

Index of Transportation Measure Quantification Efforts: Methodology Matrix

Final Report

30 September 1998

PREPARED FOR

**U.S. Environmental Protection Agency
Regional and State Programs Division
2000 Traverwood Drive
Ann Arbor
Michigan 48105**

**Index of Transportation
Measure Quantification
Efforts: Methodology Matrix**

Final Report

Prepared for:

U.S. Environmental Protection Agency
Regional and State Programs Division
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Date: 20 January 1999

Subject: Requested documents

From: TRAQ Center
Office of Mobile Sources

To: Barb Laurenson
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1950 Franklin Street, 12th Floor
Oakland, CA 94612

Please find enclosed the documents that you requested through the EPA's Transportation Air Quality Information Request Line.

- 1) Quantification of Episodic Control Programs; EPA 420-R-97-006
- 2) Voluntary Mobile Source Programs: Crediting Innovation and Experimentation; EPA 420-K-97-004
- 3) Driving Alone brochure; EPA 420-F-95-011
- 4) Transportation Control Measure Information Documents; EPA 420-R-92-006
- 5) Benefits Estimates for Selected TCM Programs; EPA 420-R-98-002 (was 94-006)

The Episodic Emissions Control Programs factsheet can be downloaded from the TRAQ Center website at www.epa.gov/oms/trans/traqvolm.htm in either PDF or text only format.

Quantification document (waiting to hear from Matt)

Thank you for your request.

1. Introduction

As the importance of transportation measures and voluntary measures in air quality programs increases, a growing body of research focuses on the quantitative evaluation and analysis of these measures. The purpose of this work assignment is to develop a comprehensive index of methodologies used in assessing transportation measures and other non-mandatory programs. Quantification refers to any effort to numerically evaluate transportation measures (or other related measures) in terms of developing air quality benefits, program costs, VMT reductions, trip reductions, and/or cost-effectiveness.

2. WA Task 2 results

The results of WA Task 2 are embodied in the extensive matrix shown in Attachment 2 (and provided on the accompanying diskette in both WordPerfect and Excel format). The matrix lists transportation measures and voluntary measures along with the types of methodologies used to quantify them, and a description of the strengths and weaknesses of each methodology. In addition, the matrix lists specific reports and studies that have utilized each methodology for a particular transportation measure, along with particular advantages and disadvantages of the methodology as used in that particular research or evaluation study. Reports that analyze several transportation measures were placed in each of those transportation measure categories.

ARCADIS Geraghty & Miller developed this matrix through a detailed review of transportation measure quantification literature collected under a previous work assignment (0-04). (For more information on that work assignment, see "Index of Transportation Measure Quantification Efforts: Final Report for Task 2 and Task 3," prepared by Acurex Environmental Corporation for USEPA, September 30, 1997.)

The methodology matrix provides a clearly organized, easy-to-use summary of available methodologies for evaluating a given transportation measure, strengths and weaknesses of those methodologies, and examples of research and evaluation efforts that have utilized each of those methodologies. Local planners using this matrix should easily be able to obtain important comparative information on transportation measures and voluntary measures of interest to them, and on the particular methodologies used to estimate or evaluate the travel and emissions impacts of these measures.

The completed methodology matrix covers 27 different transportation measures, and summarizes and analyzes 38 distinct quantification methodologies, as shown in Figures 1 and 2. Note that the methodologies listed in Figure 2 are shown in the same hierarchical order in which they appear (where applicable) within each transportation measure. The methodology matrix describes the use of these methodologies in 102 documents. These documents are listed in Attachment 1.

The methodology matrix reveals certain strengths and weakness of the transportation measure quantification literature. Certain transportation measures, including HOV facilities, telecommuting, and ridesharing, have been analyzed by many researchers, using a variety of analytical techniques. Others have not received the same amount of attention. In particular, Intelligent Transportation Systems are only recently moving from "crystal ball" discussions to analytically rigorous emissions quantification. In addition, shuttle projects have received limited attention.

Similarly, certain methodologies have been used extensively in the literature. Travel demand models have been used to provide detailed travel and emissions impact assessments for a wide variety of transportation measures. Many planners and researchers, however, have found sketch planning tools to provide the right balance between cost and accuracy. Advanced analytical models that integrate existing models, or that rely on

the "next generation" of travel and emissions models, will assume increasing importance in evaluating transportation measures in the future.

3. Recommendations for further EPA research

This Work Assignment effort produced an extensive matrix for planners and policy makers to use when they need to evaluate the travel and emissions impacts of their own existing or planned transportation measures. Additional efforts to compile and index the existing literature on transportation and voluntary measure quantification efforts could focus on the following areas:

- **Procurement and analysis of additional documents.** Because the literature on transportation measures is developing rapidly, many valuable quantification efforts have been completed in the past year and were therefore not available during the literature collection portion of WA 0-04. Identifying these most recent research efforts, and preparing methodology matrix entries for them, would help keep the methodology matrix as up-to-date as possible, particularly for those segments of the literature that are developing most rapidly (ITS, for example).
- **Preparation of methodology matrix entries for additional documents already identified.** While ARCADIS Geraghty & Miller succeeded in this Work Assignment in analyzing a very large portion of the best transportation measure quantification documents collected in WA 0-04, available funding did not allow us to analyze all of the documents. Preparing methodology matrix entries for more documents from WA 0-04 would create additional value and comprehensiveness for the methodology matrix.
- **Document procurement support for planners.** The methodology matrix developed in this Work Assignment will allow local planners and policy makers to identify documents that may be most useful to them, but some of the documents may be difficult to obtain. Providing a document procurement service that helps planners obtain documents they are interested in could provide an efficient means of disseminating research results, and represent part of a "full-service" approach to helping local planners. However, copyright issues would need to be carefully worked out.
- **Prepare analysis of previous research results targeted to SIP credit issues.** In many cases, existing research results and methodologies may help planners and policy makers quantify the emissions impacts of their own local transportation measures, but in ways that may not meet EPA's standard for establishing State Implementation Plan emissions credit. A focused review and critique of selected quantification methodologies with SIP crediting requirements in mind (e.g., evaluating whether the emissions reductions are surplus and enforceable) will help local planners in working with EPA to create SIP-creditable transportation programs.

Figure 1. Transportation measures included in methodology matrix

Alternative Commute Programs
Alternative Transportation-Friendly Workplace
Bicycles
Clean Fuel Fleets
Compressed Work Week/Flex Time
Congestion Pricing
Database/ Information
Emissions Fees
Employee Commute Subsidies
Episodic/ Seasonal Controls
Feebate
Fuel Tax Increases
General
High-Occupancy Vehicle Facilities
Intelligent Transportation Systems
Intermodal
Local Land Use/Urban Design
Market Incentives
Parking Pricing/Parking Management
Regional Land Use / Growth Management
Rideshare
Scrappage
Shuttles/Station Cars
Telecommuting
Traffic Management
Trip Reduction
VMT Fees

Figure 2. Hierarchy of quantification methodologies included in matrix

<u>Modeling</u>	
1	Integrated travel demand, mode choice, traffic simulation, and emissions model
2	Integrated planning/simulation model
3	Travel demand/mode choice model
4	Modal emissions model
5	Conventional transportation planning network model
6	Vehicle queuing model
7	Freeway throughput model
8	Travel cost model
9	Demand elasticity model
10	Economic scrappage supply curve model
11	Vehicle fleet characterization and emissions model
12	Emission dispersion model (used for freeways)
<u>Statistical and empirical analysis</u>	
13	Statistical analysis of average speed of congestion pricing scenarios
14	Use of economic theory to estimate congestion price levels
15	Statistical analysis of the impacts of land use characteristics and TDM strategies on mode choice
16	Empirical analysis of the impacts of personal preference and workplace conditions on mode choice
17	Statistical analysis of factors affecting travel behavior
18	Parking supply and demand model
<u>Analysis of existing programs</u>	
19	Analysis of existing program(s) using travel diaries
20	Empirical analysis of employer-based trip reduction program
21	Empirical analysis of transportation measure implementation programs
22	Empirical analysis of transportation measure demonstration projects
23	Statistical analysis of employer ridesharing initiatives
<u>Sample survey analysis</u>	
24	Sample surveys of ridematching database program success
25	Sample survey of customer travel patterns and preferences at shopping centers
26	Sample survey of employer trip reduction program cost
27	Sample survey analysis of existing program(s)
28	Transportation survey analysis
29	Sample surveys
<u>General evaluation and analysis</u>	
30	Macro-level analysis
31	Evaluative matrix
32	Cross-sectional analysis of bicycle facilities
33	Sketch planning
34	Employer TDM cost-effectiveness model
35	Case study analysis
36	Policy analysis of transportation measures
37	Process analysis of transportation measure planning and implementation
38	Comparison and analysis of other studies

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ATTACHMENT 1

Report Bibliography

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Transportation Control Measures: Methodology Matrix

Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Alternative Commute Programs	Process analysis of transportation measure planning and implementation	Explains lessons learned during the planning and implementation of an actual transportation measure, such as reactions to expect from the public and funding sources Provides pros and cons of planning and implementation methods	Does not necessarily help quantify VT, VMT, or emissions reductions from the TCM implementation Cost can vary greatly	"Transportation Control Measures Analyzed for the Washington Region's 15 Percent Rate of Progress Plan." FHWA/Metropolitan Washington Council of Governments, February 1995.	Provides comprehensive evaluation of the selection and quantification process performed by the MWCOG for assessing various TCM measures	Addresses the strengths and weaknesses of the bottom-up, multiple committee planning process used by the COG Provides extensive, clear detail (and strengths and weaknesses) of both the evaluation tools used and each specific TCM evaluation method Estimates VT, VMT, & emission reductions and cost-effectiveness	Requires an extensive study of already-performed process	None (factors analyzed are applicable to each transportation measure analyzed during the process)
Alternative Transportation-Friendly Workplace	Travel demand/mode choice model	Somewhat applicable to multiple regions Analyst can vary input parameters	Requires region-specific household survey, land use, socioeconomic, and travel cost data Requires complex computer model Potentially high cost to use	"Implementing Effective Travel Demand Management Measures: Inventory of Measures and Synthesis of Experience." COMSIS Corporation. USDOT, September 1993. DOT-T-94-02.	Summarizes broad range of TDM measures, provides example case study analyses of each, and uses computer model to benchmark the effectiveness of each TDM	Excellent overview of the range of TDMs possible; provides description, nature of effectiveness, application setting, effectiveness potential, and cost Uses actual case studies to inform the use of a computer model for forecasting TDM effectiveness Provides a road-map to implementing TDMs	Use of the model requires local input parameters to forecast local effectiveness Model does not incorporate an emissions calculation module Most analysis is at the employer-level rather than the area-level	Level of service provided by employer: information, matching services, preferential parking, ride home programs

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Alternative Transportation-Friendly Workplace (cont.)	Travel demand/ mode choice model (cont.)			"A Survey and Analysis of Employee Responses to Employer-Sponsored Trip Reduction Incentive Programs." Schreffler, Eric N., and Mortero, Jose. COMSIS Corp. California Air Resources Board, February 1994. Contract No. A983-187.	Describes results of new survey data regarding employee travel behavior; uses mode choice and travel demand model to predict impacts of certain employer-based transportation measures	Clearly explains the process that was used: survey data acquisition, mode choice computation, and TCM effectiveness model use Data requirements are more readily available than other models User-friendly model is available for outside use; users guide is also available Survey links incentives directly to impacts on travel behavior Model includes an awareness sub-model that simulates how many people know about the possible transportation measures available to them	Does not accurately address trip-chaining and VMT reductions (only trips) Household conditions are not extensively accounted for Cost-effectiveness was not calculated Employer-level analyses only, with focus upon incentive TCMs	Guaranteed ride home Company vanpools Preferential parking Parking fees for ridesharers Carpool subsidies & transportation allowances
				"Selection and Evaluation of Travel Demand Management Measures." Taylor, Christopher J., et al. TRB Paper 971114, January 1997.	Uses Travel Demand Evaluation Model developed by COMSIS to evaluate the impact of transportation measures on mode choice and VT for the Syracuse, NY metropolitan area	Uses journey-to-work census data to develop estimates of zone-to-zone travel Evaluates both area-wide programs and employer-based programs Assesses revenue generation potential and transit subsidies	Sufficiently detailed journey-to-work census data may not be available for all cities: Syracuse has this data available due to a pilot program Requires assuming some estimates of effectiveness Does not quantify emissions reductions	Transit fare levels and travel time HOV lane time savings Parking costs Employer transit encouragement level

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed	
Alternative Transportation-Friendly Workplace (cont.)	Travel demand/ mode choice model (cont.)			"Transportation Control Measures for the San Francisco Bay Area: Analysis of Effectiveness and Costs." Harvey, G., and E. Deakin. For Bay Area Air Quality Management District, October 1991.	Describes use and results of a travel demand model employed to model the VT, VMT, and emission reductions of various transportation measures in the San Francisco Bay Area	Utilized high-quality household travel survey data and advanced modeling capabilities Emissions calculation uses standardized methods, but takes into account more subtle effects of emissions generation Provides succinct, clear data on results of study, including cost-effectiveness estimates	Does not provide detail on model operation	Many; not specified	dac
	Empirical analysis of the impacts of personal preference and workplace conditions on mode choice	Somewhat applicable to multiple regions (but likely to be influenced heavily by local factors of the study area) Can be replicated (at moderate to high cost) Does not require extensive computer model Uses actual survey data	Requires large data collection process to generate statistically significant results Personal preference and workplace conditions difficult to impact through public policy	"The Influence of Employer Ridesharing Programs on Employee Mode Choice." Ferguson, Erik. <i>Transportation</i> , vol 17, 1990.	Analyzes aggregate-level data compiled by a large Southern California regional ridesharing agency; assesses impact of employer characteristics on employee mode split	Analyzes a large data set comprising almost 10% of Los Angeles area workforce Utilizing existing agency database is a cost-effective approach Less accurate than disaggregated (employee by employee) data Includes cost-effectiveness estimations	Some findings may have been contradicted by more recent studies (e.g., study finds that large corporations have better success with rideshare programs) Aging data source: 1985 survey data Los Angeles area factors may be uncharacteristic of other regions, so results may not be applicable elsewhere Employer-derived data was acquired using different methods No estimates of emissions impacts	Level of employer effort to encourage ridesharing Size of firm	dac

Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed	
Alternative Transportation-Friendly Workplace (cont.)	Empirical analysis of transportation measure implementation programs	Somewhat applicable to multiple regions Can be replicated (at moderate cost) Does not require extensive computer model	Requires large data collection process to generate statistically significant results	"An Employer Panel for Evaluating the Effectiveness of Trip Reduction Incentives." Giuliano, Genevieve, and Wachs, Martin. In <i>Panels for Transportation Planning and Applications</i> , ed. T.F. Golob, et al, 1997.	Discusses results collected on Southern California employment sites subject to SCAQMD Regulation XV, and assesses the relative effectiveness of trip reduction strategies	Utilizes the largest trip reduction measure database available in the world Panel method allows for assessing before-and-after-TCM conditions	Database does not provide exceptional detail; report does not contain details of the level of incentive support provided to employees Only generalized effectiveness results are shown TCMs were not always implemented at the time of the survey	Not described	dac
	Empirical analysis of transportation measure demonstration projects	Requires little or no new data acquisition Relatively low cost Shows actual potential of transportation measures	Case study results do not necessarily apply to other regions	"Evaluation of Travel Demand Management Measures to Relieve Congestion." Kuzmyak, J.R., and E.N. Schreffler. Prepared by COMSIS Corp. for FHWA. FHWA/SA-90/005; DOT-T-90-14. February 1990.	Performs case studies of the effectiveness of 11 transportation demand management programs	Shows potential for reduction in commute-based trips due to implementation of transportation measures Provides high level of detail about the specific programs implemented	Generally does not evaluate specific TCM individually; programs of multiple TCMs are evaluated for effectiveness Does not quantify emission reductions Trip reductions based upon vehicle occupancy assumptions for each mode choice (carpool, vanpool, transit)	Not applicable in context of specific transportation measures	dac

Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Alternative Transportation-Friendly Workplace (cont.)	Employer TDM cost-effectiveness model	Estimates reduction in and costs of daily trips and peak period trips Aids employer determination of cost-effectiveness of TDM measures for their particular worksite	Results may vary widely from one employer to the next Many inputs may be difficult for employers or planners to quantify	"Transportation Demand Management Cost-Effectiveness Model for Suburban Employers." Dagang, Deborah A. JHK & Associates. In Transportation Research Record 1404.	Reports on the development of a model to individually evaluate the cost-effectiveness of 15 different employer-based TDM measures in suburban settings	Focus on suburban employers reflects different travel-related characteristics of suburban and urban areas Spreadsheet-based model is user-friendly and readily accessible for use at the site-specific level; model makes sensitivity analysis relatively simple Eight transportation environments were defined to represent various combinations of transportation service characteristics For employers without access to entire range of data necessary to operate model, default values are included	Most employers surveyed to develop model were unable to provide detailed cost information on the TDM measures they had implemented Does not calculate emissions directly Potential for regional bias, as model was developed in part based on a survey of suburban San Francisco Bay Area employers; model also used the SCAQMD Regulation XV and Pima Association of Governments Travel Reduction Program employer plan databases Only some TDMs included in model provide for estimates of VT reductions Use of default values could diminishes accuracy of estimates for some users	Suburban employer-based TDM measures Daily trips and peak period trips Costs and cost-effectiveness

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed	
Alternative Transportation-Friendly Workplace (cont.)	Process analysis of transportation measure planning and implementation	Explains lessons learned during the planning and implementation of an actual transportation measure, such as reactions to expect from the public and funding sources Provides pros and cons of planning and implementation methods	Does not necessarily help quantify VT, VMT, or emissions reductions from the TCM implementation Cost can vary greatly	"Transportation Control Measures Analyzed for the Washington Region's 15 Percent Rate of Progress Plan." FHWA/Metropolitan Washington Council of Governments, February 1995.	Provides comprehensive evaluation of the selection and quantification process performed by the MWCOG for assessing various transportation measures	Addresses the strengths and weaknesses of the bottom-up, multiple committee planning process used by the COG Provides extensive, clear detail (and strengths and weaknesses) of both the evaluation tools used and each specific TCM evaluation method Estimates VT, VMT, & emission reductions and cost-effectiveness	Requires an extensive study of already-performed process	None (factors analyzed are applicable to each transportation measure analyzed during the process)	dac
	Comparison and analysis of other studies	Relatively inexpensive and simple to conduct, because it requires no primary research Provides an introduction to the range of results produced by different studies, which could be used if other directly applicable research is not available Identifies advantages and disadvantages of several methodologies	Results are not directly applicable to other regions (they do not incorporate characteristics of other regions) Unlikely to provide precise estimates	"An Assessment of Transportation Control Measures, Transportation Technologies, and Pricing/Regulatory Policies." Euritt, Mark A., et al. University of Texas, Austin, Center for Transportation Research/Tellus Institute. CTR SEDC-1, June 1995.	Assesses several studies that analyze a host of transportation measures, technology options, and policies for total effectiveness and costs/benefits	Provides a solid overview of the range (and effects) of transportation measure options, as well as technology and policy options Focuses upon energy efficiency impacts in addition to emissions and VMT	Report does not contain a methodology for evaluating new TCM plans, but follow-on report focuses upon these strategies Estimates may be too rough to apply to other programs in other regions	Impacts: vehicle trips, vehicle miles traveled, and emissions Costs	dac
					"Assessment of Travel Demand Management Approaches at Suburban Activity Centers." Bhatt, Kiran, and Higgins, Thomas. K.T. Analytics. U.S. DOT, July 1989.	Surveys research studies and interviews TCM program coordinators to provide an overview of the range of effectiveness of employer-based TCM programs	Provides a large number of case study examples of both effective and ineffective TCM programs Makes recommendations to employers on how to develop a TCM program Provides a good checklist of topics to address when developing a TCM program	Report does not contain a methodology for forecasting the effectiveness of new TCM plans Only generalized evaluation of TCM effectiveness	Relative effectiveness of various transportation measure programs Implementation mechanisms

Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed	
Alternative Transportation-Friendly Workplace (cont.)	Comparison and analysis of other studies (cont.)			"Managing Transportation Demand: Markets Versus Mandates." Giuliano, Genevieve, and Martin Wachs. Reason Foundation. Policy Insight No. 142, September 1992.	Compares congestion pricing with Regulation XV for the Southern California area; describes pros and cons of each measure and discusses implications Makes policy recommendations to improve each transportation measure	Provides typology of transportation measures and identifies effectiveness and common barriers to implementation Simple side-by-side comparison of VMT reduction and cost-effectiveness for each transportation measure	Provides little detail about logistics of implementing the policy recommendations Does not quantify emission reductions	Direct vs. indirect implementation Market-based vs. performance-based implementation Efficiency and equity considerations	dac
				"The Equity and Cost Effectiveness of Employee Commute Options Programs." Farkas, Z. Andrew. Morgan State University. TRB 960078, January 1996.	Analyzes the results of surveys and transportation measure modeling studies performed for the Baltimore and Philadelphia regions	Shows different methods of using the same model: Travel Demand Evaluation Model developed by COMSIS Provides a discussion of social equity considerations based on a survey of the two regions	Philadelphia modeling assumed average vehicle ridership targets were reached and results are only applicable relative to each scenario Baltimore modeling did not estimate emissions reductions	Rideshare promotion level Parking charge level Transit subsidy levels Work schedule flexibility	dac
Bicycles	Travel demand/mode choice model	Somewhat applicable to multiple regions Analyst can vary input parameters	Requires region-specific household survey, land use, socioeconomic, and travel cost data Requires complex computer model Potentially high cost to use	"Implementing Effective Travel Demand Management Measures: Inventory of Measures and Synthesis of Experience." COMSIS Corporation. USDOT, September 1993. DOT-T-94-02.	Summarizes broad range of TDM measures, provides example case study analyses of each, and uses computer model to benchmark the effectiveness of each TDM	Excellent overview of the range of TDMs possible; provides description, nature of effectiveness, effectiveness potential, and cost Uses actual case studies to inform the use of a computer model for forecasting TDM effectiveness Provides a road-map to implementing TDMs	Use of the model requires local input parameters to forecast local effectiveness Model does not incorporate an emissions calculation module Most analysis is at the employer-level rather than the area-level	Bicycle mode share	dac

Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Bicycles (cont)	Parking supply and demand model	Somewhat applicable to multiple regions Analyst can vary input parameters	Requires computer model Potentially high cost to use	"Air Quality Offsets for Parking." Loudon, William, et al. In Transportation Research Record 1232, 1992.	Develops and uses parking supply model for downtown Portland to estimate CO emissions	Uses observed price and travel time sensitivities Uses proven models of travel behavior Incorporates integrated CO emissions model	Requires parking database: number of spaces, location, type, use patterns Requires travel database: time of arrival, travel & work mode split	Travel time & cost
	Statistical analysis of the impacts of land use characteristics and TDM strategies on mode choice	Identifies land use and urban design characteristics that are supportive of walk/bike mode choice. Standard analysis of variance using principle components allows examination of the effects of land use and TDM incentive strategies on mode choice individually and in combination. Results transferable to other urban areas in terms of relative ranking of importance of the land use and TDM factors analyzed.	Precise causality and individual impacts of factors such as transit availability or urban density on mode choice cannot be measured due to limitations of the database Potential for need to conduct extensive field research to determine land use characteristics at each sample work site. Cannot be used to determine land use and urban design characteristics' impact on a specific mode choice	"The Effects of Land Use and Travel Demand Management Strategies on Commuting Behavior: Final Report." Prepared by Cambridge Systematics, Inc. and Deakin, Harvey, Skabardonis, Inc. for the U.S. Department of Transportation, November 1994.	Develops an integrated database of land use characteristics and travel demand management (TDM) strategies (for a sample of employment locations) to determine the combined impacts of TDM programs, land use, and urban design on employee travel behavior.	Added land use and site information from field observation to the "Regulation XV" dataset of the South Coast Air Quality Management District (which included aggregate employee travel characteristics and employer incentive programs) Share of work trips made by bicycle as a percentage of the total trips in the data set is small, making identification of work site characteristics that encourage utilization of bikes difficult. Did not address residential trip end of commute, midday travel, or trip chaining as factors which influence mode choice To simplify a complicated data collection process, somewhat arbitrary indicators were used for assessment of a site's urban design and land use characteristics.	Land use and urban design of worksite TDM incentive strategies	

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed	
Bicycles (cont.)	Empirical analysis of transportation measure implementation programs	Somewhat applicable to multiple regions Can be replicated (at moderate cost) Does not require extensive computer model	Requires large data collection process to generate statistically significant results	"An Employer Panel for Evaluating the Effectiveness of Trip Reduction Incentives." Giuliano, Genevieve, and Wachs, Martin. In <i>Panels for Transportation Planning and Applications</i> , ed. T.F. Golob, et al, 1997.	Discusses results collected on Southern California employment sites subject to SCAQMD Regulation XV, and assesses the relative effectiveness of trip reduction strategies	Utilizes the largest trip reduction measure database available in the world Panel method allows for assessing before-and-after-TCM conditions	Database does not provide exceptional detail; report does not contain details of the level of incentive support provided to employees Only generalized effectiveness results are shown TCMs were not always implemented at the time of the survey	Not described	dac
	Empirical analysis of transportation measure demonstration projects	Requires little or no new data acquisition Relatively low cost Shows actual potential of transportation measures	Case study results do not necessarily apply to other regions	"Evaluation of Travel Demand Management Measures to Relieve Congestion." Kuzmyak, J.R., and E.N. Schreffler. Prepared by COMSIS Corp. for FHWA. FHWA/SA-90/005; DOT-T-90-14. February 1990.	Performs case studies of the effectiveness of 11 transportation demand management programs	Shows potential for reduction in commute-based trips due to implementation of transportation measures Provides high level of detail about the specific programs implemented	Generally does not evaluate specific TCM individually; programs of multiple TCMs are evaluated for effectiveness Does not quantify emission reductions Trip reductions based upon vehicle occupancy assumptions for each mode choice (carpool, vanpool, transit)	Not applicable in context of specific transportation measures	dac
	Sample survey of customer travel patterns and preferences at shopping centers	Somewhat applicable to multiple regions (but influenced by local factors of the study area) Does not require an extensive computer model	Requires large data collection process to generate statistically significant results Moderate to high cost	"Analysis of Indirect Source Trip Activity: Regional Shopping Centers." JHK & Associates/ K.T. Analytics/ California Air Resources Board. November 1993, ARB-R-94/510.	Surveyed customers of regional shopping centers to determine potential impact of various travel reduction measures	Uses actual survey data (including customer demographic and stated preference data) Developed calculation methodologies specific to each trip reduction measure, using site-specific data Compares data between shopping centers in different land-use types	Assumptions are required to translate stated preference data to expected outcome Does not quantify emission reductions	Distance of travel for consumers	dac

Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed	
Bicycles (cont.)	Cross-sectional analysis of bicycle facilities	Low cost to perform (if database is available)	Requires considerable database Study results do not necessarily apply to other regions	"If You Build Them, Commuters Will Use Them: Cross-sectional Analysis of Commuters and Bicycle Facilities." Nelson, Arthur C., and David Allen. Georgia Institute of Technology. TRB 970132, January 1997.	Analyzed a database of 18 US cities to determine which factors most influence increased bicycle use	Identifies some important factors affecting bicycle use, as well as several that do not affect bicycle use	Does not assess many factors that could influence bicycle use Cannot predict effectiveness of new facilities Does not perform before-and-after analysis of actual in-use facilities Requires larger database to perform more rigorous analysis	Bikeway miles per 100,000 population Terrain type Annual rain days Percent students Mean high-temperature	dac
	Sketch planning	Simple tools can generate planning-level estimates of transportation measure effectiveness at low cost Generalized tools can be somewhat applicable to multiple regions Analyst can vary input parameters	Sketch planning results are usually not the most accurate, depending on the input parameters	"Evaluating the Effectiveness of Transportation Control Measures for San Luis Obispo County, California." Morrow, David D., San Luis Obispo Air Pollution Control District, 1992.	Develops and uses a calculation methodology for estimating the trip reduction and air quality benefits of bicycle facility improvements in San Luis Obispo County	Methodologies are developed specifically for the bicycle facility improvement program Explains calculation process in detail	Requires extensive, region-specific information to accurately estimate benefits and effectiveness of the program Assumes a level of program participation (as required by the measure)	Many; not specified	dac

Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Bicycles (cont.)	Sketch planning (cont.)			"Simple Methodologies for Quantifying VT and VMT Reductions from Transportation Control and Growth Management Measures for Developing Local Trip Reduction Ordinances." Evans, V. and D. Morrow. Sonoma Technology, Inc. Air & Waste Management Assoc. 1993.	Describes development of simple methodologies for quantifying reductions in vehicle trips (VT) and vehicle miles traveled (VMT) from TCMs, for use in a planning-level context; developed originally for the South Coast Air Basin	<p>Methods to quantify VT and VMT reductions from TCMs were based upon relatively simple methods for estimating emissions and individual TCM effectiveness developed prior to this report for the South Coast AQMD</p> <p>Performance-based approach was developed rather than use mandated transportation performance standards</p> <p>Actual experience data used as much as possible: estimated trip reduction levels from each TCM was collected from other studies, and planning-level analysis uses site-specific data inputs, thus offering increased precision in emissions estimates</p> <p>Ranges in VT reductions estimates address the interactive impacts of the application of multiple transportation measures</p> <p>Equivalency factor used to convert VMT to VT can account for region-specific average trip lengths</p>	<p>Expected reductions in VT and VMT from TCMs were estimated based upon a general survey, so for a particular location different assumptions may be needed</p> <p>Applicability to other regions outside California limited by report's use of transportation data and emissions factors in the analysis which were quantified using BURDEN and EMFAC runs for 1994</p> <p>Does not incorporate any consideration of cost-effectiveness</p>	<p>Employee participation (percentage and frequency)</p> <p>Trip length</p> <p>Bike parking facilities</p> <p>Existence/extent of bike path system</p> <p>Existence of shower facilities</p>

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Bicycles (cont.)	Sketch planning (cont.)			"Evaluating Travel and Air Quality Cost-Effectiveness of Transportation Demand Management Projects." Schreffler, Eric N., Therese Costa, and Carl B. Moyer. In Transportation Research Record 1520, 1996.	Describes simple methodologies used to evaluate projects funded by the AB 2766 vehicle registration fee program in Southern California	Methodology can be used to evaluate prior projects or proposed future projects Uses available EMFAC emission rates to calculate ROG, PM10, NOx, and CO Study develops standardized worksheet to evaluate projects Study points out drawbacks of self-reported project results	Methodology relies on participation data provided by project proponents, which may not always be unbiased EMFAC7E factors are California-specific	Trips reduced Trip length Prior travel mode
	Process analysis of transportation measure planning and implementation	Explains lessons learned during the planning and implementation of an actual transportation measure, such as reactions to expect from the public and funding sources Provides pros and cons of planning and implementation methods	Does not necessarily help quantify VT, VMT, or emissions reductions from the TCM implementation Cost can vary greatly	"Transportation Control Measures Analyzed for the Washington Region's 15 Percent Rate of Progress Plan." FHWA/Metropolitan Washington Council of Governments, February 1995.	Provides comprehensive evaluation of the selection and quantification process performed by the MWCOG for assessing various TCM measures	Addresses the strengths and weaknesses of the bottom-up, multiple committee planning process used by the COG Provides extensive, clear detail (and strengths and weaknesses) of both the evaluation tools used and each specific TCM evaluation method Estimates VT, VMT, & emission reductions and cost-effectiveness	Requires an extensive study of already-performed process	None (factors analyzed are applicable to each transportation measure analyzed during the process)

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed	
Bicycles (cont.)	Comparison and analysis of other studies	Relatively inexpensive and simple to conduct, because it requires no primary research	Results are not directly applicable to other regions (they do not incorporate characteristics of other regions)	"An Assessment of Transportation Control Measures, Transportation Technologies, and Pricing/Regulatory Policies." Euritt, Mark A., et al. University of Texas, Austin, Center for Transportation Research/Tellus Institute. CTR SEDC-1, June 1995.	Assesses several studies that analyze a host of transportation measures, technology options, and policies for total effectiveness and costs/benefits	Provides a solid overview of the range (and effects) of transportation measure options, as well as technology and policy options Focuses upon energy efficiency impacts in addition to emissions and VMT	Report does not contain a methodology for evaluating new TCM plans, but follow-on report focuses upon these strategies Estimates may be too rough to apply to other programs in other regions	Impacts: vehicle trips, vehicle miles traveled, and emissions Costs	dac
		Provides an introduction to the range of results produced by different studies, which could be used if other directly applicable research is not available Identifies advantages and disadvantages of several methodologies	Unlikely to provide precise estimates	"Assessment of Travel Demand Management Approaches at Suburban Activity Centers." Bhatt, Kiran, and Higgins, Thomas. K.T. Analytics. U.S. DOT, July 1989.	Surveys research studies and interviews TCM program coordinators to provide an overview of the range of effectiveness of employer-based TCM programs	Provides a large number of case study examples of both effective and ineffective TCM programs Makes recommendations to employers on how to develop a TCM program Provides a good checklist of topics to address when developing a TCM program	Report does not contain a methodology for forecasting the effectiveness of new TCM plans Only generalized evaluation of TCM effectiveness	Relative effectiveness of various transportation measure programs Implementation mechanisms	dac
Clean Fuel Fleets	Parking supply and demand model	Somewhat applicable to multiple regions Analyst can vary input parameters	Requires computer model Potentially high cost to use	"Air Quality Offsets for Parking." Loudon, William, et al. In Transportation Research Record 1232, 1992.	Develops and uses parking supply model for downtown Portland, Oregon to estimate CO emissions	Uses observed price and travel time sensitivities Uses proven models of travel behavior Incorporates integrated CO emissions model	Requires parking database: number of spaces, location, type, use patterns Requires travel database: time of arrival, travel & work mode split	Vehicle emissions rates Number of alternative fueled vehicles	dac

Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Clean Fuel Fleets (cont.)	Comparison and analysis of other studies	<p>Relatively inexpensive and simple to conduct, because it requires no primary research</p> <p>Provides an introduction to the range of results produced by different studies, which could be used if other directly applicable research is not available</p> <p>Identifies advantages and disadvantages of several methodologies</p>	<p>Results are not directly applicable to other regions (they do not incorporate characteristics of other regions)</p> <p>Unlikely to provide precise estimates</p>	"An Assessment of Transportation Control Measures, Transportation Technologies, and Pricing/Regulatory Policies." Euritt, Mark A., et al. University of Texas, Austin, Center for Transportation Research/Tellus Institute. CTR SEDC-1, June 1995.	Assesses several studies that analyze a host of transportation measures, technology options, and policies for total effectiveness and costs/benefits	<p>Provides a solid overview of the range (and effects) of TCM options, as well as technology and policy options</p> <p>Focuses upon energy efficiency impacts in addition to emissions and VMT</p>	<p>Report does not contain a methodology for evaluating new TCM plans, but follow-on report focuses upon these strategies</p> <p>Estimates may be too rough to apply to other programs in other regions</p>	<p>Impacts: vehicle trips, vehicle miles traveled, and emissions</p> <p>Costs</p>
Compressed Work Week/ Flex Time	Travel demand/ mode choice model	<p>Somewhat applicable to multiple regions</p> <p>Analyst can vary input parameters</p>	<p>Requires region-specific household survey, land use, socioeconomic, and travel cost data</p> <p>Requires complex computer model</p> <p>Potentially high cost to use</p>	"Implementing Effective Travel Demand Management Measures: Inventory of Measures and Synthesis of Experience." COMSIS Corporation. USDOT, September 1993. DOT-T-94-02.	Summarizes broad range of TDM measures, provides example case study analyses of each, and uses computer model to benchmark the effectiveness of each TDM	<p>Excellent overview of the range of TDMs possible; provides description, nature of effectiveness, effectiveness potential, and cost</p> <p>Uses actual case studies to inform the use of a computer model for forecasting TDM effectiveness</p> <p>Provides a road-map to implementing TDMs</p>	<p>Use of the model requires local input parameters to forecast local effectiveness</p> <p>Model does not incorporate an emissions calculation module</p> <p>Most analysis is at the employer-level rather than the area-level</p>	<p>4/40, 3/36, and 9/80 work weeks</p> <p>Participation levels</p>

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Compressed Work Week/ Flex Time (cont.)	Travel demand/ mode choice model (cont.)			"Transportation Control Measure Analysis Procedures." Austin, Barbara S., et al. Systems Applications International/California Air Resources Board. Nov 1991. SYSAPP-91/141.	Describes a developed transportation demand model and explicitly discusses the calculation methodology used for several transportation measures	Model quantifies key secondary effects of TCMs (e.g. new carpooling programs may attract transit riders rather than SOV riders) Presents all the primary equations and variables used to calculate the effects of TCMs Contains a step-by-step process for evaluating packages of TCMs Explains multi-attribute analyses as applied to multiple TCM packages	Use of the model requires local input parameters to forecast local effectiveness; default values may not be sufficient; participation level data is required; base cases need to match real conditions Model does not cover all TCMs, but can be modified to do so Temporal treatment is limited to on-peak/off-peak, no spatial treatment Emissions calculations are not explicitly described in the same fashion as travel effects	Participation levels Potential shift in commute time of day
				"Selection and Evaluation of Travel Demand Management Measures." Taylor, Christopher J., et al. January, 1997. TRB 971114.	Uses Travel Demand Evaluation Model developed by COMSIS to evaluate the impact of transportation measures on mode choice and VT for the Syracuse, NY metropolitan area	Uses journey-to-work census data to develop estimates of zone-to-zone travel Evaluates both area-wide programs and employer-based programs Assesses revenue generation potential and transit subsidies	Sufficiently detailed journey-to-work census data may not be available for all cities: Syracuse has this data available due to a pilot program Requires assuming some estimates of effectiveness Does not quantify emissions reductions	Transit fare levels and travel time HOV lane time savings Parking costs Employer transit encouragement level

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Compressed Work Week/ Flex Time (cont.)	Travel demand/ mode choice model (cont.)			"Transportation Control Measures for the San Francisco Bay Area: Analysis of Effectiveness and Costs." Harvey, G., and E. Deakin. For Bay Area Air Quality Management District, October 1991.	Describes use and results of a travel demand model employed to model VT, VMT, and emission reductions of various transportation measures in the San Francisco Bay Area	Utilized high-quality household travel survey data and advanced modeling capabilities Emissions calculations use standardized methods, but takes into account more subtle effects of emissions generation Provides succinct, clear data on results of study, including cost-effectiveness estimates	Does not provide detail on model operation	Many; not specified
	Parking supply and demand model	Somewhat applicable to multiple regions Analyst can vary input parameters	Requires computer model Potentially high cost to use	"Air Quality Offsets for Parking." Loudon, William, et al. In Transportation Research Record 1232, 1992.	Develops and uses parking supply model for downtown Portland to estimate CO emissions	Uses observed price and travel time sensitivities Uses proven models of travel behavior Incorporates integrated CO emissions model	Requires parking database: number of spaces, location, type, use patterns Requires travel database: time of arrival, travel & work mode split	Time of arrival (in downtown area)

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Compressed Work Week/ Flex Time (cont.)	Statistical analysis of the impacts of land use characteristics and TDM strategies on mode choice	<p>Use of Principle Components Analysis generated composite variables (groups of land use characteristics with similar impacts)</p> <p>Standard analysis of variance using principle components allowed examination of the effects of land use and TDM incentive strategies on mode choice individually and in combination.</p> <p>Results transferable to other urban areas in terms of relative ranking of importance of the land use and TDM factors analyzed.</p>	<p>Precise causality and individual impacts of factors such as transit availability or urban density on mode choice cannot be measured due to limitations of the database</p> <p>Potential for need to conduct extensive field research to determine land use characteristics at each sample work site.</p> <p>Cannot be used to determine land use and urban design characteristics' impact on a specific mode choice</p>	"The Effects of Land Use and Travel Demand Management Strategies on Commuting Behavior: Final Report." Prepared by Cambridge Systematics, Inc. and Deakin, Harvey, Skabardonis, Inc. for the U.S. Department of Transportation, November 1994.	Develops an integrated database of land use characteristics and travel demand management (TDM) strategies (for a sample of employment locations) to determine the combined impacts of TDM programs, land use, and urban design on employee travel behavior.	Added land use and site information from field observation to the "Regulation XV" dataset of the South Coast Air Quality Management District (which included aggregate employee travel characteristics and employer incentive programs)	<p>Study conducted in Los Angeles County, and thus may be less applicable in more dense urban areas with factors such as higher average density and transit service.</p> <p>Did not address residential trip end of commute, midday travel, or trip chaining as factors which influence mode choice</p> <p>To simplify a complicated data collection process, somewhat arbitrary indicators were used for assessment of a site's urban design and land use characteristics.</p>	<p>Land use and urban design of worksite</p> <p>TDM incentive strategies</p>

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Compressed Work Week/ Flex Time (cont.)	Empirical analysis of the impacts of personal preference and workplace conditions on mode choice	Somewhat applicable to multiple regions (but likely to be influenced heavily by local factors of the study area) Can be replicated (at moderate to high cost) Does not require extensive computer model Uses actual survey data	Requires large data collection process to generate statistically significant results Personal preference and workplace conditions difficult to impact through public policy	"The Influence of Employer Ridesharing Programs on Employee Mode Choice." Ferguson, Erik. <i>Transportation</i> , vol 17, 1990.	Analyzes aggregate-level data compiled by a large Southern California regional ridesharing agency; assesses impact of employer characteristics on employee mode split	Analyzes a large data set comprising almost 10% of Los Angeles area workforce Utilizing existing agency database is a cost-effective approach Less accurate than disaggregated (employee by employee) data Includes cost-effectiveness estimations	Some findings may have been contradicted by more recent studies (e.g., study finds that large corporations have better success with rideshare programs) Aging data source: 1985 survey data Los Angeles area factors may be uncharacteristic of other regions, so results may not be applicable elsewhere Employer-derived data was acquired using different methods No estimates of emissions impacts	Level of employer effort to encourage ridesharing Size of firm
	Analysis of existing program(s) using travel diaries	Analyzes actual CWW/flex time programs Addresses travel behavior patterns Can differentiate between work and nonwork travel, and between weekday and weekend travel	Potential high cost associated with implementing travel diaries Does not address total demand for CWW/flex time Applicability of results to other regions and conditions is uncertain	"Impacts of Compressed Work Week on Vehicle Trips and Miles Traveled: Final Report." School of Urban and Regional Planning, University of Southern California, for the California Air Resources Board, October 1994. Contract No. A132-136.	Evaluates the effectiveness of CWW schedules; quantifies VT, VMT.	Controls for individual and household characteristics to isolate independent effect of work schedules on VT and VMT Differentiated between "4/40" and "9/80" CWW schedules Sample size (and therefore cost) can be varied based on level of statistical accuracy desired	Does not directly calculate emissions impacts Large sample size is needed to provide statistically robust results Travel diaries rely on honest recordkeeping by study respondents	Type of CWW schedule Individual and household characteristics

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed	
Compressed Work Week/ Flex Time (cont.)	Empirical analysis of transportation measure implementation programs	Somewhat applicable to multiple regions Can be replicated (at moderate cost) Does not require extensive computer model	Requires large data collection process to generate statistically significant results	"An Employer Panel for Evaluating the Effectiveness of Trip Reduction Incentives." Giuliano, Genevieve, and Wachs, Martin. In <i>Panels for Transportation Planning and Applications</i> , ed. T.F. Golob, et al, 1997.	Discusses results collected on Southern California employment sites subject to SCAQMD Regulation XV, and assesses the relative effectiveness of trip reduction strategies	Utilizes the largest trip reduction measure database available in the world Panel method allows for assessing before-and-after-TCM conditions	Database does not provide exceptional detail; report does not contain details of the level of incentive support provided to employees Only generalized effectiveness results are shown TCMs were not always implemented at the time of the survey	Not described	dac
	Empirical analysis of transportation measure demonstration projects	Requires little or no new data acquisition Relatively low cost Shows actual potential of transportation measure	Case study results do not necessarily apply to other regions	"Evaluation of Travel Demand Management Measures to Relieve Congestion." Kuzmyak, J.R., and E.N. Schreffler. Prepared by COMSIS Corp. for FHWA. FHWA/SA-90/005; DOT-T-90-14. February 1990.	Performs case studies of the effectiveness of 11 transportation demand management programs	Shows potential for reduction in commute-based trips due to implementation of TCMs Provides high level of detail about the specific programs implemented	Generally does not evaluate specific TCM individually; programs of multiple TCMs are evaluated for effectiveness Does not quantify emission reductions Trip reductions based upon vehicle occupancy assumptions for each mode choice (carpool, vanpool, transit)	Not applicable in context of specific transportation measures	dac

Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed	
Compressed Work Week/ Flex Time (cont.)	Empirical analysis of transportation measure demonstration projects (cont.)			"Transportation-Related Impacts of Compressed Work Week: The Denver Experiment." Atherton, Terry J., et al. In Transportation Research Record 845, 1982.	Provides before and after comparison of travel behavior for an experimental compressed-work week program for federal employees in Denver	Before-and-after approach (with a control group) accurately assesses changes in travel Utilizes actual travel diaries and surveys to track travel patterns Identifies some non-work travel impacts of compressed work weeks Information was complete and accurate due to government workplace focus	Results not as applicable to private organizations, which may not respond as well to requirements to implement compressed work week plans	9/80 schedule vs. 4/40 schedule	dac
				"Effects of Variable Work Hour Programs on Ridesharing and Organizational Effectiveness: A Case Study, Ventura County." Freas, Alyssa M. and Stuart M. Anderson. Commuter Transportation Services, Inc. In Transportation Research Record 1321, 1991.	Assesses several impacts of a pilot employer-based voluntary compressed work week program in Ventura County	Case study was carefully designed to achieve easily obtainable, useful information at the end of the study Studied the impact of CWW on not only commutes, but also employee performance, office performance, and supervisor perspectives	Study was performed within a proactive county agency, rather than a private company, which may affect the results Does not assess VMT or emissions reductions, only assesses ride share percent	Flexitime, 4/40 weeks and 9/80 weeks	dac

Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Compressed Work Week/ Flex Time (cont.)	Sketch planning	Simple tools can generate planning-level estimates of transportation measure effectiveness at low cost Generalized tools can be somewhat applicable to multiple regions Analyst can vary input parameters	Sketch planning results are usually not the most accurate, depending on the input parameters	"TCM Analyst 1.0 and User's Guide." Crawford, Jason A., et al. Texas Transportation Institute. For the Federal Highway Administration, November 1994.	Describes a computerized sketch planning tool, TCM Analyst 1.0, including input data requirements, methods of use, and an overview of the model's structure and calculation procedures	Provides a useful and relatively easy instruction manual for using TCM Analyst 1.0 Uses MOBILE5a output data (emission factors) as <i>inputs</i> to the model, providing more accurate emission benefit calculations for each TCM	Program only models limited TCMs and cannot model multiple TCM packages Requires several runs with MOBILE5a to obtain input emission factors Modeling on regional (rather than microscale) basis only	Not stated

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Compressed Work Week/ Flex Time (cont.)	Sketch planning (cont.)			"Simple Methodologies for Quantifying VT and VMT Reductions from Transportation Control and Growth Management Measures for Developing Local Trip Reduction Ordinances." Evans, V. and D. Morrow. Sonoma Technology, Inc. Air & Waste Management Assoc. 1993	Describes development of simple methodologies for quantifying reductions in vehicle trips (VT) and vehicle miles traveled (VMT) from TCMs, for use in a planning-level context; developed originally for the South Coast Air Basin	<p>Methods to quantify VT and VMT reductions from TCMs were based upon relatively simple methods for estimating emissions and individual TCM effectiveness developed prior to this report for the South Coast AQMD</p> <p>Performance-based approach was developed rather than use mandated transportation performance standards</p> <p>Actual experience data used as much as possible: estimated trip reduction levels from each TCM was collected from other studies, and planning-level analysis uses site-specific data inputs, thus offering increased precision in emissions estimates</p> <p>Ranges in VT reductions estimates address the interactive impacts of the application of multiple TCMs</p> <p>Equivalency factor used to convert VMT to VT can account for region-specific average trip lengths</p>	<p>Expected reductions in VT and VMT from TCMs were estimated based upon a general survey, so for a particular location different assumptions may be needed</p> <p>Applicability to other regions outside California limited by report's use of transportation data and emissions factors in the analysis which were quantified using BURDEN and EMFAC runs for 1994</p> <p>Does not incorporate any consideration of cost-effectiveness</p>	<p>Employee participation (percentage and frequency)</p> <p>Employer-implemented alternative work week schedule</p>

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Compressed Work Week/ Flex Time (cont.)	Sketch planning (cont.)			"Critical Analysis of Sketch-Planning Tools for Evaluating the Emission Benefits of Transportation Control Measures." Crawford, Jason A., and Raymond A. Krammes. Prepared by Texas Transportation Institute for FHWA, FHWA/TX-92/1279-5. December 1993.	Critical analysis and sensitivity analysis (using data for El Paso, Texas) of San Diego Association of Governments (SANDAG) TCM Tools method and the Systems Applications International (SAI) method; summarized in TRR 1472	Provides a thorough review of the state of the practice (as of 1993) Identifies weaknesses in the SANDAG and SAI methods as well as strengths Provides detailed sketch-planning analysis for El Paso, Texas	Many of the inputs to the SANDAG and SAI models are difficult to quantify The SANDAG and SAI models do not fully account for indirect impacts and latent travel demand	Vehicle trips VMT Average vehicle speed Emissions (HC, CO, NOx)

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Compressed Work Week/ Flex Time (cont.)	Employer TDM cost-effectiveness model	Estimates reduction in and costs of daily trips and peak period trips Aids employer determination of cost-effectiveness of TDM measures for their particular worksite	Results may vary widely from one employer to the next Many inputs may be difficult for employers or planners to quantify	"Transportation Demand Management Cost-Effectiveness Model for Suburban Employers." Dagang, Deborah A. JHK & Associates. In Transportation Research Record 1404.	Reports on the development of a model to individually evaluate the cost-effectiveness of 15 different employer-based TDM measures in suburban settings	Focus on suburban employers reflects different travel-related characteristics of suburban and urban areas Spreadsheet-based model is user-friendly and readily accessible for use at the site-specific level; model makes sensitivity analysis relatively simple Eight transportation environments were defined to represent various combinations of transportation service characteristics For employers without access to entire range of data necessary to operate model, default values are included	Most employers surveyed to develop model were unable to provide detailed cost information on the TDM measures they had implemented Does not calculate emissions directly Potential for regional bias, as model was developed in part based on a survey of suburban San Francisco Bay Area employers; model also used the SCAQMD Regulation XV and Pima Association of Governments Travel Reduction Program employer plan databases Only some TDMs included in model provide for estimates of VT reductions Use of default values could diminishes accuracy of estimates for some users	Suburban employer-based TDM measures Daily trips and peak period trips Costs and cost-effectiveness

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed	
Compressed Work Week/ Flex Time (cont.)	Process analysis of transportation measure planning and implementation	Explains lessons learned during the planning and implementation of an actual transportation measure, such as reactions to expect from the public and funding sources Provides pros and cons of planning and implementation methods	Does not necessarily help quantify VT, VMT, or emissions reductions from the TCM implementation Cost can vary greatly	"Transportation Control Measures Analyzed for the Washington Region's 15 Percent Rate of Progress Plan." FHWA/Metropolitan Washington Council of Governments, February 1995.	Provides comprehensive evaluation of the selection and quantification process performed by the MWCOG for assessing various TCM measures	Addresses the strengths and weaknesses of the bottom-up, multiple committee planning process used by the COG Provides extensive, clear detail (and strengths and weaknesses) of both the evaluation tools used and each specific TCM evaluation method Estimates VT, VMT, & emission reductions and cost-effectiveness	Requires an extensive study of already-performed process	None (factors analyzed are applicable to each transportation measure analyzed during the process)	dac
	Comparison and analysis of other studies	Relatively inexpensive and simple to conduct, because it requires no primary research Provides an introduction to the range of results produced by different studies, which could be used if other directly applicable research is not available Identifies advantages and disadvantages of several methodologies	Results are not directly applicable to other regions (they do not incorporate characteristics of other regions) Unlikely to provide precise estimates	"An Assessment of Transportation Control Measures, Transportation Technologies, and Pricing/Regulatory Policies." Euritt, Mark A., et al. University of Texas, Austin, Center for Transportation Research/Tellus Institute. CTR SEDC-1, June 1995.	Assesses several studies that analyze a host of transportation measures, technology options, and policies for total effectiveness and costs/benefits	Provides a solid overview of the range (and effects) of TCM options, as well as technology and policy options Focuses upon energy efficiency impacts in addition to emissions and VMT	Report does not contain a methodology for evaluating new TCM plans, but follow-on report focuses upon these strategies Estimates may be too rough to apply to other programs in other regions	Impacts: vehicle trips, vehicle miles traveled, and emissions Costs	dac
					"Assessment of Travel Demand Management Approaches at Suburban Activity Centers." Bhatt, Kiran, and Higgins, Thomas. K.T. Analytics. U.S. DOT, July 1989.	Surveys research studies and interviews TCM program coordinators to provide an overview of the range of effectiveness of employer-based TCM programs	Provides a large number of case study examples of both effective and ineffective TCM programs Makes recommendations to employers on how to develop a TCM program Provides a good checklist of topics to address when developing a TCM program	Report does not contain a methodology for forecasting the effectiveness of new TCM plans Only generalized evaluation of TCM effectiveness	Relative effectiveness of various transportation measure programs Implementation mechanisms

Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed	
Compressed Work Week/ Flex Time (cont.)	Comparison and analysis of other studies (cont.)			"The Equity and Cost Effectiveness of Employee Commute Options Programs." Farkas, Z. Andrew. Morgan State University. TRB 960078, January 1996.	Analyzes the results of surveys and transportation measure modeling studies performed for the Baltimore and Philadelphia regions	Shows different methods of using the same model: Travel Demand Evaluation Model developed by COMSIS Provides a discussion of social equity considerations based on a survey of the two regions	Philadelphia modeling assumed average vehicle ridership targets were reached and results are only applicable relative to each scenario Baltimore modeling did not estimate emissions reductions	Rideshare promotion level Parking charge level Transit subsidy levels Work schedule flexibility	dac
Congestion Pricing	Integrated travel demand, mode choice, traffic simulation, and emissions model	If developed, an integrated model to simulate demand, mode choice, traffic simulation, and emissions could avoid some of the shortcomings inherent in applying travel and emissions models sequentially	Integrated model has not yet been developed and would be costly to develop	"Framework for Evaluating Transportation Control Measures: Mobility, Air Quality, and Energy Tradeoffs." Euritt, Mark A., et al. University of Texas, Austin, Center for Transportation Research, Jul 94. SWUTC-94-60034-1	Proposes that an integrated model should be developed, but the performed analysis uses current models sequentially	Provides a framework for the development of a future integrated transportation and emissions model	Performed analysis not transferable to other situations	Vehicle operating cost levels Vehicle occupancy rates	dac
	Travel demand/mode choice model	Somewhat applicable to multiple regions Analyst can vary input parameters	Requires region-specific household survey, land use, socioeconomic, and travel cost data Requires complex computer model Potentially high cost to use	"Transportation Pricing Strategies for California: An Assessment of Congestion, Emissions, Energy and Equity Impacts." California Air Resources Board, June 1995. Report No. 92-316.	Develops and uses a comprehensive travel demand model to estimate the impacts of multiple transportation measures	Uses actual, available price elasticities Establishes base case by comparing to actual travel data Explores interrelations between pricing strategies	Does not model specific travel corridors (requires additional model for this purpose) Relies on uncertain forecasts of travel demand	Price level, period and location of application Price elasticity Interrelationships between pricing strategies	dac

Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed	
Congestion Pricing (cont.)	Travel demand/ mode choice model (cont.)			"Implementing Effective Travel Demand Management Measures: Inventory of Measures and Synthesis of Experience." COMSIS Corporation. USDOT, September 1993. DOT-T-94-02.	Summarizes broad range of TDM measures, provides example case study analyses of each, and uses computer model to benchmark the effectiveness of each TDM	Excellent overview of the range of TDMs possible; provides description, nature of effectiveness, application setting, effectiveness potential, and cost Uses actual case studies to inform the use of a computer model for forecasting TDM effectiveness Provides a road-map to implementing TDMs	Use of the model requires local input parameters to forecast local effectiveness Model does not incorporate an emissions calculation module Most analysis is at the employer-level rather than the area-level	Travel and traffic impact Cost-effectiveness	dac
				"The Effectiveness of Transportation Control Measures in Reducing Congestion and Improving Air Quality." Loudon, William R., et al. JHK & Associates. Air & Waste Management Association Annual Meeting & Exhibition 1993. AWMA 93-RP-149.05.	Describes a developed transportation demand model that integrates emissions calculations; provides example calculations from the model	Model has a user manual that leads the analyst step-by-step through the input of data for region specific analyses Contains extensive cost-effectiveness module Can be used at either regional or a smaller area or location Includes exhaust and evaporative emissions	Use of the model requires local input parameters to forecast local effectiveness; default values may not be sufficient	Participation level	dac
				"Transportation Control Measures for the San Francisco Bay Area: Analysis of Effectiveness and Costs." Harvey, G., and E. Deakin. For Bay Area Air Quality Management District, October 1991.	Describes use and results of a travel demand model to model VT, VMT, and emission reductions of various transportation measures in the San Francisco Bay Area	Utilized high-quality household travel survey data and advanced modeling capabilities Emissions calculations use standardized methods, but take into account more subtle effects of emissions generation Provides succinct, clear data on results of study, including cost-effectiveness estimates	Does not provide detail on model operation	Many; not specified	dac

Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed	
Congestion Pricing (cont.)	Travel demand/mode choice model (cont.)			"Transportation Pricing and Travel Behavior." Harvey, Greig W. In <i>Curbing Gridlock: Peak-Period Fees to Relieve Traffic Congestion</i> . Vol. 2. Transportation Research Board Special Report 242, 1994.	Overview paper on the effects of transportation system pricing on activity patterns and travel behavior; some emissions results	<p>Paper presents modeling results from the San Francisco Bay Area Pricing Study using the STEP model</p> <p>Quantifies VMT, trips, fuel usage, ROG, CO, NOx, and CO2</p> <p>Shows quantified travel and emissions modeling results that correspond to specific, clearly defined pricing proposals</p>	<p>Use of model developed for San Francisco Bay Area may limit usefulness of results to other regions</p> <p>Study acknowledges that the STEP model does not accurately account for regional growth or employment allocation, and treats time of day in a simplified way</p>	<p>VMT</p> <p>Vehicle trips</p> <p>Fuel usage</p> <p>Emissions (ROG, CO, NOx, CO2)</p>	drl
	Travel cost model	<p>Most accurate way of measuring true travel costs a priori</p> <p>Allows comparison of multiple scenarios</p>	<p>Results do not necessarily apply to other regions</p> <p>Requires extensive information gathering</p>	"Impacts of Congestion Pricing on Transit and Carpool Demand and Supply." Kain, John. Harvard University, 1994. TRB 940444.	Uses economic theory of travel demand, supply, and pricing, as well as assumptions about the value of time to estimate total travel costs to commuters	<p>Compares impact of congestion pricing on various income groups</p> <p>Provides excellent discussion of total costs of travel and relationship between congestion pricing and transit use</p>	<p>Requires many assumptions that could significantly affect results, including relationship between price level and traffic flow speed</p> <p>Does not quantify emission reductions</p>	<p>Congestion price level</p> <p>Flow speed</p> <p>Parking price level</p> <p>Transit service level</p> <p>Personal value of time</p>	dac

Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Congestion Pricing (cont.)	Demand elasticity model	Simple model based on economics fundamentals, using readily available data, that captures primary determinants of travel behavior Can vary inputs to model based on level of complexity desired	Model may fail to account for non-price determinants of travel behavior, or other congestion pricing program design details	"Demand Elasticity Under Time-Varying Prices: Case Study of Day-of-Week Varying Tolls on Golden Gate Bridge." Gifford, Jonathan L. and Scott W. Talkington. George Mason University, 1996.	Provides a survey overview of literature on road pricing; develops a demand elasticity model to analyze travel demand under time-varying pricing using data from the Golden Gate Bridge in 1979-1984	Presents correlation between time-varying pricing and traffic patterns; indirectly illustrates change in VT Data used are from actual applied day-of-week varying pricing	Focus on aggregate travel behavior precludes analysis about the details of travel preferences Results have limited application to other regions, as local variables such as limited transit alternatives may have influenced model results Use of single case study over period of one price change limits results applicability in other situations Elasticity estimates do not include costs of travel other than toll and gas, and include no assessment of possible mode shifts Does not quantify emissions	Travel demand characteristics Level of toll Gasoline price Price elasticity of traffic

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Congestion Pricing (cont.)	Statistical analysis of average speed of congestion pricing scenarios	Existing knowledge of speed/emissions relationships can be used to estimate the emissions impact of "peak-spreading" resulting from congestion pricing Actual travel data and congestion pricing scenarios can be compared	Speed/emissions relationships under real-world conditions are difficult to characterize accurately and are somewhat poorly understood Modal effects are not directly addressed in "average speed" analysis May only address "peak-spreading" emissions impact, not the trip-reduction and mode shift impacts of congestion pricing	"Congestion Pricing and Motor Vehicle Emissions: An Initial Review." Guensler, Randall and Daniel Sperling. In <i>Curbing Gridlock: Peak-Period Fees to Relieve Traffic Congestion</i> . Vol. 2. Transportation Research Board Special Report 242, 1994.	Examines the air quality impacts likely to result from congestion pricing; focuses on the effects of postulated changes in average vehicle operating speeds on emission rates by looking at four congestion pricing scenarios	Utilizes data from existing study on changes in travel behavior as input to analysis Statistical analysis is fairly simple and could be replicated for any data sets from travel demand and emission rate models Incorporates uncertainty associated with the use of speed correction factors	"Bootstrap" statistical approach to extrapolate data resulted in highly sample-dependent numbers, thus test samples may not have been representative of the fleet Impact of flow smoothing not well represented in an average speed modeling regime that is based on a limited number and variety of test cycles Changes in average vehicle speed yield significantly different percentage changes in emission rates for older and newer vehicles, thus fleet composition must be considered in congestion pricing scenarios Study did not include sensitivity analysis of the models--how sensitive models are to errors in estimation of the independent variable (average speed)	Average speed changes and associated emission rate changes Congestion pricing scenarios: targeted freeway pricing, partial freeway pricing, comprehensive freeway pricing, comprehensive pricing

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed	
Congestion Pricing (cont.)	Use of economic theory to estimate congestion price levels	Based upon sound economic theory Relatively easy and inexpensive to perform Somewhat applicable to multiple regions	Real life conditions may not be easily accounted for by theory	"Freeway Congestion Pricing: Another Look." Levinson, Herbert. Transportation Research Board Paper 940977, January 1994.	Identifies the appropriate level of congestion charges based upon the marginal cost of driving	Analysis based upon economic theory and Highway Capacity Manual speed-flow data	Does not address political acceptability or tolling options available for congestion pricing Prices resulting from the study may need to be adjusted downward to minimize the adverse impacts on traveling Does not quantify emissions	Variation in speed-flow relationships	dac
	Evaluative matrix	Matrix of evaluative criteria which details and compares congestion pricing options could be applied to other regions Relatively flexible in level of complexity and number of evaluation criteria or pricing scenarios input into matrix	Theoretical analysis based on models, not actual congestion pricing project data Relatively extensive location-specific study conducted from which matrix numbers were developed	"Evaluation of Congestion Pricing Alternatives in the Twin Cities." Lari, Adeel Z. and Kenneth R. Buckeye. Minnesota Department of Transportation, January 1997.	Study evaluated the relative relationships and impacts of eleven congestion pricing options in the Twin Cities metropolitan area for 1995-96 using statistically modeled data, public outreach data, and overall feasibility studies	Compared eleven different congestion pricing scenarios for the Twin Cities area against one another according to same criteria Air quality impacts measured in percent reductions in hydrocarbons (PM peak period only)	Unclear from this brief evaluative report how matrix numbers were quantified Matrix developed specifically from a congestion pricing study for the Twin Cities metropolitan area, and thus results and recommendations may only be applicable to Minneapolis/St. Paul area	Congestion relief Mode shift potential Local street impacts Air quality improvements Social and geographical equity Land use/economic impacts Public acceptability Technical feasibility Revenue and costs Operational effectiveness	dkp

Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Congestion Pricing (cont.)	Process analysis of transportation measure planning and implementation	Explains lessons learned during the planning and implementation of an actual transportation measure, such as reactions to expect from the public and funding sources	Does not necessarily help quantify VT, VMT, or emissions reductions from the TCM implementation	"Bay Bridge Congestion Pricing Project: Lessons Learned to Date." Frick, Karen, et al. Metropolitan Transportation Commission, 1996. Transportation Research Board paper 961317.	Reviews and assesses the process by which the Bay Area Congestion Pricing Task Force examined the viability of variable tolls on the San Francisco Bay Bridge	Develops detailed, valuable lessons learned during the implementation of this specific congestion pricing TCM Makes recommendations on how to develop a congestion pricing TCM that gains the approval of the public and public officials	Does not evaluate the end result effectiveness: VT, VMT, emissions reduced	Public reaction to the measure under varying toll levels and alternative commute options Allocation of toll monies and equity issues
				"Transportation Control Measures Analyzed for the Washington Region's 15 Percent Rate of Progress Plan." FHWA/Metropolitan Washington Council of Governments, February 1995.	Provides comprehensive evaluation of the selection and quantification process performed by the MWCOG for assessing various TCM measures	Addresses the strengths and weaknesses of the bottom-up, multiple committee planning process used by the COG Provides extensive, clear detail (and strengths and weaknesses) of both the evaluation tools used and each specific TCM evaluation method Estimates VT, VMT, & emission reductions and cost-effectiveness	Requires an extensive study of already-performed process	None (factors analyzed are applicable to each transportation measure analyzed during the process)

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed			
Congestion Pricing (cont.)	Comparison and analysis of other studies	Relatively inexpensive and simple to conduct, because it requires no primary research	Results are not directly applicable to other regions (they do not incorporate characteristics of other regions)	"An Assessment of Transportation Control Measures, Transportation Technologies, and Pricing/Regulatory Policies." Euritt, Mark A., et al. University of Texas, Austin, Center for Transportation Research/Tellus Institute. CTR SEDC-1, June 1995.	Assesses several studies that analyze a host of transportation measures, technology options, and policies for total effectiveness and costs/benefits	Provides a solid overview of the range (and effects) of TCM options, as well as technology and policy options	Report does not contain a methodology for evaluating new TCM plans, but follow-on report focuses upon these strategies	Impacts: vehicle trips, vehicle miles traveled, and emissions Costs	dac		
		Provides an introduction to the range of results produced by different studies, which could be used if other directly applicable research is not available	Unlikely to provide precise estimates								
		Identifies advantages and disadvantages of several methodologies									
				"Demand Elasticity Under Time-Varying Prices: Case Study of Day-of-Week Varying Tolls on Golden Gate Bridge." Gifford, Jonathan L. and Scott W. Talkington. George Mason University, 1996.	Provides a survey overview of literature on road pricing; develops a demand elasticity model to analyze travel demand under time-varying pricing using data from the Golden Gate Bridge in 1979-1984	Survey includes both theoretical and applied work	Focus on aggregate travel behavior precludes analysis about the details of travel preferences Results limited in indirect applicability to congestion pricing on bridges	Travel demand characteristics Level of toll Gasoline price Price elasticity of traffic			
				"Managing Transportation Demand: Markets Versus Mandates." Giuliano, Genevieve, and Martin Wachs. Reason Foundation, September 1992. Policy Insight No. 142.	Compares congestion pricing with Regulation XV for the Southern California area; describes pros and cons of each measure and discusses implications	Provides typology of TCMs and identifies effectiveness and common barriers to implementation Simple side-by-side comparison of VMT reduction and cost-effectiveness for each TCM Makes policy recommendations to improve each TCM	Provides little detail about logistics of implementing the policy recommendations Does not quantify emission reductions	Direct vs. indirect implementation Market-based vs. performance-based implementation Efficiency and equity considerations	dac		

Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Congestion Pricing (cont.)	Comparison and analysis of other studies (cont.)			"Transportation Pricing and Travel Behavior." Harvey, Greig W. In <i>Curbing Gridlock: Peak-Period Fees to Relieve Traffic Congestion</i> . Vol. 2. Transportation Research Board Special Report 242, 1994.	Overview paper on the effects of transportation system pricing on activity patterns and travel behavior; some emissions results	Paper reviews empirical results and anecdotal from several transportation pricing projects and studies Review of existing results focuses on aggregate demand elasticity	Wide variability of results reviewed limits their usefulness	Aggregate demand elasticity
Database/ Information	Empirical analysis of transportation measure demonstration projects	Requires little or no new data acquisition Relatively low cost Shows actual potential of transportation measures	Case study results do not necessarily apply to other regions	"Evaluation of Travel Demand Management Measures to Relieve Congestion." Kuzmyak, J.R., and E.N. Schreffler. Prepared by COMSIS Corp. for FHWA. FHWA/SA-90/005; DOT-T-90-14. February 1990.	Performs case studies of the effectiveness of 11 transportation demand management programs	Shows potential for reduction in commute-based trips due to implementation of transportation measures Provides high level of detail about the specific programs implemented	Generally does not evaluate specific transportation measure individually; programs of multiple transportation measures are evaluated for effectiveness Does not quantify emission reductions Trip reductions based upon vehicle occupancy assumptions for each mode choice (carpool, vanpool, transit)	Not applicable in context of specific transportation measures

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Database/ Information (cont.)	Sample surveys of ridematching database program success	Uses statistically representative sample population to make estimates of overall impact of ridematching services on ridesharing Sample size (and therefore cost) can be varied based on level of statistical accuracy desired Surveys can be done periodically to determine changes in rideshare placement rates over time, and impacts of special promotions such as "Try Transit" weeks	Surveys can entail significant costs "Revolving door" characteristic of ridesharing programs can be difficult to address with accuracy Relationship between ridesharing participation, VMT, and emissions requires additional analysis If surveys are performed differently in different regions, direct comparisons of results may not be valid	"Rideshare Placement Measurement: A Proposed Standard Methodology." King, Michael, and Barbara Alderson. California State University at Chico, June 1995.	Develops methodology for quantifying rideshare placement levels for ridematching services; discusses pilot testing of methodology (note: this methodology is currently used by RIDES for Bay Area Commuters in the San Francisco Bay Area).	Survey methodology is generic and can be applied to any region Methodology distinguishes between three types of rideshare placements (trial, maintenance, and ongoing) to reflect their different impact on travel and emissions	Only quantifies rideshare placement; does not directly quantify VMT and emissions impact	Rideshare placement rate (trial, maintenance, and ongoing) Survey response rate Statistical sampling error
Emissions Fees	Travel demand/ mode choice model	Somewhat applicable to multiple regions Analyst can vary input parameters	Requires region-specific household survey, land use, socioeconomic, and travel cost data Requires complex computer model Potentially high cost to use	"Transportation Pricing Strategies for California: An Assessment of Congestion, Emissions, Energy and Equity Impacts." California Air Resources Board, June 1995. Report No. 92-316.	Develops and uses a comprehensive travel demand model to estimate the impacts of multiple transportation measures	Establishes base case by comparing to actual travel data Explores interrelations between pricing strategies	Does not contain a highway-network model to include level-of-service changes Forecasts rely on estimations of changes in household travel data	Fee level as a function of mileage, make, model & model year Price elasticity Interrelationships between pricing strategies

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Emissions Fees (cont.)	Travel demand/ mode choice model (cont.)			"Transportation Pricing and Travel Behavior." Harvey, Greig W. In <i>Curbing Gridlock: Peak-Period Fees to Relieve Traffic Congestion</i> . Vol. 2. Transportation Research Board Special Report 242, 1994.	Overview paper on the effects of transportation system pricing on activity patterns and travel behavior; some emissions results	<p>Paper presents modeling results from the San Francisco Bay Area Pricing Study using the STEP model</p> <p>Quantifies VMT, trips, fuel usage, ROG, CO, NOx, and CO2</p> <p>Shows quantified travel and emissions modeling results that correspond to specific, clearly defined pricing proposals</p>	<p>Use of model developed for San Francisco Bay Area may limit usefulness of results to other regions</p> <p>Study acknowledges that the STEP model does not accurately account for regional growth or employment allocation, and treats time of day in a simplified way</p>	<p>VMT</p> <p>Vehicle trips</p> <p>Fuel usage</p> <p>Emissions (ROG, CO, NOx, CO2)</p>
Employee Commute Subsidies	Travel demand/ mode choice model	<p>Somewhat applicable to multiple regions</p> <p>Analyst can vary input parameters</p>	<p>Requires region-specific household survey, land use, socioeconomic, and travel cost data</p> <p>Requires complex computer model</p> <p>Potentially high cost to use</p>	"Implementing Effective Travel Demand Management Measures: Inventory of Measures and Synthesis of Experience." COMSIS Corporation. USDOT, September 1993. DOT-T-94-02.	Summarizes broad range of TDM measures, provides example case study analyses of each, and uses computer model to benchmark the effectiveness of each TDM	<p>Excellent overview of the range of TDMs possible; provides description, nature of effectiveness, application setting, effectiveness potential, and cost</p> <p>Uses actual case studies to inform the use of a computer model for forecasting TDM effectiveness</p> <p>Provides a road-map to implementing TDMs</p>	<p>Use of the model requires local input parameters to forecast local effectiveness</p> <p>Model does not incorporate an emissions calculation module</p> <p>Most analysis is at the employer-level rather than the area-level</p>	<p>Subsidy level</p> <p>Average vehicle ridership</p>

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Employee Commute Subsidies (cont.)	Travel demand/ mode choice model (cont.)			"A Survey and Analysis of Employee Responses to Employer-Sponsored Trip Reduction Incentive Programs." Schreffler, Eric N., and Mortero, Jose. COMSIS Corp. California Air Resources Board, February 1994. Contract No. A983-187.	<p>Describes results of new survey data regarding employee travel behavior; uses mode choice and travel demand model to predict impacts of certain employer-based transportation measures</p> <p>Clearly explains the process that was used: survey data acquisition, mode choice computation, and TCM effectiveness model use</p> <p>Data requirements are more readily available than other models</p> <p>User-friendly model is available for outside use; users guide is also available</p> <p>Survey links incentives directly to impacts on travel behavior</p> <p>Model includes an awareness sub-model that simulates how many people know about the possible TCMs available to them</p>	<p>Does not accurately address trip-chaining and VMT reductions (only trips)</p> <p>Household conditions are not extensively accounted for</p> <p>Cost-effectiveness was not calculated</p> <p>Employer-level analyses only, with focus upon incentive TCMs</p>	<p>Guaranteed ride home</p> <p>Company vanpools</p> <p>Preferential parking</p> <p>Parking fees for ridesharers</p> <p>Carpool subsidies & transportation allowances</p>	dac
				"Selection and Evaluation of Travel Demand Management Measures." Taylor, Christopher J., et al. TRB 971114, January 1997.	<p>Uses Travel Demand Evaluation Model developed by COMSIS to evaluate the impact of transportation measures on mode choice and VT for the Syracuse, NY metropolitan area</p> <p>Uses journey-to-work census data to develop estimates of zone-to-zone travel</p> <p>Evaluates both area-wide programs and employer-based programs</p> <p>Assesses revenue generation potential and transit subsidies</p>	<p>Sufficiently detailed journey-to-work census data may not be available for all cities: Syracuse has this data available due to a pilot program</p> <p>Requires assuming some estimates of effectiveness</p> <p>Does not quantify emissions reductions</p>	<p>Transit fare levels and travel time</p> <p>HOV lane time savings</p> <p>Parking costs</p> <p>Employer transit encouragement level</p>	dac

Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Employee Commute Subsidies (cont.)	Travel demand/mode choice model (cont.)			"Transportation Control Measures for the San Francisco Bay Area: Analysis of Effectiveness and Costs." Harvey, G., and E. Deakin. For Bay Area Air Quality Management District, October 1991.	Describes use and results of a travel demand model to model VT, VMT, and emission reductions of various transportation measures in the San Francisco Bay Area	Utilized high-quality household travel survey data and advanced modeling capabilities Emissions calculations uses standardized methods, but takes into account more subtle effects of emissions generation Provides succinct, clear data on results of study, including cost-effectiveness estimates	Does not provide detail on model operation	Many; not specified

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Employee Commute Subsidies (cont.)	Statistical analysis of the impacts of land use characteristics and TDM strategies on mode choice	<p>Use of Principle Components Analysis generated composite variables (groups of land use characteristics with similar impacts)</p> <p>Standard analysis of variance using principle components allowed examination of the effects of land use and TDM incentive strategies on mode choice individually and in combination.</p> <p>Results transferable to other urban areas in terms of relative ranking of importance of the land use and TDM factors analyzed.</p>	<p>Precise causality and individual impacts of factors such as transit availability or urban density on mode choice cannot be measured due to limitations of the database</p> <p>Potential for need to conduct extensive field research to determine land use characteristics at each sample work site.</p> <p>Cannot be used to determine land use and urban design characteristics' impact on a specific mode choice</p>	"The Effects of Land Use and Travel Demand Management Strategies on Commuting Behavior: Final Report." Prepared by Cambridge Systematics, Inc. and Deakin, Harvey, Skabardonis, Inc. for the U.S. Department of Transportation, November 1994.	Develops an integrated database of land use characteristics and travel demand management (TDM) strategies (for a sample of employment locations) to determine the combined impacts of TDM programs, land use, and urban design on employee travel behavior.	<p>Quantified interactive effect of financial incentives and one or more land use site characteristics.</p> <p>Added land use and site information from field observation to the "Regulation XV" dataset of the South Coast Air Quality Management District (which included aggregate employee travel characteristics and employer incentive programs)</p>	<p>Study conducted in Los Angeles County, and thus may be less applicable in more dense urban areas with factors such as higher average density and transit service.</p> <p>Did not address residential trip end of commute, midday travel, or trip chaining as factors which influence mode choice</p> <p>To simplify a complicated data collection process, somewhat arbitrary indicators were used for assessment of a site's urban design and land use characteristics.</p>	<p>Land use and urban design of worksite</p> <p>TDM incentive strategies</p>

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed	
Employee Commute Subsidies (cont.)	Empirical analysis of the impacts of personal preference and workplace conditions on mode choice	Somewhat applicable to multiple regions (but likely to be influenced heavily by local factors of the study area) Can be replicated (at moderate to high cost) Does not require extensive computer model Uses actual survey data	Requires large data collection process to generate statistically significant results Personal preference and workplace conditions difficult to impact through public policy	"The Influence of Employer Ridesharing Programs on Employee Mode Choice." Ferguson, Erik. <i>Transportation</i> , vol 17, 1990.	Analyzes aggregate-level data compiled by a large Southern California regional ridesharing agency; assesses impact of employer characteristics on employee mode split	Analyzes a large data set comprising almost 10% of Los Angeles area workforce Utilizing existing agency database is a cost-effective approach Less accurate than disaggregated (employee by employee) data Includes cost-effectiveness estimations	Some findings may have been contradicted by more recent studies (e.g., study finds that large corporations have better success with rideshare programs) Aging data source: 1985 survey data Los Angeles area factors may be uncharacteristic of other regions, so results may not be applicable elsewhere Employer-derived data was acquired using different methods No estimates of emissions impacts	Level of employer effort to encourage ridesharing Size of firm	dac
	Parking supply and demand model	Somewhat applicable to multiple regions Analyst can vary input parameters	Requires computer model Potentially high cost to use	"Air Quality Offsets for Parking." Loudon, William, et al. In <i>Transportation Research Record</i> 1232, 1992.	Develops and uses parking supply model for downtown Portland to estimate CO emissions	Uses observed price and travel time sensitivities Uses proven models of travel behavior Incorporates integrated CO emissions model	Requires parking database: number of spaces, location, type, use patterns Requires travel database: time of arrival, travel & work mode split	Price level	dac

Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed	
Employee Commute Subsidies (cont.)	Empirical analysis of transportation measure implementation programs	Somewhat applicable to multiple regions Can be replicated (at moderate cost) Does not require extensive computer model	Requires large data collection process to generate statistically significant results	"An Employer Panel for Evaluating the Effectiveness of Trip Reduction Incentives." Giuliano, Genevieve, and Wachs, Martin. In <i>Panels for Transportation Planning and Applications</i> , ed. T.F. Golob, et al, 1997.	Discusses results collected on Southern California employment sites subject to SCAQMD Regulation XV, and assesses the relative effectiveness of trip reduction strategies	Utilizes the largest trip reduction measure database available in the world Panel method allows for assessing before-and-after-TCM conditions	Database does not provide exceptional detail; report does not contain details of the level of incentive support provided to employees Only generalized effectiveness results are shown TCMs were not always implemented at the time of the survey	Not described	dac
				"Employee Trip Reduction Without Government Mandates: Cost and Effectiveness Estimates From Chicago." Pagano, Anthony and JoAnn Verdin. University of Illinois at Chicago. Transportation Research Board Paper 971281, 1997.	Evaluated the cost and effectiveness of employee trip reduction programs through the use of an independent evaluation of demonstration projects implemented in the Chicago area	Estimates planning, maintenance, and voluntary implementation, and incentive costs for trip reduction programs Intensive data collection, especially for cost estimates, including before and after surveys and interviews of program administrators participating in the demonstration projects Addresses statistical relationships of organization type to costs and outcomes, of costs to strategies and incentives, of outcomes to strategies and incentives, and of cost to outcomes Addresses differences in outcome by organizational type (factory vs. office)	Made generalized assumption of staff costs needed to implement trip reduction programs Intensive data collection requires demonstration project and surveys, or application of Chicago area data Results have limited application to other regions, as local Chicago variables such as availability of transit alternatives may have influenced model results	Trip reduction program implementation process utilized Obstacles and success factors Program costs and effectiveness	dkp

Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed	
Employee Commute Subsidies (cont.)	Empirical analysis of transportation measure demonstration projects	Requires little or no new data acquisition Relatively low cost Shows actual potential of transportation measures	Case study results do not necessarily apply to other regions	"Evaluation of Travel Demand Management Measures to Relieve Congestion." Kuzmyak, J.R., and E.N. Schreffler. Prepared by COMSIS Corp. for FHWA. FHWA/SA-90/005; DOT-T-90-14. February 1990.	Performs case studies of the effectiveness of 11 transportation demand management programs	Shows potential for reduction in commute-based trips due to implementation of transportation measures Provides high level of detail about the specific programs implemented	Generally does not evaluate specific transportation measure individually; programs of multiple transportation measures are evaluated for effectiveness Does not quantify emission reductions Trip reductions based upon vehicle occupancy assumptions for each mode choice (carpool, vanpool, transit)	Not applicable in context of specific transportation measures	dac
	Sketch planning	Simple tools can generate planning-level estimates of transportation measure effectiveness at low cost Generalized tools can be somewhat applicable to multiple regions Analyst can vary input parameters	Sketch planning results are usually not the most accurate, depending on the input parameters	"Evaluating the Effectiveness of Transportation Control Measures for San Luis Obispo County, California." Morrow, David D., San Luis Obispo Air Pollution Control District, 1992.	Develops and uses a calculation methodology for estimating the trip reduction and air quality benefits of employer trip reduction requirements in San Luis Obispo County	Methodologies are developed specifically for the employer trip reduction program Explains calculation process in detail	Requires extensive, region-specific information to accurately estimate benefits and effectiveness of the program Assumes a level of program participation (as required by the measure)	Many; not specified	dac

Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Employee Commute Subsidies (cont.)	Employer TDM cost-effectiveness model	Estimates reduction in and costs of daily trips and peak period trips Aids employer determination of cost-effectiveness of TDM measures for their particular worksite	Results may vary widely from one employer to the next Many inputs may be difficult for employers or planners to quantify	"Transportation Demand Management Cost-Effectiveness Model for Suburban Employers." Dagang, Deborah A. JHK & Associates. In Transportation Research Record 1404.	Reports on the development of a model to individually evaluate the cost-effectiveness of 15 different employer-based TDM measures in suburban settings	Focus on suburban employers reflects different travel-related characteristics of suburban and urban areas Spreadsheet-based model is user-friendly and readily accessible for use at the site-specific level; model makes sensitivity analysis relatively simple Eight transportation environments were defined to represent various combinations of transportation service characteristics For employers without access to entire range of data necessary to operate model, default values are included	Most employers surveyed to develop model were unable to provide detailed cost information on the TDM measures they had implemented Does not calculate emissions directly Potential for regional bias, as model was developed in part based on a survey of suburban San Francisco Bay Area employers; model also used the SCAQMD Regulation XV and Pima Association of Governments Travel Reduction Program employer plan databases Only some TDMs included in model provide for estimates of VT reductions Use of default values could diminishes accuracy of estimates for some users	Suburban employer-based TDM measures Daily trips and peak period trips Costs and cost-effectiveness

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Employee Commute Subsidies (cont.)	Process analysis of transportation measure planning and implementation	Explains lessons learned during the planning and implementation of an actual transportation measure, such as reactions to expect from the public and funding sources Provides pros and cons of planning and implementation methods	Does not necessarily help quantify VT, VMT, or emissions reductions from the transportation measure implementation Cost can vary greatly	"Transportation Control Measures Analyzed for the Washington Region's 15 Percent Rate of Progress Plan." FHWA/Metropolitan Washington Council of Governments, February 1995.	Provides comprehensive evaluation of the selection and quantification process performed by the MWCOG for assessing various transportation measures	Addresses the strengths and weaknesses of the bottom-up, multiple committee planning process used by the COG Provides extensive, clear detail (and strengths and weaknesses) of both the evaluation tools used and each specific transportation measure evaluation method Estimates VT, VMT, and emission reductions and cost-effectiveness	Requires an extensive study of already-performed process	None (factors analyzed are applicable to each transportation measure analyzed during the process)
	Comparison and analysis of other studies	Relatively inexpensive and simple to conduct, because it requires no primary research Provides an introduction to the range of results produced by different studies, which could be used if other directly applicable research is not available Identifies advantages and disadvantages of several methodologies	Results are not directly applicable to other regions (they do not incorporate characteristics of other regions) Unlikely to provide precise estimates	"An Assessment of Transportation Control Measures, Transportation Technologies, and Pricing/Regulatory Policies." Euritt, Mark A., et al. University of Texas, Austin, Center for Transportation Research/Tellus Institute. CTR SEDC-1, June 1995.	Assesses several studies that analyze a host of transportation measures, technology options, and policies for total effectiveness and costs/benefits	Provides a solid overview of the range (and effects) of TCM options, as well as technology and policy options Focuses upon energy efficiency impacts in addition to emissions and VMT	Report does not contain a methodology for evaluating new TCM plans, but follow-on report focuses upon these strategies Estimates may be too rough to apply to other programs in other regions	Impacts: vehicle trips, vehicle miles traveled, and emissions Costs

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed	
Employee Commute Subsidies (cont.)	Comparison and analysis of other studies (cont.)			"Assessment of Travel Demand Management Approaches at Suburban Activity Centers." Bhatt, Kiran, and Higgins, Thomas. K.T. Analytcs. U.S. DOT, July 1989.	Surveys research studies and interviews TCM program coordinators to provide an overview of the range of effectiveness of employer-based TCM programs	Provides a large number of case study examples of both effective and ineffective TCM programs Makes recommendations to employers on how to develop a TCM program Provides a good checklist of topics to address when developing a TCM program	Report does not contain a methodology for forecasting the effectiveness of new TCM plans Only generalized evaluation of TCM effectiveness	Relative effectiveness of various transportation measure programs Implementation mechanisms	dac
				"Managing Transportation Demand: Markets Versus Mandates." Giuliano, Genevieve, and Martin Wachs. Reason Foundation. Policy Insight No. 142, September 1992.	Compares congestion pricing with Regulation XV for the Southern California area; describes pros and cons of each measure and discusses implications	Provides typology of transportation measures and identifies effectiveness and common barriers to implementation Simple side-by-side comparison of VMT reduction and cost-effectiveness for each transportation measure Makes policy recommendations to improve each transportation measure	Provides little detail about logistics of implementing the policy recommendations Does not quantify emission reductions	Direct vs. indirect implementation Market-based vs. performance-based implementation Efficiency and equity considerations	dac
				"The Equity and Cost Effectiveness of Employee Commute Options Programs." Farkas, Z. Andrew. Morgan State University. TRB 960078, January 1996.	Analyzes the results of surveys and transportation measure modeling studies performed for the Baltimore and Philadelphia regions	Shows different methods of using the same model: Travel Demand Evaluation Model developed by COMSIS Provides a discussion of social equity considerations based on a survey of the two regions	Philadelphia modeling assumed average vehicle ridership targets were reached and results are only applicable relative to each scenario Baltimore modeling did not estimate emissions reductions	Rideshare promotion level Parking charge level Transit subsidy levels Work schedule flexibility	dac

Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Episodic/seasonal controls	Sample survey analysis of existing program(s)	<p>Uses sample population to make estimates of overall impact of episodic/seasonal controls</p> <p>Sample size (and therefore cost) can be varied based on level of statistical accuracy desired</p> <p>Surveys can be done periodically to determine changes in program effectiveness over time</p>	<p>Surveys can entail significant costs</p> <p>Daily travel patterns are influenced by so many things that isolating the impact of episodic programs can be difficult to address with accuracy through statistical sampling</p> <p>If surveys are performed differently in different regions, direct comparisons of results may not be valid</p>	"Sacramento Regional Spare the Air 1996: A Report on Two Public Opinion Surveys." Lamare, Jude, The Cleaner Air Partnership. 1997.	Summarizes findings regarding public participation in Sacramento's Spare the Air program, based on telephone interviews	<p>Generates estimates of awareness of program and participation in program (in terms of trips reduced)</p> <p>By identifying reasons for program participation, and how participants shifted trips, study results can be used to improve episodic program design</p>	<p>Telephone survey responses may be biased for several reasons</p> <p>Uses only brief telephone interviews</p> <p>Survey respondents may not be statistically representative of regional population</p> <p>Only uses survey data from one smog episode in a given year, with no control group</p> <p>Unable to assess with confidence the relationship between program characteristics and program effectiveness</p>	<p>Awareness of episodic program</p> <p>Participation in episodic program</p>

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Feebate	Comparison and analysis of other studies	<p>Relatively inexpensive and simple to conduct, because it requires no primary research</p> <p>Provides an introduction to the range of results produced by different studies, which could be used if other directly applicable research is not available</p> <p>Identifies advantages and disadvantages of several methodologies</p>	<p>Results are not directly applicable to other regions (they do not incorporate characteristics of other regions)</p> <p>Unlikely to provide precise estimates</p>	"An Assessment of Transportation Control Measures, Transportation Technologies, and Pricing/Regulatory Policies." Euritt, Mark A., et al. University of Texas, Austin, Center for Transportation Research/Tellus Institute. CTR SEDC-1, June 1995.	Assesses several studies that analyze a host of transportation measures, technology options, and policies for total effectiveness and costs/benefits	<p>Provides a solid overview of the range (and effects) of TCM options, as well as technology and policy options</p> <p>Focuses upon energy efficiency impacts in addition to emissions and VMT</p>	<p>Report does not contain a methodology for evaluating new TCM plans, but follow-on report focuses upon these strategies</p> <p>Estimates may be too rough to apply to other programs in other regions</p>	<p>Impacts: vehicle trips, vehicle miles traveled, and emissions</p> <p>Costs</p>
Fuel Tax Increases	Travel demand/mode choice model	<p>Somewhat applicable to multiple regions</p> <p>Analyst can vary input parameters</p>	<p>Requires region-specific household survey, land use, socioeconomic, and travel cost data</p> <p>Requires complex computer model</p> <p>Potentially high cost to use</p>	"Transportation Pricing Strategies for California: An Assessment of Congestion, Emissions, Energy and Equity Impacts." California Air Resources Board, June 1995. Report No. 92-316.	Develops and uses a comprehensive travel demand model to estimate the impacts of multiple transportation measures	<p>Establishes base case by comparing to actual travel data</p> <p>Explores interrelations between pricing strategies</p>	<p>Does not contain a highway-network model to include level-of-service changes</p> <p>Forecasts rely on estimations of changes in household travel data</p>	<p>Tax level</p> <p>Price elasticity</p> <p>Interrelationships between pricing strategies</p>

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Fuel Tax Increases (cont.)	Travel demand/ mode choice model (cont.)			"The Effectiveness of Transportation Control Measures in Reducing Congestion and Improving Air Quality." Loudon, William R., et al. JHK & Associates. Air & Waste Management Association Annual Meeting & Exhibition 1993. AWMA 93-RP-149.05.	Describes a developed transportation demand model that integrates emissions calculations; provides example calculations from the model	Model has a user manual that leads the analyst step-by-step through the input of data for region specific analyses Contains extensive cost-effectiveness module Can be used at either regional or a smaller area or location Includes exhaust and evaporative emissions	Use of the model requires local input parameters to forecast local effectiveness; default values may not be sufficient	Tax level
				"Transportation Pricing and Travel Behavior." Harvey, Greig W. In <i>Curbing Gridlock: Peak-Period Fees to Relieve Traffic Congestion</i> . Vol. 2. Transportation Research Board Special Report 242, 1994.	Overview paper on the effects of transportation system pricing on activity patterns and travel behavior; some emissions results	Paper presents modeling results from the San Francisco Bay Area Pricing Study using the STEP model Quantifies VMT, trips, fuel usage, ROG, CO, NOx, and CO2 Shows quantified travel and emissions modeling results that correspond to specific, clearly defined pricing proposals	Use of model developed for San Francisco Bay Area may limit usefulness of results to other regions Study acknowledges that the STEP model does not accurately account for regional growth or employment allocation, and treats time of day in a simplified way	VMT Vehicle trips Fuel usage Emissions (ROG, CO, NOx, CO2)

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed	
Fuel Tax Increases (cont.)	Comparison and analysis of other studies	Relatively inexpensive and simple to conduct, because it requires no primary research	Results are not directly applicable to other regions (they do not incorporate characteristics of other regions)	"An Assessment of Transportation Control Measures, Transportation Technologies, and Pricing/Regulatory Policies." Euritt, Mark A., et al. University of Texas, Austin, Center for Transportation Research/Tellus Institute. CTR SEDC-1, June 1995.	Assesses several studies that analyze a host of transportation measures, technology options, and policies for total effectiveness and costs/benefits	Provides a solid overview of the range (and effects) of TCM options, as well as technology and policy options Focuses upon energy efficiency impacts in addition to emissions and VMT	Report does not contain a methodology for evaluating new TCM plans, but follow-on report focuses upon these strategies Estimates may be too rough to apply to other programs in other regions	Impacts: vehicle trips, vehicle miles traveled, and emissions Costs	dac
		Provides an introduction to the range of results produced by different studies, which could be used if other directly applicable research is not available Identifies advantages and disadvantages of several methodologies	Unlikely to provide precise estimates					"Transportation Pricing and Travel Behavior." Harvey, Greig W. In <i>Curbing Gridlock: Peak-Period Fees to Relieve Traffic Congestion</i> . Vol. 2. Transportation Research Board Special Report 242, 1994.	Overview paper on the effects of transportation system pricing on activity patterns and travel behavior; some emissions results
General	Travel demand/mode choice model	Somewhat applicable to multiple regions Analyst can vary input parameters	Requires region-specific household survey, land use, socioeconomic, and travel cost data Requires complicated computer model Potentially high cost to use	"Travel Markets: An Approach to TCM Effectiveness Evaluation." Torluemke, Donald A. Ekistic Mobility Consultants, 1992.	Describes a TDM evaluation methodology and model (GRACIE) that utilizes "travel market" characteristics rather than origin-destination data to classify trips	Travel market segmentation provides useful groupings with similar consumer attributes that can be affected homogeneously by TDMs Travel markets are more easily understood	Travel market data is lacking; requires converting origin-destination data to travel market data Does not show results of using the model	Travel market characteristics	dac

Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
General (cont.)	Modal emissions model	A modal emissions model, which estimates emissions as a function of vehicle operating modes rather than average vehicle speeds, would greatly improve the evaluation of transportation measures that affect the modal operation of vehicles	An emissions model, unless integrated with a travel model, does not calculate travel activity impacts of transportation measures Modal emissions models are still in the development stage	"Overview of the Georgia Tech GIS-Based Modal Emissions Model." Guensler, Randall, et al. Georgia Tech Research Partnership. April 1997.	Describes Georgia Tech's development of a motor vehicle emissions model within a geographic information system (GIS) framework	Model is GIS-based, and is compatible with the analytical frameworks currently employed by most state DOTs and metropolitan planning organizations All model components, assumptions, and algorithms can be validated against real-world data Paper discusses how the model would provide better evaluations of certain transportation measures such as gross-emitter strategies	Model is still under development	Fleet composition Vehicle activity Emission rates
High-Occupancy Vehicle Facilities	Integrated travel demand, mode choice, traffic simulation, and emissions model	If developed, an integrated model to simulate demand, mode choice, traffic simulation, and emissions could avoid some of the shortcomings inherent in applying travel and emissions models sequentially	Integrated model has not yet been developed and would be costly to develop	"Framework for Evaluating Transportation Control Measures: Mobility, Air Quality, and Energy Tradeoffs." Euritt, Mark A., et al. University of Texas, Austin, Center for Transportation Research, Jul 94, SWUTC-94-60034-1	Proposes that an integrated model should be developed, but the performed analysis uses current models sequentially	Provides a framework for the development of a future integrated transportation and emissions model	Performed analysis not transferable to other situations	Vehicle operating cost levels Vehicle occupancy rates

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
High-Occupancy Vehicle Facilities (cont.)	Integrated planning/simulation model	Combines the strengths of regional transportation planning models and traffic simulation models Somewhat applicable to multiple regions Analyst can vary input parameters	Requires very detailed input data Requires complex computer model Potentially high cost to use	"Intelligent Transportation Systems Impact Assessment Framework: Final Report." Volpe National Transportation Systems Center, September 30, 1995	Describes development and application of an analytical tool to predict ITS impacts, with a focus on Advanced Traffic Management Systems	Model integrates transportation planning and traffic simulation in an iterative fashion, and includes emissions and fuel consumption modules Report describes use of model to analyze the potential use of ITS in the I-880 corridor in Alameda County, California, modeling ramp metering, traffic signal coordination, integrated traffic management, incident management, and HOV lanes Emissions module uses accepted EMFAC and MOBILE factors	Relatively high cost and complexity Locally specific input data makes the I-880 results of limited use in other areas	Operational Measures of Effectiveness: VMT, traffic volume, average vehicle speed, vehicle hours of delay, fuel consumption Emission Measures of Effectiveness: CO, HC, NOx Safety Measures of Effectiveness: personal injury levels, property damage, total accidents
	Travel demand/mode choice model	Somewhat applicable to multiple regions Analyst can vary input parameters	Requires region-specific household survey, land use, socioeconomic, and travel cost data Requires complex computer model Potentially high cost to use	"Implementing Effective Travel Demand Management Measures: Inventory of Measures and Synthesis of Experience." COMSIS Corporation. USDOT, September 1993. DOT-T-94-02.	Summarizes broad range of TDM measures, provides example case study analyses of each, and uses computer model to benchmark the effectiveness of each TDM	Excellent overview of the range of TDMs possible; provides description, nature of effectiveness, application setting, effectiveness potential, and cost Uses actual case studies to inform the use of a computer model for forecasting TDM effectiveness Provides a road-map to implementing TDMs	Use of the model requires local input parameters to forecast local effectiveness Model does not incorporate an emissions calculation module Most analysis is at the employer-level rather than the area-level	Vehicle occupancy: 2, 3, or 4 or more people required for HOV lane use Preferential parking Average vehicle ridership

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
High-Occupancy Vehicle Facilities (cont.)	Travel demand/ mode choice model (cont.)			"The Effects of New High-Occupancy Vehicle Lanes on Travel and Emissions." Johnston, Robert A., and Raju Ceerla. In <i>Transportation Research A</i> , vol. 30 no. 1, pp. 35-50, 1996.	Reviews past modeling efforts and travel demand simulations of HOV lanes, including interactions between HOV lanes, pricing measures, transit expansion, and transit-oriented development.	Incorporates feedback procedure to account for potential induced travel demand resulting from new HOV lanes Compares HOV lanes with other transportation strategies, including pricing, transit improvements, and transit-oriented development Uses available EMFAC7E emission rates to calculate TOG, NOx, and CO	Results are geared toward specific Sacramento policy proposals, and are not directly transferable to other areas EMFAC7E factors are California-specific	Travel characteristics: VMT, total v ehicle hours, vehicle hours of delay, transit trips, HOV trips Emissions: TOG, CO, NOx
				"Selection and Evaluation of Travel Demand Management Measures." Taylor, Christopher J., et al. TRB 971114, January 1997.	Uses Travel Demand Evaluation Model developed by COMSIS to evaluate the impact of transportation measures on mode choice and VT for the Syracuse, NY metropolitan area	Uses journey-to-work census data to develop estimates of zone-to-zone travel Evaluates both area-wide programs and employer-based programs Assesses revenue generation potential and transit subsidies	Sufficiently detailed journey-to-work census data may not be available for all cities: Syracuse has this data available due to a pilot program Requires assuming some estimates of effectiveness Does not quantify emissions reductions	Transit fare levels and travel time HOV lane time savings Parking costs Employer transit encouragement level
	Vehicle queuing model	Calculates aggregate vehicle delay (not just individual vehicle travel time) Applicable to any highway Analyst can vary input parameters Relatively low cost to use	Requires computer model Theoretical rather than empirical Requires many simplifying assumptions	"An Analysis of the Effectiveness of High Occupancy Vehicle Lanes." Dahlgren, J. W. Institute of Transportation Studies, UC Berkeley, 1994. UCB-ITS-DS-94-2.	Develops and uses extensive freeway queuing model that simulates the addition of HOV or general purpose lanes	Uses range of travel mode (HOV or LOV) sensitivities Addresses impact on route choice, travel time, induced trips & growth Incorporates integrated emissions model Requires limited data	Assumes bottleneck creates delay (not maximum flow capacity)	Percentage of HOV drivers Initial vehicle delay Number of lanes Travel time elasticities

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed	
High-Occupancy Vehicle Facilities (cont.)	Freeway throughput model	May be applicable to actual corridors, given accurate knowledge of key assumptions Low to moderate cost	Assumptions are required that may heavily impact the results	"Negative Impacts of HOV Facilities on Transit." Vuchic, Vukan R., et al. University of Pennsylvania/University of Delaware. January 1995. TRB 950543.	Surveyed the quantity and quality of bus and HOV lanes in several cities; modeled differences in impacts between bus-only and HOV lanes	Provides quantitative and qualitative arguments for bus-only lanes Results are consistent with actual demonstration project findings, and show potential to reduce VMT	Amount and composition of latent demand for freeway use is assumed Shifts in passengers from SOV to HOV lanes are assumed Does not model emissions	Addition of bus-only or HOV lane Conversion of bus-only or HOV lane	dac
	Emission dispersion model (used for freeways)	Readily available models Applicable to any highway Analyst can vary input parameters Relatively low cost to use	Requires computer model Requires many simplifying assumptions	"Air Quality Impacts of HOV Facilities." Chatterjee, Aun. et al. University of Tennessee, January 1996. TRB 960425.	Uses an emissions dispersion model to estimate CO and NOx concentrations along a freeway with HOV lanes	Establishes an upper and lower bound on emission concentration impacts due to HOV lanes Includes impacts of latent demand	Highly theoretical study with idealized conditions; does not use actual data Assumes mode choice splits	Bus-only lanes vs. multiple passenger lanes	dac
	Empirical analysis of transportation measure implementation programs	Somewhat applicable to multiple regions Can be replicated (at moderate cost) Does not require extensive computer model	Requires large data collection process to generate statistically significant results	"Evaluating the Seattle I-5 North HOV Lane 2+ Occupancy Requirement Demonstration." Turnbull, Katherine F. et al. Texas Transportation Institute. January 1993.	Summarizes the impact (on the HOV lane and general purpose lanes) of a demonstration project which lowered the minimum vehicle occupancy requirement on the I-5 North HOV lanes in Seattle from 3 or more persons per vehicle to 2 or more persons per vehicle	Provides overview of general trends and impacts of a reduction in HOV lane requirements Information evaluated in study was obtained through special surveys and from ongoing monitoring efforts by Washington State's Department of Transportation	Factors under study in travel corridor may have been influenced and confounded by additional variables Changes in travel characteristics as a result of demonstration project may not have emerged immediately after implementation, and thus may not show up in evaluation Analysis limited by availability of data, especially for the period immediately preceding the start of the demonstration	Impact of changing HOV lane vehicle occupancy requirements Traffic levels and traffic conditions during morning and afternoon peak hours and peak periods	dkp

Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
High-Occupancy Vehicle Facilities (cont.)	Case study analysis	<p>Analyzing case studies is relatively easy and inexpensive</p> <p>Different case studies can be compared to determine factors influencing the effectiveness of an HOV strategy</p>	<p>Case-study analysis frequently does not provide rigorous quantitative results</p> <p>Effectiveness of case studies may be due to local factors specific to that case</p>	"High-Occupancy Vehicle Project Case Studies: Historical Trends and Project Experiences." Turnbull, Katherine. Texas Transportation Institute. Prepared for Federal Transit Administration, August 1992.	<p>Presents the examination of historical trends and current experiences with HOV projects on freeways or in separate rights-of-way in selected case studies nationwide; looks specifically at air quality and emissions effects in a Houston case study</p>	<p>Selected case studies evaluated represent a mix of old and new projects, HOV design treatments, and geographic coverage</p> <p>Provides a summary of the experience to date with a variety of HOV projects in North America.</p> <p>Utilizes existing data from case studies, such as mode choice surveys of HOV facility users to draw general conclusions</p> <p>Identifies measures of effectiveness for use in evaluating each of the factors analyzed, and provides examples of how the case studies relate to the different measures</p>	<p>Conclusions and comparisons drawn from relatively little data in some cases</p> <p>Effectiveness of HOV facilities not calculated in terms of emissions but are generally given in before-and-after person and vehicle volume comparisons and percentages relative to general traffic lanes</p> <p>Compares case studies of ongoing projects of differing ages, and in different locations (each with unique factors such as weather, transit issues, and public opinions); thus, conclusions drawn could include errors in consistency or comparability of data</p> <p>Does not provide emissions estimates</p>	<p>Person movement capacity and per-lane efficiency of the freeway facility</p> <p>Bus service operating efficiencies</p> <p>Travel time savings and trip time reliability</p> <p>Air quality and energy impacts</p> <p>Impacts on the operation of the freeway general-purpose lanes</p> <p>Safety</p> <p>Public support</p> <p>Cost-effectiveness</p>

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed	
High-Occupancy Vehicle Facilities (cont.)	Case study analysis (cont.)			"Assessment of High-Occupancy Vehicle Facilities in North America: Executive Report." Turnbull, Katherine. Texas Transportation Institute. Prepared for Federal Transit Administration, August 1992.	Included in a series of reports prepared as part of a three-year assessment	<p>Selected case studies evaluated represent a mix of old and new projects, HOV design treatments, and geographic coverage</p> <p>Provides a summary of the experience to date with a variety of HOV projects in North America.</p> <p>Utilizes existing data from case studies, such as mode choice surveys of HOV facility users to draw general conclusions</p> <p>Identifies measures of effectiveness for use in evaluating each of the factors analyzed, and provides examples of how the case studies relate to the different measures</p>	<p>Conclusions and comparisons drawn from relatively little data in some cases</p> <p>Effectiveness of HOV facilities not calculated in terms of emissions but are generally given in before-and-after person and vehicle volume comparisons and percentages relative to general traffic lanes</p> <p>Compares case studies of ongoing projects of differing ages, and in different locations (each with unique factors such as weather, transit issues, and public opinions); thus, conclusions drawn could include errors in consistency or comparability of data</p> <p>Does not provide emissions estimates</p>	<p>Person movement capacity and per-lane efficiency of the freeway facility</p> <p>Bus service operating efficiencies</p> <p>Travel time savings and trip time reliability</p> <p>Air quality and energy impacts</p> <p>Impacts on the operation of the freeway general-purpose lanes</p> <p>Safety</p> <p>Public support</p> <p>Cost-effectiveness</p>	dkp
	Sketch planning	<p>Simple tools can generate planning-level estimates of transportation measure effectiveness at low cost</p> <p>Generalized tools can be somewhat applicable to multiple regions</p> <p>Analyst can vary input parameters</p>	Sketch planning results are usually not the most accurate, depending on the input parameters	"TCM Analyst 1.0 and User's Guide." Crawford, Jason A., et al. Texas Transportation Institute. For the Federal Highway Administration, November 1994.	Describes a computerized sketch planning tool, TCM Analyst 1.0, including input data requirements, methods of use, and an overview of the model's structure and calculation procedures	<p>Provides a useful and relatively easy instruction manual for using TCM Analyst 1.0</p> <p>Uses MOBILE5a output data (emission factors) as <i>inputs</i> to the model, providing more accurate emission benefit calculations for each TCM</p>	<p>Program only models limited TCMs and cannot model multiple TCM packages</p> <p>Requires several runs with MOBILE5a to obtain input emission factors</p> <p>Modeling on regional (rather than microscale) basis only</p>	Not stated	dac

Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
High-Occupancy Vehicle Facilities (cont.)	Process analysis of transportation measure planning and implementation	Explains lessons learned during the planning and implementation of an actual transportation measure, such as reactions to expect from the public and funding sources Provides pros and cons of planning and implementation methods	Does not necessarily help quantify VT, VMT, or emissions reductions from the transportation measure implementation Cost can vary greatly	"Transportation Control Measures Analyzed for the Washington Region's 15 Percent Rate of Progress Plan." FHWA/Metropolitan Washington Council of Governments, February 1995.	Provides comprehensive evaluation of the selection and quantification process performed by the MWCOG for assessing various transportation measures	Addresses the strengths and weaknesses of the bottom-up, multiple committee planning process used by the COG Provides extensive, clear detail (and strengths and weaknesses) of both the evaluation tools used and each specific transportation measure evaluation method Estimates VT, VMT, and emission reductions and cost-effectiveness	Requires an extensive study of already-performed process	None (factors analyzed are applicable to each transportation measure analyzed during the process)
	Comparison and analysis of other studies	Relatively inexpensive and simple to conduct, because it requires no primary research Provides a review of the results produced by different HOV facilities in North America, which could be used if other directly applicable research is not available Identifies advantages and disadvantages of several methodologies	Results are not directly applicable to other regions (local inputs may play a significant role in determining the travel and emissions impacts of HOV facilities) Unlikely to provide precise estimates	"An Assessment of Transportation Control Measures, Transportation Technologies, and Pricing/Regulatory Policies." Euritt, Mark A., et al. University of Texas, Austin, Center for Transportation Research/Tellus Institute. CTR SEDC-1, June 1995.	Assesses several studies that analyze a host of transportation measures, technology options, and policies for total effectiveness and costs/benefits	Provides a solid overview of the range (and effects) of TCM options, as well as technology and policy options Focuses upon energy efficiency impacts in addition to emissions and VMT	Report does not contain a methodology for evaluating new TCM plans, but follow-on report focuses upon these strategies Estimates may be too rough to apply to other programs in other regions	Impacts: vehicle trips, vehicle miles traveled, and emissions Costs
				"The Effects of New High-Occupancy Vehicle Lanes on Travel and Emissions." Johnston, Robert A., and Raju Ceerla. In <i>Transportation Research A</i> , vol. 30 no. 1, pp. 35-50, 1996.	Reviews past modeling efforts and travel demand simulations of HOV lanes	Provides an overview and critique of previous HOV impact assessment efforts, with recommendations for improvements Summarizes modeling issues related to the Federal and California Clean Air Acts	Various travel characteristics, depending on the specific study reviewed	

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
High-Occupancy Vehicle Facilities (cont.)	Comparison and analysis of other studies (cont.)			"Assessment of High-Occupancy Vehicle Facilities in North America: Executive Report." Turnbull, Katherine. Texas Transportation Institute. Prepared for Federal Transit Administration, August 1992.	Summarizes an assessment of HOV lane projects on freeways or separate rights-of-way in North America; includes suggested procedures for evaluating HOV projects (summarizes four other reports prepared as part of the same three-year assessment)	Identifies clear objectives for developing HOV facilities and corresponding measures of effectiveness, as well as general threshold guidelines (ranges) and data needs Details suggested approach for evaluating operating HOV projects Focuses on overall impacts of HOV facilities on person and vehicle movement, cost effectiveness, implementation risks and flexibility, and use Extensive data collection done which provides a large data set detailing the status of HOV facilities in North America (including HOV utilization by passengers and vehicles)	Compares case studies of ongoing projects of differing ages, and in different locations (each with unique factors such as weather, transit issues, and public opinions); thus, conclusions drawn could include errors in consistency or comparability of data Conclusions and comparisons drawn from relatively little data in some cases Does not provide emissions estimates	Design treatments, operating scenarios, enforcement techniques, utilization levels, and general experiences with HOV facilities Institutional arrangements associated with the development and operation, historical trends in use, and impacts of the facilities
				"HOV Lanes and Ramp Metering: Can They Work Together for Air Quality?" Shoemaker, Bill R. and Edward C. Sullivan. Transportation Research Board Paper 940444. January 1994.	Comments on the analysis process used to assess the air quality impacts of HOV land and ramp metering projects, and examines the degree to which these measures are effective and compatible where jointly applied to improve freeway operations	Illustrates the process of analysis and decision-making, as well as the key role of analytical modeling, required in the San Francisco Bay Area to gain approval for HOV lane and ramp metering projects at the regional level Examines the interrelationships, and potentially perverse effects, between HOV lanes and ramp metering	Identifies need for estimating disaggregate mode-specific emission factors, including vehicle fleet characteristics, and identifies difficulties in doing so	Interrelationships between HOV lanes and ramp metering

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
High-Occupancy Vehicle Facilities (cont.)	Comparison and analysis of other studies (cont.)			"The Effect of HOV Lanes in Reducing Emissions." Bieberitz, John A. ITE 1993 Compendium of Technical Papers.	Describes and assesses analyses of several HOV demonstration projects to inform estimates of a HOV lane use in the Milwaukee area	Compares data from demonstration projects in several cities Estimates include traffic growth rates	Does not provide cost-effectiveness of HOV lanes Assumes HOV lanes are constructed on all segments of the freeways in the Milwaukee area	Traffic growth rates
Intelligent Transportation Systems	Integrated planning/simulation model	Combines the strengths of regional transportation planning models and traffic simulation models Somewhat applicable to multiple regions Analyst can vary input parameters	Requires very detailed input data Requires complex computer model Potentially high cost to use	"Intelligent Transportation Systems Impact Assessment Framework: Final Report." Volpe National Transportation Systems Center, September 30, 1995	Describes development and application of an analytical tool to predict ITS impacts, with a focus on Advanced Traffic Management Systems	Model integrates transportation planning and traffic simulation in an iterative fashion, and includes emissions and fuel consumption modules Report describes use of model to analyze the potential use of ITS in the I-880 corridor in Alameda County, California, modeling ramp metering, traffic signal coordination, integrated traffic management, incident management, and HOV lanes Emissions module uses accepted EMFAC and MOBILE factors	Relatively high cost and complexity Locally specific input data makes the I-880 results of limited use in other areas	Operational Measures of Effectiveness: VMT, traffic volume, average vehicle speed, vehicle hours of delay, fuel consumption Emission Measures of Effectiveness: CO, HC, NOx Safety Measures of Effectiveness: personal injury levels, property damage, total accidents

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Intelligent Transportation Systems (cont.)	Travel demand/mode choice model	Somewhat applicable to multiple regions Analyst can vary input parameters	Requires region-specific household survey, land use, socioeconomic, and travel cost data Requires complicated computer model Potentially high cost to use	"Transportation Control Measures for the San Francisco Bay Area: Analysis of Effectiveness and Costs." Harvey, G., and E. Deakin. For Bay Area Air Quality Management District, October 1991.	Describes use and results of a travel demand model to model VT, VMT, and emission reductions of various transportation measures in the San Francisco Bay Area	Utilized high-quality household travel survey data and advanced modeling capabilities Emissions calculations uses standardized methods, but takes into account more subtle effects of emissions generation Provides succinct, clear data on results of study, including cost-effectiveness estimates	Does not provide detail on model operation	Many; not specified
				"Travel, Emissions, and Consumer Benefits of Advanced Transit Technologies in the Sacramento Region." Johnston, Robert and Rodier, Caroline. University of California, Davis. California PATH Research Report, July 1996.	Uses comprehensive Sacramento Regional Travel Demand Model (SACMET 95) to estimate the possible future impact of ITS on travel mode, emissions, and consumer welfare	Appendices provide thorough explanation of modeling equations, assumptions and variables Explores interrelations between income level and consumer welfare	Model is not integrated with a land use model; effects of major changes in transportation network are not taken in account Use of the model requires local input parameters to forecast local effectiveness More research is necessary to generate useful results	Vehicle miles and total hours traveled Hours of delay and free flow Transportation mode split: single occupant shared ride, transit, walk, bike

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Intelligent Transportation Systems (cont.)	Vehicle queuing model	Calculates vehicle delay and vehicle speeds, to which emission factors can be applied Applicable to any roadway or roadway type Analyst can vary input parameters Relatively low cost to use	Queuing model is theoretical in nature rather than empirical It is difficult to check results of theoretical ITS studies against empirical results due to the relatively low current level of ITS deployment Requires computer model Requires many simplifying assumptions	"Methodology for Evaluating ATIS Impacts on Air Quality." Al-Deek, H. et al. Journal of Transportation Engineering, vol. 121, no. 4, Jul/Aug 1995, pp. 376-384.	Presents an analytical method for evaluating the emissions impact of rerouting traffic guided with ATIS (using a deterministic queuing model), and applies the method to a simple network. Evaluates CO, VOC, and NOx impact.	Uses MOBILE5a emission factors to estimate CO, VOC, and NOx impacts Estimates impacts of ATIS at different levels of market penetration and in different years Can be applied to simple or complex road networks	Does not account for transient emissions associated with acceleration	ATIS market penetration level Road network characteristics Traffic incident characteristics
	Empirical analysis of transportation measure demonstration projects	Requires little or no new data acquisition Relatively low cost Shows actual potential of transportation measures	Case study results do not necessarily apply to other regions	"Environmental Considerations for Planning Advanced Traffic Management Systems." Kraft, Walter H., and William A. Redl, in <i>Resource Papers for the 1994 ITE International Conference</i> , 1994.	Reviews environmental factors related to ITS strategies, and presents a case study of New Jersey DOT I-80 Metropolitan Area Guidance Information and Control (MAGIC) project	Combines general discussion with case study results from an actual ITS project Evaluates changes in VMT and emissions (CO, HC, and NOx) at the corridor level Includes cost/benefit analysis results Tracks changes in VMT and emissions impacts over time	Emissions calculation methodology and results not presented in great detail	Land use and physical features Emissions (CO, HC, NOx) Benefit/cost ratio

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Intelligent Transportation Systems (cont.)	Empirical analysis of transportation measure demonstration projects (cont.)			"ITS Benefits: Continuing Successes and Operational Test Results." Prepared by Mitretek Systems for Federal Highway Administration. Draft, September 19, 1997.	Highlights existing and predicted ITS benefits identified from a variety of ITS implementation programs, focusing on U.S. DOT-funded Field Operational Tests and other programs resulting from recent federal initiatives	<p>Reports benefits from a variety of projects covering a variety of ITS technologies</p> <p>Includes ITS benefits related to safety, time, throughput, cost, customer satisfaction, energy, and environment</p> <p>Describes quantified emissions impacts for projects in Seattle, Boston, Oklahoma, New Jersey, Los Angeles, and Abeline (Texas)</p> <p>Includes example emissions results for Advanced Traveler Information Systems, electronic toll collection, and traffic signal systems</p>	<p>Reports results but does not show analysis methods or calculations</p> <p>Not all reported results have been validated for completeness and reliability</p>	Varies depending on project summarized, but can include: VMT, vehicle trips, vehicle speeds, fuel usage, emissions (HC, CO, Nox)
	Sketch planning	<p>Simple tools can generate planning-level estimates of transportation measure effectiveness at low cost</p> <p>Generalized tools can be somewhat applicable to multiple regions</p> <p>Analyst can vary input parameters</p>	<p>Sketch planning results are usually not the most accurate, depending on the input parameters</p> <p>The relatively low current level of ITS deployment makes validation of sketch planning results difficult</p> <p>Requires many simplifying assumptions</p>	"Potential Emission and Air Quality Impacts of Intelligent Vehicle-Highway Systems." Ostria, Sergio, and Michael F. Lawrence. In Transportation Research Record 1444, 1994.	Discusses short-term and long-term impacts of ITS technology bundles on trips, mode split, and emissions at a regional and corridor level	<p>Provides a broad initial assessment of the expected direction of impact (positive, negative, insignificant, uncertain) of ITS bundles on travel behavior and emissions (HC, CO, NOx)</p> <p>Utilizes solid <i>a priori</i> reasoning to predict impacts</p>	<p>Discussion is theoretical rather than empirical</p> <p>Does not estimate the magnitude of travel or emissions impacts</p> <p>Evaluates ITS technology bundles rather than individual ITS technologies or ITS-related policy options</p>	<p>Traffic flow</p> <p>Vehicle trips</p> <p>Trip distance</p> <p>Mode shifts</p> <p>Emissions (HC, CO, NOx)</p>

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Intelligent Transportation Systems (cont.)	Sketch planning (cont.)			"Potential Contributions of intelligent Vehicle/Highway Systems (IVHS) to Reducing Transportation's Greenhouse Gas Production." Shladover, Steven E. PATH, Institute of Transportation Studies, U.C. Berkeley. August 1991.	Identifies role of ITS in affecting travel demand and supply and categorizes subtypes of ITS	Good categorization of various subtypes of ITS Identifies clearly how ITS influences short-term travel patterns and reduces traffic incidents	Provides little quantification of VMT and delay reductions, no emissions reductions Inconclusive evidence for effect on greenhouse gases, since long-term effects of ITS are unknown	Several subtypes of ITS
				"Assessing the Emission Impacts of IVHS in an Uncertain Future." Washington, Simon P., Randall Guensler, and Daniel Sperling. University of California Transportation Center. Working Paper UCTC No. 298, 1993.	Summarizes the likely impacts of three ITS technology bundles (Advanced Traffic management Systems, Advanced Traveller Information Systems, and Advanced Vehicle Control Systems) under different sets of current and future assumptions	Provides background for evaluating a range of emissions impacts of ITS Assesses potential changes in ITS emissions impacts due to future changes in vehicle fleet composition and driver behavior Highlights potential synergies among ITS technologies and policy options	Does not address specific policies or programs that would impact vehicle fleet composition and driver behavior Assesses the expected direction, but not the magnitude, of ITS emissions impacts Does not draw upon data from specific existing ITS projects	Travel impacts Emissions impacts

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Intelligent Transportation Systems (cont.)	Sketch planning (cont.)			"Emissions Impacts of Intelligent Vehicle Highway Systems." Washington, Simon, Randall Guensler, and Daniel Sperling. U.C. Davis Institute of Transportation Studies, UCD-RP-13-93. 1993.	A preliminary assessment of emissions impacts of ITS technology bundles	Provides framework for evaluating emissions impacts of ITS Discusses potential ITS impacts of VMT, trip-end emissions, engine idling, diurnal and refueling emissions, and modal emissions activity Identifies role of ITS in reducing emissions impacts associated with non-recurrent traffic congestion Addresses potential role of ITS technologies in implementing demand management strategies such as congestion pricing and preferential treatment of shared modes	Assesses the expected direction, but not the magnitude, of ITS emissions impacts Does not draw upon data from specific existing ITS projects	VMT Vehicle trips Modal emissions activity
	Process analysis of transportation measure planning and implementation	Explains lessons learned during the planning and implementation of an actual transportation measure, such as reactions to expect from the public and funding sources Provides pros and cons of planning and implementation methods	Does not necessarily help quantify VT, VMT, or emissions reductions from the transportation measure implementation Cost can vary greatly	"Transportation Control Measures Analyzed for the Washington Region's 15 Percent Rate of Progress Plan." FHWA/Metropolitan Washington Council of Governments, February 1995.	Provides comprehensive evaluation of the selection and quantification process performed by the MWCOG for assessing various transportation measures	Addresses the strengths and weaknesses of the bottom-up, multiple committee planning process used by the COG Provides extensive, clear detail (and strengths and weaknesses) of both the evaluation tools used and each specific transportation measure evaluation method Estimates VT, VMT, and emission reductions and cost-effectiveness	Requires an extensive study of already-performed process	None (factors analyzed are applicable to each transportation measure analyzed during the process)

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed	
Intelligent Transportation Systems (cont.)	Comparison and analysis of other studies	Relatively inexpensive and simple to conduct, because it requires no primary research	Results are not directly applicable to other regions (they do not incorporate characteristics of other regions)	"An Assessment of Transportation Control Measures, Transportation Technologies, and Pricing/Regulatory Policies." Euritt, Mark A., et al. University of Texas, Austin, Center for Transportation Research/Tellus Institute. CTR SEDC-1, June 1995.	Assesses several studies that analyze a host of transportation measures, technology options, and policies for total effectiveness and costs/benefits	Provides a solid overview of the range (and effects) of TCM options, as well as technology and policy options Focuses upon energy efficiency impacts in addition to emissions and VMT	Report does not contain a methodology for evaluating new TCM plans, but follow-on report focuses upon these strategies Estimates may be too rough to apply to other programs in other regions	Impacts: vehicle trips, vehicle miles traveled, and emissions Costs	dac
		Provides a review of the results produced by different HOV facilities in North America, which could be used if other directly applicable research is not available Identifies advantages and disadvantages of several methodologies	Unlikely to provide precise estimates	"An Assessment of IVHS-APTS Technology Impacts on Energy Consumption and Vehicle Emissions of Transit Bus Fleets." Jolibois, Sylvan C. Jr., and Adib Kanafani. California PATH Research Report. August 1994.	Examines the potential impacts of Advanced Public Transportation Systems (APTS) technologies in terms of vehicle emissions, air quality, and fuel consumption through a research review, and makes subsequent policy recommendations	Provides a qualitative assessment of Intelligent Vehicle-Highway Systems technologies on air quality and energy consumption in both short and long term Presents review of certain APTS program areas, specifically transit operations of motorized bus fleets Provides ratios of transit bus emissions to auto emissions (per passenger and per vehicle) for HC, CO, NOx, and PM	Report does not contain a methodology for quantification of emissions from specific transportation measures Emissions ratios may be based on overly optimistic ridership estimates	Impacts of Advanced Public Transportation Systems (APTS) technologies on vehicle emissions and fuel consumption Smart Traveler, Smart Vehicle, and Smart Intermodal systems	dkp

Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Intermodal	Empirical analysis of transportation measure demonstration projects	Requires little or no new data acquisition Relatively low cost Shows actual potential of transportation measures	Case study results do not necessarily apply to other regions	"Evaluation of Travel Demand Management Measures to Relieve Congestion." Kuzmyak, J.R., and E.N. Schreffler. Prepared by COMSIS Corp. for FHWA. FHWA/SA-90/005; DOT-T-90-14. February 1990.	Performs case studies of the effectiveness of 11 transportation demand management programs	Shows potential for reduction in commute-based trips due to implementation of transportation measures Provides high level of detail about the specific programs implemented	Generally does not evaluate specific transportation measure individually; programs of multiple transportation measures are evaluated for effectiveness Does not quantify emission reductions Trip reductions based upon vehicle occupancy assumptions for each mode choice (carpool, vanpool, transit)	Not applicable in context of specific transportation measures

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed	
Local Land Use/Urban Design	Travel demand/ mode choice model	State-of-the-art method of analyzing individual travel behavior	Requires region-specific household survey, land use, socioeconomic, and travel cost data	"The Effectiveness of Transportation Control Measures in Reducing Congestion and Improving Air Quality." Loudon, William R., et al. JHK & Associates. Air & Waste Management Association Annual Meeting & Exhibition 1993. AWMA 93-RP-149.05.	Describes a developed transportation demand model that integrates emissions calculations; provides example calculations from the model	Model has a user manual that leads the analyst step-by-step through the input of data for region specific analyses Contains extensive cost-effectiveness module Can be used at either regional or a smaller area or location Includes exhaust and evaporative emissions	Use of the model requires local input parameters to forecast local effectiveness; default values may not be sufficient	Commuter trip length reduction through new zoning controls	dac
		Model's structure and parameters offer considerable insight into what factors influence travel mode selection, and therefore can be used to evaluate different scenarios and details in program design	Requires complex computer model Potentially high cost to use Does not directly provide emissions estimates Precision of analysis will depend on accuracy of both growth projections and estimates of "holding capacity" of targeted household and employment growth transfer zones						"Testing the Impact of Alternative Land Use Scenarios Using a Travel Demand Forecasting Model." Steiss, Todd Alan. Baltimore Metropolitan Council, Transportation Planning Division. Transportation Research Board Paper 960898.
		Travel demand models can be used to evaluate combinations of transportation measures as well as individual measures							
		Can be used to isolate the impact of land use changes on a transportation network, minimizing other factors such as other transportation measures							

Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Local Land Use/Urban Design (cont.)	Conventional transportation planning network model	Can be used to isolate the effect on travel patterns of different street layouts for neotraditional and conventional neighborhoods	<p>Hypothetical modeling exercise; does not use actual performance data from existing neotraditional and conventional developments</p> <p>Models do not account for many aspects of local land use strategies, such as mixed land uses, street characteristics like street and lane width and landscaping, and differences in development densities and parking availability</p> <p>Modeling analysis of a local street network does not account for interaction between neighborhood and regional travel</p>	"Comparative Assessment of Travel Characteristics for Neotraditional Designs." McNally, Michael and Sherry Ryan. Institute of Transportation Studies. In Transportation Research Record 1400.	Evaluates the performance differences of two hypothetical street networks designed to replicate a neotraditional and a conventional suburban community; determines that neotraditional street networks can improve transportation system performance	<p>Uses generalized, hypothetical transportation network designs in order to generate broad conclusions rather than localized network-specific conclusions</p> <p>Examines effect neotraditional design has on reducing vehicle kilometers and vehicle hours traveled</p> <p>Generates results consistent with earlier findings by others</p> <p>To isolate the impact of the street layout, all other aspects of the modeled communities are held constant</p>	<p>The study does not calculate emissions directly; transportation impacts are measured in terms of vehicle kilometers traveled, average trip lengths, and congestion on links and at intersections</p> <p>Model does not take into account narrower rights-of-way and denser grid that usually typify neotraditional developments; assumed equal trade-off</p> <p>Because hypothetical subarea is only 0.5 square miles, many assumptions need to be made about external trips</p> <p>Trip generation rates, other travel parameters, and friction factors which were adopted from the City of Irvine could have introduced some error, as they were developed for a study area larger than that used in this exercise</p>	<p>Transportation systems of hypothetical neotraditional and conventional subdivisions</p> <p>Vehicle kilometers traveled</p> <p>Mean trip length by trip type</p> <p>Intersection capacity utilization (ICU)</p>

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Local Land Use/Urban Design (cont.)	Statistical analysis of factors affecting travel behavior	Utilizes actual data from travel diaries, surveys, and/or local and household characteristics Relatively simple approach (does not require computer modeling) Some results may have applicability to other regions	Complexity of relationship between travel behavior and urban form can make it difficult to achieve statistically significant results Causality can be difficult to establish Uncertain applicability to multiple regions (but can be duplicated at moderate cost, if necessary)	"A Micro-Analysis of Land Use and Travel in Five Neighborhoods in the San Francisco Bay Area." Kitamura, Ryuichi, et al. Institute of Transportation Studies, UC Davis. November, 1994.	Analyzes surveys of five Bay Area neighborhoods; assesses impact of land use characteristics and attitudes on travel behavior	Utilizes actual survey data from five different neighborhoods for comparison Distinguishes between impact of land use characteristics, attitudes, and income Explores multiple variables (household size, profession, environmental attitude, time pressure, etc.)	More research is necessary to reach conclusions that are useful to land use planners Diaries and surveys require time-intensive, methodical approach	Land use characteristics (access to transit, sidewalk/bikeway availability, etc.) Personal attitudes related to environment, mobility, etc.
				"Using Residential Patterns and Transit to Decrease Auto Dependence and Costs." Holtzclaw, John. For Natural Resources Defense Council, June 1994.	Evaluates the effects of neighborhood characteristics (density, transit accessibility, neighborhood shopping, and pedestrian accessibility) on household vehicle ownership and VMT, based on data from 27 neighborhoods in California.	Explores some key relationships between often-overlooked neighborhood characteristics and travel behavior Uses innovative techniques to account for transit accessibility, neighborhood shopping, and pedestrian accessibility Uses data from a wide variety of California neighborhoods, from central city to suburban fringe	Evaluates VMT per household, but does not estimate emissions impacts directly Study does not account for several potentially important neighborhood characteristics, including parking availability and proximity to the urban center Results may not be applicable outside of California	Annual VMT per household Household vehicle ownership Neighborhood characteristics (density, transit accessibility, neighborhood shopping, and pedestrian accessibility) Household income

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Local Land Use/Urban Design (cont.)	Statistical analysis of factors affecting travel behavior (cont.)			"Effect of Urban Development Patterns on Transportation Energy Use." Cheslow, Melvyn D., and J. Kevin Neels. In Transportation Research Record 764, 1980.	Addresses the influence of travel patterns on energy use, and analyzes the relationships between these travel characteristics and measures of urban form	Analyzes actual trip data from a pooled sample of interview surveys in eight standard metropolitan statistical areas (SMSAs) nationwide Focuses on variation in fuel use between different neighborhoods and metropolitan areas	Does not define exactly how urban structure may affect travel characteristics Study sample included few metropolitan areas, and was therefore unable to pinpoint the urban-scale characteristics that distinguished the different metropolitan regions Study does not include mixed land-use scenarios, or walking trips in travel characteristics analyzed Does not address economic and social costs and feasibility of implementing changes in urban development patterns	Land use characteristics Household travel patterns Transportation energy use
				"The Odds on TODs: Examining the Potential of Transit-Oriented Development in the San Francisco Bay Area." Luscher, Dan. Harvard University, April 1995.	Quantifies VMT impact of hypothetical transit-oriented developments based on regression analysis; estimates costs and benefits of transit-oriented development; shorter version appears in Berkeley Planning Journal, vol. 9, 1995.	Identifies key relationships between neighborhood characteristics and total travel Uses hypothetical transit-oriented developments that are similar to actual developments being built Estimates a range of travel impacts per transit-oriented development as well as for the San Francisco Bay region as a whole	Does not estimate emissions impacts directly Results assume very widespread implementation of transit-oriented development Results may not be applicable outside of California	Annual VMT per household Household income Neighborhood characteristics (density, transit accessibility, distance from central business district)

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed	
Local Land Use/Urban Design (cont.)	Statistical analysis of factors affecting travel behavior (cont.)			"Travel Behavior as a Function of Accessibility, Land Use Mixing, and Land Use Balance: Evidence from the San Francisco Bay Area." Kockelman, Kara M. University of California, Berkeley. TRB 970048.	Correlates land use and travel behavior databases for the San Francisco Bay Area to determine the impact of land use mix, balance, and accessibility on travel patterns	Utilizes 1990 census and hectare-level land-use description data from actual surveys for accurate characterizations of local populations and land use zones Develops descriptive definitions for characterizing land use data (accessibility, mix, and balance) to more accurately determine the influence of land use on travel behavior Results may not be heavily influenced by local conditions	Similar data may not be available in the same format in other areas Results show elasticities of VMT, auto ownership, and personal vehicle choice with respect to land use accessibility, mix, and balance, but do not calculate VMT or emission reductions from these characteristics	Land use accessibility, mix, and balance Income per household member Auto ownership Household size Job and population density	dac
				"An Assessment of the Land Use - Transportation System and Travel Behavior." McNally, Michael G., and Anup Kulkarni. U.C. Irvine. TRB 971120, January 1997.	Correlates land use, socioeconomic, and travel behavior databases for Orange County neighborhoods to determine the impact of land use on travel patterns	Uses comprehensive list of indices to evaluate neighborhood characteristics (e.g., population density, number of 3-way intersections, etc.) and cluster them into 3 distinct themes Studied socioeconomic demographics in conjunction with land use patterns to determine which is more influential on trip patterns	Cannot investigate correlation between household income and choice of neighborhood theme Quantifies only trip rate and mode share	Neighborhood network characteristics Socioeconomic demographics Land use types Accessibility	dac
				"Transit-Oriented Development in the Sun Belt." Messenger, Todd, and Reid Ewing. In Transportation Research Record 1552, 1996.	Determined the minimum housing and workplace density required to support a given transit service level in the Dade County, Florida area	Provides detailed equations used to calculate results Allows for interactive effects between variables Utilizes traffic analysis zone data from the Census	Accuracy may be very region-specific Does not quantify travel or emission reductions	Residence and workplace density Automobile ownership Rail availability Parking charge Roadway network	dac

Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Local Land Use/Urban Design (cont.)	Statistical analysis of the impacts of land use characteristics and TDM strategies on mode choice	<p>Use of Principle Components Analysis generated composite variables (groups of land use characteristics with similar impacts)</p> <p>Standard analysis of variance using principle components allowed examination of the effects of land use and TDM incentive strategies on mode choice individually and in combination.</p> <p>Results transferable to other urban areas in terms of relative ranking of importance of the land use and TDM factors analyzed.</p>	<p>Precise causality and individual impacts of factors such as transit availability or urban density on mode choice cannot be measured due to limitations of the database</p> <p>Potential for need to conduct extensive field research to determine land use characteristics at each sample work site.</p> <p>Cannot be used to determine land use and urban design characteristics' impact on a specific mode choice</p>	"The Effects of Land Use and Travel Demand Management Strategies on Commuting Behavior: Final Report." Prepared by Cambridge Systematics, Inc. and Deakin, Harvey, Skabardonis, Inc. for the U.S. Department of Transportation, November 1994.	Develops an integrated database of land use characteristics and travel demand management (TDM) strategies (for a sample of employment locations) to determine the combined impacts of TDM programs, land use, and urban design on employee travel behavior.	Added land use and site information from field observation to the "Regulation XV" dataset of the South Coast Air Quality Management District (which included aggregate employee travel characteristics and employer incentive programs)	<p>Study conducted in Los Angeles County, and thus may be less applicable in more dense urban areas with factors such as higher average density and transit service.</p> <p>Did not address residential trip end of commute, midday travel, or trip chaining as factors which influence mode choice</p> <p>To simplify a complicated data collection process, somewhat arbitrary indicators were used for assessment of a site's urban design and land use characteristics.</p>	<p>Land use and urban design of worksite</p> <p>TDM incentive strategies</p>

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed	
Local Land Use/Urban Design (cont.)	Empirical analysis of transportation measure demonstration projects	Requires little or no new data acquisition Relatively low cost Shows actual potential of transportation measures Identifies barriers to implementing transportation measures	Case study results do not necessarily apply to other regions	"Land Use Regulations to Promote Ridesharing: An Evaluation of the Seattle Approach." McCutcheon, Melody, and Jeffrey Hamm. <i>Transportation Quarterly</i> , vol. 37 no. 4, 1983.	Evaluates the effectiveness of developer-based land use regulations to promote ridesharing in Seattle's central business district	Identifies barriers to enforcing parking management practices at businesses; suggests improvements	Does not quantify trip, VMT, or emissions reductions Study was performed before significant data existed on the effectiveness of the whole program	Availability of nearby parking Developer cooperation with requirements	dac
	Sketch planning	Simple tools can generate planning-level estimates of transportation measure effectiveness at low cost Generalized tools can be somewhat applicable to multiple regions Analyst can vary input parameters	Sketch planning results are usually not the most accurate, depending on the input parameters	"Transportation-Related Land Use Strategies to Minimize Motor Vehicle Emissions: An Indirect Source Research Study." Dagang, Deborah A. JHK & Associates, Inc. For California Air Resources Board. June 1995.	Based upon a review of relevant literature, case studies, and a travel survey study, this report recommends community-level performance goals, and presents appropriate transportation-related land use strategies and implementation mechanisms	Performance goals are expressed as annual VT per household, annual VMT per household, modal shares, and estimated related vehicular emissions Addresses differences in community type, as three ranges of performance goals for urban and suburban areas and two ranges of performance goals for exurban/rural areas are specified Recommended community-wide packages of transportation-related land use strategies address difficulty of quantifying reductions in VT and emissions from individual strategies applied separately or on a site-specific basis	Applicability of performance goals and strategy recommendations to regions outside California limited by study's use of primarily Californian communities case studies and data Performance goals, strategies, and implementation mechanisms do not include consideration of cost-effectiveness Performance goal development can not use available BURDEN activity data, as it is not specific enough to allow accurate segmentation by type of community within a metropolitan area	Transportation-related land use strategies	dkp

Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Local Land Use/Urban Design (cont.)	Sketch planning (cont.)			"Simple Methodologies for Quantifying VT and VMT Reductions from Transportation Control and Growth Management Measures for Developing Local Trip Reduction Ordinances." Evans, V. and D. Morrow. Sonoma Technology, Inc. Air & Waste Management Assoc. 1993	Describes development of simple methodologies for quantifying reductions in vehicle trips (VT) and vehicle miles traveled (VMT) from TCMs, for use in a planning-level context; specifically analyzes pedestrian improvements	<p>Methods to quantify VT and VMT reductions from TCMs were based upon relatively simple methods for estimating emissions and individual TCM effectiveness developed prior to this report for the South Coast AQMD</p> <p>Performance-based approach was developed rather than use mandated transportation performance standards</p> <p>Actual experience data used as much as possible: estimated trip reduction levels from each TCM was collected from other studies, and planning-level analysis uses site-specific data inputs, thus offering increased precision in emissions estimates</p> <p>Ranges in VT reductions estimates address the interactive impacts of the application of multiple TCMs</p> <p>Equivalency factor used to convert VMT to VT can account for region-specific average trip lengths</p>	<p>Expected reductions in VT and VMT from TCMs were estimated based upon a general survey, so for a particular location different assumptions may be needed</p> <p>Applicability to other regions outside California limited by report's use of transportation data and emissions factors in the analysis which were quantified using BURDEN and EMFAC runs for 1994</p> <p>Does not incorporate any consideration of cost-effectiveness</p>	<p>Employee participation (percentage and frequency)</p> <p>Trip length</p> <p>Existence/extent of pedestrian path system</p> <p>Existence of shower facilities</p>

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Local Land Use/Urban Design (cont.)	Process analysis of transportation measure planning and implementation	Explains lessons learned during the planning and implementation of an actual transportation measure, such as reactions to expect from the public and funding sources Provides pros and cons of planning and implementation methods	Does not necessarily help quantify VT, VMT, or emissions reductions from the transportation measure implementation Cost can vary greatly	"Transportation Control Measures Analyzed for the Washington Region's 15 Percent Rate of Progress Plan." FHWA/Metropolitan Washington Council of Governments, February 1995.	Provides comprehensive evaluation of the selection and quantification process performed by the MWCOG for assessing various transportation measures	Addresses the strengths and weaknesses of the bottom-up, multiple committee planning process used by the COG Provides extensive, clear detail (and strengths and weaknesses) of both the evaluation tools used and each specific transportation measure evaluation method Estimates VT, VMT, and emission reductions and cost-effectiveness	Requires an extensive study of already-performed process	None (factors analyzed are applicable to each transportation measure analyzed during the process)
	Comparison and analysis of other studies	Relatively inexpensive and simple to conduct, because it requires no primary research Provides a review of the results produced by different HOV facilities in North America, which could be used if other directly applicable research is not available Identifies advantages and disadvantages of several methodologies	Results are not directly applicable to other regions (they do not incorporate characteristics of other regions) Unlikely to provide precise estimates	"An Assessment of Transportation Control Measures, Transportation Technologies, and Pricing/Regulatory Policies." Euritt, Mark A., et al. University of Texas, Austin, Center for Transportation Research/Tellus Institute. CTR SEDC-1, June 1995.	Assesses several studies that analyze a host of transportation measures, technology options, and policies for total effectiveness and costs/benefits	Provides a solid overview of the range (and effects) of TCM options, as well as technology and policy options Focuses upon energy efficiency impacts in addition to emissions and VMT	Report does not contain a methodology for evaluating new TCM plans, but follow-on report focuses upon these strategies Estimates may be too rough to apply to other programs in other regions	Impacts: vehicle trips, vehicle miles traveled, and emissions Costs

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Local Land Use/Urban Design (cont.)	Comparison and analysis of other studies (cont.)			<p>"Transportation-Related Land Use Strategies to Minimize Motor Vehicle Emissions: An Indirect Source Research Study." Dagang, Deborah A. JHK & Associates, Inc. For California Air Resources Board. June 1995.</p>	<p>Based upon a review of relevant literature, case studies, and a travel survey study, this report recommends community-level performance goals, and presents appropriate transportation-related land use strategies and implementation mechanisms</p>	<p>Includes an extensive literature review matrix and annotated bibliography summarizing quantifiable effectiveness data of transportation-related land use strategies in local, national, and international cases</p> <p>Preliminary estimates of individual transportation-related land use strategy effectiveness are developed from the literature review</p> <p>Utilized as a resource an existing detailed examination of travel data and transportation and land use characteristics in California (by John Holtzclaw for the Natural Resources Defense Council, 1994)</p> <p>Travel and land use data from selected Portland, Oregon, and Canadian cities were examined to provide a basis of comparison for the characteristics found in the Californian case studies</p>	<p>Much of literature on transportation-related land use strategies does not contain analyses of modeled or empirical data, thus somewhat limiting scope of data included</p> <p>Literature survey does not contain emissions estimates, but subsequent sketch planning focuses on emissions related to VT and VMT performance goals</p>	<p>Transportation-related land use strategies</p> <p>Land use and transportation characteristics' impact on creation and support of public transit systems and pedestrian-accessible communities</p>

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed	
Market Incentives	Travel demand/mode choice model	Somewhat applicable to multiple regions Analyst can vary input parameters	Requires region-specific household survey, land use, socioeconomic, and travel cost data Requires complicated computer model Potentially high cost to use	"Selection and Evaluation of Travel Demand Management Measures." Taylor, Christopher J., et al. TRB 971114, January 1997.	Uses Travel Demand Evaluation Model developed by COMSIS to evaluate the impact of transportation measures on mode choice and VT for the Syracuse, NY metropolitan area	Uses journey-to-work census data to develop estimates of zone-to-zone travel Evaluates both area-wide programs and employer-based programs Assesses revenue generation potential and transit subsidies	Sufficiently detailed journey-to-work census data may not be available for all cities: Syracuse has this data available due to a pilot program Requires assuming some estimates of effectiveness Does not quantify emissions reductions	Transit fare levels and travel time HOV lane time savings Parking costs Employer transit encouragement level	dac
				"Transportation Control Measures for the San Francisco Bay Area: Analysis of Effectiveness and Costs." Harvey, G., and E. Deakin. For Bay Area Air Quality Management District, October 1991.	Describes use and results of a travel demand model to model VT, VMT, and emission reductions of various transportation measures in the San Francisco Bay Area	Utilized high-quality household travel survey data and advanced modeling capabilities Emissions calculations uses standardized methods, but takes into account more subtle effects of emissions generation Provides succinct, clear data on results of study, including cost-effectiveness estimates	Does not provide detail on model operation	Many; not specified	dac
	Sample survey of customer travel patterns and preferences at shopping centers	Somewhat applicable to multiple regions (but influenced by local factors of the study area) Does not require an extensive computer model	Requires large data collection process to generate statistically significant results Moderate to high cost	"Analysis of Indirect Source Trip Activity: Regional Shopping Centers." Prepared by JHK & Associates and K.T. Analytics for the California Air Resources Board. ARB-R-94/510, November 1993.	Surveyed customers of regional shopping centers to determine potential impact of various travel reduction measures	Uses actual survey data (including customer demographic and stated preference data) Developed calculation methodologies specific to each trip reduction measure, using site-specific data Compares data between shopping centers in different land-use types	Assumptions are required to translate stated preference data to expected outcome Does not quantify emission reductions	Transit subsidy/validation	dac

Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed	
Market Incentives (cont.)	Process analysis of transportation measure planning and implementation	Explains lessons learned during the planning and implementation of an actual transportation measure, such as reactions to expect from the public and funding sources Provides pros and cons of planning and implementation methods	Does not necessarily help quantify VT, VMT, or emissions reductions from the transportation measure implementation Cost can vary greatly	"Transportation Control Measures Analyzed for the Washington Region's 15 Percent Rate of Progress Plan." FHWA/Metropolitan Washington Council of Governments, February 1995.	Provides comprehensive evaluation of the selection and quantification process performed by the MWCOG for assessing various transportation measures	Addresses the strengths and weaknesses of the bottom-up, multiple committee planning process used by the COG Provides extensive, clear detail (and strengths and weaknesses) of both the evaluation tools used and each specific transportation measure evaluation method Estimates VT, VMT, and emission reductions and cost-effectiveness	Requires an extensive study of already-performed process	None (factors analyzed are applicable to each transportation measure analyzed during the process)	dac
	Comparison and analysis of other studies	Relatively inexpensive and simple to conduct, because it requires no primary research Provides an introduction to the range of results produced by different studies, which could be used if other directly applicable research is not available	Results are not directly applicable to other regions (they do not incorporate characteristics of other regions) Unlikely to provide precise estimates	"Managing Transportation Demand: Markets Versus Mandates." Giuliano, Genevieve, and Martin Wachs. Reason Foundation. Policy Insight No. 142, September 1992.	Compares congestion pricing with Regulation XV for the Southern California area; describes pros and cons of each measure and discusses implications	Provides typology of transportation measures and identifies effectiveness and common barriers to implementation Simple side-by-side comparison of VMT reduction and cost-effectiveness for each transportation measure Makes policy recommendations to improve each transportation measure	Provides little detail about logistics of implementing the policy recommendations Does not quantify emission reductions	Direct vs. indirect implementation Market-based vs. performance-based implementation Efficiency and equity considerations	dac
		Identifies advantages and disadvantages of several methodologies			"The Equity and Cost Effectiveness of Employee Commute Options Programs." Farkas, Z. Andrew. Morgan State University. TRB 960078, January 1996.	Analyzes the results of surveys and transportation measure modeling studies performed for the Baltimore and Philadelphia regions	Shows different methods of using the same model: Travel Demand Evaluation Model developed by COMSIS Provides a discussion of social equity considerations based on a survey of the two regions	Philadelphia modeling assumed average vehicle ridership targets were reached and results are only applicable relative to each scenario Baltimore modeling did not estimate emissions reductions	Rideshare promotion level Parking charge level Transit subsidy levels Work schedule flexibility

Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed	
Parking Pricing/ Parking Management	Travel demand/ mode choice model	Somewhat applicable to multiple regions Analyst can vary input parameters	Requires region-specific household survey, land use, socioeconomic, and travel cost data Requires complex computer model Potentially high cost to use	"Transportation Pricing Strategies for California: An Assessment of Congestion, Emissions, Energy and Equity Impacts." California Air Resources Board, June 1995. Report No. 92-316.	Develops and uses a comprehensive travel demand model to estimate the impacts of multiple transportation measures	Uses actual, available price elasticities Establishes base case by comparing to actual travel data Explores interrelations between pricing strategies	Does not contain a highway-network model to include level-of-service changes Forecasts rely on estimations of changes in household travel data	Price level, period and location of application Price elasticity Interrelationships between pricing strategies	dac
				"Implementing Effective Travel Demand Management Measures: Inventory of Measures and Synthesis of Experience." COMSIS Corporation. USDOT, September 1993. DOT-T-94-02.	Summarizes broad range of TDM measures, provides example case study analyses of each, and uses computer model to benchmark the effectiveness of each TDM	Excellent overview of the range of TDMs possible; provides description, nature of effectiveness, application setting, effectiveness potential, and cost Uses actual case studies to inform the use of a computer model for forecasting TDM effectiveness Provides a road-map to implementing TDMs	Use of the model requires local input parameters to forecast local effectiveness Model does not incorporate an emissions calculation module Most analysis is at the employer-level rather than the area-level	Fee level	dac
				"The Effectiveness of Transportation Control Measures in Reducing Congestion and Improving Air Quality." Loudon, William R., et al. JHK & Associates. Air & Waste Management Association Annual Meeting & Exhibition 1993. AWMA 93-RP-149.05.	Describes a developed transportation demand model that integrates emissions calculations; provides example calculations from the model	Model has a user manual that leads the analyst step-by-step through the input of data for region specific analyses Contains extensive cost-effectiveness module Can be used at either regional or a smaller area or location Includes exhaust and evaporative emissions	Use of the model requires local input parameters to forecast local effectiveness; default values may not be sufficient	Fee level during commute trip parking times	dac

Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Parking Pricing/ Parking Management (cont.)	Travel demand/ mode choice model (cont.)			"Transportation Control Measure Analysis Procedures." Austin, Barbara S., et al. Systems Applications International/California Air Resources Board. Nov 1991. SYSAPP-91/141.	Describes a developed transportation demand model and explicitly discusses the calculation methodology used for several transportation measures	Model quantifies key secondary effects of TCMs (e.g. new carpooling programs may attract transit riders rather than SOV riders) Presents all the primary equations and variables used to calculate the effects of TCMs Contains a step-by-step process for evaluating packages of TCMs Explains multi-attribute analyses as applied to multiple TCM packages	Use of the model requires local input parameters to forecast local effectiveness; default values may not be sufficient; participation level data is required; base cases need to match real conditions Model does not cover all TCMs, but can be modified to do so Temporal treatment is limited to on-peak/off-peak, no spatial treatment Emissions calculations are not explicitly described in the same fashion as travel effects	Level of people affected by parking measures Availability of spillover parking Interaction with rideshare & transit programs Price level

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Parking Pricing/ Parking Management (cont.)	Travel demand/ mode choice model (cont.)			"A Survey and Analysis of Employee Responses to Employer-Sponsored Trip Reduction Incentive Programs." Schreffler, Eric N., and Mortero, Jose. COMSIS Corp. California Air Resources Board, February 1994. Contract No. A983-187.	Describes results of new survey data regarding employee travel behavior; uses mode choice and travel demand model to predict impacts of certain employer-based transportation measures	Clearly explains the process that was used: survey data acquisition, mode choice computation, and TCM effectiveness model use Data requirements are more readily available than other models User-friendly model is available for outside use; users guide is also available Survey links incentives directly to impacts on travel behavior Model includes an awareness sub-model that simulates how many people know about the possible TCMs available to them	Does not accurately address trip-chaining and VMT reductions (only trips) Household conditions are not extensively accounted for Cost-effectiveness was not calculated Employer-level analyses only, with focus upon incentive TCMs	Guaranteed ride home Company vanpools Preferential parking Parking fees for ridesharers Carpool subsidies & transportation allowances
				"Estimating the Travel and Parking Demand Effects of Employer-Paid Parking." Willson, Richard. UCTC No. 39, University of California Transportation Center, Berkeley, 1992.	Uses a multinomial logit model to estimate the influence of employer-paid parking on the mode of transportation used to the workplace	Explains the main variables and equations used to compute probabilities Includes impact of complementary transportation measures such as rideshare incentives and flextime	Data set not developed for this particular modeling effort and missing key variables such as vehicle availability per household Model mostly useful in metropolitan area where parking market is more developed	Transportation mode (solo, carpool, or transit) Cars per 100 employees Elasticity of demand for each mode

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed	
Parking Pricing/ Parking Management (cont.)	Travel demand/ mode choice model (cont.)			"Selection and Evaluation of Travel Demand Management Measures." Taylor, Christopher J., et al. TRB 971114, January 1997.	Uses Travel Demand Evaluation Model developed by COMSIS to evaluate the impact of transportation measures on mode choice and VT for the Syracuse, NY metropolitan area	Uses journey-to-work census data to develop estimates of zone-to-zone travel Evaluates both area-wide programs and employer-based programs Assesses revenue generation potential and transit subsidies	Sufficiently detailed journey-to-work census data may not be available for all cities: Syracuse has this data available due to a pilot program Requires assuming some estimates of effectiveness Does not quantify emissions reductions	Transit fare levels and travel time HOV lane time savings Parking costs Employer transit encouragement level	dac
				"Transportation Control Measures for the San Francisco Bay Area: Analysis of Effectiveness and Costs." Harvey, G., and E. Deakin. For Bay Area Air Quality Management District, October 1991.	Describes use and results of a travel demand model to model VT, VMT, and emission reductions of various transportation measures in the San Francisco Bay Area Provides succinct, clear data on results of study, including cost-effectiveness estimates	Utilized high-quality household travel survey data and advanced modeling capabilities Emissions calculations uses standardized methods, but takes into account more subtle effects of emissions generation	Does not provide detail on model operation	Many; not specified	dac
				"Transportation Pricing and Travel Behavior." Harvey, Greig W. In <i>Curbing Gridlock: Peak-Period Fees to Relieve Traffic Congestion</i> . Vol. 2. Transportation Research Board Special Report 242, 1994.	Overview paper on the effects of transportation system pricing on activity patterns and travel behavior; some emissions results	Paper presents modeling results from the San Francisco Bay Area Pricing Study using the STEP model Quantifies VMT, trips, fuel usage, ROG, CO, NOx, and CO2 Shows quantified travel and emissions modeling results that correspond to specific, clearly defined pricing proposals	Use of model developed for San Francisco Bay Area may limit usefulness of results to other regions Study acknowledges that the STEP model does not accurately account for regional growth or employment allocation, and treats time of day in a simplified way	VMT Vehicle trips Fuel usage Emissions (ROG, CO, NOx, CO2)	drl

Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed	
Parking Pricing/ Parking Management (cont.)	Parking supply and demand model	Somewhat applicable to multiple regions Analyst can vary input parameters	Requires computer model Potentially high cost to use	"Air Quality Offsets for Parking." Loudon, William, et al. In <i>Transportation Research Record</i> 1232, 1992.	Develops and uses parking supply model for downtown Portland to estimate CO emissions	Uses observed price and travel time sensitivities Uses proven models of travel behavior Incorporates integrated CO emissions model	Requires parking database: number of spaces, location, type, use patterns Requires travel database: time of arrival, travel & work mode split	Price level	dac
	Empirical analysis of transportation measure implementation programs	Somewhat applicable to multiple regions Can be replicated (at moderate cost) Does not require extensive computer model	Requires large data collection process to generate statistically significant results	"An Employer Panel for Evaluating the Effectiveness of Trip Reduction Incentives." Giuliano, Genevieve, and Wachs, Martin. In <i>Panels for Transportation Planning and Applications</i> , ed. T.F. Golob, et al, 1997.	Discusses results collected on Southern California employment sites subject to SCAQMD Regulation XV, and assesses the relative effectiveness of trip reduction strategies	Utilizes the largest trip reduction measure database available in the world Panel method allows for assessing before-and-after-TCM conditions	Database does not provide exceptional detail; report does not contain details of the level of incentive support provided to employees Only generalized effectiveness results are shown TCMs were not always implemented at the time of the survey	Not described	dac
				"Reducing Drive-Along Rates at Small Employer Sites: Costs and Benefits of Local Trip Reduction Ordinances: Pasadena Towers Case Study." Stewart, Jacqueline. In <i>Transportation Research Record</i> 1433, 1994.	Evaluates the cost effectiveness of a building-based trip reduction plan implemented in compliance to a local ordinance in Pasadena, California	Attitudinal survey includes the influences of building tenant company size as well as schedule and lifestyle of employees	Uses small data sets therefore results vary widely with the behavior of a few individuals Does not establish a standard to evaluate average vehicle ridership results obtained Results may not be transferable to other employer sites or regions Does not quantify emission impacts	Program cost and distribution of cost Benefits to developer, tenants and city Average vehicle ridership	fk

Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Parking Pricing/ Parking Management (cont.)	Empirical analysis of transportation measure demonstration projects	Requires little or no new data acquisition	Case study results do not necessarily apply to other regions	"Evaluation of Travel Demand Management Measures to Relieve Congestion." Kuzmyak, J.R., and E.N. Schreffler. Prepared by COMSIS Corp. for FHWA. FHWA/SA-90/005; DOT-T-90-14. February 1990.	Performs case studies of the effectiveness of 11 transportation demand management programs	Shows potential for reduction in commute-based trips due to implementation of transportation measures	Generally does not evaluate specific transportation measure individually; programs of multiple transportation measures are evaluated for effectiveness	Not applicable in context of specific transportation measures
		Relatively low cost					Provides high level of detail about the specific programs implemented	
	Shows actual potential of transportation measures	Identifies barriers to implementing transportation measures					Trip reductions based upon vehicle occupancy assumptions for each mode choice (carpool, vanpool, transit)	
				"Land Use Regulations to Promote Ridesharing: An Evaluation of the Seattle Approach." McCutcheon, Melody, and Jeffrey Hamm. <i>Transportation Quarterly</i> , vol. 37 no. 4, 1983.	Evaluates the effectiveness of developer-based land use regulations to promote ridesharing in Seattle's central business district	Identifies barriers to enforcing parking management practices at businesses; suggests improvements	Does not quantify trip, VMT, or emissions reductions	Availability of nearby parking
							Study was performed before significant data existed on the effectiveness of the whole program	Developer cooperation with requirements
	Transportation survey analysis	Somewhat applicable to multiple regions (but influenced by local factors of the study area)	Requires large data collection process	"Cashing Out Employer-Paid Parking: A Precedent for Congestion Pricing?" Shoup, Donald. University of California, Los Angeles, 1994. Contained in Transportation Research Board SR 242.	Uses transportation survey data to assess vehicle trip, VMT, and fuel use changes if cash payments were made available to employees in lieu of subsidized parking	Uses actual transportation behavior data for the Los Angeles region in addition to available supplementary data	Requires care when inferring applicability of results to other regions	Value of parking subsidy
		Can be replicated (at moderate cost)				Requires only simple calculations		Level of cash payments in lieu of parking subsidy
		Does not require extensive computer model				Provides rebuttals to arguments against cash payments		

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed	
Parking Pricing/ Parking Management (cont.)	Transportation survey analysis (cont.)			"Analysis of Indirect Source Trip Activity: Regional Shopping Centers." Prepared by JHK & Associates and K.T. Analytics for the California Air Resources Board. ARB-R-94/510, November 1993.	Surveyed customers of regional shopping centers to determine potential impact of various travel reduction measures	Uses actual survey data (including customer demographic and stated preference data) Developed calculation methodologies specific to each trip reduction measure, using site-specific data Compares data between shopping centers in different land-use types	Assumptions are required to translate stated preference data to expected outcome Does not quantify emission reductions	Parking fee level Amount of other nearby parking Proximity of potential high-occupancy preferred parking	dac
	Sketch planning	Simple tools can generate planning-level estimates of transportation measure effectiveness at low cost Generalized tools can be somewhat applicable to multiple regions Analyst can vary input parameters	Sketch planning results are usually not the most accurate, depending on the input parameters	"TCM Analyst 1.0 and User's Guide." Crawford, Jason A., et al. Texas Transportation Institute. For the Federal Highway Administration, November 1994.	Describes a computerized sketch planning tool, TCM Analyst 1.0, including input data requirements, methods of use, and an overview of the model's structure and calculation procedures	Provides a useful and relatively easy instruction manual for using TCM Analyst 1.0 Uses MOBILE5a output data (emission factors) as <i>inputs</i> to the model, providing more accurate emission benefit calculations for each TCM	Program only models limited TCMs and cannot model multiple TCM packages Requires several runs with MOBILE5a to obtain input emission factors Modeling on regional (rather than microscale) basis only	Not stated	dac
				"Critical Analysis of Sketch-Planning Tools for Evaluating the Emission Benefits of Transportation Control Measures." Crawford, Jason A., and Raymond A. Krammes. Prepared by Texas Transportation Institute for FHWA, FHWA/TX-92/1279-5. December 1993.	Critical analysis and sensitivity analysis (using data for El Paso, Texas) of San Diego Association of Governments (SANDAG) TCM Tools method and the Systems Applications International (SAI) method; summarized in TRR 1472	Provides a thorough review of the state of the practice (as of 1993) Identifies weaknesses in the SANDAG and SAI methods as well as strengths Provides detailed sketch-planning analysis for El Paso, Texas	Many of the inputs to the SANDAG and SAI models are difficult to quantify The SANDAG and SAI models do not fully account for indirect impacts and latent travel demand	Vehicle trips VMT Average vehicle speed Emissions (HC, CO, NOx)	drl

Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Parking Pricing/ Parking Management (cont.)	Process analysis of transportation measure planning and implementation	Explains lessons learned during the planning and implementation of an actual transportation measure, such as reactions to expect from the public and funding sources Provides pros and cons of planning and implementation methods	Does not necessarily help quantify VT, VMT, or emissions reductions from the transportation measure implementation Cost can vary greatly	"Transportation Control Measures Analyzed for the Washington Region's 15 Percent Rate of Progress Plan." FHWA/Metropolitan Washington Council of Governments, February 1995.	Provides comprehensive evaluation of the selection and quantification process performed by the MWCOG for assessing various transportation measures	Addresses the strengths and weaknesses of the bottom-up, multiple committee planning process used by the COG Provides extensive, clear detail (and strengths and weaknesses) of both the evaluation tools used and each specific transportation measure evaluation method Estimates VT, VMT, and emission reductions and cost-effectiveness	Requires an extensive study of already-performed process	None (factors analyzed are applicable to each transportation measure analyzed during the process)
	Comparison and analysis of other studies	Relatively inexpensive and simple to conduct, because it requires no primary research Provides a review of the results produced by different HOV facilities in North America, which could be used if other directly applicable research is not available Identifies advantages and disadvantages of several methodologies	Results are not directly applicable to other regions (they do not incorporate characteristics of other regions) Unlikely to provide precise estimates	"An Assessment of Transportation Control Measures, Transportation Technologies, and Pricing/Regulatory Policies." Euritt, Mark A., et al. University of Texas, Austin, Center for Transportation Research/Tellus Institute. CTR SEDC-1, June 1995.	Assesses several studies that analyze a host of transportation measures, technology options, and policies for total effectiveness and costs/benefits	Provides a solid overview of the range (and effects) of TCM options, as well as technology and policy options Focuses upon energy efficiency impacts in addition to emissions and VMT	Report does not contain a methodology for evaluating new TCM plans, but follow-on report focuses upon these strategies Estimates may be too rough to apply to other programs in other regions	Impacts: vehicle trips, vehicle miles traveled, and emissions Costs

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Parking Pricing/ Parking Management (cont.)	Comparison and analysis of other studies (cont.)			"Assessment of Travel Demand Management Approaches at Suburban Activity Centers." Bhatt, Kiran, and Higgins, Thomas. K.T. Analytics. U.S. DOT, July 1989.	Surveys research studies and interviews TCM program coordinators to provide an overview of the range of effectiveness of employer-based TCM programs	Provides a large number of case study examples of both effective and ineffective TCM programs Makes recommendations to employers on how to develop a TCM program Provides a good checklist of topics to address when developing a TCM program	Report does not contain a methodology for forecasting the effectiveness of new TCM plans Only generalized evaluation of TCM effectiveness	Relative effectiveness of various transportation measure programs Implementation mechanisms
				"Parking Subsidies and Travel Choices: Assessing the Evidence." Willson, Richard W. and Donald C. Shoup. In <i>Transportation</i> , vol. 17, 1990.	Reviews empirical case studies of the relationship between employer-paid parking and solo commuting	Draws out analogous results from a variety of existing case studies to show range of impacts of employer-paid parking and solo driving Case studies cover a variety of locations (downtown and suburban), employer types (public and private) and employee categories (professional and clerical) Case study results are reinforced by survey findings cited in the paper Provides an estimated range for the elasticity of demand for solo driving with respect to parking price	Because most case studies are from Los Angeles, results may not be representative of other areas Range of results is very wide, so the results cannot directly be used to accurately estimate the impacts of another program Does not quantify VMT or emissions impacts	Existence of employer-paid parking Travel mode (solo driver, non-solo driver)

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed	
Parking Pricing/ Parking Management (cont.)	Comparison and analysis of other studies (cont.)			"The Equity and Cost Effectiveness of Employee Commute Options Programs." Farkas, Z. Andrew. Morgan State University. TRB 960078, January 1996.	Analyzes the results of surveys and transportation measure modeling studies performed for the Baltimore and Philadelphia regions	Shows different methods of using the same model: Travel Demand Evaluation Model developed by COMSIS Provides a discussion of social equity considerations based on a survey of the two regions	Philadelphia modeling assumed average vehicle ridership targets were reached and results are only applicable relative to each scenario Baltimore modeling did not estimate emissions reductions	Rideshare promotion level Parking charge level Transit subsidy levels Work schedule flexibility	dac
				"Transportation Pricing and Travel Behavior." Harvey, Greig W. In <i>Curbing Gridlock: Peak-Period Fees to Relieve Traffic Congestion</i> . Vol. 2. Transportation Research Board Special Report 242, 1994.	Overview paper on the effects of transportation system pricing on activity patterns and travel behavior; some emissions results	Paper reviews empirical results and anecdotal from several transportation pricing projects and studies Review of existing results focuses on aggregate demand elasticity	Wide variability of results reviewed limits their usefulness	Aggregate demand elasticity	drl

Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Regional Land Use/ Growth Management	Conventional transportation planning network model	Can be used to isolate the effect on travel patterns of different land use patterns	<p>Hypothetical modeling exercise; does not use actual performance data from existing neighborhoods</p> <p>Models do not account for many aspects of land use strategies, such as mixed land uses, street characteristics like street and lane width and landscaping, and differences in development densities and parking availability</p> <p>Modeling analysis of a local street network does not account for interaction between neighborhood and regional travel</p>	"The Impacts of Various Land Use Strategies on Suburban Mobility." Middlesex Somerset Mercer Regional Council (MSM). For the Federal Transit Administration. December 1992.	Examines the interaction between suburban land use trends and regional traffic conditions utilizing three different models of high density, mixed-use centers; tested the model's transportation effects on Trenton and New Brunswick suburban region	<p>Used TransCAD transportation modeling package, which incorporates land use elements in a GIS format with a traditional four-step transportation planning model</p> <p>Regional transportation model used to evaluate effects of the 3 mixed-use centers (transit, short-drive, and walking) includes modeling of trip generation, distribution, mode split, and route assignment</p>	<p>Regionwide tripmaking formulas concentrated on suburban practices and do not provide a good reflection of urban tripmaking conditions</p> <p>Study does not calculate emissions directly; transportation impacts are measured in Vehicle Trips and Vehicle Miles Traveled</p> <p>Model assumes that all new development locates in cities or in higher-density, mixed-use centers</p>	Transportation effects of suburban, higher density, mixed use centers, measured in: vehicle trips, level of vehicle miles traveled, level of delay experienced, and average speed
	Statistical analysis of factors affecting travel behavior	<p>Utilizes actual data from travel diaries, surveys, and/or local and household characteristics</p> <p>Relatively simple approach (does not require computer modeling)</p> <p>Some results may have applicability to other regions</p>	<p>Complexity of relationship between travel behavior and urban form can make it difficult to achieve statistically significant results</p> <p>Causality can be difficult to establish</p> <p>Uncertain applicability to multiple regions (but can be duplicated at moderate cost, if necessary)</p>	"Using Residential Patterns and Transit to Decrease Auto Dependence and Costs." Holtzclaw, John. For Natural Resources Defense Council, June 1994.	Evaluates the effects of neighborhood characteristics (density, transit accessibility, neighborhood shopping, and pedestrian accessibility) on household vehicle ownership and VMT, based on data from 27 neighborhoods in California.	<p>Explores some key relationships between often-overlooked neighborhood characteristics and travel behavior</p> <p>Uses innovative techniques to account for transit accessibility, neighborhood shopping, and pedestrian accessibility</p> <p>Uses data from a wide variety of California neighborhoods, from central city to suburban fringe</p>	<p>Evaluates VMT per household, but does not estimate emissions impacts directly</p> <p>Study does not account for several potentially important neighborhood characteristics, including parking availability and proximity to the urban center</p> <p>Results may not be applicable outside of California</p>	<p>Annual VMT per household</p> <p>Household vehicle ownership</p> <p>Neighborhood characteristics (density, transit accessibility, neighborhood shopping, and pedestrian accessibility)</p> <p>Household income</p>

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed	
Rideshare	Travel demand/ mode choice model	Somewhat applicable to multiple regions Analyst can vary input parameters	Requires region- specific household survey, land use, socioeconomic, and travel cost data Requires complex computer model Potentially high cost to use	"Implementing Effective Travel Demand Management Measures: Inventory of Measures and Synthesis of Experience." COMSIS Corporation. USDOT, September 1993. DOT-T-94-02.	Summarizes broad range of TDM measures, provides example case study analyses of each, and uses computer model to benchmark the effectiveness of each TDM	Excellent overview of the range of TDMs possible; provides description, nature of effectiveness, application setting, effectiveness potential, and cost Uses actual case studies to inform the use of a computer model for forecasting TDM effectiveness Provides a road-map to implementing TDMs	Use of the model requires local input parameters to forecast local effectiveness Model does not incorporate an emissions calculation module Most analysis is at the employer-level rather than the area-level	Level of service provided by employer: information, matching services, preferential parking, ride home programs Average vehicle ridership	dac
				"The Effectiveness of Transportation Control Measures in Reducing Congestion and Improving Air Quality." Loudon, William R., et al. JHK & Associates. Air & Waste Management Association Annual Meeting & Exhibition 1993. AWMA 93-RP- 149.05.	Describes a developed transportation demand model that integrates emissions calculations; provides example calculations from the model	Model has a user manual that leads the analyst step-by-step through the input of data for region specific analyses Contains extensive cost- effectiveness module Can be used at either regional or a smaller area or location Includes exhaust and evaporative emissions	Use of the model requires local input parameters to forecast local effectiveness; default values may not be sufficient	Employee incentives	dac

Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Rideshare (cont.)	Travel demand/ mode choice model (cont.)			"Transportation Control Measure Analysis Procedures." Austin, Barbara S., et al. Systems Applications International/California Air Resources Board. Nov 1991. SYSAPP-91/141.	Describes a developed transportation demand model and explicitly discusses the calculation methodology used for several transportation measures	<p>Model quantifies key secondary effects of TCMs (e.g. new carpooling programs may attract transit riders rather than SOV riders)</p> <p>Presents all the primary equations and variables used to calculate the effects of TCMs</p> <p>Contains a step-by-step process for evaluating packages of TCMs</p> <p>Explains multi-attribute analyses as applied to multiple TCM packages</p>	<p>Use of the model requires local input parameters to forecast local effectiveness; default values may not be sufficient; participation level data is required; base cases need to match real conditions</p> <p>Model does not cover all TCMs, but can be modified to do so</p> <p>Temporal treatment is limited to on-peak/off-peak, no spatial treatment</p> <p>Emissions calculations are not explicitly described in the same fashion as travel effects</p>	<p>Effect of park and ride lots</p> <p>Formation of new versus existing carpools</p>

dac

Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed	
Rideshare (cont.)	Travel demand/ mode choice model (cont.)			<p>"A Survey and Analysis of Employee Responses to Employer-Sponsored Trip Reduction Incentive Programs." Schreffler, Eric N., and Mortero, Jose. COMSIS Corp. California Air Resources Board, February 1994. Contract No. A983-187.</p>	<p>Describes results of new survey data regarding employee travel behavior; uses mode choice and travel demand model to predict impacts of certain employer-based transportation measures</p>	<p>Clearly explains the process that was used: survey data acquisition, mode choice computation, and TCM effectiveness model use</p> <p>Data requirements are more readily available than other models</p> <p>User-friendly model is available for outside use; users guide is also available</p> <p>Survey links incentives directly to impacts on travel behavior</p> <p>Model includes an awareness sub-model that simulates how many people know about the possible TCMs available to them</p>	<p>Does not accurately address trip-chaining and VMT reductions (only trips)</p> <p>Household conditions are not extensively accounted for</p> <p>Cost-effectiveness was not calculated</p> <p>Employer-level analyses only, with focus upon incentive TCMs</p>	<p>Guaranteed ride home</p> <p>Company vanpools</p> <p>Preferential parking</p> <p>Parking fees for ridesharers</p> <p>Carpool subsidies & transportation allowances</p>	dac
				<p>"Selection and Evaluation of Travel Demand Management Measures." Taylor, Christopher J., et al. TRB 971114, January 1997.</p>	<p>Uses Travel Demand Evaluation Model developed by COMSIS to evaluate the impact of transportation measures on mode choice and VT for the Syracuse, NY metropolitan area</p>	<p>Uses journey-to-work census data to develop estimates of zone-to-zone travel</p> <p>Evaluates both area-wide programs and employer-based programs</p> <p>Assesses revenue generation potential and transit subsidies</p>	<p>Sufficiently detailed journey-to-work census data may not be available for all cities: Syracuse has this data available due to a pilot program</p> <p>Requires assuming some estimates of effectiveness</p> <p>Does not quantify emissions reductions</p>	<p>Transit fare levels and travel time</p> <p>HOV lane time savings</p> <p>Parking costs</p> <p>Employer transit encouragement level</p>	dac

Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed	
Rideshare (cont.)	Travel demand/ mode choice model (cont.)			"Transportation Control Measures for the San Francisco Bay Area: Analysis of Effectiveness and Costs." Harvey, G., and E. Deakin. For Bay Area Air Quality Management District, October 1991.	Describes use and results of a travel demand model to model VT, VMT, and emission reductions of various transportation measures in the San Francisco Bay Area	Utilized high-quality household travel survey data and advanced modeling capabilities Emissions calculations uses standardized methods, but takes into account more subtle effects of emissions generation Provides succinct, clear data on results of study, including cost-effectiveness estimates	Does not provide detail on model operation	Many; not specified	dac
	Empirical analysis of the impacts of personal preference and workplace conditions on mode choice	Somewhat applicable to multiple regions (but likely to be influenced heavily by local factors of the study area) Can be replicated (at moderate to high cost) Does not require extensive computer model Uses actual survey data	Requires large data collection process to generate statistically significant results Personal preference and workplace conditions difficult to impact through public policy	"Improving the Effectiveness of Ridesharing Programs." Stevens, William F. <i>Transportation Quarterly</i> , October 1990. Vol. 44 No. 4.	Describes the methodology and results of a survey to determine which personal preference and workplace factors affect rideshare participation	Uses actual data from a survey of current and past rideshare participants as well as a random sample of potential participants Survey instrument developed through focus groups and interviews for better results	Some findings may have been contradicted by more recent studies (e.g., study finds that large corporations have better success with rideshare programs)	Rideshare logistics and personal flexibility Monetary: parking, fuel Interpersonal issues ("having someone to talk to") Altruism	dac

Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Rideshare (cont.)	Empirical analysis of the impacts of personal preference and workplace conditions on mode choice (cont.)			"The Influence of Employer Ridesharing Programs on Employee Mode Choice." Ferguson, Erik. <i>Transportation</i> , vol 17, 1990.	Analyzes aggregate-level data compiled by a large Southern California regional ridesharing agency; assesses impact of employer characteristics on employee mode split	<p>Analyzes a large data set comprising almost 10% of Los Angeles area workforce</p> <p>Utilizing existing agency database is a cost-effective approach</p> <p>Less accurate than disaggregated (employee by employee) data</p> <p>Includes cost-effectiveness estimations</p>	<p>Some findings may have been contradicted by more recent studies (e.g., study finds that large corporations have better success with rideshare programs)</p> <p>Aging data source: 1985 survey data</p> <p>Los Angeles area factors may be uncharacteristic of other regions, so results may not be applicable elsewhere</p> <p>Employer-derived data was acquired using different methods</p> <p>No estimates of emissions impacts</p>	<p>Level of employer effort to encourage ridesharing</p> <p>Size of firm</p>

dac

Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed	
Rideshare (cont.)	Empirical analysis of the impacts of personal preference and workplace conditions on mode choice (cont.)			"The Effectiveness of Ridesharing Incentives." Brownstone, David, and Thomas F. Golob, in <i>Regional Science and Urban Economics</i> , vol. 22, 1992.	Evaluates the travel impacts of certain incentives designed to promote ridesharing (carpooling and vanpooling) on work trips, using data from a study of full-time workers' commuting behavior in the Los Angeles area	Analysis is based on a rich data set Evaluates potential impact on ridesharing of employer-provided preferential parking and HOV lanes Provides insight into which household characteristics and employer characteristics influence ridesharing	Does not directly quantify VMT or emissions impacts Conclusions may not apply to areas other than Southern California	Mode choice (always rideshare, sometimes rideshare, always drive alone) Individual characteristics (income, age, gender) Commute characteristics (distance, HOV lane available) Employer incentives (flexible schedule, preferential parking, cost subsidy, guaranteed ride home) Employer size	drl
	Empirical analysis of transportation measure implementation programs	Somewhat applicable to multiple regions Can be replicated (at moderate cost) Does not require extensive computer model	Requires large data collection process to generate statistically significant results	"An Employer Panel for Evaluating the Effectiveness of Trip Reduction Incentives." Giuliano, Genevieve, and Wachs, Martin. In <i>Panels for Transportation Planning and Applications</i> , ed. T.F. Golob, et al, 1997.	Discusses results collected on Southern California employment sites subject to SCAQMD Regulation XV, and assesses the relative effectiveness of trip reduction strategies	Utilizes the largest trip reduction measure database available in the world Panel method allows for assessing before-and-after-TCM conditions	Database does not provide exceptional detail; report does not contain details of the level of incentive support provided to employees Only generalized effectiveness results are shown TCMs were not always implemented at the time of the survey	Not described	dac

Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed	
Rideshare (cont.)	Empirical analysis of transportation measure implementation programs (cont.)			"The Los Angeles County Route 14 Vanpool and Buspool Demonstration Project: An Analysis of its Effectiveness in Reducing Long Distance Commuter Trips." Blanchard, Donna et al. Transportation Research Board. July 1993.	Addresses the effectiveness of a demonstration vanpool and buspool project, an incentive-based program established to relieve congestion and improve air quality along the Los Angeles County Route 14 corridor	Calculates the total number of vehicle trips and vehicle miles traveled reduced, by origin and destination, of program participants Phase II follow-up project to include computerized tracking program and data collection	Does not provide emissions estimates Requires costly administration, tracking and data collection efforts; participant program exit information often incomplete Report does not contain details of participants' prior mode choice or commute length	Vanpool and buspool incentives: rider rebate, child care bonus, and emergency (guaranteed) rides home Program participation Cost-effectiveness	dkp
	Empirical analysis of transportation measure demonstration projects	Requires little or no new data acquisition Relatively low cost Shows actual potential of transportation measures Identifies barriers to implementing transportation measures	Case study results do not necessarily apply to other regions	"Evaluation of Travel Demand Management Measures to Relieve Congestion." Kuzmyak, J.R., and E.N. Schreffler. Prepared by COMSIS Corp. for FHWA. FHWA/SA-90/005; DOT-T-90-14. February 1990.	Performs case studies of the effectiveness of 11 transportation demand management programs	Shows potential for reduction in commute-based trips due to implementation of transportation measures Provides high level of detail about the specific programs implemented	Generally does not evaluate specific transportation measure individually; programs of multiple transportation measures are evaluated for effectiveness Does not quantify emission reductions Trip reductions based upon vehicle occupancy assumptions for each mode choice (carpool, vanpool, transit)	Not applicable in context of specific transportation measures	dac
				"Land Use Regulations to Promote Ridesharing: An Evaluation of the Seattle Approach." McCutcheon, Melody, and Jeffrey Hamm. <i>Transportation Quarterly</i> , vol. 37 no. 4, 1983.	Evaluates the effectiveness of developer-based land use regulations to promote ridesharing in Seattle's central business district	Identifies barriers to enforcing parking management practices at businesses; suggests improvements	Does not quantify trip, VMT, or emissions reductions Study was performed before significant data existed on the effectiveness of the whole program	Availability of nearby parking Developer cooperation with requirements	dac

Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed	
Rideshare (cont.)	Empirical analysis of transportation measure demonstration projects (cont.)			"Transportation-Related Impacts of Compressed Work Week: The Denver Experiment." Atherton, Terry J., et al. In Transportation Research Record 845, 1982.	Provides before and after comparison of travel behavior for an experimental compressed-work week program for federal employees in Denver	<p>Before-and-after approach (with a control group) accurately assesses changes in travel</p> <p>Utilizes actual travel diaries and surveys to track travel patterns</p> <p>Identifies some non-work travel impacts of compressed work weeks</p> <p>Information was complete and accurate due to government workplace focus</p>	Private organizations may not respond as well to requirements to implement compressed work week plans	9/80 schedule vs. 4/40 schedule	dac
	Statistical analysis of employer ridesharing initiatives	<p>Utilizes large database of existing employers that implement transportation measures</p> <p>Relatively low-cost (provided data does not need to be collected)</p>	<p>May not assess causes of statistical significance found</p> <p>Results not necessarily applicable to other regions</p>	"Evaluation of Employer-Sponsored Ridesharing Programs in Southern California." Ferguson, Erik T., Georgia Institute of Technology. In Transportation Research Record 1280, 1990.	Analyzes database of surveys of employer-sponsored ridesharing programs in Southern California to determine relevant factors on effectiveness	<p>Utilizes large existing database for the region, increasing validity of results</p> <p>Assesses cost-effectiveness at varying program sizes</p> <p>Assesses interaction between alternative work schedules and ridesharing</p> <p>Attempts to explain reasons behind statistical significance of certain factors</p>	<p>Sample database may be biased (they were all clients of a centralized ridesharing agency)</p> <p>Primarily analyzes employer-based measures only</p>	<p>Level and type of direct ridesharing incentives</p> <p>Firm size and type</p> <p>Dollars spent on rideshare programs</p>	dac

Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Rideshare (cont.)	Sample surveys	Uses statistically representative sample population to make estimates of impact of ridesharing strategies on the ridesharing participation and effectiveness	Surveys can entail significant costs "Revolving door" characteristic of ridesharing programs can be difficult to address with accuracy Relationship between ridesharing participation, VMT, and emissions requires additional analysis	"Rideshare Placement Measurement: A Proposed Standard Methodology." King, Michael, and Barbara Alderson. California State University at Chico, June 1995.	Develops methodology for quantifying rideshare placement levels for ridematching services; discusses pilot testing of methodology (note: this methodology is currently used by RIDES for Bay Area Commuters in the San Francisco Bay Area).	Survey methodology is generic and can be applied to any region Methodology distinguishes between three types of rideshare placements (trial, maintenance, and ongoing) to reflect their different impact on travel and emissions	Only quantifies rideshare placement; does not directly quantify VMT and emissions impact	Rideshare placement rate (trial, maintenance, and ongoing) Survey response rate Statistical sampling error
		Sample size (and therefore cost) can be varied based on level of statistical accuracy desired Surveys can be done periodically to determine changes in ridesharing rates over time, and impacts of special promotions such as "Try Transit" weeks	If surveys are performed differently in different regions, direct comparisons of results may not be valid Survey results can be subject to various kinds of response bias	"Cost-Effectiveness of Private Employer Ridesharing Programs: An Employer's Assessment." Wegmann, Frederick J. University of Tennessee. In Transportation Research Record 1212, 1989.	Conducts and analyzes sample surveys with the aim of documenting the cost and benefits available to private-sector employers through the operation of employer ridesharing programs	Survey methodology is generic and can be applied to any region Diverse study sample included respondents from throughout the U.S., and represented companies in central business districts, within city limits, and in suburbs, from a diversity of industry types	Only quantifies rideshare cost-effectiveness to employers; does not directly quantify VMT and emissions impact Quantitative estimates of ridesharing benefits are very difficult to make; therefore, further follow up with a subset of the sample surveyed was required to convert general estimates of benefits into annual monetary values Most benefits cited by respondents were of an intangible nature; therefore, the data base necessary to generate cost-benefit analyses does not exist	Employer ridesharing costs, including vanpooling and vanpooling subsidy costs; employer parking costs Ridesharing cost-effectiveness Ridesharing benefits

drl

dkp

Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Rideshare (cont.)	Sketch planning	Simple tools can generate planning-level estimates of transportation measure effectiveness at low cost Generalized tools can be somewhat applicable to multiple regions Analyst can vary input parameters	Sketch planning results are usually not the most accurate, depending on the input parameters	"TCM Analyst 1.0 and User's Guide." Crawford, Jason A., et al. Texas Transportation Institute. For the Federal Highway Administration, November 1994.	Describes a computerized sketch planning tool, TCM Analyst 1.0, including input data requirements, methods of use, and an overview of the model's structure and calculation procedures	Provides a useful and relatively easy instruction manual for using TCM Analyst 1.0 Uses MOBILE5a output data (emission factors) as <i>inputs</i> to the model, providing more accurate emission benefit calculations for each TCM	Program only models limited TCMs and cannot model multiple TCM packages Requires several runs with MOBILE5a to obtain input emission factors Modeling on regional (rather than microscale) basis only	Not stated

dac

Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Rideshare (cont.)	Sketch planning (cont.)			"Simple Methodologies for Quantifying VT and VMT Reductions from Transportation Control and Growth Management Measures for Developing Local Trip Reduction Ordinances." Evans, V. and D. Morrow. Sonoma Technology, Inc. Air & Waste Management Assoc. 1993	Describes development of simple methodologies for quantifying reductions in vehicle trips (VT) and vehicle miles traveled (VMT) from TCMs, for use in a planning-level context; developed originally for the South Coast Air Basin	<p>Methods to quantify VT and VMT reductions from TCMs were based upon relatively simple methods for estimating emissions and individual TCM effectiveness developed prior to this report for the South Coast AQMD</p> <p>Performance-based approach was developed rather than use mandated transportation performance standards</p> <p>Actual experience data used as much as possible: estimated trip reduction levels from each TCM was collected from other studies, and planning-level analysis uses site-specific data inputs, thus offering increased precision in emissions estimates</p> <p>Ranges in VT reductions estimates address the interactive impacts of the application of multiple TCMs</p> <p>Equivalency factor used to convert VMT to VT can account for region-specific average trip lengths</p>	<p>Expected reductions in VT and VMT from TCMs were estimated based upon a general survey, so for a particular location different assumptions may be needed</p> <p>Applicability to other regions outside California limited by report's use of transportation data and emissions factors in the analysis which were quantified using BURDEN and EMFAC runs for 1994</p> <p>Does not incorporate any consideration of cost-effectiveness</p>	<p>Employee participation (percentage and frequency)</p> <p>Employer trip-reduction plan</p> <p>Distance to work</p> <p>Distance to and existence of Park-n-Ride lots</p>

dkp

Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed	
Rideshare (cont.)	Sketch planning (cont.)			"Evaluating Travel and Air Quality Cost-Effectiveness of Transportation Demand Management Projects." Schreffler, Eric N., Therese Costa, and Carl B. Moyer. In Transportation Research Record 1520, 1996.	Describes simple methodologies used to evaluate projects funded by the AB 2766 vehicle registration fee program in Southern California	Methodology can be used to evaluate prior projects or proposed future projects Uses available EMFAC emission rates to calculate ROG, PM10, NOx, and CO Study develops standardized worksheet to evaluate projects Study points out drawbacks of self-reported project results	Methodology relies on participation data provided by project proponents, which may not always be unbiased EMFAC7E factors are California-specific	Trips reduced Trip length Prior travel mode	drl
				"Critical Analysis of Sketch-Planning Tools for Evaluating the Emission Benefits of Transportation Control Measures." Crawford, Jason A., and Raymond A. Krammes. Prepared by Texas Transportation Institute for FHWA, FHWA/TX-92/1279-5. December 1993.	Critical analysis and sensitivity analysis (using data for El Paso, Texas) of San Diego Association of Governments (SANDAG) TCM Tools method and the Systems Applications International (SAI) method; summarized in TRR 1472	Provides a thorough review of the state of the practice (as of 1993) Identifies weaknesses in the SANDAG and SAI methods as well as strengths Provides detailed sketch-planning analysis for El Paso, Texas	Many of the inputs to the SANDAG and SAI models are difficult to quantify The SANDAG and SAI models do not fully account for indirect impacts and latent travel demand	Vehicle trips VMT Average vehicle speed Emissions (HC, CO, NOx)	drl

Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Rideshare (cont.)	Employer TDM cost-effectiveness model	Estimates reduction in and costs of daily trips and peak period trips Aids employer determination of cost-effectiveness of TDM measures for their particular worksite	Results may vary widely from one employer to the next Many inputs may be difficult for employers or planners to quantify	"Transportation Demand Management Cost-Effectiveness Model for Suburban Employers." Dagang, Deborah A. JHK & Associates. In Transportation Research Record 1404.	Reports on the development of a model to individually evaluate the cost-effectiveness of 15 different employer-based TDM measures in suburban settings	Focus on suburban employers reflects different travel-related characteristics of suburban and urban areas Spreadsheet-based model is user-friendly and readily accessible for use at the site-specific level; model makes sensitivity analysis relatively simple Eight transportation environments were defined to represent various combinations of transportation service characteristics For employers without access to entire range of data necessary to operate model, default values are included	Most employers surveyed to develop model were unable to provide detailed cost information on the TDM measures they had implemented Does not calculate emissions directly Potential for regional bias, as model was developed in part based on a survey of suburban San Francisco Bay Area employers; model also used the SCAQMD Regulation XV and Pima Association of Governments Travel Reduction Program employer plan databases Only some TDMs included in model provide for estimates of VT reductions Use of default values could diminishes accuracy of estimates for some users	Suburban employer-based TDM measures Daily trips and peak period trips Costs and cost-effectiveness

dkp

Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Rideshare (cont.)	Process analysis of transportation measure planning and implementation	Explains lessons learned during the planning and implementation of an actual transportation measure, such as reactions to expect from the public and funding sources Provides pros and cons of planning and implementation methods	Does not necessarily help quantify VT, VMT, or emissions reductions from the transportation measure implementation Cost can vary greatly	"Transportation Control Measures Analyzed for the Washington Region's 15 Percent Rate of Progress Plan." FHWA/Metropolitan Washington Council of Governments, February 1995.	Provides comprehensive evaluation of the selection and quantification process performed by the MWCOG for assessing various transportation measures	Addresses the strengths and weaknesses of the bottom-up, multiple committee planning process used by the COG Provides extensive, clear detail (and strengths and weaknesses) of both the evaluation tools used and each specific transportation measure evaluation method Estimates VT, VMT, and emission reductions and cost-effectiveness	Requires an extensive study of already-performed process	None (factors analyzed are applicable to each transportation measure analyzed during the process)
	Comparison and analysis of other studies	Relatively inexpensive and simple to conduct, because it requires no primary research Provides a review of the results produced by different HOV facilities in North America, which could be used if other directly applicable research is not available Identifies advantages and disadvantages of several methodologies	Results are not directly applicable to other regions (they do not incorporate characteristics of other regions) Unlikely to provide precise estimates	"An Assessment of Transportation Control Measures, Transportation Technologies, and Pricing/Regulatory Policies." Euritt, Mark A., et al. University of Texas, Austin, Center for Transportation Research/Tellus Institute. CTR SEDC-1, June 1995.	Assesses several studies that analyze a host of transportation measures, technology options, and policies for total effectiveness and costs/benefits	Provides a solid overview of the range (and effects) of TCM options, as well as technology and policy options Focuses upon energy efficiency impacts in addition to emissions and VMT	Report does not contain a methodology for evaluating new TCM plans, but follow-on report focuses upon these strategies Estimates may be too rough to apply to other programs in other regions	Impacts: vehicle trips, vehicle miles traveled, and emissions Costs

dac

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Rideshare (cont.)	Comparison and analysis of other studies (cont.)			"Assessment of Travel Demand Management Approaches at Suburban Activity Centers." Bhatt, Kiran, and Higgins, Thomas. K.T. Analytics. U.S. DOT, July 1989.	Surveys research studies and interviews TCM program coordinators to provide an overview of the range of effectiveness of employer-based TCM programs	Provides a large number of case study examples of both effective and ineffective TCM programs Makes recommendations to employers on how to develop a TCM program Provides a good checklist of topics to address when developing a TCM program	Report does not contain a methodology for forecasting the effectiveness of new TCM plans Only generalized evaluation of TCM effectiveness	Relative effectiveness of various transportation measure programs Implementation mechanisms
				"Parking Subsidies and Travel Choices: Assessing the Evidence." Willson, Richard W. and Donald C. Shoup. In <i>Transportation</i> , vol. 17, 1990.	Reviews empirical case studies of the relationship between employer-paid parking and solo commuting	Draws out analogous results from a variety of existing case studies to show range of impacts of employer-paid parking and solo driving Case studies cover a variety of locations (downtown and suburban), employer types (public and private) and employee categories (professional and clerical) Case study results are reinforced by survey findings cited in the paper Provides an estimated range for the elasticity of demand for solo driving with respect to parking price	Because most case studies are from Los Angeles, results may not be representative of other areas Range of results is very wide, so the results cannot directly be used to accurately estimate the impacts of another program Does not quantify VMT or emissions impacts	Existence of employer-paid parking Travel mode (solo driver, non-solo driver)

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed	
Rideshare (cont.)	Comparison and analysis of other studies (cont.)			"Managing Transportation Demand: Markets Versus Mandates." Giuliano, Genevieve, and Martin Wachs. Reason Foundation. Policy Insight No. 142, September 1992.	Compares congestion pricing with Regulation XV for the Southern California area; describes pros and cons of each measure and discusses implications	Provides typology of transportation measures and identifies effectiveness and common barriers to implementation Simple side-by-side comparison of VMT reduction and cost-effectiveness for each transportation measure Makes policy recommendations to improve each transportation measure	Provides little detail about logistics of implementing the policy recommendations Does not quantify emission reductions	Direct vs. indirect implementation Market-based vs. performance-based implementation Efficiency and equity considerations	dac
				"The Equity and Cost Effectiveness of Employee Commute Options Programs." Farkas, Z. Andrew. Morgan State University. TRB 960078, January 1996.	Analyzes the results of surveys and transportation measure modeling studies performed for the Baltimore and Philadelphia regions	Shows different methods of using the same model: Travel Demand Evaluation Model developed by COMSIS Provides a discussion of social equity considerations based on a survey of the two regions	Philadelphia modeling assumed average vehicle ridership targets were reached and results are only applicable relative to each scenario Baltimore modeling did not estimate emissions reductions	Rideshare promotion level Parking charge level Transit subsidy levels Work schedule flexibility	dac
				"The Determinants of Ridesharing: Literature Review." Hwang, Keith and Genevieve Giuliano. University of California Transportation Center, May 1990. UCTC 38.	Reviews dozens of studies in a general discussion of ridesharing	Integrates results and citations of many papers in a clear description of each issue impacting ridesharing, including reasons for effectiveness Describes effectiveness of programs, as well as employee and workplace characteristics that are favorable for ridesharing Describes some interaction between other transportation measures (e.g., HOV facilities) and ridesharing	Comments about each study may be too brief to provide clear guidance for TCM planning Does not provide VMT or emissions reduction, only mode share data	Many are briefly touched upon	dac

Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed	
Scrappage	Economic scrappage supply curve model	A rigorous approach based on economic fundamentals	Level of precision most applicable to small-scale programs, as models of this type usually will not capture price effects on the used-car market following withdrawal of a large fraction of the existing old vehicles	"An Economic Analysis of Scrappage." Hahn, Robert W. American Enterprise Institute, July 1993.	Estimates the number and value of old vehicles to determine costs and benefits of scrappage program	Uses available EMFAC7E emission rates Uses available fleet composition figures Uses available "Gold Book" vehicle value figures	Operating costs not included in economic assessment EMFAC7E factors are California-specific Assumes unknown human factors and behaviors	Fleet composition Vehicle "Gold Book" value Replacement vehicle characteristics Variable discount rates Interaction with I&M programs	dac
		Relatively low cost to use Models of this type could be extended to evaluate impacts of other transportation measures that impact older vehicles, such as I/M and emissions fees	Models of this type are theoretical rather than empirical, and therefore may not accurately characterize participation rates and other aspects of real-world behavior Remaining life and usage of scrapped vehicles, as well as replacement vehicle characteristics, are fundamentally difficult to estimate with precision	"Estimating an Emissions Supply Function from Accelerated Vehicle Retirement Programs." Alberini, Anna et al. Resources for the Future, January 1994.	Study develops methodology which predicts participation rates, expected remaining life, and an emissions supply function at alternative offer prices for several types of pre-1980s vehicle scrap programs	Analysis is based on extensive surveys of old vehicle owners and vehicle emissions testing data collected through a particular scrappage program Study develops empirical measure of the link between vehicle condition and expected remaining life, and owner's estimation of vehicle value to determine costs and emission reduction potential of program Study conducts surveys of participants and non-participants for information about remaining life and usage of scrapped vehicle	Survey data used is specific to scrappage program in Delaware 1992-93, so results may not be applicable to other regions and programs Sample of owners surveyed did not represent a random sample of the population of pre-1980 vehicle owners Scope of data on emissions of scrapped vehicles is limited as only a sample of vehicles valued at less than the bounty amount offered were tested Assumes that scrapped vehicle replacement is from "average" fleet in terms of emissions levels	Individual owner behavior and vehicle's remaining life Minimum willingness to accept bounty amount; also determined by blue book value, condition of car, and past and future costs of operating the car	dkp

Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed	
Scrappage (cont.)	Vehicle fleet characterization and emissions model	Utilizes standard planning model used by regulatory agencies High flexibility to manipulate input data	Requires detailed understanding of computer model's methodologies and source code Results are not readily applicable to other regions Difficult and costly to replicate	"Vehicle Scrappage: An Alternative to More Stringent New Vehicle Standards in California." Lyons, James, et al. Sierra Research. For Texaco Inc. SR95-03-02. March 1995.	Modifies source code for California-specific EMFAC/BURDEN fleet characterization and emissions model to evaluate the effect of scrappage programs on emissions in the South Coast Air Basin	Use of EMFAC/BURDEN makes analysis highly consistent with California Air Resources Board's fleet and emissions characterizations, which helps compare emissions reductions to inventory Allows considerable flexibility in testing specific scrappage scenarios Compares scrappage scenarios to other emission reduction alternatives (e.g., reduced standards) Light-, medium-, and heavy-duty programs assessed	Does not incorporate actual elasticities between scrappage bounty and number of vehicles scrapped (elasticities are assumed)	Age threshold for scrapped vehicles Number of total vehicles scrapped	dac
	Process analysis of transportation measure planning and implementation	Explains lessons learned during the planning and implementation of an actual transportation measure, such as reactions to expect from the public and funding sources Provides pros and cons of planning and implementation methods	Does not necessarily help quantify VT, VMT, or emissions reductions from the transportation measure implementation Cost can vary greatly	"Transportation Control Measures Analyzed for the Washington Region's 15 Percent Rate of Progress Plan." FHWA/Metropolitan Washington Council of Governments, February 1995.	Provides comprehensive evaluation of the selection and quantification process performed by the MWCOG for assessing various transportation measures	Addresses the strengths and weaknesses of the bottom-up, multiple committee planning process used by the COG Provides extensive, clear detail (and strengths and weaknesses) of both the evaluation tools used and each specific transportation measure evaluation method Estimates VT, VMT, and emission reductions and cost-effectiveness	Requires an extensive study of already-performed process	None (factors analyzed are applicable to each transportation measure analyzed during the process)	dac

Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed	
Scrappage (cont.)	Comparison and analysis of other studies	<p>Relatively inexpensive and simple to conduct, because it requires no primary research</p> <p>Provides a review of the results produced by different HOV facilities in North America, which could be used if other directly applicable research is not available</p> <p>Identifies advantages and disadvantages of several methodologies</p>	<p>Results are not directly applicable to other regions (they do not incorporate characteristics of other regions)</p> <p>Unlikely to provide precise estimates</p>	"Meeting Clean Air Act Emissions Standards: A Cost-Effectiveness Analysis of Car Scrappage." DeCardy, Christopher. Harvard University, April 1994.	Compares 4 studies on scrappage cost-effectiveness; proposes new scrappage study that would develop accurate inputs for calculating cost-effectiveness	<p>Provides several estimates of cost-effectiveness from each study</p> <p>Identifies reasons why 4 studies overestimate cost-effectiveness of scrapping</p> <p>Performing the proposed study would clarify uncertainties in cost-effectiveness</p>	<p>Estimates may still be too rough to apply to other programs in other regions</p> <p>Does not identify all costs and benefits of scrappage programs</p> <p>Does not address potential equity impacts of scrappage</p> <p>Analyzes only HC emissions</p>	<p>Outside factors affecting scrappage programs (e.g I&M programs)</p> <p>Levels of participation in scrappage programs</p> <p>Sources of data (e.g. for emission rates, MOBILE vs. actual testing)</p> <p>Level of bounty offered</p> <p>Affect of scrappage programs on market forces</p>	dac
				"An Assessment of Transportation Control Measures, Transportation Technologies, and Pricing/Regulatory Policies." Euritt, Mark A., et al. University of Texas, Austin, Center for Transportation Research/Tellus Institute. CTR SEDC-1, June 1995.	Assesses several studies that analyze a host of transportation measures, technology options, and policies for total effectiveness and costs/benefits	<p>Focuses upon energy efficiency impacts in addition to emissions and VMT</p>	<p>Report does not contain a methodology for evaluating new TCM plans, but follow-on report focuses upon these strategies</p> <p>Estimates may be too rough to apply to other programs in other regions</p>	<p>Impacts: vehicle trips, vehicle miles traveled, and emissions</p> <p>Costs</p>	dac
				"Uncertain Air Quality Impacts of Automobile Retirement Programs." Shi-Ling Hsu and Daniel Sperling. In Transportation Research Record 1444, 1995.	Identifies and analyzes the areas of uncertainty in determining emission impacts of scrappage programs	<p>Provides a comprehensive list of parameters needed to calculate the cost effectiveness of a scrappage program</p> <p>Identifies the reasons why previous estimates are inaccurate</p>	<p>Does not propose suggestions to reduce uncertainty encountered in previous studies</p> <p>Impacts of regional differences are not thoroughly discussed</p>	<p>Average annual mileage and remaining life of retired autos</p> <p>HC, NOx and CO emissions of retired autos</p> <p>Annual mileage of replacement autos and average emissions</p>	fk

Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Shuttles/ Station Cars	Sample survey of customer travel patterns and preferences at shopping centers	Somewhat applicable to multiple regions (but influenced by local factors of the study area) Does not require an extensive computer model	Requires large data collection process to generate statistically significant results Moderate to high cost	"Analysis of Indirect Source Trip Activity: Regional Shopping Centers." Prepared by JHK & Associates and K.T. Analytics for the California Air Resources Board. ARB-R-94/510, November 1993.	Surveyed customers of regional shopping centers to determine potential impact of various travel reduction measures	Uses actual survey data (including customer demographic and stated preference data) Developed calculation methodologies specific to each trip reduction measure, using site-specific data Compares data between shopping centers in different land-use types	Assumptions are required to translate stated preference data to expected outcome Does not quantify emission reductions	Availability of nearby transit Availability of nearby rail
	Sketch planning	Simple tools can generate planning-level estimates of transportation measure effectiveness at low cost Generalized tools can be somewhat applicable to multiple regions Analyst can vary input parameters	Sketch planning results are usually not the most accurate, depending on the input parameters	"Evaluating Travel and Air Quality Cost-Effectiveness of Transportation Demand Management Projects." Schreffler, Eric N., Therese Costa, and Carl B. Moyer. In Transportation Research Record 1520, 1996.	Describes simple methodologies used to evaluate projects funded by the AB 2766 vehicle registration fee program in Southern California	Methodology can be used to evaluate prior projects or proposed future projects Uses available EMFAC emission rates to calculate ROG, PM10, NOx, and CO Study develops standardized worksheet to evaluate projects Study points out drawbacks of self-reported project results	Methodology relies on participation data provided by project proponents, which may not always be unbiased EMFAC7E factors are California-specific	Trips reduced Trip length Prior travel mode

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Shuttles/ Station Cars (cont.)	Process analysis of transportation measure planning and implementation	Explains lessons learned during the planning and implementation of an actual transportation measure, such as reactions to expect from the public and funding sources Provides pros and cons of planning and implementation methods	Does not necessarily help quantify VT, VMT, or emissions reductions from the transportation measure implementation Cost can vary greatly	"Transportation Control Measures Analyzed for the Washington Region's 15 Percent Rate of Progress Plan." FHWA/Metropolitan Washington Council of Governments, February 1995.	Provides comprehensive evaluation of the selection and quantification process performed by the MWCOG for assessing various transportation measures	Addresses the strengths and weaknesses of the bottom-up, multiple committee planning process used by the COG Provides extensive, clear detail (and strengths and weaknesses) of both the evaluation tools used and each specific transportation measure evaluation method Estimates VT, VMT, and emission reductions and cost-effectiveness	Requires an extensive study of already-performed process	None (factors analyzed are applicable to each transportation measure analyzed during the process)
Telecom- muting	Travel demand/ mode choice model	Somewhat applicable to multiple regions Analyst can vary input parameters	Requires region-specific household survey, land use, socioeconomic, and travel cost data Requires complex computer model Potentially high cost to use	"Implementing Effective Travel Demand Management Measures: Inventory of Measures and Synthesis of Experience." COMSIS Corporation. USDOT, September 1993. DOT-T-94-02.	Summarizes broad range of TDM measures, provides example case study analyses of each, and uses computer model to benchmark the effectiveness of each TDM	Excellent overview of the range of TDMs possible; provides description, nature of effectiveness, application setting, effectiveness potential, and cost Uses actual case studies to inform the use of a computer model for forecasting TDM effectiveness Provides a road-map to implementing TDMs	Use of the model requires local input parameters to forecast local effectiveness Model does not incorporate an emissions calculation module Most analysis is at the employer-level rather than the area-level	Participation levels

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Telecommuting (cont.)	Travel demand/mode choice model (cont.)			"The Effectiveness of Transportation Control Measures in Reducing Congestion and Improving Air Quality." Loudon, William R., et al. JHK & Associates. Air & Waste Management Association Annual Meeting & Exhibition 1993. AWMA 93-RP-149.05.	Describes a developed transportation demand model that integrates emissions calculations; provides example calculations from the model	Model has a user manual that leads the analyst step-by-step through the input of data for region specific analyses Contains extensive cost-effectiveness module Can be used at either regional or a smaller area or location Includes exhaust and evaporative emissions	Use of the model requires local input parameters to forecast local effectiveness; default values may not be sufficient	Participation levels
				"Transportation Control Measure Analysis Procedures." Austin, Barbara S., et al. Systems Applications International/California Air Resources Board. Nov 1991. SYSAPP-91/141.	Describes a developed transportation demand model and explicitly discusses the calculation methodology used for several transportation measures	Model quantifies key secondary effects of TCMS (e.g. new carpooling programs may attract transit riders rather than SOV riders) Presents all the primary equations and variables used to calculate the effects of TCMS Contains a step-by-step process for evaluating packages of TCMS Explains multi-attribute analyses as applied to multiple TCM packages	Use of the model requires local input parameters to forecast local effectiveness; default values may not be sufficient; participation level data is required; base cases need to match real conditions Model does not cover all TCMS, but can be modified to do so Temporal treatment is limited to on-peak/off-peak, no spatial treatment Emissions calculations are not explicitly described in the same fashion as travel effects	Work and non-work trip increases by the telecommuter and other household members Satellite centers

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Telecommuting (cont.)	Empirical analysis of transportation measure implementation programs	Analyzes actual telecommuting programs Addresses travel behavior patterns Does not require extensive computer model	Applicability of results to other regions and conditions is uncertain Is not likely to address total demand for telecommuting	"An Employer Panel for Evaluating the Effectiveness of Trip Reduction Incentives." Giuliano, Genevieve, and Wachs, Martin. In <i>Panels for Transportation Planning and Applications</i> , ed. T.F. Golob, et al, 1997.	Discusses results collected on Southern California employment sites subject to SCAQMD Regulation XV, and assesses the relative effectiveness of trip reduction strategies	Utilizes the largest trip reduction measure database available in the world Panel method allows for assessing before-and-after-TCM conditions	Database does not provide exceptional detail; report does not contain details of the level of incentive support provided to employees Only generalized effectiveness results are shown TCMs were not always implemented at the time of the survey	Not described
	Empirical analysis of transportation measure demonstration projects	Requires little or no new data acquisition Relatively low cost Shows actual potential of transportation measure	Case study results do not necessarily apply to other regions	"Impacts of Center-Based Telecommuting on Travel and Emissions: Analysis of the Puget Sound Demonstration Project." Henderson, Dennis K., and Mohktarian, Patricia L. Institute of Transportation Studies, University of California, Davis, 1996. Vol. 1.	Analyzes the Puget Sound telecommuting project data to determine trip, VMT, and emissions reduction	Uses both case-study and composite-average approaches Implemented travel diary logs rather than surveys	Travel mode choice impacts not extensively studied Study participants not representative of general workforce Household members not included in study	Center versus Home-based telecommuting Center-based telecommuting versus not telecommuting Total VMT versus number of cold starts

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Telecommuting (cont.)	Empirical analysis of transportation measure demonstration projects (cont.)			"The Travel and Emissions Impacts of Telecommuting for the State of California Telecommuting Pilot Project." Koenig, Brett E., et al. Transportation Research, 1996. Vol 4 no. 1. pp. 13-32.	Analyzes the State of California telecommuting project data to determine trip, VMT, and emissions reduction	<p>Identifies the number of and effects of non-commute trips during days in which telecommuting took place</p> <p>Implemented travel diary logs to account for all trips taken by study participants</p> <p>Actual vehicle model year and speed data is used instead of fleet averages</p> <p>Assesses the impact of lowered average speeds caused by telecommuting</p> <p>Analyzes exhaust, running, and evaporative losses</p> <p>Participants were studied before and after telecommuting began</p>	<p>Study participants are not representative of general workforce and emission reductions should not be applied to whole population</p> <p>Does not accurately model emissions from accelerations and decelerations; only average speed used</p> <p>Travel mode choice impacts not extensively studied</p> <p>Household are members not included in the study analysis</p> <p>Does not model indirect telecommuting impacts (e.g. residential location shifts)</p>	<p>Affect of telecommuting on non-commute trips</p> <p>Average speeds, hot and cold starts</p> <p>Total VMT versus number of cold starts</p> <p>Variation between before and after telecommuting groups</p> <p>Time of day for trips</p>

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Telecommuting (cont.)	Empirical analysis of transportation measure demonstration projects (cont.)			"The Effectiveness of Telecommuting as a Transportation Control Measure." Sampath, Srikanth, S. Saxene, and P. Mokhtarian. <i>In Transportation Planning and Air Quality: Proceedings of the National Conference, American Society of Civil Engineers, 1991.</i>	Examines the potential of telecommuting as a strategy for managing travel demand by studying the travel and air quality implications of the State of California Telecommuting Pilot Project	<p>Evaluates the index of efficiency (ratio of emissions reductions to distance reduction) for telecommuting's success in reducing travel</p> <p>Computes and compares travel and emissions evaluations from before the telecommuting project's implementation, as well as both commute and stay-at-home days once the program had begun</p> <p>Emissions analysis includes conversion to vehicle-based numbers from person-based telecommuting data using "vehicle movement profiles"</p> <p>Uses accepted EMFAC7D emission factors</p>	<p>Uses existing State of California Telecommuting Pilot Project data, thus may have limited replicability without same type of data from other telecommuting projects</p> <p>EMFAC7D emission factors are California-specific</p> <p>Only addresses the direct air quality impacts of telecommuting (does not address indirect impacts such as net air quality effects of non-transportation energy consumed while telecommuting)</p>	Travel Factors and Trip Characteristics (including: distance traveled by auto, number of hot and cold starts, speed, type of vehicle, and ambient temperature)

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Telecommuting (cont.)	Empirical analysis of transportation measure demonstration projects (cont.)			"Methodological Issues in the Estimation of the Travel, Energy, and Air Quality Impacts of Telecommuting." Mokhtarian, Patricia L. et al. <i>Transportation Research A</i> . Vol. 29A, No. 4, 1995.	Examines existing empirical findings with respect to the impacts of telecommuting on travel, energy use, and air quality, by addressing eight telecommuting pilot projects that included evaluations of the transportation-related impacts of telecommuting	<p>Utilizes existing data from telecommuting pilot projects to draw general conclusions on travel, air quality and energy impacts in short and long term</p> <p>Selected pilot projects evaluated represented a mix of telecommuting project evaluation methodologies and varied geographic coverage</p> <p>Presents an ideal method for evaluating the transportation impacts of telecommuting programs</p>	<p>Study compared pilot projects in different locations (each with unique factors such as weather, transit issues, and traffic congestion levels); therefore, conclusions drawn could include errors of comparability of data</p> <p>Pilot projects chosen disproportionately represent western U.S.</p> <p>Only one pilot project included in study quantified emissions (used California EMFAC7E and BURDEN7E emissions inventory models)</p> <p>Differences in data and methodologies from pilot projects influences precision in evaluation of a number of factors</p>	<p>Travel impacts: commute, total weekday, and household travel</p> <p>Energy impacts: transportation, household and net energy</p> <p>Air quality impacts</p> <p>Potential long-term impacts</p>

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Telecommuting (cont.)	Macro-level analysis	Provides estimates of overall travel and emissions impacts of telecommuting Applicable to multiple geographic areas	Generally unable to evaluate impacts of smaller-scale telecommuting programs Cannot be used to evaluate impacts of specific program design elements on telecommuting Macro-level results may have substantial uncertainty	"Energy Efficiency in the U.S. Economy, Technical Report One: Energy, Emissions, and Social Consequences of Telecommuting." U.S. Department of Energy, DOE/PO-0026. June 1994.	Evaluates, at the national level, the direct and indirect effects of telecommuting on travel, traffic congestion, energy use, and emissions; also examines social impacts.	Incorporates indirect impacts such as latent travel demand and urban decentralization Evaluates current and projected future impacts Uses MOBILE emission factors Includes sensitivity analysis Uses existing algorithms such as the Roadway Congestion Index developed by the Texas Transportation Institute	Study does not distinguish between market-driven telecommuting and potential policy-driven telecommuting (i.e., telecommuting resulting from a specific government policy or program) Study does not show results for individual urban areas	Telecommuting levels Level of roadway congestion Latent travel demand Location patterns and urban density Total hours of delay Average speeds Emissions (HC, CO, NOx) Monetized costs and benefits
	Sketch planning	Simple tools can generate planning-level estimates of transportation measure effectiveness at low cost Generalized tools can be somewhat applicable to multiple regions Analyst can vary input parameters	Sketch planning results are usually not the most accurate, depending on the input parameters	"TCM Analyst 1.0 and User's Guide." Crawford, Jason A., et al. Texas Transportation Institute. For the Federal Highway Administration, November 1994.	Describes a computerized sketch planning tool, TCM Analyst 1.0, including input data requirements, methods of use, and an overview of the model's structure and calculation procedures	Provides a useful and relatively easy instruction manual for using TCM Analyst 1.0 Uses MOBILE5a output data (emission factors) as <i>inputs</i> to the model, providing more accurate emission benefit calculations for each TCM	Program only models limited TCMs and cannot model multiple TCM packages Requires several runs with MOBILE5a to obtain input emission factors Modeling on regional (rather than microscale) basis only	Not stated

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Telecommuting (cont.)	Sketch planning (cont.)			"Simple Methodologies for Quantifying VT and VMT Reductions from Transportation Control and Growth Management Measures for Developing Local Trip Reduction Ordinances." Evans, V. and D. Morrow. Sonoma Technology, Inc. Air & Waste Management Assoc. 1993	Describes development of simple methodologies for quantifying reductions in vehicle trips (VT) and vehicle miles traveled (VMT) from TCMs, for use in a planning-level context; developed originally for the South Coast Air Basin	<p>Methods to quantify VT and VMT reductions from TCMs were based upon relatively simple methods for estimating emissions and individual TCM effectiveness developed prior to this report for the South Coast AQMD</p> <p>Performance-based approach was developed rather than use mandated transportation performance standards</p> <p>Actual experience data used as much as possible: estimated trip reduction levels from each TCM was collected from other studies, and planning-level analysis uses site-specific data inputs, thus offering increased precision in emissions estimates</p> <p>Ranges in VT reductions estimates address the interactive impacts of the application of multiple TCMs</p> <p>Equivalency factor used to convert VMT to VT can account for region-specific average trip lengths</p>	<p>Expected reductions in VT and VMT from TCMs were estimated based upon a general survey, so for a particular location different assumptions may be needed</p> <p>Applicability to other regions outside California limited by report's use of transportation data and emissions factors in the analysis which were quantified using BURDEN and EMFAC runs for 1994</p> <p>Does not incorporate any consideration of cost-effectiveness</p>	<p>Employee participation (percentage and frequency)</p> <p>Employer-implemented home-based telecommuting program</p>

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Telecommuting (cont.)	Sketch planning (cont.)			"Evaluating Travel and Air Quality Cost-Effectiveness of Transportation Demand Management Projects." Schreffler, Eric N., Therese Costa, and Carl B. Moyer. In Transportation Research Record 1520, 1996.	Describes simple methodologies used to evaluate projects funded by the AB 2766 vehicle registration fee program in Southern California	Methodology can be used to evaluate prior projects or proposed future projects Uses available EMFAC emission rates to calculate ROG, PM10, NOx, and CO Study develops standardized worksheet to evaluate projects Study points out drawbacks of self-reported project results	Methodology relies on participation data provided by project proponents, which may not always be unbiased EMFAC7E factors are California-specific	Trips reduced Trip length Prior travel mode

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Telecommuting (cont.)	Employer TDM cost-effectiveness model	Estimates reduction in and costs of daily trips and peak period trips Aids employer determination of cost-effectiveness of TDM measures for their particular worksite	Results may vary widely from one employer to the next Many inputs may be difficult for employers or planners to quantify	"Transportation Demand Management Cost-Effectiveness Model for Suburban Employers." Dagang, Deborah A. JHK & Associates. In Transportation Research Record 1404.	Reports on the development of a model to individually evaluate the cost-effectiveness of 15 different employer-based TDM measures in suburban settings	Focus on suburban employers reflects different travel-related characteristics of suburban and urban areas Spreadsheet-based model is user-friendly and readily accessible for use at the site-specific level; model makes sensitivity analysis relatively simple Eight transportation environments were defined to represent various combinations of transportation service characteristics For employers without access to entire range of data necessary to operate model, default values are included	Most employers surveyed to develop model were unable to provide detailed cost information on the TDM measures they had implemented Does not calculate emissions directly Potential for regional bias, as model was developed in part based on a survey of suburban San Francisco Bay Area employers; model also used the SCAQMD Regulation XV and Pima Association of Governments Travel Reduction Program employer plan databases Only some TDMs included in model provide for estimates of VT reductions Use of default values could diminishes accuracy of estimates for some users	Suburban employer-based TDM measures Daily trips and peak period trips Costs and cost-effectiveness

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Telecommuting (cont.)	Process analysis of transportation measure planning and implementation	Explains lessons learned during the planning and implementation of an actual transportation measure, such as reactions to expect from the public and funding sources Provides pros and cons of planning and implementation methods	Does not necessarily help quantify VT, VMT, or emissions reductions from the transportation measure implementation Cost can vary greatly	"Transportation Control Measures Analyzed for the Washington Region's 15 Percent Rate of Progress Plan." FHWA/Metropolitan Washington Council of Governments, February 1995.	Provides comprehensive evaluation of the selection and quantification process performed by the MWCOG for assessing various transportation measures	Addresses the strengths and weaknesses of the bottom-up, multiple committee planning process used by the COG Provides extensive, clear detail (and strengths and weaknesses) of both the evaluation tools used and each specific transportation measure evaluation method Estimates VT, VMT, and emission reductions and cost-effectiveness	Requires an extensive study of already-performed process	None (factors analyzed are applicable to each transportation measure analyzed during the process)
	Comparison and analysis of other studies	Relatively inexpensive and simple to conduct, because it requires no primary research Provides a review of the results produced by different HOV facilities in North America, which could be used if other directly applicable research is not available Identifies advantages and disadvantages of several methodologies	Results are not directly applicable to other regions (they do not incorporate characteristics of other regions) Unlikely to provide precise estimates	"An Assessment of Transportation Control Measures, Transportation Technologies, and Pricing/Regulatory Policies." Euritt, Mark A., et al. University of Texas, Austin, Center for Transportation Research/Tellus Institute. CTR SEDC-1, June 1995.	Assesses several studies that analyze a host of transportation measures, technology options, and policies for total effectiveness and costs/benefits	Provides a solid overview of the range (and effects) of TCM options, as well as technology and policy options Focuses upon energy efficiency impacts in addition to emissions and VMT	Report does not contain a methodology for evaluating new TCM plans, but follow-on report focuses upon these strategies Estimates may be too rough to apply to other programs in other regions	Impacts: vehicle trips, vehicle miles traveled, and emissions Costs

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Telecom-muting (cont.)	Comparison and analysis of other studies (cont.)			"Assessment of Travel Demand Management Approaches at Suburban Activity Centers." Bhatt, Kiran, and Higgins, Thomas. K.T. Analytics. U.S. DOT, July 1989.	Surveys research studies and interviews TCM program coordinators to provide an overview of the range of effectiveness of employer-based TCM programs	Provides a large number of case study examples of both effective and ineffective TCM programs Makes recommendations to employers on how to develop a TCM program Provides a good checklist of topics to address when developing a TCM program	Report does not contain a methodology for forecasting the effectiveness of new TCM plans Only generalized evaluation of TCM effectiveness	Relative effectiveness of various transportation measure programs Implementation mechanisms
Traffic Management	Integrated planning/simulation model	Combines the strengths of regional transportation planning models and traffic simulation models Somewhat applicable to multiple regions Analyst can vary input parameters	Requires very detailed input data Requires complex computer model Potentially high cost to use	"Intelligent Transportation Systems Impact Assessment Framework: Final Report." Volpe National Transportation Systems Center, September 30, 1995	Describes development and application of an analytical tool to predict ITS impacts, with a focus on Advanced Traffic Management Systems	Model integrates transportation planning and traffic simulation in an iterative fashion, and includes emissions and fuel consumption modules Report describes use of model to analyze the potential use of ITS in the I-880 corridor in Alameda County, California, modeling ramp metering, traffic signal coordination, integrated traffic management, incident management, and HOV lanes Emissions module uses accepted EMFAC and MOBILE factors	Relatively high cost and complexity Locally specific input data makes the I-880 results of limited use in other areas	Operational Measures of Effectiveness: VMT, traffic volume, average vehicle speed, vehicle hours of delay, fuel consumption Emission Measures of Effectiveness: CO, HC, NOx Safety Measures of Effectiveness: personal injury levels, property damage, total accidents

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Traffic Management (cont.)	Travel demand/mode choice model	Somewhat applicable to multiple regions Analyst can vary input parameters	Requires region-specific household survey, land use, socioeconomic, and travel cost data Requires complex computer model Potentially high cost to use	"The Effectiveness of Transportation Control Measures in Reducing Congestion and Improving Air Quality." Loudon, William R., et al. JHK & Associates. Air & Waste Management Association Annual Meeting & Exhibition 1993. AWMA 93-RP-149.05.	Describes a developed transportation demand model that integrates emissions calculations; provides example calculations from the model	Model has a user manual that leads the analyst step-by-step through the input of data for region specific analyses Contains extensive cost-effectiveness module Can be used at either regional or a smaller area or location Includes exhaust and evaporative emissions	Use of the model requires local input parameters to forecast local effectiveness; default values may not be sufficient	Signal timing improvements (level not stated)
				"Transportation Control Measure Analysis Procedures." Austin, Barbara S., et al. Systems Applications International/California Air Resources Board. Nov 1991. SYSAPP-91/141.	Describes a developed transportation demand model and explicitly discusses the calculation methodology used for several transportation measures	Model quantifies key secondary effects of TCMs (e.g. new carpooling programs may attract transit riders rather than SOV riders) Presents all the primary equations and variables used to calculate the effects of TCMs Contains a step-by-step process for evaluating packages of TCMs Explains multi-attribute analyses as applied to multiple TCM packages	Use of the model requires local input parameters to forecast local effectiveness; default values may not be sufficient; participation level data is required; base cases need to match real conditions Model does not cover all TCMs, but can be modified to do so Temporal treatment is limited to on-peak/off-peak, no spatial treatment Emissions calculations are not explicitly described in the same fashion as travel effects	Addition of a lane

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed	
Traffic Management (cont.)	Travel demand/ mode choice model (cont.)			"Transportation Control Measures for the San Francisco Bay Area: Analysis of Effectiveness and Costs." Harvey, G., and E. Deakin. For Bay Area Air Quality Management District, October 1991.	Describes use and results of a travel demand model to model VT, VMT, and emission reductions of various transportation measures in the San Francisco Bay Area	Utilized high-quality household travel survey data and advanced modeling capabilities Emissions calculations uses standardized methods, but takes into account more subtle effects of emissions generation Provides succinct, clear data on results of study, including cost-effectiveness estimates	Does not provide detail on model operation	Many; not specified	dac
	Freeway throughput model	May be applicable to actual corridors, given accurate knowledge of key assumptions Low to moderate cost	Assumptions are required that may heavily impact the results	"A Case for Freeway Mainline Metering." Haboian, Kevin A. Parsons Brinckerhoff Quade & Douglas. In Transportation Research Record 1494, 1995.	Uses INTRAS freeway model to measure the impact of ramp metering and freeway (mainline) metering to improve vehicle travel times and reduce traffic delay	INTRAS model simulates vehicles as separate units rather than groups, improving simulation Provides average vehicle speeds on the freeway for several scenarios and metering configurations	Does not clearly explain fundamental principle behind effectiveness of freeway metering Does not assess impact of vehicles diverting around metering point Does not calculate VMT or emission reductions Does not discuss ways to counter political resistance to freeway metering	Ramp metering intervals Mainline meter activation thresholds	dac
	Parking supply and demand model	Somewhat applicable to multiple regions Analyst can vary input parameters	Requires computer model Potentially high cost to use	"Air Quality Offsets for Parking." Loudon, William, et al. In Transportation Research Record 1232, 1992.	Develops and uses parking supply model for downtown Portland to estimate CO emissions	Uses observed price and travel time sensitivities Uses proven models of travel behavior Incorporates integrated CO emissions model	Requires parking database: number of spaces, location, type, use patterns Requires travel database: time of arrival, travel & work mode split	Average speed of vehicles	dac

Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed	
Traffic Management (cont.)	Empirical analysis of transportation measure demonstration projects	Requires little or no new data acquisition Relatively low cost Shows actual potential of transportation measures	Case study results do not necessarily apply to other regions	"Ramp Metering: Does it Really Work?" Robinson, James, and Mark Doctor. FHWA/ITE 1989 Compendium of Technical Papers.	Evaluates effectiveness of several ramp metering projects across the nation, identifies limitations and issues for implementation	Compares several types of ramp-metering projects under different circumstances Provides effectiveness in terms of vehicle speed increases or travel time decreases as well as reductions in accidents Discusses types of ramp-metering systems, metering rates, ramp geometries, and diversion problems	Some of the projects implemented other transportation measures concurrently with the ramp-metering project, so it is difficult to examine the effectiveness of this program only Does not quantify VMT or emissions reductions	On-ramp queue length Wait times	dac
				"Environmental Considerations for Planning Advanced Traffic Management Systems." Kraft, Walter H., and William A. Redl, in <i>Resource Papers for the 1994 ITE International Conference</i> , 1994.	Reviews environmental factors related to ITS strategies, and presents a case study of New Jersey DOT I-80 Metropolitan Area Guidance Information and Control (MAGIC) project	Combines general discussion with case study results from an actual ITS project Evaluates changes in VMT and emissions (CO, HC, and NOx) at the corridor level Includes cost/benefit analysis results Tracks changes in VMT and emissions impacts over time	Emissions calculation methodology and results not presented in great detail	Land use and physical features Emissions (CO, HC, NOx) Benefit/cost ratio	drl

Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Traffic Management (cont.)	Empirical analysis of transportation measure demonstration projects (cont.)			"ITS Benefits: Continuing Successes and Operational Test Results." Prepared by Mitretek Systems for Federal Highway Administration. Draft, September 19, 1997.	Highlights existing and predicted ITS benefits identified from a variety of ITS programs, including traffic management projects, focusing on U.S. DOT-funded Field Operational Tests and other programs resulting from recent federal initiatives	Reports benefits from a variety of projects covering a variety of ITS technologies, including several traffic management strategies Includes ITS and traffic management benefits related to safety, time, throughput, cost, customer satisfaction, energy, and environment Includes example emissions results for electronic toll collection and traffic signal system projects in Oklahoma, New Jersey, Los Angeles, and Abeline (Texas)	Reports results but does not show analysis methods or calculations Not all reported results have been validated for completeness and reliability	Varies depending on project summarized, but can include: VMT, vehicle trips, vehicle speeds, fuel usage, emissions (HC, CO, NOx)
	Sketch planning	Simple tools can generate planning-level estimates of transportation measure effectiveness at low cost Generalized tools can be somewhat applicable to multiple regions Analyst can vary input parameters	Sketch planning results are usually not the most accurate, depending on the input parameters	"TCM Analyst 1.0 and User's Guide." Crawford, Jason A., et al. Texas Transportation Institute. For the Federal Highway Administration, November 1994.	Describes a computerized sketch planning tool, TCM Analyst 1.0, including input data requirements, methods of use, and an overview of the model's structure and calculation procedures	Provides a useful and relatively easy instruction manual for using TCM Analyst 1.0 Uses MOBILE5a output data (emission factors) as <i>inputs</i> to the model, providing more accurate emission benefit calculations for each TCM	Program only models limited TCMs and cannot model multiple TCM packages Requires several runs with MOBILE5a to obtain input emission factors Modeling on regional (rather than microscale) basis only	Not stated

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Traffic Management (cont.)	Sketch planning (cont.)			"Potential Emission and Air Quality Impacts of Intelligent Vehicle-Highway Systems." Ostria, Sergio, and Michael F. Lawrence. In Transportation Research Record 1444, 1994.	Discusses short-term and long-term impacts of ITS technology bundles, including traffic and incident management systems, on trips, mode split, and emissions at a regional and corridor level	Provides a broad initial assessment of the expected direction of impact (positive, negative, insignificant, uncertain) of traffic and incident management systems on travel behavior and emissions (HC, CO, NOx) Utilizes solid <i>a priori</i> reasoning to predict impacts	Discussion is theoretical rather than empirical Does not estimate the magnitude of travel or emissions impacts Evaluates traffic and incident management systems mostly as an ITS technology bundle rather than as individual ITS technologies or specific traffic management strategies	Traffic flow Vehicle trips Trip distance Mode shifts Emissions (HC, CO, NOx)
	Process analysis of transportation measure planning and implementation	Explains lessons learned during the implementation of an actual transportation measure, such as reactions from the public and funding sources, as well as projected versus actual benefits Provides pros and cons of planning and implementation methods	Does not necessarily help quantify VT, VMT, or emissions reductions from the transportation measure implementation	"Freeway Ramp Metering Effects in Denver." Corcoran, Lawrence J. and Gordon A. Hickman. ITE 1989 Compendium of Technical Papers.	Reviews and assesses the implementation, system expansion, projected and actual benefits of the freeway ramp metering demonstration project begun in 1981 in the Denver metropolitan area	Compares projected and actual benefits, in percentages, of increased speed, reduced VHT, reduced emissions, reduced accidents, and minimized diversion Long term nature of the demonstration project, and subsequent expansion of ramp metering, demonstrated a quantified level of motorist and media support, as well as a measure of motorist violation rates	Does not evaluate the end result effectiveness in terms of VT or VMT reduced	Speed increase Reduced VHT, emissions, and accidents Diversion minimization

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Traffic Management (cont.)	Process analysis of transportation measure planning and implementation (cont.)			"Transportation Control Measures Analyzed for the Washington Region's 15 Percent Rate of Progress Plan." FHWA/Metropolitan Washington Council of Governments, February 1995.	Provides comprehensive evaluation of the selection and quantification process performed by the MWCOG for assessing various transportation measures	Addresses the strengths and weaknesses of the bottom-up, multiple committee planning process used by the COG Provides extensive, clear detail (and strengths and weaknesses) of both the evaluation tools used and each specific transportation measure evaluation method Estimates VT, VMT, and emission reductions and cost-effectiveness	Requires an extensive study of already-performed process	None (factors analyzed are applicable to each transportation measure analyzed during the process)
	Comparison and analysis of other studies	Relatively inexpensive and simple to conduct, because it requires no primary research Provides a review of the results produced by different HOV facilities in North America, which could be used if other directly applicable research is not available Identifies advantages and disadvantages of several methodologies	Results are not directly applicable to other regions (they do not incorporate characteristics of other regions) Unlikely to provide precise estimates	"An Assessment of Transportation Control Measures, Transportation Technologies, and Pricing/Regulatory Policies." Euritt, Mark A., et al. University of Texas, Austin, Center for Transportation Research/Tellus Institute. CTR SEDC-1, June 1995.	Assesses several studies that analyze a host of transportation measures, technology options, and policies for total effectiveness and costs/benefits	Provides a solid overview of the range (and effects) of TCM options, as well as technology and policy options Focuses upon energy efficiency impacts in addition to emissions and VMT	Report does not contain a methodology for evaluating new TCM plans, but follow-on report focuses upon these strategies Estimates may be too rough to apply to other programs in other regions	Impacts: vehicle trips, vehicle miles traveled, and emissions Costs

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Traffic Management (cont.)	Comparison and analysis of other studies (cont.)			"HOV Lanes and Ramp Metering: Can They Work Together for Air Quality?" Shoemaker, Bill R. and Edward C. Sullivan. Transportation Research Board Paper 940444. January 1994.	Comments on the analysis process used to assess the air quality impacts of HOV land and ramp metering projects, and examines the degree to which these measures are effective and compatible where jointly applied to improve freeway operations	Illustrates the process of analysis and decision-making, as well as the key role of analytical modeling, required in the San Francisco Bay Area to gain approval for HOV lane and ramp metering projects at the regional level Examines the interrelationships, and potentially perverse effects, between HOV lanes and ramp metering	Identifies need for estimating disaggregate mode-specific emission factors, including vehicle fleet characteristics, and identifies difficulties in doing so	Interrelationships between HOV lanes and ramp metering
Trip Reduction (cont.)	Travel demand/ mode choice model	Somewhat applicable to multiple regions Analyst can vary input parameters	Requires region-specific household survey, land use, socioeconomic, and travel cost data Requires complex computer model Potentially high cost to use	"Implementing Effective Travel Demand Management Measures: Inventory of Measures and Synthesis of Experience." COMSIS Corporation. USDOT, September 1993. DOT-T-94-02.	Summarizes broad range of TDM measures, provides example case study analyses of each, and uses computer model to benchmark the effectiveness of each TDM	Excellent overview of the range of TDMs possible; provides description, nature of effectiveness, application setting, effectiveness potential, and cost Uses actual case studies to inform the use of a computer model for forecasting TDM effectiveness Provides a road-map to implementing TDMs	Use of the model requires local input parameters to forecast local effectiveness Model does not incorporate an emissions calculation module Most analysis is at the employer-level rather than the area-level	Level of service provided by employer: information, matching services, preferential parking, ride home programs

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Trip Reduction (cont.)	Travel demand/mode choice model (cont.)			"A Survey and Analysis of Employee Responses to Employer-Sponsored Trip Reduction Incentive Programs." Schreffler, Eric N., and Mortero, Jose. COMSIS Corp. California Air Resources Board, February 1994. Contract No. A983-187.	Describes results of new survey data regarding employee travel behavior; uses mode choice and travel demand model to predict impacts of certain employer-based transportation measures	<p>Clearly explains the process that was used: survey data acquisition, mode choice computation, and TCM effectiveness model use</p> <p>Data requirements are more readily available than other models</p> <p>User-friendly model is available for outside use; users guide is also available</p> <p>Survey links incentives directly to impacts on travel behavior</p> <p>Model includes an awareness sub-model that simulates how many people know about the possible transportation measures available to them</p>	<p>Does not accurately address trip-chaining and VMT reductions (only trips)</p> <p>Household conditions are not extensively accounted for</p> <p>Cost-effectiveness was not calculated</p> <p>Employer-level analyses only, with focus upon incentive TCMS</p>	<p>Guaranteed ride home</p> <p>Company vanpools</p> <p>Preferential parking</p> <p>Parking fees for ridesharers</p> <p>Carpool subsidies & transportation allowances</p>

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Trip Reduction (cont.)	Empirical analysis of the impacts of personal preference and workplace conditions on mode choice	Somewhat applicable to multiple regions (but likely to be influenced heavily by local factors of the study area) Can be replicated (at moderate to high cost) Does not require extensive computer model Uses actual survey data	Requires large data collection process to generate statistically significant results Personal preference and workplace conditions difficult to impact through public policy	"The Influence of Employer Ridesharing Programs on Employee Mode Choice." Ferguson, Erik. <i>Transportation</i> , vol 17, 1990.	Analyzes aggregate-level data compiled by a large Southern California regional ridesharing agency; assesses impact of employer characteristics on employee mode split	Analyzes a large data set comprising almost 10% of Los Angeles area workforce Utilizing existing agency database is a cost-effective approach Less accurate than disaggregated (employee by employee) data Includes cost-effectiveness estimations	Some findings may have been contradicted by more recent studies (e.g., study finds that large corporations have better success with rideshare programs) Aging data source: 1985 survey data Los Angeles area factors may be uncharacteristic of other regions, so results may not be applicable elsewhere Employer-derived data was acquired using different methods No estimates of emissions impacts	Level of employer effort to encourage ridesharing Size of firm

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Trip Reduction (cont.)	Statistical analysis of the impacts of land use characteristics and TDM strategies on mode choice	Identifies land use and urban design characteristics that are supportive of walk/bike mode choice. Standard analysis of variance using principle components allows examination of the effects of land use and TDM incentive strategies on mode choice individually and in combination. Results transferable to other urban areas in terms of relative ranking of importance of the land use and TDM factors analyzed.	Precise causality and individual impacts of factors such as transit availability or urban density on mode choice cannot be measured due to limitations of the database Potential for need to conduct extensive field research to determine land use characteristics at each sample work site. Cannot be used to determine land use and urban design characteristics' impact on a specific mode choice	"The Effects of Land Use and Travel Demand Management Strategies on Commuting Behavior: Final Report." Prepared by Cambridge Systematics, Inc. and Deakin, Harvey, Skabardonis, Inc. for the U.S. Department of Transportation, November 1994.	Develops an integrated database of land use characteristics and travel demand management (TDM) strategies (for a sample of employment locations) to determine the combined impacts of TDM programs, land use, and urban design on employee travel behavior.	Added land use and site information from field observation to the "Regulation XV" dataset of the South Coast Air Quality Management District (which included aggregate employee travel characteristics and employer incentive programs)	Study conducted in Los Angeles County, and thus may be less applicable in more dense urban areas with factors such as higher average density and transit service. Share of work trips made by bicycle as a percentage of the total trips in the data set is small, making identification of work site characteristics that encourage utilization of bikes difficult. Did not address residential trip end of commute, midday travel, or trip chaining as factors which influence mode choice To simplify a complicated data collection process, somewhat arbitrary indicators were used for assessment of a site's urban design and land use characteristics.	Land use and urban design of worksite TDM incentive strategies

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Trip Reduction (cont.)	Empirical analysis of employer-based trip reduction program	Somewhat applicable to multiple regions Can be replicated (at moderate cost) Does not require extensive computer model	Requires large data collection process to generate statistically significant results	"SB 836 Evaluation Methodology: Baseline and Methodology to Measure the Effectiveness of Voluntary Ridesharing and Other Rule 2202 Replacement Measures," Final Report. Schreffler, Eric et al, for Regional Transportation Agencies' Coalition. July 1997.	Describes methodology for evaluation of voluntary ridesharing in the South Coast Air Basin; includes review of current employer trip reduction program evaluation practices	Methodology is rigorous and uses multiple data sources: a "State of the Commute" survey, an employer worksite activity survey, and an employee AVR survey Methodology is designed to compare voluntary ridesharing with mandatory ridesharing, thus isolating the relative emissions impact of ridesharing rules Uses existing data sources where possible Attempts to identify causality Methodology is designed to meet EPA requirement for State Implementation Plan credit	Extensive data sources are required Obtaining analogous "before" and "after" data to compare mandatory and voluntary ridesharing can be difficult Data sources and analysis are specific to Southern California	Primary measures: vehicle trips, VMT, emissions (CO, VOC, NOx) Secondary measures: average vehicle ridership, mode split

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Trip Reduction (cont.)	Empirical analysis of employer-based trip reduction program (cont.)			"Employee Trip Reduction Without Government Mandates: Cost and Effectiveness Estimates From Chicago." Pagano, Anthony and JoAnn Verdin. University of Illinois at Chicago. Transportation Research Board Paper 971281, 1997.	Evaluated the cost and effectiveness of employee trip reduction programs through the use of an independent evaluation of demonstration projects implemented in the Chicago area	<p>Estimates planning, maintenance, and voluntary implementation, and incentive costs for trip reduction programs</p> <p>Intensive data collection, especially for cost estimates, including before and after surveys and interviews of program administrators participating in the demonstration projects</p> <p>Addresses statistical relationships of organization type to costs and outcomes, of costs to strategies and incentives, of outcomes to strategies and incentives, and of cost to outcomes</p> <p>Addresses differences in outcome by organizational type (factory vs. office)</p>	<p>Made generalized assumption of staff costs needed to implement trip reduction programs</p> <p>Intensive data collection requires demonstration project and surveys, or application of Chicago area data</p> <p>Results have limited application to other regions, as local Chicago variables such as availability of transit alternatives may have influenced model results</p>	<p>Trip reduction program implementation process utilized</p> <p>Obstacles and success factors</p> <p>Program costs and effectiveness</p>	dkp
	Empirical analysis of transportation measure implementation programs	<p>Somewhat applicable to multiple regions</p> <p>Can be replicated (at moderate cost)</p> <p>Does not require extensive computer model</p>	Requires large data collection process to generate statistically significant results	"An Employer Panel for Evaluating the Effectiveness of Trip Reduction Incentives." Giuliano, Genevieve, and Wachs, Martin. In <i>Panels for Transportation Planning and Applications</i> , ed. T.F. Golob, et al, 1997.	Discusses results collected on Southern California employment sites subject to SCAQMD Regulation XV, and assesses the relative effectiveness of trip reduction strategies	<p>Utilizes the largest trip reduction measure database available in the world</p> <p>Panel method allows for assessing before-and-after-TCM conditions</p>	<p>Database does not provide exceptional detail; report does not contain details of the level of incentive support provided to employees</p> <p>Only generalized effectiveness results are shown</p> <p>TCMs were not always implemented at the time of the survey</p>	Not described	dac

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Trip Reduction (cont.)	Empirical analysis of transportation measure implementation programs (cont.)			"Reducing Drive-Along Rates at Small Employer Sites: Costs and Benefits of Local Trip Reduction Ordinances: Pasadena Towers Case Study." Stewart, Jacqueline. In <i>Transportation Research Record 1433</i> , 1994.	Evaluates the cost effectiveness of a building-based trip reduction plan implemented in compliance to a local ordinance in Pasadena, California	Attitudinal survey includes the influences of building tenant company size as well as schedule and lifestyle of employees	<p>Uses small data sets therefore results vary widely with the behavior of a few individuals</p> <p>Does not establish a standard to evaluate average vehicle ridership results obtained</p> <p>Results may not be transferable to other employer sites or regions</p> <p>Does not quantify emission impacts</p>	<p>Program cost and distribution of cost</p> <p>Benefits to developer, tenants and city</p> <p>Average vehicle ridership</p>

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed	
Trip Reduction (cont.)	Empirical analysis of transportation measure implementation programs (cont.)			"Feasibility of Employee Trip Reduction as a Regional Transportation Control Measure." Lupa, Mary R. University of Illinois at Chicago. In Transportation Research Record 1459.	Conducts a policy analysis of employee trip reduction, and a preliminary cost comparison of employee trip reduction among transportation measures	Evaluates effectiveness of employee trip reduction measures on improving air quality according to relief of traffic congestion, relief of ROG, maintenance of personal privacy and autonomy, and according to market-based VMT pricing possibilities Calculates the megagrams per year reduced of the pollutant chosen to measure the effectiveness of the transportation measure, as well as the cost of the strategy Determines that employee trip reduction strategies cannot successfully be separated from related mode split component strategies such as transit expansion, transit user subsidy, and parking fees	Does not evaluate emissions other than ROG	Cost effectiveness of employee trip reduction Effectiveness of employee trip reduction measures on improving air quality	dkp
	Empirical analysis of transportation measure demonstration projects	Requires little or no new data acquisition Relatively low cost Shows actual potential of transportation measures	Case study results do not necessarily apply to other regions	"Evaluation of Travel Demand Management Measures to Relieve Congestion." Kuzmyak, J.R., and E.N. Schreffler. Prepared by COMSIS Corp. for FHWA. FHWA/SA-90/005; DOT-T-90-14. February 1990.	Performs case studies of the effectiveness of 11 transportation demand management programs	Shows potential for reduction in commute-based trips due to implementation of transportation measures Provides high level of detail about the specific programs implemented	Generally does not evaluate specific TCM individually; programs of multiple TCMs are evaluated for effectiveness Does not quantify emission reductions Trip reductions based upon vehicle occupancy assumptions for each mode choice (carpool, vanpool, transit)	Not applicable in context of specific transportation measures	dac

Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Trip Reduction (cont.)	Statistical analysis of employer ridesharing initiatives	Utilizes large database of existing employers that implement transportation measures Relatively low-cost (provided data does not need to be collected)	May not assess causes of statistical significance found Results not necessarily applicable to other regions	"Evaluation of Employer-Sponsored Ridesharing Programs in Southern California." Ferguson, Erik T., Georgia Institute of Technology. In Transportation Research Record 1280, 1990.	Analyzes database of surveys of employer-sponsored ridesharing programs in Southern California to determine relevant factors on effectiveness	Utilizes large existing database for the region, increasing validity of results Assesses cost-effectiveness at varying program sizes Assesses interaction between alternative work schedules and ridesharing Attempts to explain reasons behind statistical significance of certain factors	Sample database may be biased (they were all clients of a centralized ridesharing agency) Primarily analyzes employer-based measures only	Level and type of direct ridesharing incentives Firm size and type Dollars spent on rideshare programs
	Sample survey of customer travel patterns and preferences at shopping centers	Somewhat applicable to multiple regions (but influenced by local factors of the study area) Does not require an extensive computer model	Requires large data collection process to generate statistically significant results Moderate to high cost	"Analysis of Indirect Source Trip Activity: Regional Shopping Centers." JHK & Associates/ K.T. Analytics/California Air Resources Board. November 1993, ARB-R-94/510.	Surveyed customers of regional shopping centers to determine potential impact of various travel reduction measures	Uses actual survey data (including customer demographic and stated preference data) Developed calculation methodologies specific to each trip reduction measure, using site-specific data Compares data between shopping centers in different land-use types	Assumptions are required to translate stated preference data to expected outcome Does not quantify emission reductions	Distance of travel for consumers

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Trip Reduction (cont.)	Sample survey of employer trip reduction program cost	<p>Uses statistically representative sample population to make estimates of overall impact of general trip reduction strategies such as employer-based trip reduction rules</p> <p>Sample size (and therefore cost) can be varied based on level of statistical accuracy desired</p> <p>Surveys can be done periodically to determine changes in program effectiveness over time</p>	<p>Surveys can entail significant costs</p> <p>If surveys are performed differently in different regions, direct comparisons of results may not be valid</p> <p>Survey results can be subject to various kinds of response bias</p>	"South Coast Air Quality Management District Regulation XV Cost Survey," and "AQMD Survey Follow-Up." Ernst & Young. For South Coast Air Quality Management District, 1992.	<p>Estimates cost of complying with South Coast Air Quality Management District Regulation XV trip reduction rule using employer surveys; follow-up document presents results of on-site interviews of 17 companies</p>	<p>Survey methodology is generic and can be applied to any region</p> <p>Regulation XV compliance paperwork allowed for an exact definition of the "target population"</p> <p>All affected companies surveyed, not just a representative sample</p> <p>Methodology combines broad survey with focused on-site interviews to gauge validity of responses</p>	<p>Only quantifies cost of ridesharing programs; does not directly quantify trip reductions or emissions reductions</p> <p>Accuracy of employer responses is questionable</p> <p>Study results do not allow characterization of the linkage between a given company's spending on a trip reduction program with the effectiveness of that program</p>	Cost of ridesharing program (in \$ per employee)
	Sketch planning	<p>Simple tools can generate planning-level estimates of transportation measure effectiveness at low cost</p> <p>Generalized tools can be somewhat applicable to multiple regions</p> <p>Analyst can vary input parameters</p>	<p>Sketch planning results are usually not the most accurate, depending on the input parameters</p>	"Critical Analysis of Sketch-Planning Tools for Evaluating the Emission Benefits of Transportation Control Measures." Crawford, Jason A., and Raymond A. Krammes. Prepared by Texas Transportation Institute for FHWA, FHWA/TX-92/1279-5. December 1993.	<p>Critical analysis and sensitivity analysis (using data for El Paso, Texas) of San Diego Association of Governments (SANDAG) TCM Tools method and the Systems Applications International (SAI) method; summarized in TRR 1472</p>	<p>Provides a thorough review of the state of the practice (as of 1993)</p> <p>Identifies weaknesses in the SANDAG and SAI methods as well as strengths</p> <p>Provides detailed sketch-planning analysis for El Paso, Texas</p>	<p>Many of the inputs to the SANDAG and SAI models are difficult to quantify</p> <p>The SANDAG and SAI models do not fully account for indirect impacts and latent travel demand</p>	<p>Vehicle trips</p> <p>VMT</p> <p>Average vehicle speed</p> <p>Emissions (HC, CO, NOx)</p>

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Trip Reduction (cont.)	Sketch planning (cont.)			"Simple Methodologies for Quantifying VT and VMT Reductions from Transportation Control and Growth Management Measures for Developing Local Trip Reduction Ordinances." Evans, V. and D. Morrow. Sonoma Technology, Inc. Air & Waste Management Assoc. 1993.	Describes development of simple methodologies for quantifying reductions in vehicle trips (VT) and vehicle miles traveled (VMT) from TCMs, for use in a planning-level context; developed originally for the South Coast Air Basin	<p>Methods to quantify VT and VMT reductions from TCMs were based upon relatively simple methods for estimating emissions and individual TCM effectiveness developed prior to this report for the South Coast AQMD</p> <p>Performance-based approach was developed rather than use mandated transportation performance standards</p> <p>Actual experience data used as much as possible: estimated trip reduction levels from each TCM was collected from other studies, and planning-level analysis uses site-specific data inputs, thus offering increased precision in emissions estimates</p> <p>Ranges in VT reductions estimates address the interactive impacts of the application of multiple transportation measures</p> <p>Equivalency factor used to convert VMT to VT can account for region-specific average trip lengths</p>	<p>Expected reductions in VT and VMT from TCMs were estimated based upon a general survey, so for a particular location different assumptions may be needed</p> <p>Applicability to other regions outside California limited by report's use of transportation data and emissions factors in the analysis which were quantified using BURDEN and EMFAC runs for 1994</p> <p>Does not incorporate any consideration of cost-effectiveness</p>	<p>Employee participation (percentage and frequency)</p> <p>Trip length</p> <p>Bike parking facilities</p> <p>Existence/extent of bike path system</p> <p>Existence of shower facilities</p>

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Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Trip Reduction (cont.)	Employer TDM cost-effectiveness model	Estimates reduction in and costs of daily trips and peak period trips Aids employer determination of cost-effectiveness of TDM measures for their particular worksite	Results may vary widely from one employer to the next Many inputs may be difficult for employers or planners to quantify	"Transportation Demand Management Cost-Effectiveness Model for Suburban Employers." Dagang, Deborah A. JHK & Associates. In Transportation Research Record 1404.	Reports on the development of a model to individually evaluate the cost-effectiveness of 15 different employer-based TDM measures in suburban settings	Focus on suburban employers reflects different travel-related characteristics of suburban and urban areas Spreadsheet-based model is user-friendly and readily accessible for use at the site-specific level; model makes sensitivity analysis relatively simple Eight transportation environments were defined to represent various combinations of transportation service characteristics For employers without access to entire range of data necessary to operate model, default values are included	Most employers surveyed to develop model were unable to provide detailed cost information on the TDM measures they had implemented Does not calculate emissions directly Potential for regional bias, as model was developed in part based on a survey of suburban San Francisco Bay Area employers; model also used the SCAQMD Regulation XV and Pima Association of Governments Travel Reduction Program employer plan databases Only some TDMs included in model provide for estimates of VT reductions Use of default values could diminishes accuracy of estimates for some users	Suburban employer-based TDM measures Daily trips and peak period trips Costs and cost-effectiveness

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Trip Reduction (cont.)	Case study analysis	Analyzing case studies of transportation projects is relatively easy and inexpensive Different case studies can be compared to determine factors influencing the effectiveness of an transportation measure	Case-study analysis frequently does not provide rigorous quantitative results Effectiveness of case studies may be due to local factors specific to that case	"Transportation Demand Management: Case Studies of Medium-Sized Employers." Rutherford, G. Scott et al. In Transportation Research Record 1459.	Presents travel mode split results for 14 medium-sized employers that practice various forms of transportation demand management	Chosen companies represent a variety of locations, business type, and transportation measures. Explains regional variation of policy and constraints for transportation measures (parking availability, price, public transportation network)	Data collected do not contribute to a clear conclusion on the most effective transportation measure Does not provide discussion of emission benefits Does not contain cost/benefit analysis	Transportation mode split: single occupant vehicle, transit, carpool Employee transportation coordination support time	fk
	Policy analysis of transportation measures	Addresses political feasibility of transportation measure implementation and generalized estimate of success given local travel behavior and characteristics. Relatively simple and inexpensive to conduct, as it requires no primary research	Unlikely to provide precise emission estimates	"Feasibility of Employee Trip Reduction as a Regional Transportation Control Measure." Lupa, Mary R. University of Illinois at Chicago. In Transportation Research Record 1459.	Conducts a policy analysis of employee trip reduction, and a preliminary cost comparison of employee trip reduction among transportation measures	Analyzes shortcomings to indirect transportation measures such as employee trip reduction Provides a solid overview of employee trip reduction as an evolving TCM and an arena for strategic planning using tools such as direct political action, classic economics, technological implementation, pricing, and regional consensus building	Draws conclusions as to feasibility of implementing employee trip reduction, but gives no precise estimation of emissions	Employee trip reduction	dkp

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Trip Reduction (cont.)	Process analysis of transportation measure planning and implementation	Explains lessons learned during the planning and implementation of an actual transportation measure, such as reactions to expect from the public and funding sources Provides pros and cons of planning and implementation methods	Does not necessarily help quantify VT, VMT, or emissions reductions from the TCM implementation Cost can vary greatly	"Transportation Control Measures Analyzed for the Washington Region's 15 Percent Rate of Progress Plan." FHWA/Metropolitan Washington Council of Governments, February 1995.	Provides comprehensive evaluation of the selection and quantification process performed by the MWCOG for assessing various transportation measures	Addresses the strengths and weaknesses of the bottom-up, multiple committee planning process used by the COG Provides extensive, clear detail (and strengths and weaknesses) of both the evaluation tools used and each specific TCM evaluation method Estimates VT, VMT, & emission reductions and cost-effectiveness	Requires an extensive study of already-performed process	None (factors analyzed are applicable to each transportation measure analyzed during the process)	dac
	Comparison and analysis of other studies	Relatively inexpensive and simple to conduct, because it requires no primary research Provides an introduction to the range of results produced by different studies, which could be used if other directly applicable research is not available Identifies advantages and disadvantages of several methodologies	Results are not directly applicable to other regions (they do not incorporate characteristics of other regions) Unlikely to provide precise estimates	"An Assessment of Transportation Control Measures, Transportation Technologies, and Pricing/Regulatory Policies." Euritt, Mark A., et al. University of Texas, Austin, Center for Transportation Research/Tellus Institute. CTR SEDC-1, June 1995.	Assesses several studies that analyze a host of transportation measures, technology options, and policies for total effectiveness and costs/benefits	Provides a solid overview of the range (and effects) of transportation measure options, as well as technology and policy options Focuses upon energy efficiency impacts in addition to emissions and VMT	Report does not contain a methodology for evaluating new TCM plans, but follow-on report focuses upon these strategies Estimates may be too rough to apply to other programs in other regions	Impacts: vehicle trips, vehicle miles traveled, and emissions Costs	dac
					"Assessment of Travel Demand Management Approaches at Suburban Activity Centers." Bhatt, Kiran, and Higgins, Thomas. K.T. Analytics. U.S. DOT, July 1989.	Surveys research studies and interviews TCM program coordinators to provide an overview of the range of effectiveness of employer-based TCM programs	Provides a large number of case study examples of both effective and ineffective TCM programs Makes recommendations to employers on how to develop a TCM program Provides a good checklist of topics to address when developing a TCM program	Report does not contain a methodology for forecasting the effectiveness of new TCM plans Only generalized evaluation of TCM effectiveness	Relative effectiveness of various transportation measure programs Implementation mechanisms

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Trip Reduction (cont.)	Comparison and analysis of other studies (cont.)			"Managing Transportation Demand: Markets Versus Mandates." Giuliano, Genevieve, and Martin Wachs. Reason Foundation. Policy Insight No. 142, September 1992.	Compares congestion pricing with Regulation XV for the Southern California area; describes pros and cons of each measure and discusses implications	Provides typology of transportation measures and identifies effectiveness and common barriers to implementation Simple side-by-side comparison of VMT reduction and cost-effectiveness for each transportation measure Makes policy recommendations to improve each transportation measure	Provides little detail about logistics of implementing the policy recommendations Does not quantify emission reductions	Direct vs. indirect implementation Market-based vs. performance-based implementation Efficiency and equity considerations	dac
				"The Equity and Cost Effectiveness of Employee Commute Options Programs." Farkas, Z. Andrew. Morgan State University. TRB 960078, January 1996.	Analyzes the results of surveys and transportation measure modeling studies performed for the Baltimore and Philadelphia regions	Shows different methods of using the same model: Travel Demand Evaluation Model developed by COMSIS Provides a discussion of social equity considerations based on a survey of the two regions	Philadelphia modeling assumed average vehicle ridership targets were reached and results are only applicable relative to each scenario Baltimore modeling did not estimate emissions reductions	Rideshare promotion level Parking charge level Transit subsidy levels Work schedule flexibility	dac
				"Evaluation of Employee Trip Reduction Programs Based on California's Experience with Regulation XV." Orski, C. Kenneth. Institute of Transportation Engineers. January 1994.	Summarizes the results of an evaluation of employee trip reduction programs, based on California's experience with Regulation XV	As their techniques and targets are closely parallel, empirical data for Regulation XV was used to represent projected results of the Federal Clean Air Act, so lessons evaluated may be relevant to other metropolitan areas Able to draw general conclusions of employee trip reduction program effectiveness, based on assessment of numerous California studies available at the time	Report does not contain a methodology for evaluating new TCM plans California-specific factors may influence and limit applicability of conclusions to other regions	South Coast Air Quality Management District Regulation XV results to date Areawide program impact Program costs and effectiveness	dkp

Transportation Measure	Methodology	Advantages of Methodology	Disadvantages of Methodology	Report	Description	Advantages of Study	Disadvantages of Study	Factors Analyzed
Trip Reduction (cont.)	Comparison and analysis of other studies (cont.)			"Employee Trip Reduction Programs: An Evaluation." Orski, C. Kenneth. In <i>Transportation Quarterly</i> , Vol. 47, No. 3, July 1993.	Addresses feasibility and cost of attaining the mode shift goal in CAA 182(d)(1)(B), and the resulting impact on regional trip volume, vehicle miles traveled, automotive emissions, and air quality if the goals were met	As their techniques and targets are closely parallel, empirical data for Regulation XV was used to represent projected results of the Federal Clean Air Act, so lessons evaluated may be relevant to other metropolitan areas Able to draw general conclusions of employee trip reduction program effectiveness, based on assessment of numerous California studies available at the time	California-specific factors may influence and limit applicability of conclusions to other regions Report does not contain a methodology for evaluating new TCM plans	South Coast Air Quality Management District Regulation XV results to date Long-term program effects on modal choice Areawide program impact Program costs and effectiveness
VMT Fees	Travel demand/ mode choice model	Somewhat applicable to multiple regions Analyst can vary input parameters	Requires region-specific household survey, land use, socioeconomic, and travel cost data Requires complex computer model Potentially high cost to use	"Transportation Pricing Strategies for California: An Assessment of Congestion, Emissions, Energy and Equity Impacts." California Air Resources Board, June 1995. Report No. 92-316.	Develops and uses a comprehensive travel demand model to estimate the impacts of multiple transportation measures	Uses actual, available price elasticities Establishes base case by comparing to actual travel data Explores interrelations between pricing strategies	Does not contain a highway-network model to include level-of-service changes Forecasts rely on estimations of changes in household travel data	Fee level Price elasticity Interrelationships between pricing strategies

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