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Report to Congressional Requesters

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URBAN TRANSPORTATION

Reducing Vehicle Emissions With Transportation Control Measures

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Resources, Community, and
Economic Development Division

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The Honorable Max Baucus
Chairman
The Honorable John H. Chafee
Ranking Minority Member
Committee on Environment and Public Works
United States Senate

The Honorable Norman Y. Mineta
Chairman
The Honorable Bud Shuster
Ranking Minority Member
Committee on Public Works and Transportation
House of Representatives

Motor vehicles are the dominant source of many of the air pollutants that contribute to environmental problems in many urban areas. Excessive levels of ozone and carbon monoxide in urban areas are linked to a variety of health effects, including lung and cardiovascular disease. In 1989, the Office of Technology Assessment estimated that the value of the health benefits to be realized by meeting federal ozone standards could range between $1.3 billion and $9.5 billion annually.[1]

This report responds to your request that, as part of our review of the implementation of the Intermodal Surface Transportation Efficiency Act (ISTEA), we examine the use of transportation control measures (TCM) to control mobile source emissions. TCMs are programs or activities that states and localities can implement to encourage the traveling public to rely less on the automobile or to use the automobile more efficiently. These programs include traditional approaches, such as improving commuter train service, encouraging employer-provided carpooling incentives, and synchronizing traffic lights to improve the flow of traffic. They also include economic measures, such as imposing regional gasoline taxes and motor vehicle emissions fees. Specifically, we agreed to (1) review evidence on the effectiveness of TCMs in reducing pollution and (2) assess the prospects for implementing TCMs in areas that have not attained federal air quality standards for ozone and carbon monoxide. To meet these objectives, among other things, we conducted a nationwide

[1]Catching Our Breath: Next Steps for Reducing Urban Ozone, Office of Technology Assessment (Washington, D.C.: U.S. Government Printing Office, May 1990).

survey of 119 metropolitan planning organizations in ozone and carbon monoxide nonattainment areas.

Results in Brief

Our nationwide survey, reviews of federal and state air quality studies, and discussions with transportation and air quality experts revealed that the traditional TCMs listed in the Clean Air Act Amendments of 1990 (CAAA) are projected to reduce regionwide hydrocarbon and carbon monoxide emissions from 0 to 5 percent of total emissions. We found a strong consensus among transportation planners that TCMs are complementary programs that will supplement improvements in emissions technology, cleaner fuel, and vehicle inspection and maintenance programs. TCMs have traditionally been used to reduce congestion and fuel consumption and will play a growing role in transportation planning. ISTEA and CAAA contain funding and enforcement provisions that will encourage states to emphasize TCMs in the future. Fifty-six percent of the surveyed metropolitan planning organizations stated that TCMs would receive strong emphasis in their transportation programs in the next 5 years (1993-98). Only 8 percent of the surveyed metropolitan planning organizations reported that TCMs had received strong emphasis in their programs during the last 5 years (1987-92).

Further research on the effectiveness of TCMs may also enhance the prospects for implementing them. Current evidence is outdated and depends on models that do not reliably measure the effects of TCMs on travelers' behavior. In using traditional TCMs—such as mass transit, ridesharing, and traffic signal synchronization—transportation planners will be challenged by trends toward greater public reliance on the automobile and low-density land use that undermines the viability of alternatives to the single-occupant vehicle.

We found a strong consensus that market-based TCMs—financial disincentives that change travel behavior, such as gasoline taxes or emissions fees—may be more effective than traditional TCMs in reducing automobile use. These measures may be particularly important, since traditional TCMs target the home-to-work commute, which in 1990 accounted for only one-fourth of all vehicle trips—about a 6-percent decline since 1969. According to a recent analysis in the San Francisco Bay region, an extensive program of traditional TCMs would reduce carbon monoxide emissions by 5.4 percent; the inclusion of several market-based measures would reduce emissions by 22.5 percent. Department of Transportation (DOT) and Environmental Protection Agency (EPA) officials

are encouraging states to implement market-based TCMs. However, since these measures add to the cost of driving, they are economically and politically painful; 80 percent of the surveyed metropolitan planning organizations agreed that public resistance to these measures made their implementation highly unlikely. Localities that find market-based TCMs unfeasible may obtain maximum benefits from traditional TCMs through several approaches, including focusing on specific congested corridors and implementing TCMs that reduce the number of trips as well as the number of vehicle miles traveled.

Background

Motor vehicles contribute substantially to high levels of ozone and carbon monoxide—two of the most widespread air quality problems in the United States.[2] Federal policy has long promoted a variety of approaches to reduce air pollution from motor vehicles, including improving emissions technology, developing cleaner fuels, and introducing vehicle inspection and maintenance programs. In addition, federal transportation and clean air policies have sought to reduce emissions and traffic congestion through TCM programs that range from installing bicycle storage facilities at transit stations to establishing high-occupancy-vehicle (HOV) lanes and regionwide carpooling programs. TCMs also include mandatory employer-based programs, such as Regulation XV in California's South Coast Air Basin. This program requires large employers to increase the average occupancy of vehicles arriving at the workplace in order to reduce overall automobile use. Appendix I includes a detailed list and description of these measures.

CAAA and ISTEA emphasize the role of TCMs in state and local efforts to reduce emissions from transportation sources. These laws also allow considerable flexibility in the use of TCMs. CAAA requires states to submit state implementation plans outlining their efforts to meet federal air quality standards. CAAA also requires that states with severe and extreme ozone nonattainment areas use TCMs to offset the growth in emissions due to increases in vehicle miles traveled. Furthermore, CAAA lists 16 TCM strategies that states and localities can include in their transportation plans. ISTEA reinforced the CAAA mandates by limiting the use of federal transportation funds in areas violating federal air quality standards. For example, ISTEA states that, in certain nonattainment areas, federal funds may not be used for highway projects that will significantly increase the

[2]Motor vehicles do not emit ozone. Rather, they emit hydrocarbons that undergo chemical reactions in the atmosphere and produce ozone.

carrying capacity for single-occupant vehicles unless such projects are part of an approved congestion management system.

Impact of TCMs on Reducing Emissions May Be Modest

Projections of the impact of TCMs on reducing regional hydrocarbon and carbon monoxide emissions generally range from less than 1 percent to 5 percent. Experts we spoke to generally regarded TCMs as incremental, supportive measures that supplement other approaches, such as improvements in emissions technology and cleaner fuels, which are expected to yield far greater reductions in emissions.

Table 1 shows the range of reductions in emissions expected from TCMs, as found in our survey and cited in other studies. Only in California's South Coast region does the predicted reduction in emissions significantly exceed the range cited in national studies.

Table 1: Projected Role of TCMs in Reducing Total Hydrocarbon and Carbon Monoxide Emissions

Source of projection	Percent reduction in hydrocarbon emissions	Percent reduction in carbon monoxide emissions
1992 GAO survey	0-3	0-3
1992 Federal Highway Administration[a]	2-5	2-5
1991 and 1992 California[b]		
South Coast	4.0	10.8
San Diego	4.1	N/A[c]
Bay Area	2.1	5.4

Note: The percentages in this table are projections, not actual results.

[a]Percentages based on Federal Highway Administration estimates.

[b]These three California air quality plans were prepared in accordance with the California Clean Air Act of 1988. The South Coast encompasses metropolitan Los Angeles, and the Bay Area encompasses San Francisco and Oakland.

[c]Data not available.

According to our nationwide survey of metropolitan planning organizations in ozone and carbon monoxide nonattainment areas, transportation planners generally expect TCMs to reduce emissions by less than 1 percent to 3 percent. Eighty-three percent of the ozone nonattainment metropolitan planning organizations expressing an opinion said that TCMs could reduce emissions by 0 to 3 percent. Ten percent expected reductions in emissions of between 4 and 10 percent, and 6 percent expected reductions of over 10 percent. Eighty percent of

carbon monoxide nonattainment metropolitan planning organizations expressing an opinion expected reductions in emissions of 0 to 3 percent. Thirteen percent expected reductions of between 4 and 10 percent, and 7 percent expected reductions of over 10 percent.[3]

Although some metropolitan planning organizations did not know by how much TCMs would reduce hydrocarbon or carbon monoxide emissions, DOT and EPA officials expected that traditional TCMs would continue to reduce emissions by 0 to 5 percent. A 1992 Federal Highway Administration (FHWA) report, which summarized key issues in air quality and transportation planning, concluded that typical TCMs would rarely yield more than a 5-percent reduction in emissions and in most cases would not yield more than a 2-percent reduction. A 1983 FHWA report summarizing the 1982 state implementation plans found that TCMs would serve to supplement other control strategies, such as improvements in automobile technology. The FHWA report also found that 24 to 47 percent of the expected reductions in hydrocarbon emissions would come from industrial and other stationary source controls, 41 to 62 percent from motor vehicle emissions controls, and 8 to 14 percent from automobile inspection programs. TCMs would contribute reductions of 1 to 7 percent and in most cases well under 5 percent.

The three California plans prepared under California state law project a 2.1- to 4.1-percent reduction in hydrocarbon emissions and a 5.4- to 10.8-percent reduction in carbon monoxide emissions. However, some assumptions in these plans about the effects of implementing TCMs on travel habits may be optimistic. For example, the South Coast Air Quality Management Plan incorporates a regulation designed to increase the number of occupants per vehicle to 1.5.[4] However, a subsequent analysis of the plan found that, to achieve this goal, about two-thirds of the work force would have to take carpools to their workplace. Such a level of participation could be difficult to achieve.

Our reviews of transportation and air quality literature and interviews with experts generally supported our overall findings on the effectiveness of TCMs. Virtually none of the literature we reviewed or the persons we

[3]Forty-six percent of the metropolitan planning organizations did not know what reductions in hydrocarbon emissions TCMs would provide. Twenty-seven percent did not know what reductions in carbon monoxide emissions TCMs would provide.

[4]This requirement, known as Regulation XV, requires all employers in the region with 100 or more employees to increase the number of occupants per vehicle arriving at the workplace. The target for average vehicle occupancy varies geographically, but the target for the largest area—the developed urban and suburban parts of the air quality district—is 1.5.

interviewed stated that TCMs would significantly reduce emissions. Nearly all discussions of the impact of TCMs on air quality emphasized their modest but complementary role. For example, the Manager of the National Association of Regional Councils' (NARC) Clean Air Project stated that TCMs should be viewed as incremental, supportive measures rather than as the bedrock of an air quality improvement program. He noted that improvements in tailpipe emissions control technology, automobile inspection programs, and cleaner fuels would be the keys to lowering emissions from motor vehicles.

ISTEA and CAAA Will Encourage TCM Implementation, but Challenges Remain

As a result of ISTEA and CAAA, states and metropolitan planning organizations will include more TCM programs in their transportation and clean air plans over the next 5 years. Provisions such as ISTEA's Congestion Mitigation and Air Quality Improvement Program (CMAQ) and CAAA's highway fund sanctions will encourage greater implementation of TCMs. Moreover, additional research on the effectiveness of TCMs may further encourage states and metropolitan planning organizations to implement TCM programs. Current evidence on the effectiveness of TCMs is outdated and relies on models that may not accurately measure the effects of TCMs on commuters' behavior. In addition, transportation planners will be challenged by trends toward greater public reliance on the automobile and toward low-density land use that undermines the viability of alternatives to the single-occupant vehicle.

ISTEA and CAAA Will Encourage TCM Implementation

Our survey of metropolitan planning organizations found that ISTEA and CAAA will encourage states to implement more TCMs in the future. It found that two of ISTEA's funding provisions—CMAQ and the flexible use of Surface Transportation Program funds—will particularly encourage the planning and implementation of TCMs. Under CMAQ, ISTEA authorized a total of $6 billion (for fiscal years 1992-97) to fund transportation projects that enhance air quality. The Surface Transportation Program gives states broad discretion in the use of funds, allowing them, for example, to fund projects that would promote alternatives to the single-occupant vehicle. Table 2 lists these funding sources and other provisions of ISTEA and CAAA that, according to the surveyed metropolitan planning organizations, will promote the planning and implementation of TCMs.

Partly as a result of these statutory provisions, 56 percent of the surveyed metropolitan planning organizations stated that TCMs would receive strong emphasis in their transportation programs in the next 5 years (1993-98).

Only 8 percent of the surveyed metropolitan planning organizations reported that TCMs had received strong emphasis in their programs in the last 5 years (1987-92).

Table 2: Provisions of ISTEA and CAAA That Encourage the Use of TCMs

Legislative provision	Percentage of metropolitan planning organizations citing provision as positive factor	Possible impact on TCM implementation
ISTEA Congestion Mitigation and Air Quality Improvement Program	96	Program provides $6 billion through 1997 for projects likely to contribute to the attainment of national air quality standards.
ISTEA Flexible Use of Surface Transportation Program Funds	77	States may transfer up to 100 percent of highway funds to support mass transit.
ISTEA-Mandated Management System Addressing Traffic Congestion	74	Management system may encourage implementation of TCMs
CAAA Sanctions	86	State may lose federal highway funds unless it implements TCMs in its implementation plan.
CAAA Transportation Conformity Requirements	88	CAAA requires state transportation plans to agree with state air quality plans and requires expeditious implementation of TCMs.

Information on the Effectiveness of TCMs Is Limited

After considerable research on TCMs in the late 1970s and early 1980s, very little occurred during the balance of the 1980s. According to the manager of NARC's Clean Air Project, little money was available during the 1980s for evaluating and assessing TCMs at the federal, state, or local levels. The Chair of the NARC TCM Advisory Panel said that information on the effectiveness of TCMs is needed to help localities justify their implementation.

In addition, existing models used to predict reductions in emissions from TCM programs have yet to capture accurately the effects of TCMs on travel behavior and therefore on emissions. For example, synchronizing traffic signals can improve traffic flow along densely traveled corridors, thereby

reducing the emissions associated with congestion. The improved flow can be viewed as an increase in capacity. However, the increase in capacity may lead to an increase in demand, as the traveling public takes trips previously forgone because of congestion. Such a reaction may reestablish congestion. According to a modeling expert from the University of California at Los Angeles, each step in the modeling process has large margins of error.

The results of our survey corroborated the need for better methodologies and data on the effectiveness of TCMs. Half of the surveyed metropolitan planning organizations stated that they did not have adequate information and methodological tools to calculate the impacts of TCMs on emissions. Only 8 percent strongly believed that the tools were adequate, while 30 percent expressed some confidence. Among metropolitan planning organizations in areas of serious, severe, and extreme ozone nonattainment, 59 percent did not believe that the tools were adequate, while 34 percent expressed confidence in their adequacy. According to EPA officials, within the next 2 years, models that can predict shifts in travel behavior resulting from the implementation of TCMs—and, hence, the effects of TCMs on emissions—will be available for states and municipalities to use.

Long-Standing Travel and Land-Use Trends Challenge Efforts to Curb Automobile Use

Recent data on national trends in automobile use show that transportation planners face challenges in changing the public's travel habits. Americans are becoming more, not less, automobile-oriented. Data from DOT's Nationwide Personal Transportation Survey show that the number of vehicles, licensed drivers, and vehicle trips per household steadily increased from 1969 to 1990. In addition, both vehicle trips and vehicle miles traveled increased faster than associated variables, such as the total population. Commuting habits have also deteriorated from the standpoint of controlling emissions. Census data show that the percentage of workers driving to work alone increased from 64 to 73 percent between 1980 and 1990. In contrast, the percentage of the total work force using mass transit or carpools decreased from 26 to 18 percent.

In addition, the home-to-work trip, which TCMs are often designed to address, accounts for a shrinking share of total personal travel. In 1990, the work commute accounted for about 26 percent of all vehicle trips per household—down from 32 percent in 1969. Furthermore, the total number of work trips per household was virtually unchanged from 1969 to 1990, while trips for personal business and shopping increased by 111 and

62 percent, respectively. As the work commute shrinks as a percentage of total vehicle use, transportation planners may find it necessary to implement TCMs that affect other kinds of personal travel. Appendix II contains expanded data on personal travel patterns.

Our nationwide survey confirmed that these trends could limit the effectiveness of TCMs. Seventy-seven percent of the surveyed metropolitan planning organizations responded that regional trends in automobile use could impede the effectiveness of TCMs, while 73 percent said that the level of public willingness to change travel behavior could do so.

In addition, over 70 percent of the surveyed metropolitan planning organizations identified residential and commercial land-use patterns as impediments to the effectiveness of TCMs. Land-use trends in many urban areas have made the single-occupant automobile an increasingly indispensable form of travel. Mass transit and even carpool arrangements are less viable in the sprawling, low-density suburban developments whose growth has characterized many urban areas in recent years. As more people stop commuting to a central business district and begin commuting from suburb to suburb, alternatives to single-occupant vehicles, such as mass transit and ridesharing, become less practical.

Market-Based TCMs and Other Approaches May Maximize Reductions in Emissions

Market-based TCMs—that is, TCMs that impose financial disincentives on the use of automobiles—may be the most effective means of changing emissions-producing travel behavior. Although CAAA does not require the implementation of market-based TCMs, states may enact legislation authorizing or requiring them. Such measures may include an increase in the gasoline tax or a highway congestion pricing program. Sixty-four percent of the metropolitan planning organizations responding to our survey stated that such measures would be more effective in reducing emissions than traditional TCMs. Recent analysis in the San Francisco Bay region shows that market-based TCMs may be far more effective in reducing emissions than the more traditional TCMs. Because such measures would visibly add to the cost of driving, their implementation would probably face strong public resistance. For jurisdictions that find market-based measures politically unfeasible, traditional TCMs may be needed to offset the projected growth in automobile use and to improve mobility. Transportation planners may get optimal results from such TCMs if they focus on localized benefits and ensure that the TCMs promote multiple social goals, complement and reinforce one another, and reduce the number of trips rather than just the number of vehicle miles traveled.

Market-Based Measures May Deter Motor Vehicle Use More Than Other TCMs

We found a strong consensus among transportation and air quality officials that market-based TCMs would be more effective in discouraging automobile use than traditional TCMs. Market-based TCMs can include a wide variety of approaches, such as increased gasoline taxes, highway congestion pricing, and emissions fees.

According to advocates, market-based measures could have the dual benefit of strongly discouraging motor vehicle use and reducing emissions while ensuring that the full costs of driving, including the costs of air pollution and congestion, are borne by those responsible for generating them. Both DOT and EPA officials asserted that such measures would be needed to obtain more than the 0- to 5-percent reductions in emissions typically available from the traditional TCMs listed in CAAA. In part, market-based TCMs could reduce emissions more than traditional TCMs because they can be applied to all types of travel, whereas CAAA's traditional TCMs principally affect the work commute. This distinction is important, especially since the work commute has been shrinking as a portion of total travel.

Our national survey revealed a broad consensus among metropolitan planning organizations that market-based measures could be more effective than other types of TCMs in reducing emissions. Sixty-four percent of respondents agreed that market-based measures could more effectively reduce automobile use than TCMs that do not directly increase the cost of driving. Eleven percent were undecided, and 18 percent disagreed.

At least one metropolitan planning organization has proposed market-based measures. In 1990, the San Francisco metropolitan planning organization proposed a series of user fees to ensure that Bay Area drivers bore the actual costs of driving. The proposal included (1) fees based on a vehicle's emissions output, (2) regionwide freeway congestion pricing, and (3) a $2-per-gallon increase in regional gasoline taxes. With market-based measures included, the Bay Area 1991 Clean Air Plan projected an 8.4-percent decrease for hydrocarbon emissions and a 22.5-percent decrease for carbon monoxide emissions. In contrast, reductions of 2.1 percent for hydrocarbon emissions and 5.4 percent for carbon monoxide emissions were projected without market-based measures. However, these measures have not yet been implemented in the Bay Area. Currently, the Bay Area air quality agency and metropolitan planning organization are working to obtain the state enabling legislation needed for certain market-based measures.

Consumers' responses to recent changes in gasoline prices appear to support the rationale for market-based measures. For example, after oil prices declined in 1986 to almost half their previous level, average daily oil consumption increased to its highest level in 5 years. Conversely, consumption fell in 1990 because of higher oil prices triggered by the Persian Gulf War.

Despite their projected success in reducing emissions, market-based measures may be difficult to implement. Our survey found that 80 percent of the responding metropolitan planning organizations agreed that the public's resistance to market-based measures made their implementation highly unlikely. Our survey and the comments of many interviewees indicated that there was an inverse relationship between the potential effectiveness of market-based TCMs and the likelihood of their being accepted by the public. Critics of these measures stated that they could have an adverse effect on lower-income individuals who have no alternatives to driving to the workplace. Advocates contended that market-based measures could be implemented so as to minimize their regressive effect. For example, the Bay Area Economic Forum proposed that revenues from congestion and emissions fees be used to finance public transportation and other alternatives to single-occupant vehicles.[5]

Benefits From Traditional TCMs Can Be Maximized

Because many areas may find market-based TCMs politically unfeasible, they may have to rely on traditional TCMs in devising strategies for controlling emissions. Evidence we reviewed showed that certain strategies for implementing traditional TCMs could help ensure that they effectively supplement other methods for reducing air pollution and achieve other social benefits. These strategies include focusing TCMs on achieving localized benefits, emphasizing their multiple benefits, ensuring that they complement and reinforce one another, and selecting TCMs that reduce the number of trips as well as the number of vehicle miles traveled.

Focus TCMs on Localized Benefits

Analyses of state plans submitted to EPA under the Clean Air Act Amendments of 1977 found that TCMs could be more effective in solving localized carbon monoxide problems than regional ozone problems. While TCMs were projected to reduce carbon monoxide emissions from less than 1 to 5 percent regionally, they were projected to be more effective in solving localized carbon monoxide problems. For example, in the 1970s and early 1980s, New York City implemented an extensive bus lane

[5]The Bay Area Economic Forum, Market Based Solutions to the Transportation Crisis: Incentives to Clean the Air and Ease Congestion (San Francisco: May 1990).

program. This program was intended to give buses priority as the most efficient movers of people on city streets and to reduce emissions at carbon monoxide hotspots in the city. Subsequent air quality analyses on one corridor found that carbon monoxide emissions dropped by 90 percent in the area of the newly implemented bus lane. This reduction was possible because carbon monoxide violations, unlike ozone violations, are typically very localized.

Similarly, Los Angeles began implementing an automated traffic surveillance and control system in 1984. Since that time, several evaluation studies have found that this system provided notable benefits compared with the system it replaced. The studies of the most recently evaluated areas indicate that emissions were reduced by 14 percent, travel time was cut by 18 percent, and fuel consumption was lowered by 13 percent.

In addition, a 1992 EPA review of TCM benefits found that the TCMs listed in CAAA have influenced travelers' behavior, sometimes significantly, for particular target groups. For example, in 1985, a California Telecommuting Pilot Project led to a 30-percent reduction in the home-to-work trip rate among program participants. Emissions of hydrocarbon and carbon monoxide were reduced by a comparable percentage.

Emphasize Complementary TCMs With Multiple Benefits

TCM packages could include elements that would complement and reinforce rather than counteract one another. Complementary TCMs could enhance efforts to address both regional and localized emissions problems. For example, regionwide car pool or van pool programs combined with a network of HOV lanes would reinforce one another. However, widespread use of alternative work schedules, such as flextime programs, could undermine a ridesharing program, since different work schedules would be incompatible with time-specific ridesharing arrangements. Nonetheless, alternative work schedules could help reduce congestion during peak travel hours and thereby improve the flow of traffic.

In addition, TCMs could be implemented to promote multiple social goals, such as conserving fuel and reducing congestion as well as reducing emissions. DOT has encouraged the use of TCMs to improve mobility and reduce congestion since the 1960s and cited them as means for conserving fuel during the oil crises of the 1970s. Our national survey found that metropolitan planning organizations in nonattainment areas view reducing congestion and improving mobility as more important benefits of TCMs than reducing emissions. Fifty-four percent of the responding metropolitan

planning organizations said that reducing congestion and improving mobility are the most important benefits of TCMs, while 39 percent said that reducing emissions was the most important. TCMs may be more easily implemented when they achieve noticeable reductions in congestion as well as less noticeable improvements in air quality.

Implement TCMs That Reduce Numbers of Trips

TCMs designed to reduce numbers of trips are more likely to reduce emissions than TCMs aimed only at reducing numbers of vehicle miles traveled. Motor vehicles emit hydrocarbons (1) during the cold start phase, which occurs during the first few minutes of operation when the vehicle's catalytic converter is cold and is not functioning at full capacity; (2) under regular running conditions; and (3) during the hot soak phase, which occurs after the engine has been turned off and the engine's heat causes gasoline still in the carburetor or fuel system to evaporate.

Because of cold start and hot soak emissions, a 5-mile trip may produce nearly as much hydrocarbon emission as a 10-mile trip. Therefore, a telecommuting TCM program that lets employees work at home could reduce both the number of trips by commuters and the emissions associated with the cold start and hot soak phases.

Conclusions

DOT has long encouraged states and localities to use TCMs to improve mobility and reduce congestion. ISTEA and CAAA elevated TCMs to greater importance as means of addressing air pollution problems. Although TCMs may be projected to reduce overall emissions by less than 5 percent, they can complement other programs specifically designed to address pollution problems in the nation's nonattainment areas. Moreover, the additional reductions in emissions resulting from traditional TCM programs may help localities meet the attainment standards mandated in CAAA. If localities require additional measures to reduce automobile use and improve air quality, they may need to implement market-based TCMs. Although pricing measures are projected to be more effective than traditional TCMs in reducing air pollution, they are also less acceptable because their implementation would directly increase costs for the traveling public.

Regardless of the types of TCMs that localities and states implement, more research on the effectiveness of TCMs is clearly needed. Because transportation planners nationwide will be re-emphasizing the need for TCMs in the next 5 years, this period offers an opportunity for updating experience-based analyses of TCMs. Assessments of the impact of TCMs on reducing emissions will both provide needed updates to the literature on

TCMs and, if traditional TCMs prove ineffective, help transportation planners justify market-based measures in the future.

Recommendations

ISTEA and CAAA give states and localities flexibility in using TCMs to control emissions. However, more information on the effectiveness of TCMs is clearly needed, particularly so that states can better plan for their use. Therefore, we recommend that the Secretary of Transportation and the Administrator of the Environmental Protection Agency

- require local areas to assess the impact of implemented TCMs on reducing emissions and
- cooperate in gathering and disseminating this updated information to states and localities in ozone and carbon monoxide nonattainment areas.

Agency Comments

We met with the Chief of FHWA's Noise and Air Quality Branch, environmental specialists at the Federal Transit Administration, the Chief of the Transportation Section of EPA's Office of Mobile Sources, and other DOT and EPA officials to discuss the facts, conclusions, and recommendations in this report. Where appropriate, we incorporated their comments. In general, agency officials agreed with our findings and conclusions. In particular, they concurred with the need for market-based measures and additional data on the effectiveness of TCMs. As agreed with your offices, we did not obtain written agency comments on a draft of this report.

Scope and Methodology

We surveyed 119 metropolitan planning organizations in areas that had not attained federal air quality standards for ozone and carbon monoxide. We received responses from 100 metropolitan planning organizations, including all of the organizations from the areas with the most serious air quality problems. A copy of sections I through III of the questionnaire with the final results appears in appendix III of this report.[6] We obtained information from metropolitan planning organizations on the factors that could impede and facilitate the implementation of TCMs in their areas. We reviewed and analyzed the results of DOT's 1990 Nationwide Personal Transportation Survey and data on personal travel from the 1990 Census. We conducted site visits and interviewed officials from the respective

[6]Only sections I through III of the questionnaire apply to this work. Section IV, which focuses on the effects of TCM exemptions on the use of alternative fuels, appears in a separate report. See Alternative Fueled Vehicles: Potential Impact of Exemptions From Transportation Control Measures (GAO/RCED-93-125, Apr. 19, 1993).

metropolitan planning organizations as well as state transportation and air quality officials in six nonattainment cities: Chicago, Houston, Los Angeles, Philadelphia, San Diego, and San Francisco. We also interviewed officials at the Federal Highway Administration, the Federal Transit Administration, the Environmental Protection Agency, and the National Association of Regional Councils, as well as other experts on transportation and air quality.

A list of the literature we reviewed on the effectiveness of TCMs in reducing emissions appears in the bibliography. We conducted our work between July 1992 and March 1993 in accordance with generally accepted government auditing standards.

We will send copies of this report to interested congressional committees; the Secretary of Transportation; the Administrator, Federal Highway Administration; the Administrator, Federal Transit Administration; and the Administrator, Environmental Protection Agency. We will make copies available to others upon request.

This work was performed under the direction of Kenneth M. Mead, Director, Transportation Issues, who can be reached on (202) 512-2834. Other major contributors to this report are listed in appendix IV.

J. Dexter Peach
Assistant Comptroller General

Contents

Abbreviations

CAAA	Clean Air Act Amendments of 1990
CMAQ	Congestion Mitigation and Air Quality Improvement Program
DOT	Department of Transportation
EPA	Environmental Protection Agency
FHWA	Federal Highway Administration
ISTEA	Intermodal Surface Transportation Efficiency Act
GAO	General Accounting Office
HOV	high-occupancy-vehicle
NARC	National Association of Regional Councils
TCM	transportation control measure

Description of Transportation Control Measures

Transportation control measures (TCM) are programs to control mobile source emissions. The Clean Air Act does not define TCMs; it only lists certain strategies. The California state Clean Air Act of 1988 defines TCMs as ". . . any strategy to reduce vehicle trips, vehicle use, vehicle miles traveled, vehicle idling, or traffic congestion for the purpose of reducing motor vehicle emissions." A definition developed by the Department of Transportation (DOT) and the Environmental Protection Agency (EPA) includes any measure in state implementation plans that reduces emissions by reducing vehicle use or changing traffic flow; it specifically excludes technology-based, fuel-based, and maintenance-based measures that control vehicle emissions.

TCMs include a wide variety of strategic and tactical approaches. One range of approaches, known as transportation supply management, involves low-cost techniques for optimizing the capacity of highways and streets, thereby improving the flow of traffic and reducing the high emissions associated with slow speeds. In contrast, another range of approaches, known as transportation demand management, is aimed at reducing the number of vehicles operating on highways and streets during peak commuter hours. Examples of these approaches, their implementors, and descriptions of their air quality objectives are described more fully in table I.1.

Table I.1: Examples and Descriptions of TCMs

Strategies	Examples of approaches	Possible implementors	Objectives
Supply management			
Traffic signalization improvements	Improve signal timing and synchronization	Local governments	Reduce delays and stopping and starting of traffic caused by poorly timed signals
Traffic operations improvements	Convert two-way streets to one way Create continuous strip turn lanes	Local governments	Improve travel time and increase roadway capacity by changing traffic patterns in congested areas
Enforcement and management programs	Establish incident management systems to respond to disabled vehicles and traffic accidents Meter ramps to regulate vehicle access to freeways	State departments of transportation	Quickly resolve incidents causing traffic congestion and maintain free-flowing conditions on main highway

(continued)

Strategies	Examples of approaches	Possible implementors	Objectives
Demand management			
Public transit improvements	Develop rail transit system Implement feeder bus service Increase frequency of bus service Lower fares or simplify fare structure	Transit authorities Metropolitan planning organizations	Reduce numbers of vehicle trips and vehicle miles traveled through the use of transit instead of private passenger vehicles
Ridesharing and carpool programs	Establish local and regional commute management and information clearinghouse programs Provide subsidies and tax incentives for ridesharing	Transportation management associations consisting of developers, employers, local governments, etc. State or local governments	Reduce number of vehicle trips by providing alternatives to driving alone
High-occupancy-vehicle (HOV) lanes	Designate freeway lane for exclusive use by buses, vans, and private cars with multiple passengers Dedicate arterial lanes or streets to public transit buses	Metropolitan transportation authorities State departments of transportation Local governments	Encourage ridesharing and public transit use, thereby reducing numbers of trips and vehicle miles traveled
Bicycle and pedestrian programs	Develop bicycle and pedestrian paths Install bicycle lockers and storage facilities	Developers Local governments Employers	Encourage bicycling and walking as alternatives to automobile use when climate and proximity make these alternate modes feasible
Employer-based programs	Allow flexible work hours Create car pool and van pool programs Implement financial incentives and disincentives to reduce numbers of single-occupant vehicle commutes Permit telecommuting/ work-at-home programs	Employers	Reduce congestion by limiting vehicle concentrations at peak periods Encourage commuting by carpool and public transit rather than by single-occupant vehicles Eliminate unnecessary commutes
Park and ride/fringe parking	Expand parking facilities near public transit centers Allow parking on perimeter of downtown areas, with shuttle service to business district	Transit providers State departments of transportation Local governments	Enhance access to, and therefore attractiveness of, public transit and ridesharing arrangements Minimize congestion in downtown areas

(continued)

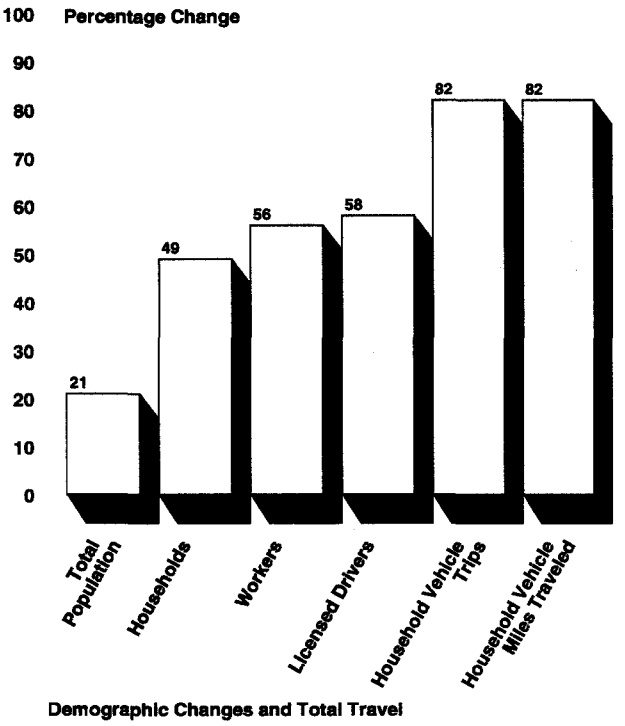
Strategies	Examples of approaches	Possible implementors	Objectives
Trip reduction ordinances	Enact laws requiring employers to increase average vehicle occupancy Adopt regulations requiring traffic mitigation measures	Local, state, or regional governments	Encourage efforts by developers and employers to reduce numbers of vehicle trips
Parking management	Enforce preferential parking for HOVs Restrict on- and off-street parking Change parking rates	Employers Local governments	Discourage single-occupant vehicle use by making parking less convenient or more expensive
Vehicle use restrictions	Designate no-drive days Designate auto-free zones in central business areas Control truck movements	State governments Regional public transportation authorities	Reduce mobile source air pollution in specific localized areas
Planning for special events	Conduct publicity campaigns to discourage or reroute automobiles during major athletic or cultural events	Sponsors of events Regional transportation planners Local governments	Mitigate the mobile emissions caused by a special event
Planning for activity centers	Adopt land-use and use regulations requiring emphasis on mass transit over single-occupant vehicles Enact mixed-use (residential and commercial) zoning ordinances	Local and regional governments	Establish activity centers in conjunction with transportation alternatives to single-occupant vehicles

Trends in Travel Affecting the Implementation of TCMs

General Travel Statistics

Since 1969, Americans have become more reliant on the automobile for personal travel. As figure II.1 shows, from 1969 to 1990, two of the key determinants of automobile emissions—vehicle trips and vehicle miles traveled—grew faster than any of these associated variables.

Figure II.1: Percentage Change in Demographic and Personal Travel Variables, 1969-90



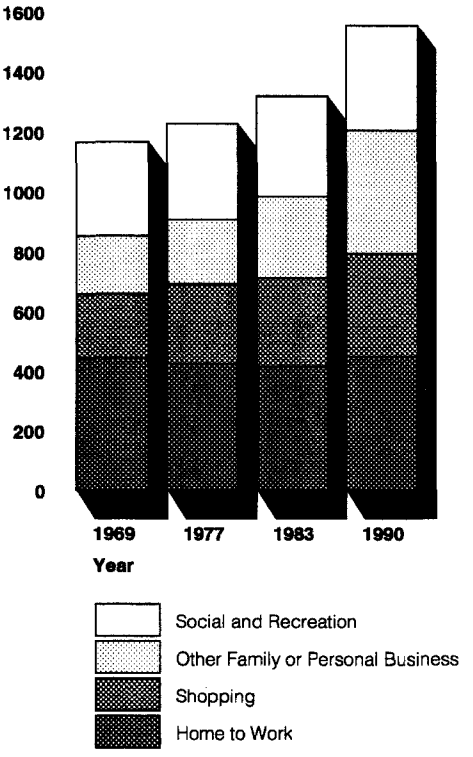
Source: GAO presentation of Federal Highway Administration (FHWA) data.

The Commute to Work

Many TCMs are intended to limit the use of the automobile for commuting to work. For example, the Clean Air Act Amendments of 1990 require large employers in severe and extreme ozone nonattainment areas to reduce the number of work-related trips by employees. This is the only mandatory TCM in the Clean Air Act. As figure II.2 shows, the work commute comprises only a limited, and stable or shrinking, portion of total travel. Therefore, such measures may have only limited, and perhaps shrinking, effectiveness over time.

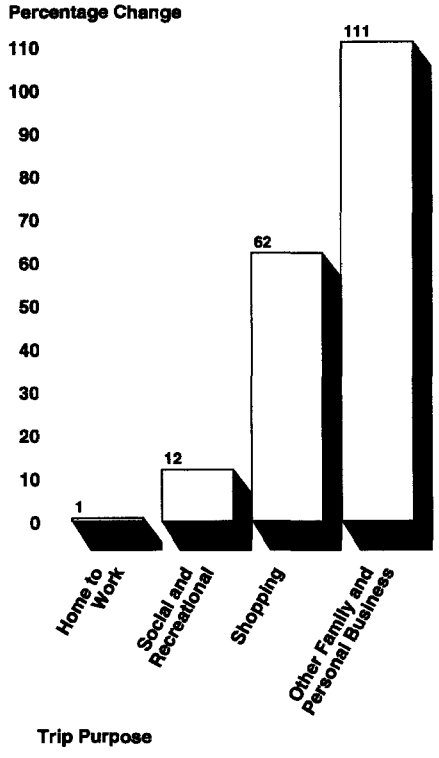
In 1990, the work commute accounted for 26 percent of all trips, down from 32 percent in 1969. Because the number of trips attributable to the work commute has remained fairly steady over this period, the reduction in commuting's share of total travel is due mainly to the substantial growth in the number of trips not related to work. For example, the average annual number of vehicle trips per household for other family and personal business grew by 111 percent, from 195 in 1969 to 411 in 1990. (See fig. II.3.)

Figure II.2: Average Annual Number of Vehicle Trips per Household, by Trip Purpose, 1969-90



Source: GAO presentation of FHWA data.

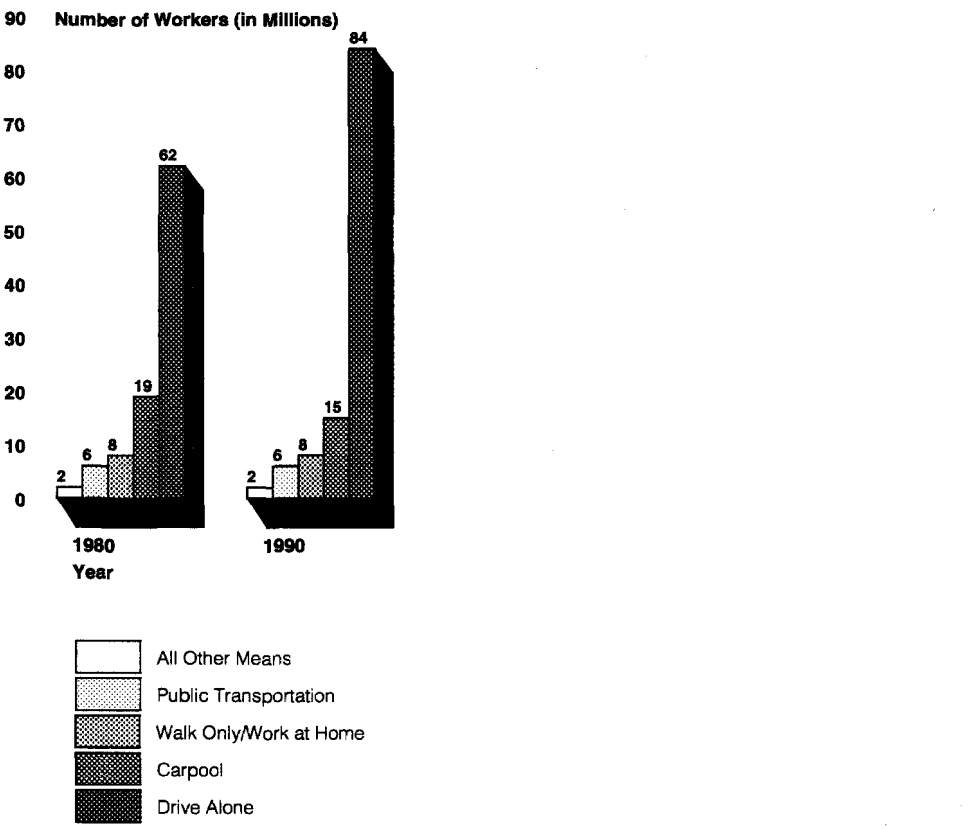
Figure II.3: Percentage Change in Average Annual Number of Vehicle Trips per Household, by Trip Purpose, 1969-90



Source: GAO presentation of FHWA data.

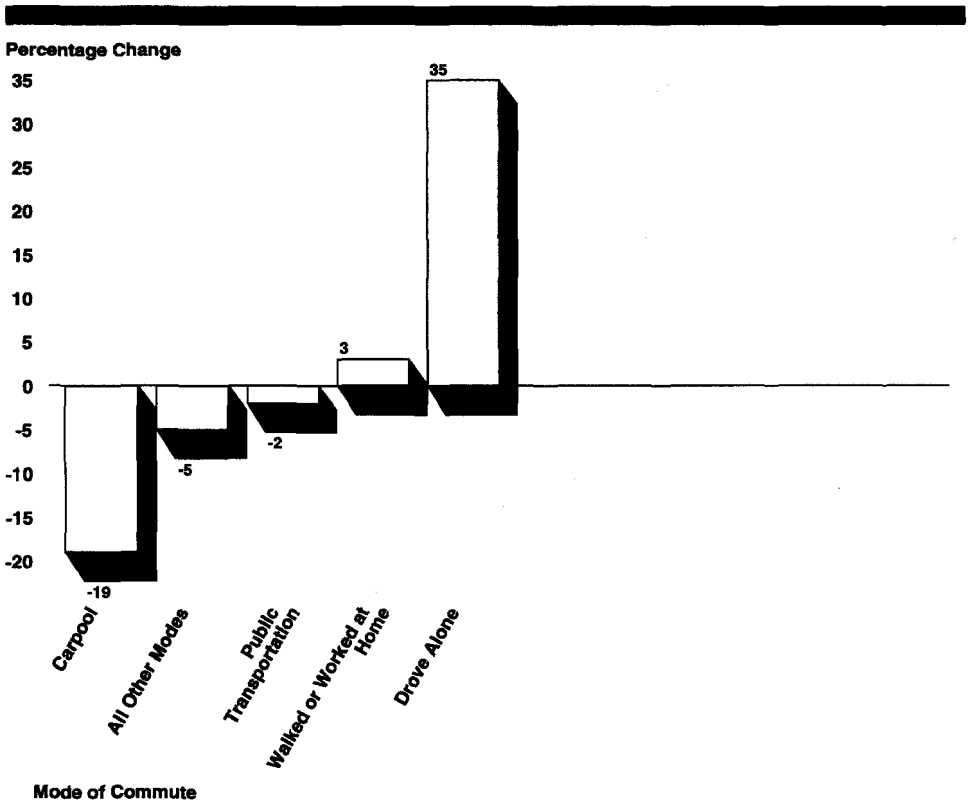
Recent trends in travel habits will challenge transportation planners to find alternatives to the automobile for the commute to work. During the 1980s, commuters generally chose driving alone over alternatives such as mass transit and carpools. This trend has continued: As figure II.4 shows, driving alone is by far the most common and rapidly growing option for commuting to work. The total number of commuters using mass transit and carpools actually declined from 1980 to 1990. Figure II.5 shows the change, by percentage of total workers, for each mode of transportation to work, from 1980 to 1990.

Figure II.4: Use of Transportation Modes for Commuting to Work, by Number of Workers, 1980 and 1990



Source: GAO presentation of FHWA data.

Figure II.5: Percentage Change in Use of Transportation Modes for Commuting to Work, 1980-90



Source: GAO presentation of FHWA data.

Survey of Metropolitan Planning Organizations

GAO Survey of Metropolitan Planning Organizations

INTRODUCTION

The U.S. General Accounting Office (GAO) is an agency of the Congress which reviews federal programs. This questionnaire concerns a review of the role of transportation control measures (TCMs) in state and local efforts to meet federal ambient air standard for ozone and carbon monoxide. As part of this effort, we wish to obtain the views of transportation and air quality officials at metropolitan planning organizations in ozone and carbon monoxide non-attainment areas. Specifically, we are interested in your organization's views regarding 1) the expected contribution of TCMs in regional efforts to meet federal air quality standards and 2) the advisability of exempting alternative-fueled vehicles from certain TCM restrictions.

For purposes of this study, transportation control measures are those listed in Section 108(f) of the federal Clean Air Act as amended and other measures intended to reduce automobile emissions through reduced automobile use and more efficient use of streets and highways. TCMs include many measures that the Department of Transportation has long encouraged as low cost transportation systems management measures to reduce traffic congestion.

Your answers will be kept **confidential**. We will not use the name of your organization in our report without your prior permission. When data analysis is complete, we will destroy the link between your organization and your returned questionnaire. We will combine your responses with those of others and report the results in summary form.

To ensure that your office's views are represented in our analysis, please return this questionnaire **no later than November 13, 1992** in the enclosed self-addressed postage paid envelope. Completing this questionnaire should take about 30 minutes of your time.

In the event that the return envelope is misplaced, please send the completed survey to:

U.S. General Accounting Office
Attn: Michael Hartnett
200 W. Adams St., Suite 700
Chicago, IL 60606

If you have any questions or comments, please call Michael Hartnett or Catherine Colwell at 1-800-333-4524.

SECTION I: BACKGROUND INFORMATION

Please provide the following information on the geographic area for which your MPO is responsible.

1. Which of the following EPA designation areas does your MPO cover?* *(Check all that apply.)*

Ozone Non-attainment Areas

__1__ Extreme ozone non-attainment area
__13__ Severe ozone non-attainment area
__19__ Serious ozone non-attainment area
__31__ Moderate ozone non-attainment area
__27__ Marginal ozone non-attainment area
__2__ Other (Please Specify)_____
__10__ None of the above

Carbon Monoxide Non-attainment Areas

__1__ Serious carbon monoxide non-attainment area
__38__ Moderate carbon monoxide non-attainment area
__6__ Other (Please Specify)_____
__56__ None of the above

*** These results reflect the 100 responses from the 119 MPOs we surveyed in the ozone and carbon monoxide non-attainment areas. However, the responses for question 1 are not a one for one match to responding MPOs because an MPO may have more than one type of non-attainment area.**

2. What is the total population of the area served by your MPO?

Range = 61,012 to 15,000,000

Median = 537,117.5

4. What is the total number of counties in the area served by your MPO?

   Range = 0 to 13 Median = 2

5. Indicate how much your area must reduce emissions of ozone precursors to come into attainment with ozone standards?* *(Check one.)*

   12 less than 1%
   4 1 - 3%
   5 4 - 6%
   1 7 - 10%
   23 11 - 15%
   8 16 - 25%
   15 more than 25%
   13 Not applicable
   19 Don't know

* Ninety MPOs reported that they include at least 1 ozone non-attainment area and should respond to this question. Three MPOs with ozone non-attainment area felt this question was not applicable.

6. Indicate how much your area must reduce emissions of carbon monoxide to come into attainment with carbon monoxide standards?* *(Check one.)*

   8 less than 1%
   5 1 - 3%
   4 4 - 6%
   4 7 - 10%
   0 11 - 15%
   4 16 - 25%
   8 more than 25%
   58 Not applicable
   9 Don't know

* Forty-four MPOs include at least 1 carbon monoxide non-attainment area and should respond to this question. Two MPOs with non-attainment areas felt that this question was not applicable.

SECTION II: TCM EFFECTIVENESS

The following questions request your opinions regarding the relative effectiveness of various TCM strategies. Please base your responses solely on your views of each measures' potential effectiveness, regardless of the likelihood of implementation.

PLEASE NOTE THAT QUESTIONS 7, 8 & 9 ASK ABOUT OZONE-RELATED EMISSIONS, WHILE QUESTIONS 10, 11 & 12 FOCUS ON CARBON MONOXIDE EMISSIONS.

7. In your opinion, what degree do the following TCMs have the potential to reduce the automobile emissions that contribute to the **ambient ozone** in your area? **If your MPO does not include an ambient ozone non-attainment area, skip to question 10.***

TCMs reducing automobile emissions that contribute to ambient ozone	Check one for each: To little or no extent (1)	To some extent (2)	To a moderate extent (3)	To a great extent (4)	To a very great extent (5)	No opinion (6)	No answer (7)
1. Highway surveillance and control systems	28	36	15	3	0	6	2
2. Incident management and motorist aid programs	25	36	15	7	0	5	2
3. Traffic signal system improvement	6	24	36	15	6	2	1
4. Widening of roads without major construction	17	33	23	11	1	3	2
5. Improved public transit	12	37	21	8	8	2	2
6. HOV Lanes	34	32	12	4	2	4	2
7. Employer based transportation plans	13	35	22	10	3	5	2
8. Trip reduction ordinances	20	29	20	8	2	9	2
9. Park-and-ride and park-and-pool lots	15	43	18	8	2	2	2
10. Auto use restrictions (e.g., time of day)	31	18	13	10	4	11	3
11. Ride sharing programs and computerized ride match programs	14	39	21	8	1	4	3
12. Bicycle and pedestrian measures	43	30	7	3	0	4	3
13. Programs to reduce extended idling of vehicles	28	30	16	5	2	7	2

Question #7 continued.

TCMs reducing automobile emissions that contribute to ambient ozone	Check one for each: To little or no extent (1)	To some extent (2)	To a moderate extent (3)	To a great extent (4)	To a very great extent (5)	No opinion (6)	No answer (7)
14. Programs to reduce extreme low-temperature cold starts	40	17	14	5	1	11	2
15. Flexible work-schedules	20	45	14	7	1	2	1
16. Transportation planning for activity centers and special events	26	38	15	6	0	3	2
17. Removal of pre-1980 cars and light-duty trucks	11	17	27	21	9	3	2
18. Transit incentives	19	30	23	7	6	3	2
19. Parking management programs	21	33	15	12	2	5	2
20. Peak period fees/congestion pricing	24	21	17	13	7	6	2
21. Other (please specify)							

*** Ten MPOs did not respond to questions 7 through 10 because they do not have an ozone non-attainment area within their jurisdiction.**

8. To what extent (if any) are TCMs expected to reduce emissions of ozone precursors in your region between November 1992 and the time your area is required to meet federal **ambient ozone standards**? *(Check one.)*

17 less than 1%
23 1 - 3%
3 4 - 6%
2 7 - 10%
2 11 - 15%
0 16 - 25%
1 more than 25%
41 not certain at this time
1 No answer

9. In the table below, indicate which of the following best describes your efforts to assess TCM effectiveness for reducing **ambient ozone**.

	Check one for each					
Time Frame	Thorough analysis based on transportation and/or air quality models (1)	Some analysis based on spreadsheet or other rought estimates (2)	General knowledge of air quality & transportation literature (3)	No current analysis (4)	Other (please specify) (5)	No answer (6)
1. Past five years	20	19	26	19	4	2
2. Next five years	60	14	8	4	2	2

CONTINUE ——→

10. In your opinion, what degree do (if at all) the following TCMs have the potential to reduce the automobile emissions that contribute to the **ambient carbon monoxide** in your area? **If your MPO does not include an ambient carbon monoxide area, skip to question 13.***

TCMs reducing automobile emissions that contribute to ambient carbon monoxide	Check one for each: To little or no extent (1)	To some extent (2)	To a moderate extent (3)	To a great extent (4)	To a very great extent (5)	No opinion (6)	No answer (7)
1. Highway surveillance and control systems	13	19	6	1	0	2	3
2. Incident management and motorist aid programs	10	18	9	2	0	2	3
3. Traffic signal system improvement	0	9	19	8	4	1	3
4. Widening of roads without major construction	5	19	13	2	0	2	3
5. Improved public transit	8	17	12	2	1	1	3
6. HOV Lanes	18	17	4	1	0	1	3
7. Employer based transportation plans	9	16	14	1	0	1	3
8. Trip reduction ordinances	10	14	10	4	0	3	3
9. Park-and-ride and park-and-pool lots	8	25	7	0	0	1	3
10. Auto use restrictions (e.g., time of day)	14	10	6	5	4	2	3
11. Ride sharing programs and computerized ride match programs	7	25	7	1	0	1	3
12. Bicycle and pedestrian measures	25	12	2	1	0	1	3
13. Programs to reduce extended idling of vehicles	8	17	11	3	0	2	3
14. Programs to reduce extreme low-temperature cold starts	11	13	9	4	0	4	3

Question #10 continued.

TCMs reducing automobile emissions that contribute to ambient carbon monoxide	Check one for each: To little or no extent (1)	To some extent (2)	To a moderate extent (3)	To a great extent (4)	To a very great extent (5)	No opinion (6)	No answer (7)
15. Flexible work-schedules	14	22	4	0	0	1	3
16. Transportation planning for activity centers and special events	8	19	9	2	1	2	3
17. Removal of pre-1980 cars and light-duty trucks	4	15	10	7	3	2	3
18. Transit incentives	6	19	12	2	1	1	3
19. Parking management programs	9	15	9	6	1	1	3
20. Peak period fees/congestion pricing	13	9	3	10	3	3	3
21. Other (please specify)							

*** Fifty-six MPOs did not respond to questions 10 through 12 because they did not have a carbon monoxide non-attainment area within their jurisdiction.**

11. To what extent are TCMs expected to reduce total emissions of carbon monoxide in your area between November 1992 and the time your area is required to meet federal **carbon monoxide standards**? *(Check one.)*

11 less than 1%
13 1 - 3%
2 4 - 6%
2 7 - 10%
1 11 - 15%
0 16 - 25%
1 more than 25%
11 not certain at this time

12. In the table below, indicate which of the following best describes your efforts to assess TCM effectiveness for reducing ambient carbon monoxide.

Time Frame	Check one for each: Thorough analysis based on transportation and/or air quality models (1)	Some analysis based on spreadsheet or other rought estimates (2)	General knowledge of air quality & transportation literature (3)	No current analysis (4)	Other (please specify) (5)	No answer (6)
1. Past five years	12	9	12	6	1	4
2. Next five years	28	8	2	1	1	4

13. In your opinion, does your organization agree or disagree with the following statements?

Statement	Check one for each: Strongly agree (1)	Somewhat agree (2)	Undecided (3)	Somewhat disagree (4)	Strongly disagree (5)	No basis to judge (6)	No answer (7)
1. If market based measures (such as congestion pricing or a increased gas tax) could be implemented in your area, such measures would more effectively reduce automobile use than TCMs that do not directly raise the cost of driving.	28	36	11	11	7	6	1
2. Public resistance to market based measures make implementation of such measures highly unlikely in your area.	45	34	12	5	1	2	1
3. Your organization or other relevant organizations in your area have adequate information and/or methodological tools (such as transportation and air quality models) to confidently calculate the emissions impacts of a program of TCMs.	8	30	10	24	26	1	1

14. TCMs may have several social benefits. Please rank the following TCM benefits in order of importance to your area. **Please use the following scale: 1 = Most Important, 2 = 2nd Most Important, 3 = Third Most Important, 4 = Fourth Most Important, 5 = Fifth Most Important, and if applicable, 6 = Sixth Most Important**

	Ranking of Benefits						
Social Benefits of TCMs	Most important (1)	2nd most important (2)	3rd most important (3)	4th most important (4)	5th most important (5)	6th most important (6)	No answer (7)
1. Congestion reduction/improved mobility	53	33	8	3	2	0	1
2. Fuel conservation	0	14	30	35	20	0	1
3. Emissions reduction	39	27	18	5	9	1	1
4. Reduced wear and tear on highways and streets	1	4	11	29	51	3	1
5. Reduced need to expend funds for highway capacity expansion	6	20	29	24	18	2	1
6. Other							

CONTINUE ——→

SECTION III: IMPLEMENTATION OF TCMs

This section pertains to the emphasis (if any) that has been, and will be placed on TCMs during transportation planning and program implementation.

15. In the table below, indicate how much emphasis (if any) you believe was placed on TCMs in the past five years during transportation planning and program implementation and how much emphasis (if any) you believe will be placed on TCMs during the next five years.

	Check one for each					
	Strong emphasis (1)	Some emphasis (2)	Little emphasis (3)	No emphasis (4)	Don't Know (5)	No answer (6)
Transportation Planning						
1. Past five years	15	29	42	13	1	0
2. Next five years	63	33	3	0	1	0
Program Implementation						
3. Past five years	8	35	34	21	1	1
4. Next five years	56	38	3	0	2	1

CONTINUE——→

16. In your opinion, how much will the following factors facilitate or impede the implementation of TCMs in your metropolitan area?

Factors affecting the implementation of TCMs	Check one for each: Significantly facilitate (1)	Somewhat facilitate (2)	Neither facilitate nor impede (3)	Somewhat impede (4)	Significantly impede (5)	No basis to judge (6)	No answer (7)
1. Attitude of general public toward the importance of improved air quality	16	46	11	17	5	4	1
2. Level of public willingness to change travel behavior	10	9	3	29	44	4	1
3. Regional trends in automobile use	2	4	16	40	36	1	1
4. Perceptions about the connection between air quality and the metropolitan transportation system	3	45	32	10	3	6	1
5. Implementor perceptions about the air quality benefit of TCMs relative to cost	5	27	22	31	9	5	1
6. Level of coordination among planners and implementors (e.g., the MPO, cities, transit agencies, employers etc.)	24	51	12	10	2	1	0
7. Inclination of employers to support trip reduction measures	10	22	10	34	16	8	0
8. Residential development patterns	4	5	12	35	41	2	1
9. Commercial development patterns	5	7	12	39	34	2	1
10. Level of confidence among local and regional officials about TCMs emissions reductions impact	7	16	26	30	15	6	0
11. Availability of capital funds	12	24	6	34	21	2	1
12. Availability of operating funds	14	6	3	28	45	3	1

Question #16 continued.

Factors affecting the implementation of TCMs	Check one for each: Significantly facilitate (1)	Somewhat facilitate (2)	Neither facilitate nor impede (3)	Somewhat impede (4)	Significantly impede (5)	No basis to judge (6)	No answer (7)
13. Flexibility of state matching funds	8	36	21	17	8	9	1
14. State policy(ies) or practices (please specify)							
15. Federal policy(ies) or practices (please specify)							

17. Please list any other factors (if any) that may facilitate or impede implementation of TCMs in your area.

18. The Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) and the Clean Air Act Amendments of 1990 contain various provisions that could affect future use of TCMs. In the following table, indicate how much (if at all) the listed federal policy factors will encourage or discourage the transportation planning and program implementation of TCMs in your area over the next five years?

	Check one for each						
Factors	Strongly encourage (1)	Somewhat encourage (2)	Neither encourage nor discourage (3)	Somewhat discourage (4)	Strongly discourage (5)	No opinion (6)	No answer (7)
1. Congestion Mitigation and Air Quality Improvement Program funds (ISTEA Section 1008)	57	38	2	1	0	1	1
2. Flexible use of Surface Transportation Program funds (ISTEA Section 1007)	13	64	21	2	0	0	0
3. Restrictions on federal funds for increased carrying capacity for single-occupant vehicles in ozone and carbon monoxide non-attainment areas (ISTEA Section 1024)	18	47	24	6	1	3	1
4. Transferability of transit funds to highway projects (ISTEA Section 3013)	0	23	57	14	3	2	1
5. Equivalent matching share policy, (80/20 for both highways and transit)(ISTEA Section 3006)	6	31	55	5	0	2	1
6. ISTEA-required metropolitan and state congestion relief planning factor (ISTEA Section 1024)	17	55	20	0	1	7	0
7. ISTEA mandated management system addressing traffic congestion (ISTEA Section 1034)	21	53	21	1	0	4	0

Question #18 continued.

Factors	Check one for each: Strongly encourage (1)	Somewhat encourage (2)	Neither encourage nor discourage (3)	Somewhat discourage (4)	Strongly discourage (5)	No opinion (6)	No answer (7)
8. ISTEA mandated management system addressing intermodal facilities (ISTEA Section 1034)	10	34	47	1	0	7	1
9. ISTEA mandated management system addressing public transportation facilities and equipment (ISTEA Section 1034)	7	45	42	2	0	4	0
10. Clean Air Act Sanctions for non-attainment (CAA Section 179)	39	46	9	3	2	0	1
11. Clean Air Act transportation conformity requirements (CAA Section 176(c))	32	56	11	1	0	0	0

19. Please identify any federal policy initiatives or modifications that could help facilitate the implementation of a program of TCMs in your area.

Major Contributors to This Report

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