/index.htm).

[5] *What Is Least Cost Planning?* (www.wsdot.wa.gov/regions/northwest/planning/least_cost_planning.htm), 1999; ECONorthwest and PBQD, *Evaluation of Transportation Alternatives; Least-Cost Planning: Principles, Applications and Issues*, Metropolitan Planning Tech. Rpt. #6, FHWA (www.fhwa.dot.gov/environment), 1995; *The Integrated Transport Planning Beginner's Handbook*, International Institute for Energy Conservation (Washington DC; www.iiec.org), 1996.

[6] Phil Goodwin, *Solving Congestion*, Inaugural Lecture for the Professorship of Transport Policy, University College London (London; www.ucl.ac.uk/~ucetwww/pbginau.htm), October 1997.

expansion by seven years.[7] Even greater TDM investments would probably be justified if additional nonmarket benefits were included in the analysis, such as reduced environmental impacts, and increased travel choices for nondrivers.

Least cost planning requires accurate prediction of "generated traffic," additional vehicle trips that tend to occur when capacity increases on congested roads. Ignoring this impact tends to overstate the benefits and understate the costs of increased roadway capacity.[8]

3. Comprehensive Market Reforms

The existing transport market has a number of distortions that encourage excessive automobile use.[9] Since governments must tax something to raise revenue, many economists recommend shifting taxes away from desirable activities to those that have more social costs.[10] Revenue from higher fuel taxes could reduce employment and general sales taxes. This can provide economic benefits by encouraging energy efficiency and technological innovation, reduce the economic costs of imported petroleum, and encourage employment and investment. One study found that increasing fuel taxes and using the revenues to replace income taxes could increase GDP by 7.7% and average household wealth by 5.5%, while reducing fossil-fuel use by 38%.[11]

4. Market TDM

Broad public relations programs can educate people about potential travel options and new policies, and explain their purpose and benefits.[12] Education programs can educate employers, developers and land owners about their potential benefits from reduced parking costs, public and employee relations benefits, reduced conflicts with local residents, and increased worker productivity from TDM programs.[13] Employees are more likely to participate in TDM programs if they receive direct encouragement from company officials.[14] TDM promotion requires high quality, professional campaigns.[15]

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[7] Caroline Rodier and Robert Johnston, "Incentives for Local Governments to Implement Travel Demand Management Measures," *Transportation Research A*, Vol. 31, No. 4, pp. 295-308, 1997.
[8] Todd Litman, *Generated Traffic; Implications for Transport Planning*, VTPI (www.vtpi.org), 1997.
[9] Todd Litman, *Socially Optimal Transport Prices and Markets*, VTPI (www.vtpi.org), 1998.
[10] Alan Durning and Yoram Bauman, *Tax Shift*, Northwest Environment Watch (Seattle; www.northwestwatch.org), 1998; Center for a Sustainable Economy (www.sustainableeconomy.org); Redefining Progress (www.rprogress.org).
[11] Douglas Norland and Kim Ninassi, *Price It Right; Energy Pricing and Fundamental Tax Reform*, Alliance to Save Energy (Washington DC; www.ase.org) 1998.
[12] *Go Boulder* (http://go.boulder.co.us/pubs/publications_menu.html) is good example. Also see Travelsmart campaign in Perth, Australia (http://sunsite.anu.edu.au/wa/bta/9805citw.htm#travelsmart).
[13] Frederick Wegmann, "Cost-Effectiveness of Private Employer Rideshare Programs: An Employer's Assessment," *Transportation Research Record, #1212*, 1991, pp. 88-100.
[14] Ali Modarres, "Evaluating Employer-Based Transportation Demand Management Programs," *Transportation Research*, 27A, No. 4, 1993, pp. 291-297.
[15] Information and Publicity Helping the Objective of Reducing Motorized Mobility (INPHORMM) (www.wmin.ac.uk/Env/UDP/phorm/inphormm.htm); Peter Everett and Lucie Ozanne, "Marketing Theory and Urban Transportation Policy," *Transportation Research Record #1402*, Oct. 1993, pp. 51-56.

5. Commute Trip Reduction Programs

Commute Trip Reduction (CTR) programs provide individual commuters with resources and incentives to reduce their vehicle trips. This often involves shifting parking subsidies and traffic management resources to supporting alternative travel modes. Trip reductions of 10-30% are common. Examples include:

- "Commuter Choice" parking cash out, and similar programs.[16]
- Transit discounts, rideshare programs, non-motorized travel, and reduce parking subsidies.
- Grade through high schools that encourage parents and students to use alternative modes.[17]
- Trip reduction programs for government agencies.[18]

6. Campus Transportation Management Programs[19]

College, university and research park campuses are particularly appropriate for transportation management, since they can provide central coordination and support. An increasing number of colleges offer free or discounted transit passes to all students and staff, rideshare and van pooling programs, bicycle and pedestrian improvements, parking price increases, coordination for recreation activity transportation (such as a ski bus program at Colorado University), and other support services.[20] Such programs are often cheaper to the campus than providing increased parking capacity and dealing with local traffic congestion, and are valued by students, particularly those with lower incomes.

7. Local Transportation Management Programs and Laws[21]

Municipal and regional government can establish programs and laws to support, coordinate and require specific transportation management activities. For example, they can require or reward: developments that are located in more accessible areas, employee TDM programs, tradeoffs between parking requirements and TDM programs, and bicycle/pedestrian facilities.

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[16] Commuter Choice Program, Transportation Air Quality Center, USEPA (www.epa.gov/oms/traq); Philip Winters and Daniel Rudge, *Commute Alternatives Educational Outreach*, National Urban Transit Institute, Center for Urban Transportation Research, USF (Tampa; www.cutr.eng.usf.edu), 1995; Washington State CTR Program (www.wsdot.wa.gov/pubtran/ctr).

[17] "Active and Safe Routes to School" (Ottawa; www.goforgreen.ca); Way To Go! School Program, (www.waytogo.icbc.bc.ca); SUSTRANS Safe Routes to School Project (www.sustrans.co.uk/srts).

[18] Nancy Skinner and Stuart Cohen, *Commuting in the Greenhouse; Automobile Trip Reduction Programs for Municipal Employees*, International Council for Local Environmental Initiatives (www.iclei.org), 1996.

[19] Françoise Poinsatte and Will Toor, *Finding a New Way: Campus Transportation for the 21st Century*, University of Colorado Environmental Center (Boulder; ecology@stripe.colorado.edu), 1999. For examples visit websites for the University of Washington U-PASS program at www.washington.edu/upass, and the University of British Columbia's TREK program at www.trek.ubc.ca.

[20] James Meyer and Edward Beimborn, *Evaluation of an Innovative Transit Pass Program: the UPASS*, Wisconsin Department of Transportation (www.uwm.edu/dept.cuts/upassum.htm), 1996; Michael E. Williams and Kathleen L. Petrait, "U-PASS: A Model Transportation Management Program that Works," *Transportation Research Record 1404*, 1993, pp. 73-81.

[21] Pleasanton, TSM Program (www.sustainable.doe.gov/codes/pleasnt1.htm), 1997; City of Cambridge, *Parking And Transportation Demand Management Planning* (http://bpc.iserver.net/codes/cbridge)

8. Transportation Management Associations (TMAs) and Coordinators

TMAs coordinate transport activities at worksite, neighborhood or municipal level, which is more effective than smaller, individual programs managed by individual employers.[22] Such programs distribute information, organize transportation fairs, perform ride matching, manage parking, sponsor guaranteed ride home services, and help plan transit, bicycle and pedestrian improvements, site amenities, etc.[23]

9. Manage Special Transport Activities (freight, special events, etc.)

Certain types of travel can be managed for efficiency. For example, travel to major sport and cultural events may be managed by providing shuttle buses, restricted parking, and information on travel alternatives.[24] The travel industry can develop and promote car-free vacations. Heavy trucks can be prohibited in congested areas during peak periods.[25]

10. Access Management[26]

Access management refers to coordination between roadway design and landuse planning to improve transportation. It includes the appropriate placement and design of driveways and sidestreets to minimize conflicts and hazards along arterials, and the design and location of development to improve access by different modes and minimize traffic problems.[27] Access management can help increase mobility and safety for non-motorized travel, improve transit service efficiency, and create more efficient land use.

11. Monitor Travel

"You can't manage what you can't measure." A significant amount of effort is often expended during TDM program development to monitor existing travel in order to provide baseline data and to determine which measures are most appropriate for specific situations. Surveys may be performed by firms or regional planning agencies.

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[22] Erik Ferguson, Catherine Ross and Michael Meyer, "Transportation Management Associations: Organization, Implementation, and Evaluation," *Transportation Research Record 1346*, 1992, pp. 36-43; Shirley Morrison Loveless and Jill Sebest Welch, "Growing to Meet the Challenges; Emerging Roles for Transportation Management Associations," *Transportation Research Record 1659* (www.nationalacademies.org/trb), 1999, pp. 121-128.

[23] For resources contact the Association for Commuter Transportation (http://tmi.cob.fsu.edu/act/act.htm). For an excellent example see the Hope Hospital transport website at www.hop.man.ac.uk/transport.

[24] Nada D. Trout and Gerald L. Ullman, "A Special Event Park-and-Ride Shuttle Bus Success Story," *ITE Journal*, December 1997, pp. 38-43.

[25] Hitoshi Ieda, "Potential of Regional Goods Transport Collaboration Toward Sustainable Urban Development," *IATSS Research*, Vol. 19, No. 2, Sept. 1995, pp. 79-87.

[26] U.S. National Transportation Library, Access Management Publication (www.bts.gov/ntl/subjects/access.html); Elizabeth Humstone & Julie Campoli, *Roadway Access Management Guide*, (www.plannersweb.com/access.html); website www.accessmanagement.gov.

[27] *Land Development and Subdivision Regulations that Support Access Management*, Center for Urban Transportation Research, University of South Florida (www.cutr.eng.usf.edu), 1995.

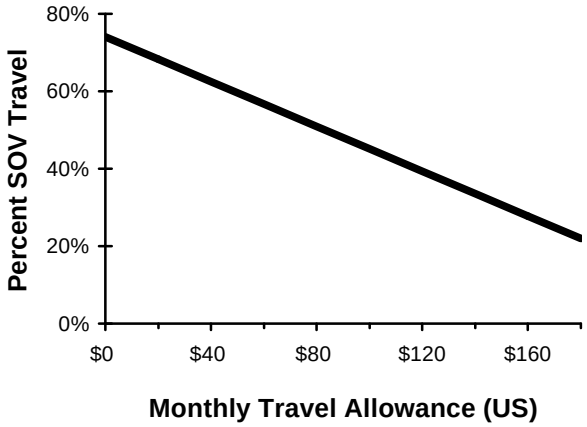
B. Alternative Mode Improvements and Encouragement

This includes measures that increase the number and quality of travel choices, and provide users with incentives to use more efficient modes.

1. Transportation Allowances/Subsidized Transit Passes

Transportation allowances or subsidized transit/van pool fares give employees a financial incentive to use alternative modes.[28] Such programs typically reduce automobile commutes by 10-30% compared with employers who provide free parking but no benefits for other modes.[29] Figure 1 illustrates the effect such economic incentives typically have on single occupant vehicle (SOV) commuting.

Figure 1 **Effect of Economic Incentives on SOV Rates**[30]



SOV travel decline as economic incentives for other modes increase.

2. Park-and-Ride Facilities

Park-and-ride lots allow suburban commuters to leave their vehicle while ridesharing or taking public transit.[31] Their effectiveness depends significantly on TDM goals. Automobile park-and-ride use reduces urban traffic congestion and downtown parking demand, but provides only minor reductions in air pollution and energy consumption since a major portion of automobile emissions occur during the first few kilometers that a vehicle is driven. In some circumstances, park-and-ride facilities may encourage urban sprawl by reducing the cost of long distance commutes.

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[28] Kiran Bhatt, "Review of Transportation Allowance Programs," *Transportation Research Record 1321*, 1991, pp. 45-50.
[29] Commuter Choice Program (www.epa.gov/oms/traq); Commuter Check (www.commutercheck.com).
[30] Rutherford, et al., "Transportation Demand Management: Case Studies of Medium-Size Employers," *Transportation Research Record, #1459*, 1995, p.15.
[31] Joan Al-Kazily, "Analysis of Park-and Ride Lot Use in the Sacramento Region," *Transportation Research Record 1321*, 1991, pp. 1-6.

3. HOV Facilities and Preferential Treatments

High occupant vehicles (HOVs) include transit buses, van pools, and car pools with either 2+, 3+ or 4+ passengers. HOV facilities include dedicated traffic lanes and queue-jumping lanes at highway on-ramps. Recent innovation in traffic light controls allows transit buses to receive preferential treatment in urban arterial traffic. HOV priority measures are efficient use of road space, an incentive for mode shift, and a way to minimize motor vehicle traffic while providing access to areas of intense activity, such as shopping districts and employment centers. HOV facility use depends on its specific location, and how well it integrates with other transit and rideshare promotion efforts. In general, HOV facilities are considered most effective in attracting additional HOV users where they save more than 10 minutes per trip.

4. Transit Service Improvements[32]

There are many potential ways to improve transit service, including additional routes, increased service frequency, express bus service, jitneys and paratransit,[33] reduced fares, improved information, more bus pullouts and shelters, and various comfort improvements. Each of these can have a role in encouraging a shift from auto to transit. Transit use tends to increase if individuals can easily purchase monthly passes.[34] Transit pass marketing can be particularly effective at collages and universities.[35] Various new transit fare payment methods allow faster boarding and eliminate barriers, particularly the need to have exact change.

5. Reform Motor Carrier Regulations for Competition and Efficiency[36]

Many jurisdictions limit transportation service competition. Private bus and jitney services are often prohibited or restricted in order to favor public monopoly transit. Regulations should be minimized and focused to address specific problems while encouraging competition, consumer choice and innovation. Taxies and taxibuses can provide cost efficient public transit services at times and areas where demand is low.[37]

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[32] John Pucher and Christian Lefevre, *The Urban Transport Crisis in Europe and North America*, MacMillan (London), 1997.

[33] Eric Bruun and Edward Morlok, *Advanced Minibus Concept: A New ITS Based Service for Low Density Markets*, Dept. of Systems Engineering, University of Pennsylvania (Philadelphia), May 1995.

[34] Judith Schwenk, *TransitChek in the New York City and Philadelphia Areas*, Volpe Transportation Systems Centre, USDOT (Washington DC; http://ohm.volpe.dot.gov), October 1995; Oram Associates, *Impact of the Bay Area Commuter Check Program: Results of 1994 Employee Survey*, Metropolitan Transportation Commission (www.commutercheck.com), 1995.

[35] UW UPass (www.washington.edu/upass); James Meyer and Edward Beimborn , *An Evaluation of an Innovative Transit Pass Program: The UPASS*, Wisconsin DOT; USDOT (DOT-T-96-16), March 1996.

[36] Daniel Klein, Adrian Moore and Binyam Reja, "Free to Cruise: Creating Curb Space for Jitneys," *Access*, No. 8, Spring 1996, pp. 2-6.

[37] Michel Trudel, "The Taxi as a Transit Mode," *Transportation Quarterly*, Vol. 53, No. 4, Fall 1999, pp. 121-130.

6. Rideshare Programs

Ridesharing includes carpooling, vanpooling, and subscription express bus (it is sometimes defined to also include conventional public transit). Rideshare programs typically provide car and vanpool matching, and vanpool sponsorship.[38] They may be managed at the firm, site or regional level.[39] A recent study identified various specific changes to transportation laws and policy to support vanpool programs.[40] Similar measures may be needed to promote express bus service.

7. Free Transit Zones and Shuttle Service

Free bus or shuttle service can be provided within central business districts and other areas of heavy demand. For example, comfortable and inexpensive shuttle bus service in Boulder, Colorado is designed to attract people out of their car.[41] These help reduce automobile trips within that area, and provide mobility for non-drivers.

8. Bicycle Improvements

Bicycle transportation is effective at meeting TDM goals since it tends to replace short distance, cold start trips.[42] There are many specific methods for accommodating and encouraging bicycle transportation.[43] Some facilities provide savings worth many times their initial cost, while others are hardly used. Bicycle paths that provide a shortcut or allow bicyclists to avoid heavy traffic, and secure and weather protected bicycle parking suitable for all day storage, appear to be especially effective in shifting automobile travel to bicycling.[44] Since bicycle planning has only recently received serious support there is a backlog of cost-effective improvements in most communities.

9. Pedestrian Improvements

Many strategies can help create a more pedestrian-friendly environment, including better sidewalks, crosswalks, and other street design features that accommodate pedestrians, and traffic calming strategies to reduce traffic speeds and volumes.[45] Building site design also affects pedestrian travel.[46] Residents of pedestrian-friendly areas tend to walk and bicycle more, ride transit more, and drive less than comparable households in other areas.[47]

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[38] Steve Beroldo, "Ridematching System Effectiveness: A Coast-To-Coast Perspective" *Transportation Research Record 1321*, 1991, pp. 7-12.
[39] Bill Legg, "Public-Private Partnership in Transportation Demand Management," *Transportation Research Record 1346*, 1992, pp. 10-13.
[40] Urban Systems, *Potential for Commuter Vanpool Services*, GVRD (Vancouver), 1995.
[41] Go Boulder (http://go.boulder.co.us/pubs/hopskip_menu.html).
[42] Todd Litman, "Bicycling and Transportation Demand Management," *Transportation Research Record 1441*, 1994, pp. 134-140.
[43] John Pucher, "Bicycling Renaissance in North America: Recent Trends and Alternative Policies to Promote Bicycling," *Transportation Research A*, Vol. 33, Nos. 7/8, Sept./Nov. 1999, pp. 625-254.
[44] See suggestions at www.jps.net/cbc/longbikepark.html.
[45] Steven Burrington and Veronika Thiebach, *Take Back Your Streets*, Conservation Law Foundation (Boston; www.clf.org), 1995.
[46] Ellen Vanderslice, *Portland Pedestrian Design Guide*, and *Pedestrian Master Plan*, Pedestrian Transportation Program, City of Portland (www.trans.ci.portland.or.us), 1998;

10. Bicycle/Transit Integration[48]

Bicycling and transit are complementary modes. Bicycling is ideal for relatively short (less than 3 mile) trips with multiple stops on lower traffic roads, while transit is most effective when traveling longer distances along busy corridors. Coordination can be enhanced by bicycle racks and storage lockers near bus stops, racks for carrying bicycles on buses and van pools, and bike routes to transit stops.

11. Telecommuting[49]

Telecommuting is broadly defined as using communications technology to replace commuting.[50] It typically means that employers allow certain employees to work at home or at a local workstation either part- or full-time. It often requires at least some additional equipment, although as computers and communications equipment become more common and portable, incremental costs decline.

12. Alternative Work Hours

Flexible work hours ("flextime") can reduce peak period congestion directly[51] and employees often report that rigid schedules (such as needing to punch a time clock at a particular time) are a barrier to rideshare and transit use.[52] Compressed workweeks, such as four workdays of ten hours (a "4/40" schedule) reduces commuting trips by 20%, although it can increase non-work, off-peak automobile trips.[53] These scheduling options tend to be valued by employees, provided that they are optional. A recent study indicates that some of the claimed travel reductions from compressed work schedules under mandatory CTR programs may not actually occur.[54]

13. Guaranteed Ride Home

Many commuters feel trapped without a car. Guaranteed ride home programs provide occasional backup mobility.[55] This typically involves occasional use of company cars or subsidized taxi rides. Experience indicates that it is seldom used so costs are low.

Pedestrian Facilities Guidebook: Incorporating Pedestrians Into Washington's Transportation System, Washington State Department of Transportation (Olympia; www.wsdot.wa.gov/ta/t2/t2pubs.htm), 1997.

[47] Project for Public Spaces, Inc. *Transit-Friendly Streets: Design and Traffic Management Strategies to Support Livable Communities*, TCRP Report 33, TRB (Washington DC; www.nas.edu/trb), 1998; Parsons Brinckerhoff, *The Pedestrian Environment*, 1000 Friends of Oregon (www.teleport.com/~friends), 1993

[48] Transit Cooperative Research Program *TCRP Synthesis 4, Integration of Bicycles and Transit,* Transportation Research Board (www.nas.edu/trb), 1994.

[49] International Telework Association (www.telecommute.org) and InnoVisions Canada (www.ivc.ca).

[50] Mokhtarian, "Defining Telecommuting," *Transportation Research Record, #1305*, 1991, pp. 273-281.

[51] Rudy Hung, "Using Compressed Workweeks to Reduce Work Commuting," *Transportation Research A*, Vol. 30, No. 1, 1996, pp. 11-19.

[52] Alyssa Freas and Stuart Anderson, "Effects of Variable Work Hour Programs on Ridesharing and Organizational Effectiveness, *Transportation Research Record, #1321*, 1991, pp. 51-56.

[53] Amy Ho and Jakki Stewart, "Case Study on Impact of 4/40 Compressed Workweek Program on Trip Reduction," *Transportation Research Record, #1346*, 1992, pp. 25-32.

[54] Genevive Giuliano, University of Southern California, communication, July 18, 1995.

[55] Cosette Polena and Lawrence Jesse Glazer, "Examination of 11 Guaranteed Ride Home Programs Nationwide," *Transportation Research Record, #1321*, , 1991, pp. 57-65.

14. Address Security Concerns

Under some circumstances individuals feel unsafe or uncomfortable walking, bicycling or riding a bus.[56] One CTR study found that increased aesthetic and safety factors at employment sites significantly reduce automobile commuting.[57]

[56] Gerald Ingalls, David Hartgen and Timothy Owens, "Public Fear of Crime and Its Role in Bus Transit Use," *Transportation Research Record #1433*, Sept. 1994, pp. 201-211.

[57] Cambridge Systematics, *Effects of Land Use and Travel Demand Management Strategies on Commuting Behavior*, USDOT (Washington DC), DOT-T-95-06, November 1994, pp. 3-17 to 3-21.

C. Driving Disincentives

The following measures discourage automobile use.

1. Full-Cost Pricing

Full-cost pricing means that user prices reflect costs. A number of experts argue that motor vehicle travel is subsidized and underpriced, and that full-cost pricing (or at least, fuller-cost pricing) should be implemented to increase equity and economic efficiency.[58] Fuller-cost pricing would involve a number of specific changes in transportation pricing (such as mileage, road pricing, and parking charges described below).

2. Mileage Fees

Mileage fees are relatively effective at reducing vehicle travel.[59] A weight-distance fee is based on a vehicle's type, size, and weight, multiplied by mileage. This more accurately represents costs imposed than current vehicle charges.[60] A mileage-based emission charge gives consumers an incentive to reduce pollution by driving less or using a lower emission vehicle, and is more equitable than a fixed pollution charge.[61] Each 1¢/mile VMT charge is estimated to reduce vehicle travel by approximately 2%.[62]

3. Increase Fuel Taxes

Fuel taxes can be raised as part of comprehensive market reforms (such as revenue-neutral tax shifting described earlier), as a carbon tax, or to achieve specific objectives, such as roadway funding. An increasing portion of road costs are borne by general taxes rather than user fees, which tends to be unfair and inefficient.[63] External costs of petroleum production and consumption (including environmental damages, tax subsidies, micro-economic and security costs of petroleum imports) are estimated to average $0.30-1.00 per gallon.[64] General sales taxes can be applied to vehicle fuel where it is currently exempt, for the sake of economic neutrality, and fuel taxes can be increased to cover local road costs currently funded by local property and sales taxes.

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[58] Mark Delucchi, "Total Cost of Motor-Vehicle Use," *Access*, No. 8, Spring 1996, pp. 7-13; Todd Litman, *Optimal Transport Pricing and Markets*, VTPI (www.vtpi.org), 1998; IBI Group, *Full Cost Transportation Pricing Study*, Transportation and Climate Change Collaborative (Toronto), Nov. 1995.

[59] ICF Incorporated, *Opportunities to Improve Air Quality Through Transportation Pricing Programs*, USEPA (Washington DC; www.epa.gov/omswww/market.htm), Sept. 1997; Michael Cameron, *Efficiency and Fairness on the Road*, Environmental Defense Fund (Oakland; www.edf.org), 1994.

[60] *1997 Federal Highway Cost Allocation Study*, USDOT (www.ota.fhwa.dot.gov/hcas/final), 1997.

[61] Margaret Walls and Jean Hanson, *Distributional Impacts of an Environmental Tax Shift: The Case of Motor Vehicle Emissions Taxes*, Resources for the Future (Washington DC; www.rff.org/disc_papers), 1996. Lower income households tend to own relatively high polluting vehicles, but drive less than wealthier families, so a fixed annual emission charges is most regressive.

[62] *Guidance on the Use of Market Mechanisms to Reduce Transportation Emissions*, USEPA (Washington DC; www.epa.gov/omswww/market.htm) September 1997, Appendix B.

[63] Mary Hill, Brian Taylor and Martin Wach, "Gas Tax Dilemma" *Access.* Number 14, UCTC, (http://sacrates.berkeley.edu/~uctc), Spring 1999.

[64] *ExternE; Newsletter 6*, European Commission (http://externe.jrc.es), March 1998; Mark Delucchi and James Murphy, *U.S. Military Expenditures to Protect the use of Persian-Gulf Oil for Motor Vehicles*, Institute of Transportation Studies (Davis), April 1996.

4. Road Pricing

Road pricing charges for use of a specific roadway, including highway tolls and area licensing.[65] Congestion pricing is a type of road pricing that represents congestion costs a vehicle imposes on other road users.[66] Although congestion pricing is receiving increasing attention, few projects have actually been implemented.

5. Vehicle Restrictions

A number of regulatory strategies are used in various communities to discourage or prohibit automobile use. Some cities have restricted vehicles based on their license plate numbers, banned all private automobiles from downtown areas on certain days, or are implementing strategic plans to discourage private automobile use.[67] Various cities have implemented automobile restrictions,[68] including Amsterdam, which has a long-term goal of reducing automobile traffic by 50%.[69]

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[65] *Curbing Gridlock; Peak-Period Fees to Relieve Traffic Congestion*, National Research Council Special Report #242, National Academy Press (Washington DC; www.nas.edu/trb), 1994.
[66] *Buying Time; Research and Policy Symposium on the land use and Equity Impacts of Congestion Pricing*, Institute of Public Affairs, University of Minnesota (Minneapolis; www.hhh.umn.edu), 1996.
[67] Suzanne Corwhurst Lennard & Henry Lennard, *Livable Cities Observed*, Gondolier (Carmel), 1995.
[68] *Urban Travel and Sustainable Development*, OECD (Paris), 1995, pp. 114-115.
[69] Leo Lemmers, "How Amsterdam Plans to Reduce Car Traffic," *World Transport Policy and Practice*, Vol. 1, No. 1, 1995, pp. 25-28.

D. Parking Programs

Some of the most effective TDM strategies involve parking management. Comprehensive parking programs are important to avoid interjurisdictional competition and spillover.[70]

4. Increased and Marginalized Parking Prices

Charging parking at full cost can significantly reduce automobile use.[71] Table 1 summarizes the typical effect of parking charges on commute trip. Free parking is often justified by the high transaction costs of conventional meters, which require user to have correct change and predict how long they will be parked. These costs can be reduced with innovative charging technologies.[72] Parking, when it is not free, is often rented by the month, and long-term renters receive bulk discounts. To support TDM, parking should be rented on a daily basis, or monthly rates should be prorated.[73] This gives commuters an incentive to use alternative modes, even if they can only do so part-time.

Table 1 **Commute Trip Reductions from Daily Parking Charges**[74]

	$1	**$2**	**$3**	**$4**
Suburb	6.5%	15.1%	25.3%	36.1%
Suburban Center	12.3%	25.1%	37.0%	46.8%
Central Business District	17.5%	31.8%	42.6%	50.0%

2. "Cash Out" Free Parking.

This involves giving commuters who receive free parking the cash equivalent if they don't drive. [75] This tends to reduce automobile commuting by 10-40%, and increases equity by giving non-drivers a benefit comparable to what automobile commuters receive. Since parking is tax deductible but cash pays are not, it can also increase tax revenue.

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[70] K.T. Analytics, Inc., *Parking Management Strategies: A Handbook For Implementation*, Regional Transportation Authority (Chicago), 1995; Donald Shoup, "An Opportunity to Reduce Minimum Parking Requirements," *Journal of the American Planning Association*, Vol. 61, No. 1, Winter 1995, pp. 14-28.

[71] Richard Willson, "Parking Pricing Without Tears: Trip Reduction Programs," *Transportation Quarterly*, Vol. 51, No. 1, Winter 1997, pp. 79-90; Gerard Mildner, James Strathman and Martha Bianco, "Parking Policies and Commuting Behavior," *Transportation Quarterly*, Vol. 51, No. 1, Winter 1997, pp. 111-125.

[72] James Luk, *Technologies for On-Street Paid Parking*, Australian Road Research Board, 1995.

[73] For example, if parking costs $50 per month, commuters should pay $30 if they only drive 3 days a week.

[74] Philip Winters and Daniel Rudge, *Commute Alternatives Educational Outreach*, National Urban Transit Institute, Center for Urban Transportation Research (Tampa; www.cutr.eng.usf.edu), 1995, Table 3.3-8.

[75] *Local Government Guide to Parking Cash Out*, International Council for Local Environmental Initiatives, (www.iclei.org/us), 1998; Donald Shoup, "Congress Okays Cash Out," *Access*, No. 13, UCTC (http://socrates.berkeley.edu/~uctc), Fall 1998, pp. 2-8; Donald Shoup, "Cashing Out Employer-Paid Parking," *Journal of the American Planning Association*, Vol. 61, No. 1, Jan. 1995, pp. 14-28.

3. Reduced and Flexible Parking Requirements.[76]

Generous parking is required by most zoning laws, resulting in significant oversupply. This gives businesses little incentive to encourage TDM, since reduced driving results in empty parking spaces rather than financial savings. Parking facilities can be managed for greater efficiently. Shared- rather than assigned-parking spaces typically allows a 20% reduction in supply. Residential parking can be managed for greater efficiency and equity by better matching parking requirements to vehicle ownership.[77] Mixed land use allows parking supply reductions since some uses have weekday peaks, while others have evening and weekend peaks. Flexible zoning laws allow firms to trade capacity among themselves to optimize use and support TDM goals.

4. Preferential Parking for Rideshare Vehicles.

Preferential parking spaces are often allotted as an incentive to car and vanpools. The effectiveness of such a measure is uncertain. Rideshare vehicles often receive discounted or free parking where other vehicles must pay. This can be an effective TDM measure if it creates a significant price difference between SOV and rideshare travel.

[76] John Shaw, *Planning for Parking*, Public Policy Center, University of Iowa, Iowa City, 1997; Todd Litman, *Pavement Busters Handbook*, VTPI (www.vtpi.org), 1998.

[77] *Reducing Housing Costs by Rethinking Parking Requirements*, The San Francisco Planning and Urban Research Association (www.spur.org), 1998; Todd Litman, *Parking Requirement Impacts on Housing Affordability*, VTPI (www.vtpi.org), 1998.

E. Marginalizing User Costs and Reducing Automobile Ownership

Automobiles are expensive to own but cheap to use. Converting fixed costs into variable costs ("Marginalizing costs") can be effective at reducing vehicle use.

1. Prorate Insurance, Licensing and Registration by Mileage

Although insurance is the second largest motor vehicle expense, it is usually perceived as a fixed cost with respect to vehicle travel. In most cases, a reduction in driving provides little or no insurance cost savings. This is the wrong price incentive, since the more a vehicle is used, the greater are its chances of having accidents and insurance claims. This means that insurance payments on lower mileage vehicles subsidize accident costs of higher mileage drivers in the same risk class. Changing insurance pricing to make it distance-based could increase both economic efficiency and equity.[78]

Per-mile insurance would increase vehicle operating costs by 5-6¢ per mile, offset by a reduction in fixed vehicle costs of about $700 per year. This is predicted to reduce vehicle travel by approximately 10%. This price structure is justified for the sake of actuarial accuracy (premiums would more accurately reflect insurance claim costs) equity, affordability, and road safety, in addition to other TDM objectives.

2. Distance-Based Vehicle Purchase Taxes

Another feasible pricing shift is to convert vehicle purchase taxes into distance-based mileage taxes (or even fuel taxes). Purchase taxes average about $1,200 per vehicle (assuming $20,000 price and 6% average sales tax rate), which could convert to a 1¢ per mile charge (assuming 10-year vehicle life, 6% discount rate, 12,500 miles per year).

3. Encourage Vehicle Rentals and Ownership Cooperatives.[79]

Car sharing and neighborhood vehicle rentals can help create a more optimal transport market by offering more ways to use a vehicle without owning it.[80] This results in low fixed costs and relatively high variable costs (typically 25¢ per mile plus $1.00 per hour). Studies indicates that households that join carshare organizations typically reduce their driving an average of 40-60%.[81]

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[78] Todd Litman; *Distance-Based Vehicle Insurance; A Practical Strategy for More Optimal Pricing*, VTPI (www.vtpi.org), 1998; Todd Litman, "Distance-based Vehicle Insurance as a TDM Strategy," *Transportation Quarterly*, Vol. 51, No. 3, Sum. 1997, pp. 119-138.

[79] Susan Shaheen, Daniel Sperling, and Conrad Wagner, "Carsharing in Europe and North America: Past, Present, and Future," *Transportation Quarterly*, Vol. 52, No. 3, Summer 1998, pp. 35-52; Carsharing websites: at www.ecoplan.org/carshare, www.carsharing-pdx.com and www.carsharing.net).

[80] Some people have questioned the need for special car sharing programs, since most communities have automobile rental businesses. But such businesses are primarily located at airports and major commercial centers, they emphasize higher-priced vehicles, and usually price by the day. Few households have a lower-priced vehicle to rent by the hour within easy walking distance of their residences that would conveniently substitute for personally owned vehicles.

[81] K. Steininger, C. Vogl and R. Zettl, "Car Sharing Organizations," *Transport* Policy, Vol. 3, No. 4, 1996, pp. 177-185; CarSharing*: Carfree but Carefree*, Car Free Cities Network (Bruxelles); *Pay as You Drive Carsharing*, EU SAVE (ftp://ftp.the-commons.org/pub/carshare), 1998.

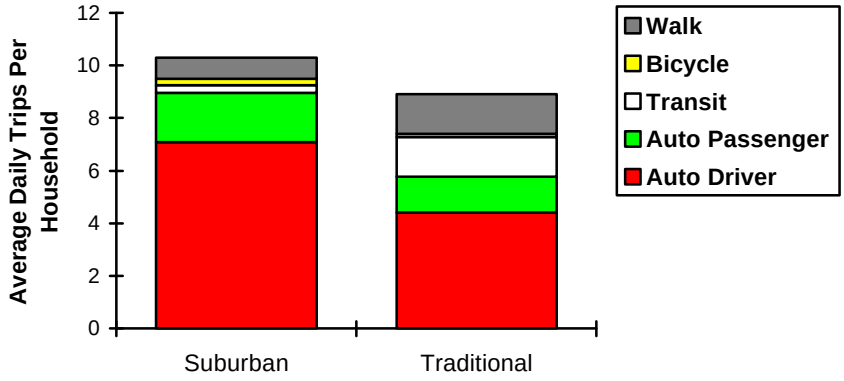
F. Land Use Management

Land use management strategies described in this section help create more transportation efficient communities.[82]

1. Higher Density/Mixed Use/Growth Management

Increased residential and employment densities, mixed land use, and jobs-housing balance can reduce total vehicle travel as common destinations (stores, services, jobs) become closer together.[83] This is called "access by proximity." These benefits occur in both urban and suburban areas.[84] For example, a household in a low density, auto-oriented suburb will make, on average, 7.7 vehicle trips per day, while the same household in a higher density, transit-oriented suburb will make 6.05 vehicle trips per day, a 21% reduction in personal travel.[85] A variety of specific land use strategies can help reduce vehicle travel.[86] The United Kingdom is using land use management as a key strategy in reducing transportation carbon emissions and other environmental impacts.[87]

Figure 2 **Average Daily Trips Per Household by Neighborhood Type**[88]



The number of trips and the portion of automobile trips per household are significantly higher in suburban communities due to poor access and fewer travel choices.

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[82] Reid Ewing, *Best Development Practices; Doing the Right Thing and Making Money at the Same Time*, Planners Press (Chicago; www.planning.org), 1996; Jack Faucett Associates and Sierra Research, *Granting Air Quality Credits for Land Use Measures: Policy Options*, USEPA (www.epa.gov/oms/transp), 1999.

[83] Eric Damian Kelly, "The Transportation Land-Use Link," *Journal of Planning Literature*, Vo. 9, No. 2, November 1994, p. 128-145.

[84] R. Ewing, P. Haliyur and G. W. Page, "Getting Around a Traditional City, a Suburban Planned Unit Development, and Everything in Between," *Transportation Research Record, #1466*, , 1995, pp. 53-62.

[85] Cambridge Systematics, Inc, *The LUTRAQ Alternative /Analysis of Alternatives*, 1000 Friends of Oregon (Portland; www.friends.org), 1992.

[86] JHK & Associates, *Transportation-Related Land Use Strategies to Minimize Motor Vehicle Emissions*, California Air Resources Board (Sacramento), 1995, p. 1-4.

[87] Ecotec Research and Transportation Planning Associates, *Reducing Transport Emissions Through Planning*, Dept. of the Environment, HMSO (London), 1993.

[88] Bruce Friedman, Stephen Gordon, John Peers, "Effect of Neotraditional Neighborhood Design on Travel Characteristics," *Transportation Research Record, #1466*, 1995, pp. 63-70.

2. Neotraditional Neighborhoods and Transit Oriented Development

Neotraditional neighborhood design emphasizes small-scale blocks, an interconnected street network, good pedestrian and bicycle facilities, and moderate to high density mixed land use. Research indicates that residents in such neighborhoods have significantly fewer automobile trips than residents in automobile dependent areas, as illustrated in Figure 2.

Transit oriented design places higher density development within reasonable walking distance of high quality transit service and design features to support a variety of modes.[89] Services frequently used by commuters should be located at transit and employment centers, including childcare, cafes, and shops.[90] Some transit oriented neighborhood, such as Peter Calthorp's Pedestrian Pockets, are designed as a unit,[91] but this is not always possible since most urban development occurs incrementally.

3. Traffic Calming

Traffic calming includes various strategies to reduce traffic speeds and volumes on specific roads, and make them more pedestrian- and bicycle-friendly.[92] This can provide a variety of economic, social and environmental benefits.[93] In many cases streets can be redesigned to provide a number of benefits.[94]

4. Transportation-Efficient Development and Location-Efficient Mortgages

Transportation-efficient housing is located to be accessible to common services (shops, schools, etc.), jobs and transit service.[95] This allows households to reduce their automobile ownership expenses. Location-efficient mortgages mean that these household transportation cost saving are considered by lenders when assess mortgages.[96] This provides an added incentive for households to choose transportation-efficient housing. Some planners are experimenting with "car free" housing developments specifically designed to accommodate households that do not own a motor vehicle and take advantage of community benefits of reduced vehicle traffic (such as using land that would be needed for parking in an automobile-dependent area for common greenspace).[97]

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[89] *Transit and Land Use*, BC Transit (Surrey), 1994.

[90] Diane Davidson, *Corporate Amenities, Trip Chaining and Transportation Demand Management*, FTA-TM 08-7002-94, USDOT (Washington DC), March 1994.

[91] Stephen Gordon and John Peers, "Designing a Community for Transportation Demand Management: The Laguna West Pedestrian Pocket," *Transportation Research Record, #1321*, 1991, pp. 138-145.

[92] TAC, *Canadian Guide To Traffic Calming*, Transportation Asso. of Canada (Ottawa; www.tac-atc.ca), 1999; PTI, *Slow Down You're Going Too Fast*, Public Technology Incorporated (http://pti.nw.dc.us/task_forces/transportation/docs/trafcalm).

[93] Todd Litman, *Traffic Calming Costs, Benefits and Equity Impacts*, VTPI (www.vtpi.org), 1997.

[94] Dan Burden and Peter Lagerway, *Road Diets Free Millions for New Investment*, Walkable Communities (www.walkable.org), 1999.

[95] Patrick Hare, *Planning, Transportation and the Home Economics of Reduced Car Ownership: Planning as if Household Budgets Mattered*, Hare Planning (Washington DC), 1995.

[96] Kim Hoeveler, "Accessibility vs. Mobility: The Location Efficient Mortgage," *Public Investment*, American Planning Asso. (Chicago; www.planning.org) and Center for Neighborhood Technology (www.cnt.org/lem), 1997; David B. Goldstein, *Making Housing More Affordable Correcting Misplaced Incentives in the Lending System*, NRDC (www.nrdc.org), 1996.

[97] Jan Scheurer, *Car-Free Housing in European Cities*, ISTP (http://wwwistp.murdoch.edu.au).

"Smart Growth" Land Use Management Practices[98]

1. Establish a comprehensive community "vision" which individual land use and transportation decisions should support. Require that development be consistent with this strategic plan.
2. Create more self-contained communities and neighborhoods, with balanced housing, jobs and commercial development. For example, develop schools, convenience shopping and recreation facilities in new subdivisions. Mix land uses at the finest grain feasible.
3. Avoid overly-restrictive zoning. Limit undesirable impacts (noise, smells and traffic) rather than broad categories of activities. For example, allow shops and services to locate in neighborhoods provided that they are sized and managed to avoid annoying residents.
4. Encourage cluster development. Keep clusters small and well defined, such as "urban villages" with distinct names and characters. Coordinate development to facilitate accessibility. For example, encourage employment centers near commercial centers, so employees can walk to perform errands during their breaks.
5. Encourage quality, higher density development. Eliminate unnecessary restrictions on density. Encourage high quality design that addresses concerns about density.
6. Encourage infill development. Review public costs to insure that public expenditures do not favor new, greenfield development over existing residents or infill development. Use impact fees and utility pricing that reflects the costs of providing public services to different sites. Encourage the rehabilitate and redevelopment of older facilities and brownfields.
7. Concentrate commercial activities in compact centers or districts. Use access management to prevent arterial strip commercial development.
8. Reduce excessive and inflexible parking and road capacity requirements.
9. Develop a network of relatively direct, interconnected street. Keep streets as narrow as possible, particularly in residential areas and commercial centers. Use traffic management and traffic calming to control vehicle impacts rather than dead ends and cul de sacs.
10. Encourage shared parking facilities and parking management strategies.
11. 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.
12. Create pedestrian- and transit-friendly commercial centers.
13. Use transportation demand management strategies to reduce total vehicle traffic.
14. Preserve open space, particularly areas with high ecological and recreational value. Channel development into areas that are already disturbed.
15. Use on-site stormwater drainage systems.
16. Place higher density housing near commercial centers, transit lines and parks.
17. Encourage a mix of housing types and prices. Develop affordable housing near employment, commercial and transport centers. Develop second suites, apartments over shops, lofts, location-efficient mortgages and other innovations that help create more affordable housing.

[98] Reid Ewing, *Best Development Practices*, Planners Press (Chicago; www.planning.org), 1996.

IV. Evaluation of TDM Strategies and Programs

There are two steps in evaluating TDM programs:

1. *Determine travel impacts.* These may include changes in travel time, mode, and the total amount of vehicle travel. There are a number of traffic and specialized models that can be used to help predict these impacts.[99] Many conventional traffic models cannot accurately evaluate TDM strategies (particularly if they have fixed trip tables, or are not calibrated for TDM-type incentives).

2. *Determine costs and benefits.* It is important to consider the full range of costs and benefits.[100] Conventional transport planning tends to focus primarily on a limited number of impacts. Costs are typically defined as financial costs to users and government agencies, while benefits are defined in terms of congestion reduction and air emission reductions. A more comprehensive analysis often gives different conclusions as to which strategies are "best" (see example in box below). In general, comprehensive analysis increases support for TDM programs, particularly those that reduce total vehicle travel, compared with increased roadway capacity, trip route- and time-shifting options.

Many TDM program impacts are economic transfers, not actual costs or benefits. For example, pricing strategies represent an increased cost to users, but revenue to the agencies or businesses that collect the revenue. The only real economic costs of such pricing strategies are the transaction costs involved in collecting fees. Of course, some costs and benefits may have greater weight in a particular planning decision. For example, costs imposed on residents in other communities are often given less weight by decision-makers in a particular jurisdiction.[101]

Some individual TDM measures (such as a guaranteed ride home and transit information improvements) have little impact on their own, but can be quite important as part of an overall program.

It is important to determine the *difference* in costs when evaluating mode shifts. For example, a shift from driving to public transit reduces automobile costs, but increases transit costs. The net benefit is therefore the difference in per-passenger-trip costs between these two modes. Computer models are available that calculate these cost differences for various modes.[102]

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[99] *TSM Cost-Effectiveness Model for Suburban Employers*, JHK & Associates (Emeryville, CA), 1995 (computer spreadsheet for evaluating employer CTR measure effectiveness, in terms of cost per trip reduced for 15 specific measures); COMSIS, *TDM Evaluation*, California Air Resources Board (Sacramento), 1994.

[100] National Highway Institute, *Estimating the Impacts of Urban Highway Alternatives*, FHWA (www.fhwa.dot.gov/environment), FHW-HI-94-053, December 1995.

[101] The ideal revenue source to most public officials is to tax foreigners living abroad (Monty Python).

[102] Todd Litman, *Transportation Cost Analyzer*, VTPI (www.vtpi.org), 1996.

Conventional vs. Comprehensive Analysis of Benefits

A main highway between a city and its suburbs is increasingly congested. Adding one lane in each direction would accommodate 3,000 additional peak period vehicles and is estimated to cost approximately $250 million, while a light rail option to accommodate the same number of trips would cost approximately $300 million.

But these estimates only consider project construction costs. Other important impacts were overlooked.[103] For example, additional vehicles traveling into the city require additional parking and exacerbate traffic congestion on surface streets, resulting in additional future expenditures on road and parking facilities. Construction traffic delays and the effects of generated traffic are ignored. These costs could be avoided if the trips were made by transit.

The highway alternative also requires users to own and drive an automobile. Although vehicle *operating costs* and *transit fares* were considered, other vehicle costs were ignored. Public transit improvements allow some households to reduce vehicle ownership costs. In addition to these financial impacts, there are also a number of environmental and social benefits. Public transit is able to serve non-drivers, reduces air and water pollution, and discourages urban sprawl.

Highway Vs. Transit Investments

Estimated costs to accommodate 3,000 new trips:

Conventional Analysis	
Light Rail:	$300 million
Highway Expansion:	$250 million
Highway Option Net Benefits:	*$50 million*
Costs Not Considered:	
Parking (assuming 3,000 urban parking spaces with average cost of $10,000 each)	~$30 million
Surface street traffic congestion (assuming 3,000 additional vehicles traveling 10 km per day, 300 days per year on surface streets during peak periods, with an average cost of $0.20 per km, over 25 years with a 7% discount rate)	~$35 million
Construction Traffic Delays	~$5 million
Generated Traffic (Reduces net benefits of highway project)	Probably substantial
Vehicle Ownership Costs (assuming 20% of users save $2,500 annually)	~$30 million
Environmental & Social Benefits	? (probably substantial)
Transit Option Net Benefits	*$50 million+*

This is not to say that highway projects are never worthwhile, but it does show that significant impacts can be overlooked, which affects the evaluation of transportation investments and policy decisions. Similarly, other TDM strategies tend to become more economically attractive as a wider range of benefits and costs are considered.

[103] National Highway Institute, *Estimating the Impacts of Urban Transportation Alternatives*, FHWA (www.fhwa.dot.gov/environment), Publication No. FHWA-HI-94-053, December 1995.

V. Equity Analysis

Some TDM strategies raise equity concerns. These should be considered directly in any TDM program planning.

Many TDM strategies benefit non-drivers, and economically and physically disadvantaged people, and therefore increase equity. Virtually all strategies that improve travel choices (improved transit service, rideshare matching, carsharing, bicycling and pedestrian facilities) and marginalize fixed costs increase equity by giving non-drivers a greater share of transportation resources, and benefit disadvantaged people.

For example, cashing-out free parking provides a new financial benefit non-drivers. Distance-based vehicle insurance also tends to benefit lower income households, which tend to drive less than average, and would therefore find vehicle insurance more affordable. CarSharing gives households more affordable alternatives to owning a vehicle. Transit oriented development and location efficient mortgages give lower income households more housing choices, and reduce total transportation costs.

Increased user costs (road pricing, mileage charges, parking charges, etc.) are often assumed to be inequitable, because they represent a relatively high burden to lower income drivers. However, such charges are no more regressive than many other fees and taxes, so their equity depends on how the revenue is used.[104] If revenues are used to reduce other taxes, returned to households as a cash refund, or improved services that benefit lower income residents (such as public transit) they can be progressive. Equity impacts often depend on the quality of travel choices. In an automobile dependent community, where driving is considered a necessity, increased user costs tends to burden lower income drivers. In a multi-modal community, driving is more of a luxury, so increased charges can be considered less regressive.

There is sometimes concern that incentives for reduced automobile use will be imposed most on lower status, lower income workers, or that such employees have less job flexibility to be able to use travel alternatives.[105] These problems can be avoided by planning that takes such concerns into account in program development.

Since the most effective TDM programs include both positive and negative incentives, it is often appropriate to implement positive incentives first, and highlight the equity benefits that result. Once travel choices increase and programs are working, negative incentives, such as increased parking charges and traffic restrictions can then be implemented.

[104] Todd Litman, "Using Road Pricing Revenue: Economic Efficiency and Equity Considerations," *Transportation Research Record 1558*, 1996, pp. 24-28.

[105] Craig Jesus Poulenez-Donovan and Cy Ulberg, "Seeing the Trees and Missing the Forest: Qualitative Versus Quantitative Research Findings in a Model Transportation Demand Management Program Evaluation," *Transportation Research Record 1459*, 1995, pp. 1-6.

Table 2 **Equity Impacts of TDM Strategies**

Type	Equity Impact	Why
Manage Special Transport Activities	Positive	For example, providing special transit services to a recreation event (a fair, festival or park) increases travel choices for non-drivers.
Transportation Allowance	Very positive	Gives non-drivers benefits comparable to parking subsidies.
Park and Ride	Positive	Benefits rideshare and public transit users.
HOV Preference	Positive	Benefits rideshare & transit users, increases travel choices for non-drivers and poor.
Transit Improvements	Very Positive	Benefits public transit users, increases travel choices for non-drivers and poor.
Rideshare Programs	Very Positive	Benefits rideshare users, increases travel choices for non-drivers and poor.
Free Transit Zones	Very Positive	Benefits public transit users, increases travel choices for non-drivers and poor.
Bicycle Improvements	Very Positive	Benefits cyclists, increases travel choices for non-drivers and poor.
Pedestrian Improvements	Very Positive	Benefits pedestrians, increases travel choices for non-drivers and poor.
Intermodal Bike	Very Positive	Benefits cyclists, increases travel choices for non-drivers and poor.
Telecommuting	Positive	Increases travel choices.
Alternative Work Hours	Positive	Increases travel choices.
Guaranteed Ride Home	Very Positive	Increases travel choices, benefits non-drivers and the poor.
Address Security	Very Positive	Benefits non-drivers and the poor.
Access Management	Positive	Benefits cyclists and pedestrians. Can lead to less automobile dependent land use.
Full Cost Pricing	Mixed	Depends on price structures, available travel choices, and how revenues are used.
Mileage Fees	Mixed	Depends on price structures, available travel choices, and how revenues are used.
Increased Fuel Taxes	Negative/Mixed	Depends on price structures, available travel choices, and how revenues are used.
Road Pricing	Negative/Mixed	Depends on price structures, available travel choices, and how revenues are used.
Vehicle Restrictions	Mixed	Positive if it increases travel conditions for non-drivers
Parking Pricing	Negative/Mixed	Depends on price structures, available travel choices, and how revenues are used.
Cash Out Parking	Very positive	Gives non-drivers benefits comparable to parking subsidies.
Reduce Parking Requirements	Mixed	Positive if it reduces costs or increases travel conditions for non-drivers
Preferential Parking	Positive	Benefits rideshare users, increases travel choices for non-drivers and poor.
Mileage-based Fees	Positive/Mixed	Distance-based insurance benefits lower mileage motorists.
Vehicle Rentals	Positive	Increases travel choices for households that do not own an automobile.
Land Use Reforms	Positive/Mixed	Can increase housing and transportation options for non-drivers and the poor.
Neotraditional Planning	Positive/Mixed	Can increase housing and transportation options for non-drivers and the poor.
Traffic calming	Very Positive	Benefits pedestrians, cyclists and urban residents.
Location-Eff. Housing	Very positive	Can increase housing and transportation options for non-drivers and the poor.

This table summarizes equity impacts and identifies strategies that most benefit non-drivers and the poor.

VI. Summary

The table below summarizes the strategies identified in this paper.

Table 3 **TDM Strategy Summary** (X=Major Role; x = Minor Role)

Type	Description	Federal	State/ Provincial	Regional/ Local	Private
Institutional Reform	Transport agencies and professionals consider and understand TDM.	X	X	X	X
Least Cost Planning	TDM competes against capacity expansion in terms of cost effectiveness.	X	X	X	X
Pricing Reforms	Comprehensive tax and price reforms.	x	X	X	
TDM Marketing	Provide public information and encouragement programs.	x	x	X	X
CTR Programs	Employee commute trip reduction programs.		x (legislation)	X	X
Campus Management Programs	Trip reduction programs on college, university and research park campuses.			X	X
Transportation Management Associations (TMAs)	TMAs provide trip reduction services in a commercial or employment center.			X	X
Manage Special Transport Activities	Manage special types of transport and special events for efficiency.		X	X	X
Access Management	Coordinate roadway and land use design.		X	X	x
Monitor TDM	Perform surveys and other monitoring of TDM program effectiveness.		x	X	X
Transportation Allowance	Provide commuters with a transportation allowance rather than free parking.				X
Park and Ride	Parking at urban-fringe transit stops.		x	X	
HOV Preference	Transit and rideshare lanes and other priority measures.		X	X	
Transit Improvements	Improved public transit service.	X	X	X	
Rideshare Programs	Rideshare promotion and matching.			X	x
Free Transit Zones	Free transit in commercial centers.		x	X	x
Bicycle Improvements	Improved bicycle planning and facilities.		x	X	
Pedestrian Improvements	Improved pedestrian planning, facilities and services.	x	X	X	
Intermodal Bike	Bike lockers at transit stops, bikeracks on transit vehicles.		x	X	
Telecommuting	Working at home to avoid commute trips.			X	X
Alternative Work Hours	Flex time and alternative work weeks (such as 4 10-hour days)			X	X
Guaranteed Ride Home	Provide a limited number of free rides home for transit & rideshare commuters.			X	X
Address Security	Address security concerns of rideshare, transit, cycle and pedestrian commuters.			X	x
Full Cost Pricing	Pricing reforms to encourage efficient transport.	x	X	x	

Transportation Demand Management Strategies - *Continued*

Type	Description	Federal	State/ Provincial	Regional/ Local	Private
Increased Fuel Taxes	Increase federal and state fuel taxes.	X	X		
Road Pricing	Road tolls and congestion pricing.	x	X	X	
Vehicle Restrictions	Prohibit vehicle use in specific areas.		x	X	
Parking Pricing	Charge users directly for parking. Charge by the hour or day rather than the month.			X	X
Cash Out Parking	Providing employees who do not drive the cash equivalent of parking subsidies.		x	X	X
Reform Parking Requirements	Reduce parking requirements in zoning laws.			X	
Preferential Parking	Preferential parking for rideshare vehicles.			x	X
Mileage-based Fees	Distance-based vehicle insurance and registration fees.		X		
Vehicle Rentals	Encourage carshare cooperatives and neighborhood vehicle rentals.			X	X
Land Use Reforms	Higher density, mixed use, growth management.		x	X	X
Neotraditional Planning	Develop neighborhoods that encourage walking, bicycling and transit use.		x	X	x
Traffic calming	Use strategies to reduce vehicle traffic speeds when appropriate.			X	
Location-Efficient Housing	Reduced parking requirements and favorable mortgages for housing in transit-oriented, accessible locations.			X	X

Travel demand management strategies can be cost effective, particularly if all their benefits are considered. They often help reduce congestion, road and parking facility costs, accidents, sprawl and pollution. Some strategies also increase equity by giving non-drivers more benefits and travel choices. A comprehensive analysis of costs and benefits tends to favor TDM over facility capacity expansion investments.

Travel demand management is a relatively new field (although many individual strategies are extremely old) which is rapidly developing. Practitioners should try to use the latest resources available when evaluating and implementing TDM programs. For more information on TDM program planning and evaluation, or any of the specific TDM measures listed here, contact the Victoria Transport Policy Institute.

Resources

American Planning Association (Chicago; www.planning.org) has extensive resources for community and transport planning.

Association for Commuter Transportation (Washington DC; 202-393-3497; http://tmi.cob.fsu.edu/act/act.htm) is a non-profit organization supporting TDM programs.

Center for a Sustainable Economy (www.sustainableeconomy.org) provides resources concerning tax shifting and environmental tax reform.

Center for Urban Transportation Research, USF (Tampa; http://cutr.eng.usf.edu) provides TDM materials and classes and publishes *TMA Clearinghouse Quarterly*.

Commuter Choice Program (www.epa.gov/oms/traq). Provides information, materials and incentives for developing employee commute trip reduction programs.

Commuter Check (www.commutercheck.com) works with transit agencies to provide transit vouchers as tax exempt employee benefit.

Detour Publications (www.web.apc.org/~detour) sells transport planning publication.

Department of the Environment, Transport and the Regions (www.local-transport.detr.gov.uk/gtp/index.htm) provides information on "Green Transport Plans."

Environment Canada **Green Lane** program (www.ec.gc.ca/emission/5-1e.html) promotes TDM and other strategies for reducing transportation environmental impacts.

Patrick Hare, *Planning, Transportation and the Home Economics of Reduced Car Ownership*, Hare Planning (Washington DC; 202-269-9334), 1995.

The **Institute of Transportation Engineers** (Washington DC; www.ite.org) has extensive technical resources on TDM, transportation planning and traffic calming.

National Bicycle and Pedestrian Clearinghouse (Washington DC; www.bikefed.org/clear.htm) provides extensive resources related to non-motorized transport planning and promotion.

National Transportation Library (www.bts.gov/NTS) has extensive resources, some of which are available to download, and others that can be ordered.

Partnership for a Walkable America (http://nsc.org/walk/wkabout.htm) promotes the benefits of walking and supports efforts to make communities more pedestrian friendly.

Policy on Travel Demand Management in Urban Areas, Institute of Engineers, Australia (www.ieaust.org.au/policy/pol_TravelUrban.htm), 1996.

Road Traffic Reduction Act 1997, Her Majesty's Stationary Office (www.hmso.gov.uk/acts/acts1997/1997054.htm).

San Francisco Planning and Urban Research (www.spur.org).

Transportation Control Measures Directory (http://yosemite.epa.gov/aa\tcmsitei.nsf) provides a searchable database of TDM program case studies.

Transportation Association of Canada (Ottawa; www.tac-atc.ca) provides a variety of resources related to transportation planning and TDM.

The **TDM Resource Center** (www.wsdot.wa.gov/Mobility/TDMhome.html) and **Northwest Technology Transfer Center** (www.wsdot.wa.gov/TA/T2) provide TDM resources.

Here are related reports available from VTPI:

Automobile Dependency and Economic Development

The Costs of Automobile Dependency

Evaluating Transportation Equity

Exploring the Paradigm Shift Needed to Reconcile Transportation and Sustainability Objectives

Potential TDM Strategies

Socially Optimal Transport Prices and Markets

Transportation Cost Analysis for Sustainability

Win-Win Transportation Management Strategies

Feedback

The Victoria Transport Policy Institute appreciates feedback, particularly suggestions for improving our products. After you have finished reading this report please let us know of any:

- Typographical errors or confusing wording.
- Concepts that were not well explained.
- Analysis that is inappropriate or incorrect.
- Additional information, ideas or references that could be added to improve the report.

Thank you very much for your help.

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