Transportation System Management, Air Quality, and Energy Conservation

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Prepared by

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PREFACE

This is one of ten bulletins in the fourth series of Information Bulletins produced by the Transportation Task Force of the Urban Consortium for Technology Initiatives. Each bulletin in this series addresses a priority transportation need identified by member jurisdictions of the Urban Consortium. The bulletins are prepared for the Transportation Task Force by the staff of Public Technology, Inc. and its consultants. In 1980, Transportation of Hazardous Materials was identified as a priority need by both the Transportation and the Fire Safety and Disaster Preparedness Task Forces of the Urban Consortium. The Information Bulletin addressing that need was prepared under their joint direction.

Nine newly identified transportation needs are covered in this fourth series of Information Bulletins:

- Economic Impacts of Transportation Restrictions
- Parking and Traffic Enforcement
- Pedestrian Traffic Safety
- School Bus Use for Non-School Transportation
- Street Management Information Systems
- Taxicabs as Public Transit
- Transportation Construction Management
- Transportation of Hazardous Materials
- Transportation System Management, Air Quality, and Energy Conservation

One Information Bulletin covering a need identified in 1979 is being updated and expanded:

- Transportation Energy Contingency Planning

The needs highlighted by Information Bulletins are selected in an annual process of needs identification used by the Urban Consortium. By focusing on the priority needs of member jurisdictions, the Consortium assures that resultant research and development efforts are responsive to local government problems.

Each bulletin provides a nontechnical overview, from the local government perspective, of issues and problems associated with each need. Current research efforts and approaches to the problem are identified. The bulletins are not an in-depth review of the state-of-the art or the state-of-the-practice. Rather, they serve to identify and raise issues and as an information base from which the Transportation Task Force selects topics that require a more substantial research effort.

The Information Bulletins are also useful to those, such as elected officials, for whom transportation is but one of many areas of concern.

The needs selection process used by the Urban Consortium is effective. Priority needs selections have been addressed by subsequent Transportation Task Force projects:

- Five Transit Actions regional meetings were held between January 1979 and May 1979 to address the need for Transit System Productivity. The product of these meetings is a Transit Actions Workbook that features techniques currently being used to improve transit system performance and productivity.

- To facilitate the provision of Transportation for Elderly and Handicapped Persons, five documents were developed: one on local government approaches, a planning checklist, an information sourcebook, a series of case studies, and a chief executive's summary.

- To help improve Center City Circulation, two new projects have been completed. Center City Environment and Circulation: Transportation Innovations in Five European Cities is the second of three volumes showing how cities use transportation and pedestrian improvements to help downtown revitalization. Another project, addressing the coordination of public transportation investments with real estate development culminated in a national conference--the second Joint Development Marketplace in Washington, D.C., in June 1980. The Marketplace was attended by over 500 persons, including exhibitors from cities and counties around the country and representatives of private development and financial organizations.

- A series of documents relating to the need for Transportation Planning and Impact Forecasting Tools has been prepared: (1) a management-level document for local officials describing manual and computer transportation planning tools available from the U.S. Department of Transportation, (2) a series of case studies of local government and transit agency applications of these tools, and (3) a guide describing ways local governments can gain access to these tools. Additional documents are being prepared on how local governments can use U.S. Census information more effectively through these U.S. Department of Transportation computer tools.

- To help meet the need to Accelerate Implementation Procedures, a conference on the Federal-Aid Urban System (FAUS) was held in Baltimore, Maryland, in May 1980, for Federal Highway Region 3. The conference was aimed at developing communication between local, State, and Federal officials to improve implementation of and clear up misunderstandings about the FAUS program.

- To meet the need to promote use of Transportation System Management (TSM) measures, a series of five regional meetings are being held in 1980 to provide local, State, and Federal officials, and representatives of transit agencies and the business community with the opportunity to exchange information about low-cost TSM projects to improve existing transportation systems.

- To facilitate the dissemination of information on local experiences in Parking Management, a technical report describing the state-of-the-art is being prepared.

- A National Transit Pricing Forum was held at Virginia Beach, Virginia, in March 1979 to address the need for more information on Innovative Fares. Much of the Forum was directed to technical advances in areas of pricing research and practice. The proceedings of this conference are available.

- Two projects were undertaken to pursue the need for Taxicabs for Public Transportation. A handbook, Taxicabs and Federal Programs, was prepared, and five regional meetings were held in March and April of 1980. In May 1980 the Transportation Task Force sponsored the National Conference on Taxicab Innovations: Service and Regulations.

Ongoing Task Force Information Dissemination and Technology Sharing needs are currently addressed by a series of SMD Briefs. These one-page reports provide up-to-date information about on-going UMTA Office of Service and Methods Demonstrations projects. In addition, the SMD HOST Program allows transportation officials from selected jurisdictions to visit one of these projects for on-site training.

Additional Technology Sharing occurs through the National Cooperative Transit Research Program (NCTRP) which was organized jointly by Public Technology, Inc., the American Public Transit Association, the Urban Mass Transportation Administration, and the Transportation Research Board to address problems relating to public transportation identified by local and state government and transit administrators.

The support of the U.S. Department of Transportation's Technology Sharing Division in the Office of the Secretary, Federal Highway Administration, National Highway Traffic Safety Administration, and Urban Mass Transportation Administration has been invaluable in the work of the Transportation Task Force of the Urban Consortium and the Public Technology, Inc. staff. The guidance offered by the Task Force members will continue to ensure that the work of the staff will meet the urgent needs identified by members of the Urban Consortium for Technology Initiatives.

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Chapter 1

ISSUES AND PROBLEMS

INTRODUCTION

Transportation System Management (TSM) has emerged in recent years as a new philosophy for urban transportation planning and development. TSM is many things to many people, but in general, it implies the fuller and more productive utilization of existing highway and public transportation resources through coordinated operations and management. The main objective of TSM is to increase the efficiency of moving people and goods throughout regional transportation systems without major new capital investments.

TSM was popularized as a concept in the early 1970s in response to many converging forces--the gasoline shortage of 1973-74, the decline of central city areas, fiscal constraints imposed on governments by inflation and declining local tax bases, and widespread concern for environmental quality. Major policy initiatives of the U.S. Department of Transportation (DOT) in the mid-1970s gave impetus to the TSM concept by favoring service-oriented, rather than facility-oriented, low-capital cost approaches to transportation problems. The idea of planning for unified intermodal urban transportation systems, rather than separate highway and transit systems, was a central element of these policy initiatives.

"TSM" has become part of the vocabulary of urban transportation professionals, although there is continuing controversy regarding its importance and definition. A variety of TSM actions have been demonstrated as effective means for achieving small reductions in energy consumption and air pollution and for stretching the capacity of transportation services and facilities. The fact that TSM can increase the efficiency and capacity of transportation systems at a low cost and, at the same time, help reduce the nation's dependence on foreign oil supplies and improve air quality has made TSM one of the leading thrusts of urban transportation policy for 1980's.

The interrelationships between urban transportation systems, land use and development patterns, air quality, energy use, public and private sector economies, and the overall quality of life in cities are exceedingly complex. Yet, there is a slowly emerging consensus in the western world that to deal effectively with the problems faced in these areas, it is necessary to recognize them as parts of an integrated whole. As France's Director General of Inland Transport, Jean Coset, noted at a recent international conference on Transportation and the Urban Environment, "Energy and public tax resources are becoming rare and valuable assets in the same way as space, air, silence, or nature."[1]

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[1]Neal Pierce, "Urban Transport Today: A Global View," <u>Transportation and the Urban Environment</u>, (Washington, D.C.: National League of Cities, 1980).

A major question we face, he suggested, is, "Can one shape the development of the urban transport system in such a way as to ensure at the same time more thrifty management of the three major resources, that is, the human environment, energy, and public money?"

This Information Bulletin attempts to address this question by providing a brief overview of the principal issues faced by local government officials as they develop and implement TSM strategies to deal with transportation, air quality, and energy problems at the local level.

TSM CONCEPTS

Objectives

There has been signficant controversy regarding the very definition of TSM. The joint planning regulations of the Federal Highway Administration (FHWA) and the Urban Mass Transportation Administration (UMTA), issued September 17, 1975,[2] describe the basis of the concept.

> Automobiles, public transit, taxis, pedestrians, and bicycles should be considered as elements of one single urban transportation system. The objective of urban transportation system management is to coordinate these individual elements through operating, regulatory, and service policies so as to achieve maximum efficiency and productivity for the system as a whole.

The proposed new joint regulations on Urban Transportation Planning, issued October 30, 1980, reiterate this basic theme.

> TSM requires the planning process to expand its focus to include assessments of improved service and operations, as well as facilities, as a potential means to maximize mobility. TSM also requires the process to address both supply and demand. The TSM concept requires viewing the transportation system as a whole with all modes receiving attention. The philosophy calls for addressing the transportation of people and goods, not merely movement of vehicles.[3]

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[2]Joint Regulations 23 CFR 450 and 49 CFR 613. U.S. Department of Transportation, Federal Highway Administration and Urban Mass Transportation Administration, "Transportation Improvement Program," Federal Register, September 17, 1975.

[3]Joint Regulations 23 CFR Parts 450,630 and 49 CFR 613. U.S. Department of Transportation, Federal Highway Administration and Urban Mass Transportation Administration, "Urban Transportation Planning, Notice of Proposed Rulemaking." Federal Register, October 30, 1980. p. 71990-72004.

Scope

Some confusion has occurred over the scope of TSM in terms of time and cost. The proposed new regulations attempt to clarify these issues.

> Since Transportation System Management actions involve operations and services on existing facilities rather than development of major new facilities, they are generally low cost. Certain actions such as high occupancy vehicle incentives or development of a transit mall, may involve substantial sums, however.
>
> TSM involves both short and long-term actions. Service and operating changes generally can be implemented more quickly than construction of new facilities and thus can have a short-range focus. However, TSM strategies may also involve long-term facility improvements (e.g. dedication of a new facility to high occupancy vehicle use) and have long-term impacts.[4]

Conflicting Perspectives

At least two divergent perspectives on the definition of TSM have emerged. To some observers, TSM is merely a new buzzword describing a number of old ideas for low-capital cost transportation system improvements. This perspective leads to a definition of TSM as a list of discrete, uncoordinated, low-capital cost, largely intramodal tactics or actions that can improve the performance of individual transportation modes.

To other observers, however, TSM provides a new basic strategy for the planning and management of urban transportation systems. This new strategy reflects a dramatic shift in focus from earlier approaches to transportation planning, engineering, and management. It includes--

- A recognition that all urban transportation modes--automobiles, public transit, paratransit, bicycles, pedestrians--have a role to play in meeting urban transportation needs.
- A strong emphasis on coordination of operating, regulatory, service, and pricing policies among all modes.
- A recognition that there are numerous segments of the urban transportation market with widely varying needs and desires. New roles for public and private transportation service providers must be explored to fulfill these needs.
- Consideration of the interaction of social and economic factors with the transportation system to identify broader system management opportunities often involving the private sector, such as alternative work schedules.

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[4] Ibid.

- A recognition that transportation and land use policies must be coordinated to improve the quality and efficiency of urban systems. Optimally, this leads to the integration of transportation, land use, and economic development policies directed at principal transportation modes.

- Development of an incremental approach to transportation system evolution, such as a progression from local bus service to express bus service to bus priority treatment to light rail as demand grows.

- Application of multiple, small-scale, partial solutions to deal with large and complex problems, such as small neighborhood parking programs and bicycle programs.

- Development of a planning process that allows short-range, low-capital cost activities to compete effectively with long-range capital improvements.

- Multi-level, coordinated planning and management which can identify and develop TSM opportunities at the appropriate level, whether local, corridor, regional, or national, and in both public and private sectors.

It has been evident to both proponents and critics of TSM that in practice, TSM planning has not been entirely successful in embodying these principles.[5] The development and implementation of tactical, intramodal TSM approaches has proven to be far easier than pursuing broad-based, intermodal TSM strategies. The numerous factors that have impeded strategic TSM approaches are discussed later in the section titled, "Planning and Implementing TSM."

MANDATES FOR TSM

FHWA-UMTA Joint Planning Regulations. Regional TSM Planning was mandated by the joint FHWA-UMTA planning regulations of September 17, 1975.[6] These regulations require programming of both highway and transit projects through a single regional Transportation Improvement

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[5]For a more detailed discussion of this point, see U.S. General Accounting Office. Stronger Federal Direction Needed to Promote Better Use of Present Urban Transportation Systems, (Washington, D.C.: GAO. October 4, 1977), (Report No. CED-79-126).

[6]These regulations were issued in support of the requirement to improve the efficiency of mass transportation service, contained in Section 5(d)(2) of the Urban Mass Transportation Act of 1964 (Pub L. 88-365, 78 Stat. 302, 49 U.S.C. 1604 (d) (2)) and were deemed to be the program of actions referred to in the expression of intent described in Section F of the Capital and Operating Assistance Formula Grants and the Interim Guidelines and Procedures (40 FR 2534, January 13, 1975). They were issued under the authority of 23 U.S.C. 104(f)(3), 134, and 315, and Sections 3, 4(a), and 5 of the UMT Act (49 U.S.C. 1602, 1603(a), and 1604).

Program (TIP), which is prepared by metropolitan planning organizations (MPOs) in coordination with local governments. A TSM component must be incorporated into the TIP along with the long-range transportation component. The TSM component provides for short-range transportation needs through more efficient use of existing transportation resources.

The 1975 joint planning regulations describe the intent and philosophy of TSM planning. They also enumerate numerous TSM actions to be considered in preparing the TSM element. These are shown in Figure 1.

The proposed TSM regulations issued October 30, 1980, reaffirm and clarify the intent of the 1975 joint planning regulations. They also further unify the U.S. DOT planning regulations for major urban transportation investments and air quality and TSM planning, and simplify the planning certification process for small metropolitan areas.

Clean Air Act

TSM-type actions must be considered for implementation by most urban regions in order to satisfy the requirements of the Clean Air Act as amended in 1977.[7] This Act establishes Federal air quality standards that must be attained by December 31, 1982. It permits five-year extensions to be granted in the case of carbon monoxide and ozone levels if a State can demonstrate that the standards cannot be met even with implementation of all reasonable stationary and transportation control measures.

Most large urban areas with carbon monoxide and ozone problems will be unable to meet the 1982 deadline even with controls on stationary sources of pollution and Federal new automobile emission standards. As a result, the Act requires these areas to develop and implement all reasonably available transportation control measures to reduce mobile source air pollution emissions.

These reasonably available measures are listed in Section 108(f) of the Clean Air Act as amended in 1977. This list is quite similar in content to the 1975 FHWA-UMTA joint planning regulations actions, cited in Figure 1. In addition to these TSM-type actions, Section 108(f) lists several other elements that can be used to help attain air quality standards. These include:

- Vehicle inspection and maintenance.
- Fuel transfer and storage controls.
- Controls on extended vehicle idling.
- Alternate fuels for engines and other fleet vehicle controls.
- Retrofit of emission devices on heavy duty vehicles.
- Extreme cold-start emission reduction programs.

The States are given responsibility for developing State Implementation Plans (SIPs) that detail how the Clean Air Act standards will be met. Local governments participate in development of the SIP, usually through the MPO. This participation includes proposing and analyzing local transportation pollution control measures and implementing or helping to implement these controls as part of a local transportation

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[7] Section 108(f) of the Clean Air Act (as amended, August 1977), 42 U.S.C. 7401 et seq.

Figure 1

ACTIONS TO BE CONSIDERED IN PREPARING TSM ELEMENT OF TIP

Actions to Encourage Efficient Use of Existing Road Space	• Traffic operations improvements Traffic channelization One-way streets Improved signalization Computerized traffic control Freeway ramp metering Reversible traffic lanes Other traffic engineering improvements • Provisions for bicycles and pedestrians Bicycle paths and wide shoulder lanes Pedestrian malls and other means of separating pedestrian and vehicular traffic Secure and convenient storage areas for bicycles Other bicycle facilitation measures • Actions to spread peak transportation demand to the off-peak period Staggered work hours Flexible work hours Reduced transit fares for off-peak transit users Increased peak-hour commuter tolls on bridges and access routes to the city • Preferential treatment for transit and high occupancy vehicles Reserved or preferential lanes on freeways and arterials Exclusive lanes to bypass congested points Exclusive lanes to toll plazas with no-stop toll collection Downtown transit malls Exclusive access ramps to freeways Bus preemption of traffic signals Strict enforcement of reserved transit rights-of-way Special turning lanes or exemption of buses from turning restrictions • Parking management and control Control of on-street parking supply, especially during peak periods Management of the number and price of public and private parking spaces Favoring parking by short-term users over all-day commuters

Figure 1 (Cont'd)

Actions to Encourage Efficient Use of Existing Road Space (Cont'd)

- Parking management and control (Cont'd)

    Provisions for residential parking permit programs
    Provision of fringe and transportation corridor parking to facilitate transfer to transit or other high-occupancy vehicles
    Strict enforcement of parking restrictions

Actions to Reduce Vehicle Use in Congested Areas

- Encouragement of carpooling and other forms of ridesharing
- Diversion, exclusion, and metering of automobile access to specific areas
- Area licenses, parking surcharges, and other forms of congestion pricing
- Establishment of car-free zones and closure of selected streets to vehicular traffic or through traffic
- Restrictions on downtown truck delivery during peak hours

Actions to Improve Transit Service

- Provision of better collection, distribution, and internal circulation services (including route-deviation and demand-responsive services) within low-density areas
- Greater flexibility and responsiveness in routing, scheduling, and dispatching of transit vehicles
- Provision of express bus services in coordination with local collection and distribution services
- Provision of extensive park-and-ride services from fringe and transportation corridor parking areas
- Provision of shuttle transit services from CBD fringe parking areas to downtown activity centers
- Encouragement of flexible paratransit services and their integration into the metropolitan public transportation system
- Simplified fare collection systems and policies
- Provision of shelters and other passenger amenities
- Better passenger information systems and services
- Specially targeted (user-side) subsidies for transportation-disadvantaged groups to increase their mobility

Actions to Increase Transit Management Efficiency

- Improved marketing
- Development of cost accounting and other management tools to improve decisionmaking
- Establishment of maintenance policies that assure greater equipment reliability
- Use of surveillance and communications technology to develop real time monitoring and control capability

control plan. The SIP and local transportation control plan must use reasonably available control technology, must be in agreement with each other, and must show commitment to implement; or sanctions may be applied by the Environmental Protection Agency against the locality or region out of compliance with the National Ambient Air Quality Standards. These sanctions can include a cutoff of Federal funds for highway and sewage treatment plant construction and a prohibition on construction of new stationary air pollution sources.

In June 1978, the U.S. Environmental Protection Agency (EPA) and the U.S. Department of Transportation signed a memorandum of understanding concerning the integration of transportation and air quality planning. U.S. DOT and U.S. EPA also jointly issued a document, "Transportation Air Quality Planning Guidelines," which is to be used by agencies at all levels of government in devising transportation plans.

Transportation control plans were due to be approved by July 1, 1979. However, most 1979 transportation plans were granted only conditional approvals from EPA, which felt that the plans fell far short of what was required. Many areas continue to work on elaboration of their transportation control plans to satisfy U.S. EPA requirements. Additional SIP revisions, for areas seeking an extension to 1987, are required by July 1, 1982. Approval criteria for the 1982 SIPs were published in September 1980. Public comments were due in December 1980.

Emergency Energy Conservation Act

TSM measures will also be a part of the programs developed as a result of the Emergency Energy Conservation Act of 1979 (EECA),[8] the enabling legislation for the Federal standby gasoline rationing plan. This Act establishes a mechanism for developing national and State energy conservation targets with requirements for States to develop State emergency conservation plans.

Section 211 of the EECA empowers the President to establish monthly emergency conservation targets for the nation and individual states for any energy source which is in danger of supply interruption. These powers can also be invoked if actions to restrain energy demand are required in order to fulfill the obligations of the United States under the international energy program.

Section 212 of the EECA requires States to submit emergency conservation plans within 45 days of the publication of targets established according to Section 211. States are encouraged to develop these plans now, before an energy emergency occurs. Section 212 (b)(2) of EECA states that:

> In the preparation of such a plan (and any amendment to the plan) the Governor shall, to the maximum extent practicable, provide for consultation with representatives of affected businesses and local governments and provide an opportunity for public comment.

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[8]Emergency Energy Conservation Act of 1979. P.L. 94-163. (42 USC 6801).

Local governments have major interests at stake as State emergency conservation plans are developed. Major elements of these plans will pertain to the transportation sector and involve TSM measures. It is thus most important that local officials take an active role in ensuring that State plans reflect local needs and are coordinated with ongoing local TSM strategies.

AIR QUALITY AND TRANSPORTATION

Mobile Source Emissions

Transportation-related air pollutants include oxides of nitrogen and hydrocarbons (which result in ozone or photochemical smog), carbon monoxide, and, to a lesser extent, suspended particulates and oxides of sulfur. Automobiles contribute the bulk of ozone-producing compounds and carbon monoxide in metropolitan areas, as Figure 2 shows. There are, however, some metropolitan areas where ozone problems are due more to stationary sources of hydrocarbons than to mobile sources. Diesel buses and trucks emit most of the mobile source oxides of sulfur and suspended particulates, but this contribution is usually only a small share of the total emissions of these pollutants.

Automobile emissions vary as a function of numerous factors. The level of mobile source emissions depends in part on the number of vehicle-miles traveled (VMT), travel speeds, and the total number of vehicle trips and cold starts that are made. Hydrocarbon emissions are particularly sensitive to the number of vehicle trips, for gasoline is incompletely burned by cold engines and evaporates from hot engines after they are shut off. Carbon monoxide emissions are also rather sensitive to the total number of trips. Higher vehicle speeds reduce the rate of carbon monoxide and hydrocarbon emissions per VMT. Nitrogen oxides are emitted at a slightly higher rate at increased travel speeds.

On the whole, total emissions are generally reduced by an increase in travel speeds, by a reduction of VMT, and by a reduced number of vehicle trips. A variety of TSM measures has been used with some success to affect these factors (see below, pp. 15-18).

Transportation-related emissions are strongly affected by vehicle technology. Federal standards for new automobile emissions have had a dramatic impact on urban pollution levels and remain the strongest mobile source-related measure for dramatic improvement of air quality. Consequently, there are currently some questions as to the cost and benefits of TSM actions when judged solely on an air quality basis.

Without proper automobile maintenance, automobile emission rates can increase substantially. Automobile inspection and maintenance (I&M) programs are vital for ensuring that motor vehicle emission rates remain as low as practically achievable. Such programs are required by the Clean Air Act for all areas that will not meet the ozone or carbon monoxide standards by 1982. Although only 5 States, Arizona, Rhode Island, Nevada, New Jersey, and Oregon, had adopted the I&M strategy prior to the 1979 SIP revisions, urban areas in 29 states will be

Table 1

MAJOR TRANSPORTATION-RELATED AIR POLLUTANTS

POLLUTANT TYPE	1976 EMISSION LEVEL (MILLIONS OF TONS) TRANSPORTATION RELATED	TOTAL	NUMBER OF URBAN AREAS (OVER 200,000 POPULATION) IN VIOLATION OF NAAQS* IN 1976 (105 TOTAL CITIES POSSIBLE)	HUMAN PHYSIOLOGICAL EFFECTS AT HIGH LEVELS OF CONCENTRATION
Photochemical Oxidants (a product of nitrogen oxides and hydrocarbons)	11 (hydrocarbons) 10 (nitrogen oxides)	28 (hydrocarbons) 23 (nitrogen oxides)	103	Eye, nose, throat irritation; coughing; shortness of breath; headache; impaired heart and lung function; altered red blood cells; laryngitis; can induce asthmatic attacks in susceptible persons.
Carbon Monoxide	70	87	59	Reduces level of oxygen in the blood, which places serious burden on the heart and respiratory system to increase blood flow. Symptoms include headache, dizziness, nausea; difficulty in breathing, fatigue, and impairment of memory.
Nitrogen Dioxide	10	23	6	Bronchitis and pneumonia, especially among infants and school age children.

Source: Dennis Bass, "Transportation and Air Quality: A New Sharper Focus," Environmental Report, (Washington, D.C: National League of Cities, July 1978).

*NAAQS is the National Ambient Air Quality Standards required to operate I&M programs by 1982.[9] Attempts to enact I&M programs in Kentucky and California have failed to win approval in those State legislatures, however, despite the threat of severe sanctions by the Federal government. Opposition to these programs has been based on the cost and burden they would impose on the average driver. Despite this controversy, I&M programs have been demonstrated to be among the most cost-effective ways of reducing air pollution. In most cases, the limited cost to automobile owners of satisfying I&M program standards is more than offset by subsequent savings in gasoline costs due to improved fuel economy. The EPA has estimated that an effective I&M program can save 3-5% in gasoline consumption. Thus, these programs essentially pay for themselves.

Stationary Source Emission Offsets

Stationary air pollution emissions tend to be somewhat different than mobile source pollutants. However, both mobile and stationary sources emit substantial amounts of hydrocarbons and nitrogen oxides (which become ozone or photochemical oxidants) and particulates. The potential therefore exists in many areas for a trade-off or offset between mobile and stationary source controls.

Local governments can play a substantial role in facilitating stationary or mobile source emission offset programs. They may aid industries in arranging for emissions offsets, acting as brokers. They may establish emission banking programs to save emission offsets for later use, in order to guarantee the availability of offsets when needed for industrial expansion or new economic developments.

Emission banking programs have been set up in a small but growing number of areas including San Francisco, Louisville, and the Puget Sound region. A state-wide program has recently been proposed by the Maryland Economic and Community Development Department.

Mobile Source Banking

The concept of emission banking has thus far been applied only to stationary sources. However, several cities, including Los Angeles, are considering the banking of mobile source emission reductions. By instituting measures beyond those specified in the transportation control plan for reducing mobile emissions, local governments and industry could create offsets to be applied against new stationary source emissions of hydrocarbons, nitrogen oxides, or particulates. For instance, a firm could provide paratransit services to its employees to bank offsets due to VMT reductions. It could establish company and employee vehicle inspection and maintenance programs, alternative fuel programs, or other TSM measures to reduce mobile source emissions.

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[9] Arizona, California, Colorado, Connecticut, Delaware, District of Columbia, Georgia, Illinois, Indiana, Kentucky, Maryland, Massachusetts, Michigan, Missouri, Nevada, New Jersey, New Mexico, New York, North Carolina, Ohio, Oregon, Pennsylvania, Rhode Island, Tennessee, Texas, Vermont, Virginia, Washington, and Wisconsin.

Local governments could institute stronger land use controls to reduce suburban sprawl. Development of controls or incentives to encourage highly integrated land use patterns at appropriate densities, with housing for low, middle, and high income families intermixed with commercial, employment, and recreational opportunities, could reduce trip lengths and make non-motorized travel more feasible for many trips. While extended monitoring of emission reductions associated with these measures would be necessary, significant community emission offsets might be obtained to further local economic development.

Only certain industries would be able to make use of mobile source emission offsets, for emissions of the same type must be involved in any trade. As Table 2 illustrates, electric generation and industrial fuel combustion are the major sources of nitrogen oxides other than transportation. Chemical manufacturing, petroleum refining, organic solvent evaporation, and petroleum storage and transport are the primary non-transportation sources of hydrocarbon emissions. Each of these sets of emission sources could be candidates for emission trading.

Other measures can be taken by local governments to encourage private sector involvement in mobile source emissions reduction. For instance, the City of Los Angeles Parking Management Plan is designed to reduce automobile traffic, parking demands, and air pollution while encouraging private sector development. The city will permit developers or employers to reduce the number of parking spaces provided in return for a commitment to reduce employee parking demand. Because parking spaces may cost up to $20,000 each in a high-rise building, there is a strong economic incentive for employers to provide transit or ridesharing services or to take other actions that encourage more efficient work trips. Under a mobile source emissions banking program, associated pollution reductions might be permitted as offsets.

Although still in the conceptual stage, mobile source banking programs could provide strong financial incentives for private sector involvement in reducing mobile source emissions. This concept may prove to be a politically and economically valuable approach to transportation controls for cleaner air.

<u>Overall Potential Impacts of TSM on Air Quality</u>

Air pollution and energy consumption are reduced by most TSM actions, but there is not a clear linear relationship between VMT, travel speeds, vehicle trips, and the reduction of fuel use and pollution. Complex air pollution emission models must be used to transform estimates of VMT and vehicle hours traveled (VHT) into estimates of emissions of various pollutants. Output from these emission models is then used in regional air quality models to estimate effects on ambient air quality. These models cannot be expected to give certain results, but do provide useful rough estimates of the effects of different measures.

Estimates of potential reductions of air pollution that can be expected from application of TSM measures vary widely. This disparity in part reflects a dispute over the level of application of TSM measures

TABLE 2

EPA-CALCULATED NATIONAL EMISSIONS ESTIMATES FOR 1977

SOURCE CATEGORY	EMISSIONS ESTIMATES, 10^3 TONS/YEAR				
	PARTICULATES*	SULFUR OXIDES	NITROGEN OXIDES	HYDROCARBONS**	CARBON MONOXIDE
Fuel combustion (point and area)	5,330	24,300	14,300	330	1,300
Residential	80	370	400	30	270
Electric generation	3,790	19,400	7,950	80	330
Industrial	1,320	3,380	5,480	210	630
Commercial-institutional	140	1,170	480	10	70
Industrial processes (point)	7,050	4,690	840	12,800	8,170
Chemical manufacturing	210	270	260	2,700	3,200
Food/agriculture	870	0	0	160	0
Primary metals	1,450	2,520	0	50	1,080
Secondary metals	230	0	0	0	690
Mineral products	3,930	720	160	60	10
Petroleum industry	80	960	420	1,010	2,490
Wood products	280	90	0	0	700
Organic solvent evaporation	0	0	0	6,630	0
Petroleum storage/ transport	0	0	0	2,060	0
Other processes	0	130	0	180	0
Solid waste disposal (point and area)	510	45	140	945	3,320
Government	90	10	30	100	450
Residential	320	15	80	720	2,100
Commercial-Institutional	35	10	15	35	90
Industrial	65	10	15	90	680
Transportation (area)	1,240	900	9,740	11,800	91,700
Gasoline vehicles	775	230	5,940	10,610	87,400
Light duty vehicles	570	160	4,040	7,000	55,700
Light duty trucks	110	40	970	1,670	11,800
Heavy duty vehicles	80	20	740	1,260	13,100
Motorcycles***	0	0	0	220	700
Off highway	15	10	185	460	6,100
Diesel vehicles	345	430	3,520	530	1,910
Heavy duty vehicles	160	200	1,530	210	1,280
Off highway	115	100	1,220	130	350
Rail	70	130	770	190	280
Aircraft	80	15	120	230	800
Vessels	35	220	160	470	1,620
Miscellaneous (area)	710	5	145	3,720	5,310
Forest fires	410	5	100	460	3,390
Forest managed burning	140	0	30	150	1,120
Agricultural burning	90	0	10	90	550
Structural fires	70	0	5	50	250
Gasoline station evaporation loss	0	0	0	1,060	0
Solvent evaporation loss	0	0	0	1,910	0
Grand total (point and area)	14,800	29,900	25,200	29,600	109,800

Source: U.S. Environmental Protection Agency. 1977 National Emissions Report. Triangle Park, N.C.: U.S. EPA, Office of Air Quality Planning and Standards, March 1980. (EPA-450/4-80-005). p. vii.

*Does not include area source fugitive dust emissions (reentrainment of dust from paved roads, unpaved roads, unpaved airstrips.)

**Hydrocarbon emission estimates are calculated as volatile organic compound (VOC) emissions. Emissions of methane, ethane, methylchloroform, and freon 113 are not included in these totals for some source categories. NEDS emissions are all calculated as total hydrocarbons.

***Highway motorcycle emissions are not included in NEDS summaries.

that is desirable and politically achievable. Many local officials are concerned that transportation control measures that increase delay, inconvenience, or costs for automobile drivers may provoke a citizen backlash against air quality programs and local authorities. Given this concern, some local officials foresee air pollution reductions of only 1% to 2% as a result of transportation control measures.[10]

In contrast, the Environmental Protection Agency estimates that transportation controls could reduce pollution levels from 15% to 20% by 1985. What is needed to achieve this, according to John Hidinger of the EPA Office of Transportation and Land Use Policy, are more innovative programs such as toll restructuring to discourage automobiles in downtown areas, substitution of transit fare subsidies for parking subsidies by employers, and restructuring of parking pricing policies.[11]

Estimates from Boston, Baltimore, Denver, and Los Angeles indicate that if all measures discussed in their transportation control plans are implemented, pollution reductions of from 5% to 8% can be expected. Vehicle inspection and maintenance programs will account for the bulk of those improvements.[12]

Many cities need to achieve pollution reductions much greater than this. For instance, to be in compliance with the Clean Air Act, Baltimore must reduce hydrocarbons by 73%, Los Angeles must reduce hydrocarbons by 65%, and Boston must reduce ozone levels by 61%.

The experience of other cities in North America, Europe, and Japan clearly demonstrate that substantial reductions of air pollution are possible through well conceived and implemented transportation policies. Figure 4 summarizes the policies and effects in several cities. The issue is thus not whether TSM can affect air quality and energy use, but what types of urban transportation policies are politically and socially feasible in American cities.

TSM will undoubtedly play a significant role in the effort to attain acceptable and healthy air quality in cities. However, public sector TSM measures will need to be augmented by greater private sector involvement in TSM, steady improvements in vehicle technology, and long-term changes in land use and transportation patterns, as well as extensive stationary source emission controls.

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[10]Robert Akin (San Antonio Traffic and Transportation Department) quoted in Urban Air, U.S. Conference of Mayors, January, 1980.

[11]Ann Seltz-Petrash, "Transportation Planners Join Battle for Cleaner Air," Civil Engineering-ASCE, V.49, No. 11, November 1979, p. 88.

[12]Ibid., p. 86.

Figure 2

EFFECT OF URBAN TRANSPORTATION MANAGEMENT POLICIES IN VARIOUS CITIES

ITY	POPULATION	KEY POLICY FEATURES	TRANSPORTATION RESULTS	ENVIRONMENTAL RESULTS
GOTHENBURG (Sweden)	454,000	Traffic cells introduced. Streetcars and buses given reserved right-of-way and priority at signals. Suburb-to-downtown express bus service started. Central area parking controlled.	Traffic accidents reduced by 36%. Regularity of bus and streetcar services improved. Costs of running public transportation reduced by 2%. An increase of 6% in weekday trips to center by bus and streetcar. Traffic on inner ring road increased by 25%.	Noise reduced from 74 to 67 decibels in main shopping street. Average level of carbon dioxide above pavements reduced from 65 pp/m to 5 pp/m; reduction of peak carbon monoxide levels by 9%. A 17% reduction in number of cars entering the central city.
NAGOYA (Japan)	2,000,000	Traffic cells established in residential quarters. Longer distance road movements segregated on a loop route equipped with linked signals. Computer-managed area traffic control, bus lanes, priorities for public transport at signals, staggered work hours, parking regulations introduced.	A 17% increase in traffic speeds on main roads covered by computer-managed signals. A 3% increase in ridership on buses using priority lanes. A 59% reduction in deaths from road accidents in the central areas and a 57% reduction in residential areas covered by cells.	A 15% reduction in cars entering the central area in the morning rush hour. A 1.5% reduction in traffic circulating in central business district. A 16% reduction in auto-related pollutants.

Source: National League of Cities. Transportation and the Urban Environment. (Washington, D.C.: July 1980), pp. 32, 41, 42.

Figure 2 (Cont'd)

CITY	POPULATION	KEY POLICY FEATURES	TRANSPORTATION RESULTS	ENVIRONMENTAL RESULTS
OTTAWA (Canada)	528,000	Between 1971 and 1976, bus services more than doubled. Fare subsidies raised from 7 to 46% public transport operating costs. Flexible working hours adopted by 50% of Ottawa's city center employees. Charges of $20 to $24 (Canadian) a month introduced for 700 spaces in federal government parking lots. Express busway 7 km long created.	Between 1972 and 1976, annual public transport ridership increased from 37 to 60 million passengers per year. Public transportation's share of total evening peak travel by road increased from 20 to 30%. The proportion of government employees driving to work dropped from 35 to 27% between 1974 and 1975.	A 15% reduction in peak period car use. Carbon monoxide levels held constant at 13.15 p/m between 1973 and 1975. (The average in large North American cities is 23 p/m). A population increase from 95,600 to 97,500 in the inner city between 1971 and 1976.
SINGAPORE	2,000,000	Supplementary licenses introduced for vehicles entering the central business district during the morning rush hour. Tax disincentives on car ownership. Publicity for car pooling. Staggering of work hours. Park-and-ride services. Improved bus service.	A reduction of traffic during the morning rush hour in the zone covered by supplementary licensing of 75%. Car pools rose from 2,137 to 4,500. A 15% increase in bus passengers between 1974 and 1976. Growth rate of car ownership fell.	A 43% reduction in overall daily traffic in the licensed zone. A 15 to 20% reduction in carbon monoxide levels.

Figure 2 (Cont'd)

TOWN	POPULATION	KEY POLICY FEATURES	TRANSPORTATION RESULTS	ENVIRONMENTAL RESULTS
BESANCON (France)	135,000	Restructured public transportation system: increased rolling stock, established bus lanes and new routes, established new fare policy and paratransit for non-peak hours. Restricted road access for certain vehicles, established traffic cells and a ring road. Set up park-and-ride areas and central area parking restrictions. Improved traffic control equipment. Established pedestrian zones.	Improvements in public transportation stimulated 75% increase in ridership over two years. Elimination of through traffic has sharply reduced central area congestion. Bus service is very frequent, fast, and comfortable.	Carbon monoxide in the central city area reduced by 67%. Less noise from private cars has been offset by more noise from buses. Accidents have decreased. Pedestrian areas have stimulated social and recreational life. Shops have improved their facades, and the city has become more attractive.
MADISON (Wisconsin, U.S.A.)	168,000	Preferential treatment for transit and high occupancy vehicles (bus lanes and transit malls); extension of bus runs so that 82% of residents are within 4 blocks of a bus stop. Extensive provision of cyclist and pedestrian facilities. Use of pricing incentives to encourage short-term parking and discourage commuter parking. Improvement of traffic flow through better signalization and use of one-way streets.	Bus patronage rose from 8 to 1.25 million between 1971 and 1976. Bicycles accounted for 9% of all person-trips in 1975. The number of bicycle trips has been increasing 10% annually in recent years, while automobile traffic in the isthmus area has been held at a nearly constant level. No demands for freeway construction have materialized. In	Combination of transit and traffic operation improvements and ridesharing led to an estimated reduction of 53.5 tons HC emissions in 1979-80 for the area. Decline in the downtown appears to have been halted. The idea that long-term land-use policies will more effectively reduce energy consumption and protect the urban environment than

Figure 2 (Cont'd)

CITY	POPULATION	KEY POLICY FEATURES	TRANSPORTATION RESULTS	ENVIRONMENTAL RESULTS
MADISON (Wisconsin, U.S.A.)	168,000	Coordination of public transportation through a single Metropolitan Transport Authority. Extensive provision for information dissemination and citizen participation. Willingness to experiment with new management ideas backed by ordinance provisions.	garages affected by pricing policies, the ratio of long- to short-term parking in the AM peak has gone from over 4:1 to below 2:1.	will short-term traffic management has achieved greater public acceptance.

ENERGY AND TSM

As the United States moves into the 1980s, it faces the prospect of renewed short- and long-term petroleum scarcity. Numerous factors suggest that U.S. reliance on foreign oil supplies should be reduced through a combination of long range conservation policies and programs including more fuel efficient cars, land use management, and alternative energy sources for both the transportation and non-transportation sectors.

The effects of TSM on energy use are subject to some of the same controversy as the effects on air quality. Few doubt the potential for saving some energy through TSM, but some question the level of implementation of TSM strategies that is politically feasible. With widespread application of TSM measures in urban regions, however, reductions in gasoline consumption of from 5% to 15% are probably achievable in the short-term. Energy conservation and contingency planners in the transportation sector can look to TSM to provide strategies for achieving significant short-term reductions of transportation energy use.

In general, the same factors that affect air pollution emissions affect gasoline consumption. Reducing VMT and vehicle trips and increasing travel speeds (below 55 mph) generally decrease gasoline use. As in the case of air pollution, interrelationships between these factors are complex.

Economic Incentives for Energy Conservation

Economic incentives for energy conservation through TSM have not received adequate attention. It is apparent, however, that by reducing gasoline consumption, local economies can be stimulated. A recent study by the Los Angeles County Transportation Commission[13] estimated that in 1979, Los Angeles motorists spent $4 billion on gasoline. If that figure could be reduced by 10%, an estimated $500 to $700 million per year would be pumped back into the local economy. By this account, gasoline conservation made possible by thoughtful transportation policies would act to increase, not decrease, consumer choice and mobility, as well as economic growth.

This study estimated that for every dollar spent on gasoline (at $1.00 a gallon) the local economy loses between 33¢ and 50¢. In States and regions without significant oil production or refinery activity, the economic losses are even higher. These adverse economic impacts are further compounded by the fact that the multiplier effect of expenditures for gasoline is significantly lower than for overall goods and services (for example, in Los Angeles, about 1.8 vs. 2.7). Thus, effective conservation of petroleum resources can directly contribute to positive local economic growth, increased disposable income available for non-transportation related goods and services, and local job creation.

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[13]Los Angeles County Transportation Commission, Transportation Energy Conservation in Los Angeles County (Los Angeles, California, November 28, 1979).

Energy Contingency Planning

Energy contingency planning is directed toward coping with a major shortage of petroleum supplies. Various TSM strategies can be essential to the preservation of mobility and basic economic activity under such circumstances, by helping to increase vehicle occupancy and transit productivity, stretching transportation resources to their limit.

Limitations on fuel supply can have a dramatic effect on traffic levels, air pollution, and accidents. For example, in New York City during the fuel shortages of mid-1979, traffic volumes in midtown Manhattan dropped by 15%. This resulted in a 39% increase in average speeds and a 36 to 38% decrease in carbon monoxide and hydrocarbon pollutants. Accidents were reduced by one-third and fatalities due to automobiles declined by 26%.[14] These observations helped the City decide to ban single-occupant vehicles from entering the downtown south of 96th Street during the morning rush hour for the duration of the April 1980 transit strike.

The demonstrated feasibility and acceptance of this automobile restriction during the transit strike has prompted the City's Department of Transportation to press ahead with plans to limit the entry of single-occupant private cars into Manhattan on a regular basis as part of their TSM element. Implementation awaits the outcome of court challenges now underway.

Other TSM actions that might, under normal circumstances in some communities, be socially or politically infeasible, deserve consideration in planning for mobility during periods of severely limited gasoline supplies. For instance, regulations that inhibit free entry of taxi service operators into the market might be suspended. School buses might be enlisted to provide transit service in suburban areas. Large employers might be pressured to implement flexible working hours. Bus stop spacing might be significantly increased to speed buses and boost their productivity. Bus routes in lower density areas might be altered to eliminate low productivity collection and distribution, allowing buses to provide efficient line haul service on principal arterials, with bicycles, carpools, and walking serving as the primary collection and distribution modes.

Planning for energy contingencies should focus on removing impediments to program implementation in advance of crisis. Such planning must therefore be as much institutional as operational. Everything should be set to go upon the declaration of an emergency.

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[14] David A. Andelman, "Plans to Limit Number of Cars Entering Manhattan," New York Times, November 28, 1980.

GOALS AND TRADE-OFFS

Different TSM strategies need to be pursued to address different problems. Some strategies will favor conservation of air quality and energy over mobility improvement; others will reduce travel time and congestion but have few or negative effects on energy and air quality. Some integrated strategies may forward both conservation and mobility. Even within the same basic goals, there may be trade-offs. For example, ozone is generally a regional problem, while carbon monoxide has more localized impacts. A region-wide carpool program may be useful in reducing regional ozone levels and yet have little impact on local carbon monoxide levels along expressways.[15]

The trade-off between conservation and mobility goals is one of the most important elements to consider in developing TSM strategies.

TSM actions generally increase transportation capacity, although they may restrict certain modes, such as single occupant automobiles. The effect of TSM actions on travel demand can be positive or negative. If travel time is reduced, travel demand (and possibly associated energy use and pollution) may increase, as latent travel demand exerts itself.

For example by improving traffic signal coordination on a major urban arterial street, it is possible to increase average travel speed and reduce stops and delays in the corridor. This generally results in lower gasoline consumption and pollution. Over time, however, the improvement in vehicle flow on the arterial street may draw traffic from other parallel routes and stimulate new travel demand. In some cases, the fuel consumption and pollution emission of the additonal cars may largely offset the fuel savings and emission reductions due to the initial signal improvement. There is some dispute among local officials and transportation professionals over the extent to which this latent demand offsets expected energy and pollution benefits. However, one recent study estimates that a traffic control improvement program reducing areawide travel time by 12% would result in only a 1% increase in areawide vehicle miles traveled.[16] If this were the case, energy consumption would be reduced by 3%, carbon monoxide and hydrocarbon emissions would be reduced by 5%, and nitrogen oxide emissions would increase by 7%. This analysis might not be valid for all urban areas, however. Signal improvements may increase travel efficiency and mobility within a corridor, but yield few benefits in terms of fuel use and air pollution emissions.

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[15] Arleen Shulman, "Transportation and the Clean Air Act," County News, May 5, 1980, (National Association of Counties, Washington, D.C.) p. 5.

[16] Fredrick Wagner, Overview of the Impacts and Costs of Traffic Control System Improvements, (Washington, D.C.: Federal Highway Administration, 1980), p. iv.

Other complicated trade-offs need to be considered when developing TSM strategies, regardless of whether local goals are oriented towards conservation, mobility, or both. Short trips, of 5 to 10 minutes duration or less, involve substantially lower fuel economy and higher emission rates than longer trips. Cold engines in many cases burn twice as much fuel per mile as fully warmed engines.[17] Thus, TSM actions that replace long commuting trips with shorter local access trips by automobile do not save energy or reduce pollution proportionately to the reduction of vehicle miles traveled (VMT), for they eliminate the higher fuel economy and lower emission rate VMT.

For example, park-and-ride services do not reduce air pollution and gasoline use as much as they reduce VMT. In extreme cases, they may have little impact on these conservation goals. While park-and-ride services convert long commuting trips into shorter trips to the park-and-ride lot, the VMT occurring under cold-start conditions are not eliminated. It is these VMT that have the highest emission and fuel use rates. Because substantial "kiss-and-ride" travel is associated with park-and-ride services, the availability of automobiles at the home end is usually increased by these services, resulting in more off-peak period VMT. In some areas of the country, developers in suburbs distant from downtown areas have advertised the proximity of their housing developments to park-and-ride lots. Thus, high quality park-and-ride services might, in the long term, encourage additional residential dispersion in low density suburban areas.

Conversely, eliminating barriers to bicycle commuting and improving transit in higher density areas may encourage urban recentralization and reduce reliance on petroleum powered vehicles. These and other actions that eliminate short automobile trips, can reduce energy use and pollutant emissions by far more than they reduce actual VMT. Because most transportation analytical models and tools are not highly detailed in their level of focus, they often overlook the true potential of TSM actions that affect short trips.

Land use and development policies have a major effect in this area and must be considered as an element of TSM. Policies that promote mixed-use developments and higher densities along transportation corridors and nodes and that aim to strengthen secondary activity centers (such as neighborhood shopping centers) can promote shorter trip lengths. When combined with coordinated parking and auto use management policies, transit services, bicycle programs, and pedestrian facilities, such land use policies can increase accessible opportunities and urban quality of life while decreasing energy use and air pollution. Developing such land use policies, however, can be politically difficult if they run counter to powerful vested interests. As with any TSM strategy, there are trade-offs to be made.

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[17] U.S. DOT, Energy Impact Analysis Resource Information, (Washington, D.C.: FHWA Office of Highway Planning and Office of Environmental Policy, June 1976).

Park-and-ride services, signalization improvements, and other TSM tactics often can yield air pollution and energy use reductions. However, careful analysis and planning is necessary to ensure that these and other TSM strategies forward their intended objectives, whether these are mobility, conservation, capital cost-savings, or local economic development.

EFFECTIVENESS OF TSM STRATEGIES

Developing Effective Local Strategies

In preparing local TSM plans, it is important to evaluate alternative strategies for attaining local and national goals. To do this, it is necessary to examine the feasibility and effectiveness of various strategies within the local context. Such planning and analysis is inherent in developing transportation control plans under the terms of the Clean Air Act and the metropolitan transportation planning process. Differences in local attitudes, goals, political and organizational structures, land use and travel patterns, existing infrastructure and management practices, and a host of other factors can affect the feasibility, desirability, and cost-effectiveness of TSM measures. While it is possible to transfer knowledge and experience gained in one jurisdiction to another, flexibility and adaptation are inevitably required.

Transportation system elements must serve varying travel needs and purposes, such as--

- Neighborhood or local (shopping, social, and recreational).
- Corridor level (suburban to downtown).
- Subarea level (suburban trips of all types).

Because of the diversity of travel needs, TSM opportunities need to be developed at each level for different trip types. Individuals in appropriate public and private organizations need to be drawn into the TSM planning and management process at each level of potential action.

A key factor in evaluating and developing TSM strategies is the consideration of interactions between various separate TSM measures. Balanced incentives and disincentives need to be combined for maximum effectiveness. For instance, untargeted downtown parking restrictions may discourage shoppers and increase VMT as commuters search for parking without reasonable alternatives. However, parking restrictions aimed at commuters, who are at the same time offered improved transit service and preferential carpool parking, may decrease vehicle miles traveled, pollution, and energy use, increase transit ridership and overall vehicle occupancy, and make it easier for shoppers to park. Such a package could reduce energy use and pollution, as well as aid downtown business and provide increased accessibility, through improved transit service, to the transit dependent.

Impacts of Specific Tactics. The effectiveness of particular TSM tactics depends on local goals and the situation in which they are to be implemented. However, it is possible to develop order-of-magnitude estimates of the generalized effects of TSM actions. While these estimates are based on numerous assumptions, which do not in all cases apply, they are useful points of departure for policy-level TSM strategy planning.

A number of effectiveness measures are available to evaluate TSM strategies. Factors of key interest include changes in--

- vehicle miles traveled (VMT).
- vehicle trips.
- vehicle hours traveled (VHT).

These three elements can be used as gross indicators of the effects of alternative TSM actions on energy use, air pollution, and mobility.

More detailed factors can and often should be analyzed to evaluate specific TSM strategies within their local context. Many techniques exist for analysis of TSM impacts. While this topic is too large for a detailed examination here, the annotated bibliography of this report contains a number of pertinent citations in the section, "Quantifying TSM Impacts." (see page 71.)

A recent study by Wagner and Gilbert, TSM: An Assessment of Impacts, sought to estimate the potential areawide impacts if various TSM actions were applied extensively in an urban area over a five-year period. This report breaks TSM actions into four classes, as shown in Table 3. The findings of this report concerning estimated changes in vehicle miles and vehicle hours of travel and order-of-magnitude cost-effectiveness of various actions are shown in Tables 3 and 4. These estimates are subject to debate, due to the many assumptions and simplifications used to derive them, but may be useful in defining areas of emphasis for local TSM strategies.

Several approaches stand out as particularly noteworthy:

- Ridesharing, which includes carpools, vanpools, and subscription buses, may be one of the most cost-effective ways of reducing VMT. Many different approaches to promoting ridesharing have shown success or promise. Employer-based programs have predominated thus far. Several transit agencies are becoming involved in ridesharing promotion to reduce peak period transit costs. Paratransit brokerage, which often includes ridesharing services, is gaining increasing recognition as an effective, intermodal, strategic TSM approach.

- Signal timing optimization, which involves ongoing management of interconnected traffic signal systems on arterial streets, is among the most cost-effective ways of reducing automobile travel delay on urban and suburban streets. Reductions in energy use and pollution emissions are likely, but may be offset by increased travel demand provoked by travel time reductions. Signal optimization is perhaps the most easily implemented and least controversial TSM action.

- Preferential treatment for high occupany vehicles (HOVs) includes a variety of treatments for buses, vanpools, and carpools, including reserved lanes on freeways and arterials, preferential entrance ramps, preferential access and parking, and bus priority signal timing and preemption. These techniques make buses and ridesharing more competitive with the automobile for the same trip, and increase transit reliability and productivity. Construction of exclusive HOV lanes is cost-effective only in corridors with a very high travel density. Priority treatment projects that take a lane from existing automobile traffic may cause political controversy if significant additional delay is imposed on non-HOV traffic. Changes in overall transportation system efficiency due to take-a-lane HOV treatments can be positive or negative, depending on local circumstances.

- Parking management includes a variety of tactics such as residential parking permit programs, on- and off-street parking restrictions, preferential parking for carpools and vanpools, pricing policies, fringe and remote park-and-ride systems, and strict enforcement policies. In combination with other TSM actions, parking management can have significant positive effects on a number of local goals. Parking policy can be used to create strong incentives and disincentives relating to various modes. Disincentives may provoke political controversy, however.

- Bicycle transportation improvements include eliminating roadway surface and design hazards, providing wide shoulder lanes, bikepaths, and secure parking facilities, improving the bicycle-transit interface, and educating drivers and bicyclists to improve bicycle safety and encourage bicycle use. These measures are encouraged as part of the new U.S. DOT Comprehensive Bicycle Transportation Program,[18] which is expected to result in gasoline savings of from 7.9 to 15.0 million barrels per year. Sixty percent of all automobile trips are of 5 miles or less distance. These short automobile trips account for disproportionate amounts of pollution and energy use relative to their share of VMT. Bicycle transportation can substitute for many of these low fuel economy, high emission rate trips.

- Work rescheduling involves application of flexible or staggered work hours, the four day 40 hour work week, and other alternative work schedules. The intent is to spread peak period travel demand into the shoulders of the peak, and to make carpooling easier for employees of different firms, thereby reducing peak congestion and increasing the utilization of non-peak period excess system capacity. Potential benefits include travel time, air pollution, and energy use reductions, and more efficient use of existing transportation capital resources. A study of one 10-mile freeway segment

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[18] US DOT, Office of the Secretary, Bicycle Transportation for Energy Conservation, (Washington, D.C., April 1980).

TABLE 3
IMPACT OF VARIOUS TSM ACTION CLASSES
FOR PROTOTYPICAL URBAN AREA OF ONE MILLION PEOPLE

	TSM ACTION CLASS	EXAMPLES OF ACTIONS	PRINCIPAL GOALS SUPPORTED	WORK TRIP CHANGES AFTER EQUILIBRIUM IS REACHED (IN %)		NON-WORK CHANGES AFTER EQUILIBRIUM IS REACHED (IN %)	
				VMT	TRAVEL TIME	VMT	TRAVEL TIME
I	Actions that reduce travel demand but have no effect on highway capacity	Ridesharing, Transit improvement, Paratransit, Bicycle facilities, Pricing incentives	Conservation and Mobility	-5.3* -2.4**	-5.3* -2.4**	+1.2* -6.1**	+0.2* -1.2**
II	Actions that enhance highway supply	Traffic engineering, Freeway management, Truck restrictions, Flextime	Mobility (may work against Conservation)	+0.6	-9.4	+2.2	-7.1
III	Actions that reduce demand and reduce supply	Preferential treatment of HOV (take-a-lane), Auto restricted zones, Parking Management	Conservation (may work against Mobility)	-6.0	-4.9	+2.0	+0.4
IV	Actions that reduce demand and enhance supply	Preferential treatment of HOV (add-a-lane)	Mobility	-0.6	-1.4	+0.2	Negligible
	Combined strategies (I)+(II)+(IV)	(see above)	Mobility	-5.4	-16.1	+3.6	-6.9
	(I)+(III)+(IV)	(see above)	Conservation and Mobility	-11.9	-11.6	+3.3	-0.6
	(I)+(II)+(III)+(IV)	(see above)	Conservation and Mobility	-11.4	-21.0	+5.5	-6.7

Source: Wagner and Gilbert, TSM: An Assessment of Impacts, p. vii-viii.

*Does not include pricing incentives and bicycle programs
**Pricing incentives alone

Table 4

COST-EFFECTIVENESS OF SELECTED TSM PROGRAMS
FOR PROTOTYPICAL URBAN AREA OF ONE MILLION PEOPLE

TSM ACTION	AREAWIDE PERCENT REDUCTION: VMT**	AREAWIDE PERCENT REDUCTION: TRAVEL TIME	ANNUAL COST	COST PER*: VMT** REDUCED	COST PER*: VHT** REDUCED
Ridesharing					
Current Program	0.2		$200,000	2 cents	
(Expanded Program)	(1.0)		$400,000	1 cent	
Express Bus Service Increase	0.3		$5-7 Million	40 cents	
Local Bus (50% Service Increase)	0.3		$5-6 Million	43 cents	
Work Rescheduling		0.4	$200,000		25 cents
Signal Timing Optimization		0.6	$250,000		2 cents
Computerized Traffic Control		1.5	$800,000		27 cents
Freeway Surveillance and Control		0.5	$1 Million		$1.00
Truck Restrictions/Enhancements		0.2	$200,000		50 cents
Comprehensive Preferential Treatments	-0.1	(+0.4)	$800,000	16 cents	(Increase)
Exclusive HOV Lanes	0.1	0.4	$5-8 Million	$1.30	$8.00

Source: Wagner and Gilbert, p. 37.

*Based on gross estimates of 24-hour VMT and VHT impacts used to produce data in Figure 5, combined with cost data from numerous sources, based on actual experience. Estimates include capital and operating costs, with various assumptions for design life. Annual VMT is assumed to be 5,000 million, annual VHT is assumed to be 200 million. Other simplifying assumptions were also used. Thus, these figures must be regarded as very gross, order-of-magnitude estimates of average costs.

**VMT stands for Vehicle Miles Traveled; VHT stands for Vehicle Hours Traveled.

in the San Francisco Bay area estimated that work rescheduling to spread peak demand could reduce travel time by 16%, fuel consumption by 1.4%, and total air pollution emissions by 5%.[19] Latent travel demand (additional travel induced by greater accessibility and reduced travel time) may counteract some of these savings. Staggered work hours, unlike flextime, can make carpool matching more difficult, thus reducing savings. Significant efforts would be required to obtain widespread private sector compliance with alternative work schedule programs.

- Traffic cells are a form of automobile restraint that has been used in a number of European cities to prevent through auto traffic in central areas. The Downtown Crossing in Boston is a limited version of this concept. City centers or residential areas bounded by main roads are divided into a series of "cells." An automobile driver who wishes to drive from one cell to another must use the "ring" or boundary road to make the trip, for automobiles are barred from crossing interior cell boundaries. Transit vehicles, cyclists, and pedestrians, however, may cross them freely. Traffic cells thus shift traffic from the interior to the periphery of the affected area and encourage alternate modes of transportation. Bus priority measures, parking restrictions, transit improvements, pedestrian streets, bicycle facilities, and other traffic management measures often are combined with traffic cells. While this type of automobile restraint can be politically controversial, it has substantially improved the urban environment and won wide acceptance in the affected communities in most areas where it has been tried. Figure 2 discusses the impacts more fully (see p. 15).

- Supplementary licenses are special supplementary vehicle licenses, which must be purchased and displayed on vehicles entering a particular area, such as a congested city center. The time period during which such licenses must be displayed is often restricted to the peak travel times. Under such schemes, buses, bicycles, and automobiles carrying more than a set number of passengers are usually given license-free passage. Various enforcement schemes have been proposed or used. Singapore was the first city to adopt this technique. Florence, Italy, uses it, and other cities are considering its use. This type of auto restraint is even more controversial than traffic cells, although the effects on mode choice, air pollution, energy use, and congestion are truly substantial. Figure 2 discusses its impacts more fully (see p. 15).

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[19] D.W. Jones, Jr., T. Nakamoto, and M. Cilliers, Flexible Work Hours: Implications for Travel Behavior and Transport Investment Policy, (Institute of Transportation Studies, Univ. of California, Berkeley, California, October 1977).

PLANNING AND IMPLEMENTING TSM

In the five years since the joint TSM regulations of 1975 were issued, limited progress has been made in developing the full potential of TSM. In the earliest part of this period, the TSM element of most regions' Transportation Improvement Programs (TIPs) consisted of uncompleted elements from the TOPICS program of the early 1970s, which mainly focused on intersection and signalization improvements, plus token programs for ridesharing and transit improvement. There was little evidence of the multimodal, coordinated, transportation planning and management that was a central goal of the 1975 TSM regulations.

Impediments to Effective TSM

More recently, there have been movements towards greater intermodal integration in some regions. However, most TSM efforts remain at the tactical, intramodal level, where extensive cooperation of multiple agencies or political jurisdictions is not required. Even at this level there are many opportunities for TSM that have not been thoroughly explored. More agressive implementation of TSM measures has been hindered by a number of factors identified by various transportation officials.

- Small, low-cost projects, no-cost management actions, and actions performed within the private sector are often discouraged by the fact that TSM planning is part of the TIP preparation process, which tends to emphasize funded grant projects. Federal paperwork and design requirements also work against small, low-cost projects.

- Intermodal TSM measures may be discouraged by the separate programming procedures for transit and highway projects. Federal funds are too often perceived by local officials as rigidly categorical and not as general transportation resources.

- Separate funding and different emphasis and interpretation among Federal agencies for energy contingency and air quality planning may act as an impediment to the integration of these two activities, which both necessarily entail the improvement of TSM.

- Conflict between MPOs, which are usually the lead agencies for TSM planning, and local governments, which are usually responsible for plan implementation, has impeded many TSM approaches. Conflict between both local and regional agencies and State Departments of Transportation, which have the power to allocate Federal highway funds, has also been an impediment.

- Local governments have often lacked the resources to enhance their own TSM capabilities, as planning funds frequently do not get passed down by the MPO. In many cases there has been little motivation for local governments to develop TSM opportunities.

- Conflict between various modal agencies and jurisdictions over goals, funding, and turf, as well as rigid bureaucratic procedures, often impedes the development of more integrated approaches to TSM.

- In practice, there has been a heavier emphasis on TSM planning than on the management of TSM activities. Scant attention has been given to the development of transportation system brokers who can focus on integrating transportation services and modulating demand at different levels, among different modes, and between public and private sectors.

- A major deficiency in technical planning tools has been the lack of knowledge and methods for considering and integrating pedestrian and bicycle facilities and services into the transportation planning process. Without such tools or agencies committed to these modes, bicycles and pedestrians have tended to lose out in the competition for transportation resources and urban space.

Successful Approaches to TSM

Most of these impediments to comprehensive TSM development involve complex institutional issues that cannot be easily or quickly resolved. Development of successful TSM programs in the short term must therefore rely upon creative and unified leadership in MPOs, local governments, transit agencies, and the private sector. This leadership must appraise local problems, opportunities, and institutional relationships and adapt TSM strategies to these conditions. Idealized methods for goal-oriented, regional system planning and implementation must be tempered by practical and political realities.

Most cases of successful TSM implementation have displayed the following characteristics:[20]

- Projects have been limited in scale and adapted to the existing political environment.

- Projects have generally involved limited, operational goals such as ameliorating specific design deficiencies or achieving savings in travel time.

- Project implementation has improved the quality of service available without substantially hurting any class of users or political jurisdiction.

- Project managers have approached implementation with a demonstration philosophy and a readiness to adjust or terminate as problems arise.

- Project design has been negotiated with affected jurisdictions and interests.

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[20]Adapted from David Jones, Jr., and Edward Sullivan, "TSM: Tinkering Superficially at the Margin?" Transportation Engineering Journal, (ASCE, Vol. 104, No. TE6, November, 1978), p. 828.

- Project motivation has frequently been provided by the ability to secure Federal funds in excess of formula entitlements.

- The project team has controlled resources that allowed side payments to offset adverse impacts. These side payments include such things as tree planting and beautification used to persuade merchants to accept bus lanes on commercial streets, and State financing of the cost of resetting signals on local streets where ramp metering has been introduced

Brokerage

Strategies that support TSM involving multiple public and private organizations have been most difficult to implement. Transportation brokerage, however, has begun to emerge as a useful concept for developing intermodal TSM strategies. A transportation broker may be a specific agency, a consultant, or a designated staff member in an employment center. The role of the broker is to integrate and coordinate public and private transportation service providers with various market elements.

Brokerage relies heavily on negotiation, coalition-building, conflict-management, and information sharing and has been applied principally in commuter ridesharing and elderly and handicapped transportation programs. One of the earliest brokerage programs was established in Knoxville, Tennessee. It involved the establishment of a regional transportation authority, vested with responsibility for all urban transportation modes except the single-passenger automobile. Transportation coordinators there have worked to match travel demand with existing and newly created transit, paratransit, van and carpool, social service, and other transportation services. Brokerage programs are being extended to include more effective integration of transit and paratransit services in Bridgeport, Connecticut; Norfolk, Virginia; Chicago, Illinois; and other areas. The brokerage concept can be expanded to encompass development of appropriate transportation mixes for new or existing employment and residential centers, through negotiations with developers, employers, neighborhood organizations, and other affected parties.

Success of the brokerage approach may depend on the development of part-time or full-time staff transportation broker positions in local governments and large employment centers to identify TSM opportunities. Transportation needs and resources are best matched at the human day-to-day level of the workplace and the neighborhood.

The optimum approach to TSM may be a combination of tactics and strategy. Tactical TSM actions are generally easier to implement since they depend less on interorganizational coordination and more on technical skills. Strategic approaches require careful management and strong leadership by local government officials. Although the strategic approach may be more difficult, it has the potential to stimulate adaptive changes in urban transportation systems, encouraging the emergence of new services better tailored to modern needs.

LOCAL GOVERNMENT ISSUES

TSM planning has been made the responsibility of MPOs, with local government involvement through the metropolitan transportation planning process. Many of the key opportunities for TSM, however, require concentration on the local and community level. They require less attention to planning and more attention to management of existing resources, both public and private, through negotiation, communication, and coalition-building.

While local government officials acknowledge that they have a major role to play in TSM planning and implementation, their involvement is inhibited by a number of existing legal and institutional factors. Some of the broader issues raised by local government officials concerned with TSM are:

- To what extent should TSM be an MPO responsibility? Many local officials believe that the MPO is not able to provide responsive leadership in TSM planning. Better coordination between planning, implementation, and ongoing management might be achieved by permitting greater flexibility in the designation of lead agencies for TSM efforts.

- What steps can be taken to assure that the transportation priorities of local governments are better reflected in approved and funded transportation projects? Local city or county governments best know their own needs. The emphasis should be that local government determines the projects and priorities and submits them to the MPO, not vice versa. It is, after all, usually the city or county agencies that provide the funds or local share to implement TSM projects.

- Should MPOs be required to pass through to local governments the bulk of Federal planning funds? Without adequate resources and incentives, many local governments are unable to dedicate sufficient support to developing local TSM opportunities.

- Should States be required to pass through to local governments a sizable portion of Federal-Aid Urban System (FAUS) funds? Presently, very little FAUS money is allocated by States to local transportation programs, for the bulk of these funds is spent on State highways. FAUS remains one of the most significant sources of funds for TSM programs.

- Can greater incentives be created to encourage TSM programs and to reward successful TSM efforts? Many of the present incentives for TSM consist of threats to impose sanctions, such as cut-off of Federal transportation and sewer grants aid and bans on new stationary source permits. There is no reward structure for good work. Some local government officials suggest the introduction of bonuses in Federal transportation aid programs, such as a 5% increase in the percentage of Federal matching aid, for attainment of certain performance objectives (an exemplary reduction of regional VMT or increase in ridesharing or transit ridership, for example). Such incentives could help local officials in developing the political constituency required to implement many TSM strategies.

- How can other issues of community concern be linked to TSM strategies to build effective support for potentially controversial TSM programs? Many local officials express concern over the political feasibility of transportation control measures. They realize that many of these measures cannot be considered unless linked to other issues, such as economic development. Some officials believe that extensive private sector involvement in transportation control measures is essential, but may not be achieved except through the introduction of other stimuli, such as growth management programs and mobile source emissions banking.

- How can present uncertainties concerning mobile source emission offsets be quickly resolved? Local government officials see the establishment of mobile source emission offset programs as a potentially powerful incentive for greater private sector involvement in transportation control measures. This involvement will be essential if TSM is to have a truly significant effect on air quality, energy conservation, and congestion, for public agencies cannot do the job alone. Presently, the establishment of such programs is inhibited by a lack of policy guidance from the EPA and a need for further research on techniques for monitoring the post-implementation effects of TSM measures on air quality.

Within the existing framework, there is much local governments can do to make TSM strategies serve their communities' needs. Local officials and their staffs can take an active role in the development of transportation control plans by the MPO. They can use existing local and regional resources to identify TSM opportunities which support other local objectives beyond air quality and energy conservation. Interagency coordination can often be improved when elected officials establish specific interagency tasks and offer visible rewards for achieving success.

Able political leadership will be required to build a constituency for TSM strategies that enjoys both public and private sector support. This constituency will be established only by making explicit the connections between TSM, economic development, environmental quality, and energy policy. Conflicts between local governments and MPOs over TSM strategy will not be easily resolved and will require extensive public education and debate as well as leadership able to forge compromises and to build effective coalitions. Properly balanced TSM strategies, combining politically acceptable incentives and disincentives, will be achieved only with the active participation of local elected officials in transportation decision-making.

Chapter 2

CONTACTS AND CURRENT PROGRAMS

Because of the wide range of activities that pertain to Transportation System Management (TSM), energy conservation, and air quality, a comprehensive listing of contacts and programs is beyond the scope of this document. The list below represents a cross-section of important general contacts and programs as starting points for more detailed inquiries.

U.S. DEPARTMENT OF TRANSPORTATION

Numerous offices within the U.S. Department of Transportation are concerned with TSM, air quality, and energy conservation. Some of the more important resources for information and assistance are listed below. The code following each name is for identification purposes in mail delivery and should be used in all written correspondence.

Office of the Secretary

- Assistant Secretary for Governmental Affairs
  Provides a variety of technical and general information to State and local governments.
  Contact: Al Linhares
  Director, Office of Technology Sharing (I-40)
  400 7th Street, S.W.
  Washington, D.C. 20590
  202/426-4208

- Office of Environment and Safety
  Coordinates air quality and transportation planning.
  Contact: Norman Cooper
  Environmental Coordination Division (P-23)
  400 7th Street, S.W.
  Washington, D.C. 20590
  202/426-4380

- Office of Environment and Safety
  Provides information and assistance in developing bicycle transportation programs.
  Contact: Maureen Craig
  Bicycle Programs Coordinator
  Environmental Coordination Division (P-23)
  400 7th Street, S.W.
  Washington, D.C. 20590
  202/426-4414

- Office of Intermodal Transportation
  Provides information on energy and transportation.
  <u>Contact:</u> Don Igo
  Chief, Energy Policy Division (P-13)
  400 7th Street, S.W.
  Washington, D.C. 20590
  202/426-0783

<u>Federal Highway Administration</u>

- Office of Highway Planning
  Engages in extensive activities supporting TSM strategy development, planning, and implementation.
  <u>Contact:</u> Gary Maring
  Chief, Transportation System Management Branch (HPP-32)
  400 7th Street, S.W.
  Washington, D.C. 20590
  202/426-0210

- Office of Program and Policy Planning
  Provides information on FHWA policy and research materials pertaining to TSM.
  <u>Contact:</u> Bruce Barkley
  Chief, Policy Planning Division (HPP-20)
  400 7th Street, S.W.
  Washington, D.C. 20590
  202/426-0226

- Office of Traffic Operations
  Provides information and technical assistance on traffic signalization improvements and optimization.
  <u>Contact:</u> Robert E. Conner
  Chief, Traffic Control Systems Division (HTO-20)
  400 7th Street, S.W.
  Washington, D.C. 20590
  202/426-0411

- Implementation Division
  Supports and disseminates a wide range of highway-related research and general information pertaining to TSM.
  <u>Contact:</u> Robert J. Betsold
  Chief, Implementation Division (HDV-20)
  400 7th Street, S.W.
  Washington, D.C. 20590
  202/426-9230

- Federal Aid Division
  Provides information on overall Federal-aid procedures and processes.
  <u>Contact:</u> Clifford R. Green
  Chief, Special Procedures Branch (HNG-11)
  400 7th Street, S.W.
  Washington, D.C. 20590
  202/426-0334

- Highway Design Division
  Provides technical assistance in planning multimodal facilities such as park-and-ride systems.
  <u>Contact:</u> Ali F. Sevin
  Chief, Environmental and Public Transportation Branch (HNG-25)
  400 7th Street, S.W.
  Washington, D.C. 20590
  202/426-0306

- Office of Environmental Policy
  Concerned with the relationship between transportation and air quality.
  <u>Contact:</u> Roy Turner
  Environmental Quality Division (HEV-21)
  400 7th Street, S.W.
  Washington, D.C. 20590
  202/426-4836

- Environmental Design and Control Division
  Does research in the area of air quality and transportation.
  <u>Contact:</u> Leonard Wood
  Environmental Control Group (HRS-42)
  400 7th Street, S.W.
  Washington, D.C. 20590
  202/426-4980

- Office of Research
  Has done research on various aspects of TSM, including a study, <u>Measures of Effectiveness for Multi-Modal Traffic Management.</u>
  <u>Contact:</u> Dan Rosen
  Analysis and Experimentation Group (HRS-31)
  400 7th Street, S.W.
  Washington, D.C. 20590
  202/557-5224

- Demonstration Projects Division (Region 15)
  Has done research on air pollution measurement and estimation related to highways.
  <u>Contact:</u> Thomas O. Edick
  Regional Engineer, FHWA Region 15
  1000 N. Glebe Road
  Arlington, Virginia 22201
  703/557-9070

<u>Urban Mass Transportation Administration</u>

- Office of Planning Methods and Support
  Develops, disseminates, and maintains manual and computer analysis tools for transportation planning. This includes packages that help to assess air quality and energy impacts of TSM.
  <u>Contact:</u> Robert B. Dial
  Chief, Office of Planning Methods and Support (UPM-20)
  400 7th Street, S.W.
  Washington, D.C. 20590
  202/452-9271

- Office of Planning Assistance
  Provides guidance in developing transportation plans. Has conducted studies yielding prototype TSM plans.
  Contact: Richard Steinmann
  Planning Research and Evaluation Division (UPM-13)
  400 7th Street, S.W.
  Washington, D.C. 20590
  202/472-5140

- Office of Policy and Program Development
  Conducts research on various TSM measures and their impact.
  Contact: Richard Cohen or James Yu
  Office of Policy Research (UPP-31)
  400 7th Street, S.W.
  Washington, D.C. 20590
  202/426-4058

- Office of Service and Methods Demonstrations
  Sponsors a wide variety of transit and paratransit demonstrations of new ideas and TSM concepts.
  Contact: Ron Fisher
  Director, Office of Service and Methods Demonstrations (UPM-30)
  400 7th Street, S.W.
  Washington, D.C. 20590
  202/426-4995

- Office of Transportation Management
  Sponsors a number of projects directed at increasing transit productivity and performance.
  Contact: Brian Cudahy
  Director, Office of Transportation Management (UPM-40)
  400 7th Street, S.W.
  Washington, D.C. 20590
  202/426-9274

- Regional Offices
  The Urban Mass Transportation Administration is administratively responsible for dispensing EPA's air quality planning funds through its regional field offices to lead planning agencies, at the direction of the EPA regional offices. These funds are distributed to the regional offices by the Office Planning Assistance.
  Contact: The UMTA Regional Offices listed in Table 5 or:
  James Getzewich
  Office of Planning Assistance (UPM-11)
  400 7th Street, S.W.
  Washington, D.C. 20590
  202/426-4991.

Table 5

UMTA Regional Offices

Region I	Transportation Systems Center, Kendall Square, 55 Broad, Cambridge, MA 02142, Tel: 617/494-2055; FTS 837-2055.
Region II	Suite 1811, 26 Federal Plaza, New York, NY 10007, Tel: 212/246-8162; FTS 264-8162.
Region III	Suite 1010, 434 Walnut Street, Philadelphia, PA 19106, Tel: 215/597-8098; FTS 597-8098.
Region IV	Suite 400, 1720 Peachtree Road, N.W. Atlanta, GA 30309, Tel: 404/526-3948; FTS 285-3948.
Region V	Suite 1740, 300 S. Wacker Drive, Chicago, IL 60606, Tel: 312/353-1000; FTS 353-1000
Region VI	Suite 9A32, 819 Taylor Street, Fort Worth, TX 76102, Tel: 817/334-3787; FTS 334-3787.
Region VII	Room 303, 6301 Rock Hill Road, Kansas City, MO 64131, Tel: 816/926-5053; FTS 926-5053.
Region VIII	Suite 1822, Prudential Plaza, 1050 17th Street, Denver, CO 80202, Tel: 303/837-3242; FTS 327-3242.
Region IX	Suite 620, Two Embarcadero Center, San Francisco, CA 94111, Tel: 415/556-2994; FTS 556-2884.
Region X	Suite 3106, Federal Building, 915 Second Avenue, Seattle, WA 98174, Tel: 206/442-4210; FTS 399-4210.

National Highway Traffic Safety Administration

- Office of State Vehicle Programs
  Inspection of vehicle pollution control devices.
  Contact: Robert B. Voas
  Office of State Vehicle Programs, (NTS-30)
  400 7th Street, S.W.
  Washington, D.C. 20590
  202/426-9294

Research and Special Programs Administration

- Office of Systems Engineering
  Research in modeling of transportation-generated air pollutants.
  Contact: Gerald Schutz
  Acting Chief, Advanced Technology Division, (DPB-25)
  400 7th Street, S.W.
  Washington, D.C. 20590
  202/426-9638

ENVIRONMENTAL PROTECTION AGENCY

EPA Headquarters

- Office of Transportation and Land Use Policy
  Provides technical and policy guidance on Clean Air Act requirements for including transportation-related control measures in State Air Quality Implementation Plans.
  Contact: John O. Hidinger, Director
  Office of Transportation and Land Use Policy (ANR-445)
  401 M Street, S.W.
  Washington, D.C. 20460
  202/775-0480

- Office of Public Awareness
  Distributes information on environmental topics, including, A Citizen's Guide to Clean Air and Transportation: Implications for Urban Revitalization and a slide show discussing the advantages and applications of various transportation control measures.
  Contact: Inez Artico
  Associate Director
  Office of Public Awareness (A-107)
  401 M Street, S.W.
  Washington, D.C. 20460
  202/755-0720

For information on EPA's air quality program, contact EPA's regional offices, listed below.

Table 6

EPA REGIONAL OFFICES

Region I	JFK Federal Building, Room 2303, Boston, MA 02203, Tel: 617/223-7210.
Region II	26 Federal Plaza, Room 908, New York, NY 10007, Tel: 212/264-2525.
Region III	Curtis Building, 6th and Walnut Streets, Philadelphia, PA 19106, Tel: 215/597-9814.
Region IV	345 Courtland Avenue, N.E., Atlanta, GA 30308, Tel: 404/881-4727.
Region V	230 S. Dearborn, Chicago, IL 60604, Tel: 312/353-2000.
Region VI	First Center Building, 1201 Elm Street, Dallas, TX 75201, Tel: 214/767-2600.
Region VII	324 East 11th Street, Kansas City, MO 64106, Tel: 816/374-5493.

Region VIII 1860 Lincoln Street, Suite 900, Denver, CO 80203, Tel: 303/837-3895.

Region IX 215 Fremont Street, San Francisco, CA 94105, Tel: 415/556-2320.

Region X 1200 Sixth Avenue, Seattle, WA 98101, Tel: 206/442-1220.

U.S. DEPARTMENT OF ENERGY

DOE Headquarters

- Office of Transportation Programs
  Provides technical assistance and publications relating to vanpooling. Sponsors research on transportation energy conservation programs.
  Contact: Lew Pratsch
  Vanpool Program Manager (5-H-044)
  U.S. Department of Energy
  1000 Independence Avenue, S.W.
  Washington, D.C. 20585
  202/252-8017

- Education Division
  Provides general information on energy conservation strategies in transportation, supports public and specialist education activities, including bicycle encouragement programs.
  Contact: James C. Kellett
  Chief, Education Division (AS-7E-054)
  U.S. Department of Energy
  Forrestal Building
  Washington, D.C. 20585
  202/252-6484

Table 7

DOE REGIONAL OFFICES

For information on specific DOE programs in transportation energy conservation contact your State energy office or one of the DOE regional offices listed below:

Region I
Mr. Robert Philpott
Director for Conservation and Energy Resource Development
Department of Energy
150 Causeway Street
Room 700
Boston, MA 02114
(617)223-3106

II
Mr. Terence Sands
Acting Director for Conservation and Environment
Department of Energy
26 Federal Plaza
Room 3206
New York, NY 10007
212/264-8856

III
Mr. William Kaplan
Director for Conservation and Energy Resource Development
Department of Energy
1421 Cherry Street
10th Floor
Philadelphia, PA 19102
215/597-3606

IV
Mr. Fred Singleton
Director for Conservation and Energy Resource Development
Department of Energy
1655 Peachtree Street, N.E.
8th Floor
Atlanta, GA 30309
404/257-2526

V
Mr. Ken Johnson
Director for Conservation and Environment
Department of Energy
175 West Jackson Boulevard
Room A333
Chicago, IL 60604
312/353-3590

VI
Mr. Dan Deaton
Director of Conservation and Environment
Department of Energy
2626 West Mockingbird Lane
Dallas, TX 75235
214/749-7714

VII
Mr. Gerald S. Thurston
Director of Conservation and Environment
Department of Energy
324 East 11th Street
Kansas City, MO 64106
816/758-3720

VIII
Mr. James McCool
Director for Conservation and Energy Resource Development
Department of Energy
P.O. Box 26247 - Belmar Branch
Lakewood, CO 80226
303/234-2165

IX
Ms. Sharon I. Sellars
Director for Conservation and Environment
Department of Energy
111 Pine Street, 4th Floor
San Francisco, CA 94111
415/556-7148

X
Mr. Gilbert S. Haselberger
Director for Energy Conservation
Department of Energy
1923 Federal Building
Seattle, WA 98174
206/442-1746

LOCAL CONTACTS AND PROGRAMS

Ridesharing Brokerage

- A private non-profit corporation has been formed in Hartford, Connecticut, to promote high-occupancy vehicle use. Initial focus is on carpool and vanpool formation, but the corporation intends to become involved in promoting flextime, parking management, HOV incentives, and downtown pedestrianization and revitalization. This brokerage program involves extensive private-public sector cooperation.

  Contact: Jonathan C. Coleman
  Executive Director
  Greater Hartford Ridesharing Corporation
  c/o Connecticut General Insurance Corporation
  Hartford, CT 06152
  203/726-5966
  203/726-5346

- The Tidewater Transportation District Commission in Norfolk-Portsmouth, Virginia, has been developing vanpool, carpool, and shared-ride taxi services as peak period supplements, reducing the need for additional transit subsidies and providing new transport services to outlying areas.

  Contact: James C. Echols
  509 E. 18th Street
  P.O. Box 660
  Norfolk, VA 23501
  804/627-9291

- The City of Knoxville and the University of Tennessee have worked together to develop an areawide transportation brokerage. This effort has involved the use of a variety of transportation resources, including regular fixed route transit service, private buses, taxis, limousines, carpools, and vanpools. Significant successes have been in the areas of labor and insurance agreements, surveying and travel matching procedures, and institutional relationships.

  Contact: Frank Davis, Jr.
  Transportation Center
  University of Tennessee
  Knoxville, TN 37916
  615/974-5255

Parking Management

- Washington, D.C. has developed a coordinated parking management program combining numerous elements to encourage transit and HOV use, to improve neighborhood quality, and to raise revenue. These elements include a residential parking permit program, strict enforcement policies using aggressive ticketing, towing, and booting, the use of civilian parking aides, and an administrative traffic adjudication process.
  Contact: James E. Clark III
  Assistant Director
  415 12th Street, N.W., Rm. 508
  Washington, D.C. 20004
  202/727-5847

- Madison, Wisconsin, has combined transit improvements with sharp increases in the cost of all-day downtown parking. The supply of short-term parking has been increased to encourage shoppers to drive downtown, while commuters have been encouraged to use transit.
  Contact: Ross Patronsky
  Project Manager
  City of Madison DOT
  111 City-County Building
  Madison, WI 53709
  608/266-4761

Bicycle Programs

- Montgomery County, Maryland, requires bicycle parking facilities at many new buildings and requires consideration of bikeways for any new or reconstructed road. The County is providing paved shoulders on many new roads for bikeways and is restriping some multi-lane roads to provide 14 foot-wide curb lanes, which permit enhanced multi-modal use. A bicycle transportation Master Plan and bike route maps have been prepared.
  Contact: Chip Johnson
  Montgomery County DOT
  6110 Executive Boulevard
  Rockville, MD 20852
  301/468-4065

- Santa Barbara, California, has several bicycle trailers, which are pulled behind buses of the Santa Barbara Metropolitan Transit District, and extensive bicycle parking along bus routes. Cyclists can thus bike to the bus and either park or take their bicycle along to continue the trip.
  Contact: Gary Gleason
  Santa Barbara Metropolitan Transit District
  P.O. Box 355
  Santa Barbara, CA 93102
  805/963-3364

- The Bay Area Rapid Transit (BART) in San Francisco, California, has a highly successful program to integrate the bicycle with rail transit. Bike lockers and racks have been placed at most BART stations. Riders who have licensed bicycles (which subjects them to periodic safety inspection) can obtain permits to carry their bikes onto BART trains during non-peak periods and on selected non-peak-direction portions of lines in the peak periods. The program has been very favorably received in the community; over 9,000 people have obtained these BART permits over the past 5 years.

  Contact: Starla Bahem
  BART
  800 Madison Street
  Oakland, CA 94605
  405/465-4100 x569

Traffic Signalization Improvements

- The City of San Antonio, Texas, has made use of the TRANSYT signal timing model to optimize signal settings for traffic flow, energy use, and air pollution emissions. Some 140 signals in the urbanized area are being coordinated.

  Contact: M. Tahir Soomro
  Department of Traffic and Transportation
  City of San Antonio
  P.O. Box 9066
  San Antonio, TX 78285
  512/299-7720

Auto Restricted Zones

- Boston, Massachusetts, has developed a very successful auto restricted zone called the Downtown Crossing, involving a combination of transit and pedestrian improvements and the closing of certain streets to automobiles. Business in the area increased significantly after implementation.

  Contact: Matt Coogan
  Boston Redevelopment Authority
  City Hall
  Boston, MA 02201
  617/722-4300 (x376)

- Portland, Oregon, has a transit mall that extends for 11 blocks on two parallel streets, each handling about 200 peak hour buses. Extensive pedestrian amenities and other features have made this a highly successful downtown development.

  Contact: Bob Post
  Engineering and Contract Director
  Tri-Met
  4012 S.E. 17th Avenue
  Portland, OR 97202
  503/238-4903

Alternative Work Schedules

- New York, New York, implemented a staggered work hour program several years ago which involved 220,000 employees in 400 Manhattan firms. Based on surveys taken before and after initiation of the program, the initial objectives were achieved. On lower Manhattan subway lines, 6% fewer passengers were carried during the busiest 10-minute period. At the Port Authority Trans Hudson (PATH) terminal, the passenger volume in the peak 15minute evening period dropped from 7,500 to 6,500, while passenger volume in the lightest 15-minute period rose to 4,600 from 3,100. Based on participant interviews, 85% of those involved in the program had favorable attitudes towards it; 50% said it reduced their commuting travel time; 22% said it increased their effectiveness at work; only 4% admitted decreased effectiveness as a result of the program.
  Contact: Ms. Lona Mayer
  Port Authority Trans Hudson Corporation
  One World Trade Center
  New York, NY 10048
  212/466-8671

- Philadelphia, Pennsylvania's Delaware Valley Regional Planning Commission (DVRPC) has been working since 1970 to develop and implement alternative work schedule programs for Philadelphia's downtown core. DVRPC and the local Chamber of Commerce established a Staggered Work Hours Committee, began breakfast meetings with local business leaders and employers, conducted follow-up programs, provided technical guidance, and implemented a broad public relations campaign in the downtown center. Eight alternatives were proposed; businesses chose between them. Results: 44,000 of the 300,000 downtown employees now participate in the program. Also, partronage on the Lindenwold line increased markedly, as the peak period (already filled to capacity) expanded.
  Contact: Mr. Randy Brubaker
  Delaware Valley Regional Planning Commission
  1819 J.F. Kennedy Boulevard
  Philadelphia, PA 19103
  215/L07-3300

Preferential Treatment for Transit

- The Dallas-Ft. Worth region presently has a handful of operating transit preferential treatment projects in conjunction with park-and-ride lots. Transportation officials are embarking on a major expansion of both preferential treatments and park-and-ride.
  Contact: William Barker
  Transportation and Energy Department
  North Central Texas Council of Governments
  P.O. Drawer COG
  Arlington, TX 76011
  817/640-3300

- San Francisco has installed several miles of arterial transit preferential streets in the downtown area to improve the movement of buses.
  Contact: Glenn Erikson
  Transit Preferential Streets Coordinator
  San Francisco Department of City Planning
  100 Larkin Street
  San Francisco, CA 94102
  415/558-5423

- Tri-Met is upgrading transit services to Portland, Oregon's east side in an evolutionary fashion, proceeding from local to express bus services to high occupancy vehicle lanes. The next progression is to light rail transit, with bus feeder services, as part of the Banfield Corridor project. This light rail service will operate in reserved lanes on downtown streets, along a congested freeway, in the center of a busy arterial corridor, and along existing freight railroad tracks, for a distance of 15 miles. Construction is underway.
  Contact: Don MacDonald
  Project Director, Banfield Light Rail Project
  Tri-Met
  4012 S.E. 17th
  Portland, OR 97202
  503/238-4959

Emission Banking Programs

- San Francisco has recently established an emissions banking program, managed by the Bay Area Air Quality Management District. This program, made possible by enabling legislation at the State level, was initiated through the efforts of the Bay Area Council, Inc., a non-profit, business-supported organization. Under the program, private firms reducing emissions beyond the requirements of the area's air quality plan can have these reductions certified for banking. The banked credits may then be later used, traded, or sold.
  Contact: Dan Goalwin
  Chief, Permits Section
  939 Ellis Street
  San Francisco, CA 94109
  415/771-6000

- Seattle-Tacoma region has had an emission offset banking program since June 1980, operated by the Puget Sound Air Pollution Control Agency. This program began with a grandfather clause giving companies 90 days to apply for emission credits for past pollution reductions in excess of NAAQ standards. A 1.3:1.0 offset ratio is used in determining credits. A monthly activity report details who owns what credits, informing the private marketplace for emission trading.
  Contact: Brent Carson
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  206/344-7335

Table 8

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Chapter 3

ANNOTATED BIBLIOGRAPHY

This bibliography was compiled by the staff of Public Technology, Inc. Its purpose is to give a sampling of the available literature rather than an exhaustive list of all sources of information on the topic.

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Discusses the role and future of TSM and the requirements of successful pursuit of TSM at various levels of detail and coordination.

Salvucci, Frederic, Charles Carlson, Brian Day, and David Gletner. Transportation Energy Contingency Strategies. U.S. Department of Transportation. Washington, D.C.: 1980.

A three-volume series on transportation energy contingency planning intended to provide technical support to State and local governments. Volume 1 describes the planning and organizational process, Volume 2 reviews specific actions to be taken, and Volume 3 is a model case study of the contingency planning process. This series focuses on transit, paratransit, and ridesharing strategies. The bicycle as a transportation mode is omitted.

Sears, Paul M. Vanpooling: The Three Major Approaches. Washington, D.C.: U.S. Department of Energy, 1979.

A manual for those providing technical assistance to existing or prospective vanpool sponsors. Includes discussion of all three major approaches to vanpooling--employer sponsored, third party sponsored, and driver owned and operated.

Transportation Research Board. Transportation System Management in 1980: State-of-the-Art and Future Directions. Special Report 190. Washington, D.C.: Transportation Research Board, 1980.

Proceedings of a workshop sponsored by U.S. DOT, November 26-29, 1979, in Arlington, Texas. Contains a number of papers on the present status and future directions of TSM in the United States. Includes summaries of workshops and conference findings.

U.S. Department of Transportation. Innovation in Public Transportation. Washington, D.C.: U.S. Department of Transportation, 1980.

A directory of recent and ongoing research done under the director of the Urban Mass Transportation Administration. Covers a wide range of topics including transit service for special groups, fare and pricing policies, innovations in conventional transit systems, paratransit, transit planning, transit technology, and many other areas. Available from Government Printing Office, Washington, D.C. 20402 (#050-014-00017-7, cost $7.).

U.S. Department of Transportation. Innovative Techniques and Methods in the Management and Operation of Public Transportation Services. Washington, D.C.: U.S. Department of Transportation (UPM-40), 1980.

A booklet describing the new Section 4(i) program of UMTA, which provides funding to local agencies to implement innovative transit programs. These can include a wide range of elements, including data management, systems marketing, personnel training, ridesharing, HOV priority treatment, and other service innovations.

U.S. Department of Energy. New Approaches to Successful Vanpooling: Five Case Studies. Washington, D.C.: U.S. Government Printing Office, 1979.

A summary of different approaches to successful vanpool operation in various parts of the U.S. Includes an appendix with selected legal, promotional, and operational documents.

U.S. General Accounting Office. Stronger Federal Direction Needed to Promote Better Use of Present Urban Transportation Systems. Washington, D.C.: U.S. General Accounting Office, Report CED-79-126, October 4, 1979.

A critical examination of the effectiveness of the 1975 FHWA-UMTA joint planning regulations which require TSM planning. Cites shortcomings in the transportation planning process which have prevented realization of the regulation's objectives. (Available free from GAO).

AIR QUALITY AND TRANSPORTATION

Adams, Brock and Douglas M. Costle. Memorandum of Understanding Between the Department of Transportation and the Environmental Protection Agency Regarding the Integration of Transportation and Air Quality Planning. Washington, D.C.: U.S. Department of Transportation, 1978.

This Memorandum of Understanding, developed pursuant to the President's request, established certain principles which the Department of Transportation and the Environmental Protection Agency agreed to follow in the preparation of more detailed regulations and administrative procedure required to achieve the objective of integrating the air quality and transportation planning processes and identified specific areas of agreement with regard to the joint administration of the air quality aspects of the planning process.

Bass, Dennis. Transportation and Air Quality: A New Sharper Focus. Washington, D.C.: National League of Cities, 1978.

This issue of the National League of Cities newsletter is designed to help local elected officials understand the air quality planning process. The article also discusses required transportation controls and how soon these controls must be implemented.

Bass, Dennis. Cities Can Use the Clean Air Act Amendments as a Tool to Stimulate Economic Development. Washington, D.C.: National League of Cities, 1979.

Programs that encourage urban economic growth, particularly in cities with dirty air, will have to be carefully adapted to the clean air requirements if disruption of economic revitalization is to be avoided. This report discusses several programs for balancing economic growth with clean air.

Cooper, Norman L. and John O. Hidinger. Integration of Air Quality and Transportation Planning. U.S. Department of Transportation and the Environmental Protection Agency. Prepared for the Air Pollution Control Association Annual Meeting. Cincinnati: 1979.

This paper provides a discussion on the merger of the transportation related planning requirements of the Clean Air Act into the metropolitan transportation planning process and its implications.

Environmental Protection Agency and U.S. Department of Transportation. Transportation-Air Quality Planning Guidelines. Washington, D.C.: Environmental Protection Agency and U.S. Department of Transportation, 1978.

These guidelines describe an acceptable process for accomplishing the continuing tasks of transportation-air quality planning and programming required by the Clean Air Act.

Environmental Protection Agency. Appendices to Transportation-Air Quality Guidelines. Washington, D.C.: Environmental Protection Agency, 1978.

The appendices contain definitions, regulations and other information that pertains to the Transportation-Air Quality Planning Guidelines.

Federal Highway Administration. How to Prepare the Transportation Portion of Your State Air Quality Implementation Plan. Washington, D.C.: U.S. Department of Transportation and the Environmental Protection Agency, 1978.

This manual describes available techniques for completing tehnical air quality planning tasks necessary in the preparation of State Implementation Plans. The range of sophistication of the techniques should be sufficient to relate to cities of different sizes, to SIPs for different years, and to the different entities responsible for the different tasks.

Hoffer, Audrey and Tom Climon. Urban Air: A Guide to the Clean Air Act for Local Elected Officials. Washington, D.C.: U.S. Conference of Mayors, 1980.

A guide to alternative strategies for achieving clean air and urban growth, including discussion of the interaction between community and economic development and air quality control measures, the role of transportation control measures, options for managing emissions growth, and energy considerations.

Institute of Public Administration et al. Evaluating Transportation Controls to Reduce Motor Vehicle Emissions in Major Metropolitan Areas. Research Triangle Park, N.C.: Environmental Protection Agency, 1972.

This report describes and evaluates transportation controls which could conceivably reduce motor vehicle emissions. These identified transportation controls were assessed for their effectiveness in reducing emissions, their feasibility, and their probable costs.

Kincannon, Benjamin and Alan H. Castaline. Information Document on Automobile Emissions Inspection and Maintenance Programs. Washington, D.C.: Environmental Protection Agency, February 1978.

This document provides information on motor vehicle emissions testing programs, usually referred to as inspection/maintenance programs. Based upon the most recent and reliable information available, background information on these programs and a review of the major issues in this area are presented. More specifically, the effectiveness, costs, and the environmental, energy, and economic impacts of inspection and maintenance programs are discussed. A comprehensive bibliography and fact sheets on existing inspection and maintenance programs are also included. The Environmental Protection Agency was required by Section 108 of the Clean Air Act to produce this document.

Liu, M.K. et al. Development of a Methodology for Designing Carbon Monoxide Monitoring Networks. Las Vegas: Office of Research and Development, Environmental and Support Laboratory, 1977.

This report discusses the theoretical basis for a method of designing air quality monitoring networks developed for application to reactive or non-reactive pollutant monitoring. Specific design steps in the report are illustrated for a carbon monoxide monitoring network. Regional or local agencies may find this useful in planning or adjusting their air quality monitoring networks.

Mields, Hugh Jr. Summary Report of the Urban Mass Transportation Administration Air Quality Executive Seminar. Washington, D.C.: U.S. Department of Transportation, 1979.

The report discusses problems experienced by officials in all levels of government in implementing the Clean Air Act. Topics covered include: legislative background, Environmental Protection Agency's policy and objectives, vehicle inspection programs, and the role of the Urban Mass Transportation Administration in helping cities achieve improved air quality.

Organization for Economic Cooperation and Development. The Cost Effectiveness of Automobile Exhaust Emission Control Regulations. Paris: OECD, 1979.

This report examines various regulatory and economic instruments that have been used or proposed to ensure maintenance of emission standards, examines related cost data, and gives emission control surveys. It arrives at a number of conclusions to provide guidelines for member countries on the most cost-effective strategies for air pollution control of motor vehicles over their lifetimes.

Pollack, R.I., et al. Highway Air Quality Impact Appraisals. Vol. I - Introduction to Air Quality Analysis. Vol. II - Guidance for Highway Planners and Engineers. Washington, D.C.: U.S. Department of Transportation, 1978.

Volume I is useful as a general reference work, particularly on the subject of emissions, atmospheric processes, and air quality models. It presents basic information useful for analyzing local or regional air quality impacts. Volume II provides guidance for transportation planners and engineers on evaluating the air quality impact of a land use or transportation plan. Techniques for compiling emissions inventories and for predicting resultant air quality are discussed.

Public Technology, Inc. Air Quality Regulation and Planning. Washington, D.C.: Government Printing Office, 1980.

Discusses some of the issues raised by the 1977 amendments to the Clean Air Act of 1970, including the involvement of local officials in the planning process, enforcement of the Act, the role of transportation control measures, and economic impacts. Includes local and Federal program and contact list as well as an annotated bibliography.

Seltz-Petrash, Ann. "Transportation Planners Join Battle for Cleaner Air," Civil Engineering-ASCE (November 1979).

Discusses the variety of actions required of cities to meet the terms of the 1977 Clean Air Act Amendments and the challenges faced by transportation planners. Based on interviews with planners in several cities.

Suhrbien, J.H. et al. Implementation and Administration of Air Quality Transportation Controls: An Analysis of the Denver, Colorado, Area. Washington, D.C.: U.S. Department of Transportation, 1978.

Using the Denver Air Quality Control Region as an example, this study examines the costs and benefits associated with the implementation and administration of transportation air quality measures required under the Clean Air Act. Program measures examined are vehicle inspection and maintenance, ridesharing, preferential treatment for high occupany vehicles, parking management, bicycling, and transit.

Transportation Research Board. "Air Quality Analysis in Transportation Planning." Transportation Research Record 670. Washington, D.C.: National Academy of Sciences, 1978.

This report consists of 15 papers on such topics as oxidant modeling, air pollution dispersion, and transportation planning and air quality.

U.S. Conference of Mayors. "New Orleans Meeting Probes Local Involvement in Clean Air Program," Urban Air. Washington, D.C.: U.S. Conference of Mayors, 1980.

Discusses an October 1979 conference on the impact of the Clean Air Act requirements on local economic and community development.

Urban Land Institute. "Air Quality and Urban Development," Environmental Comment. Washington, D.C.: Urban Land Institute, 1980.

An issue of Environmental Comment devoted to the effects of air quality controls on urban development. Examines potential impacts of various strategies and trade-offs that must be made.

Zabinski, Richard J., Gerald S. Cohen, and David T. Hartgen. Upstate New York's Response to the Mandates of the Clean Air Act. Albany: New York State Department of Transportation, 1978.

This paper describes the approaches taken by seven upstate New York urban areas found to be in violation of air quality standards for transportation-related pollutants. It describes pollutant concentration monitoring, emissions modeling, and control strategy evaluation activities undertaken by the New York State Department of Transportation and Environmental Conservation and the Metropolitan Planning Organizations for these urban areas. Preliminary estimates of the effectiveness of the recommended mobile source strategies are given as are discussions of the non-air quality impacts of the strategies.

ENERGY CONSERVATION IN TRANSPORTATION

Public Technology, Inc. Energy Contingency Planning. Washington, D.C.: Government Printing Office, 1981.

Provides an overview of general considerations faced by local government and transit agency officials in developing contingency plans for petroleum shortages. Includes local and Federal program and contact list as well as an annotated bibliography.

Ridgeway, James. Energy Efficient Community Planning: A Guide to Saving Energy and Producing Power at the Local Level. Emmaus, PA: The JG Press, Inc., 1979.

Gives an overview of how local governments can devise appropriate and constructive solutions to energy problems facing their communities. Included in the detailed case studies are discussions of how Davis, California, cut its energy use drastically through actions encouraging bicycle use and energy conservation in building design; Seattle, Washington's energy conservation and production programs; creation of a community energy corporation in Hartford, Connecticut; agricultural land preservation in Northglenn, Colorado; and a number of other local energy strategies.

U.S. Department of Transportation. Transportation Energy Activities of the U.S. Department of Transportation: A Technical Assistance Directory of Programs, Projects, Contacts, and Conferences. Washington, D.C.: U.S. Department of Transportation, 1979.

A summary of current transportation energy-related research, technical assistance, and planning materials and information sources. Also contains much information relevant to TSM, transit performance, alternative work schedules, and priority techniques for high-occupancy vehicles.

QUANTIFYING TSM IMPACTS

Abrams, Charles M., John F. DiRenzo, Steven A. Smith, and Robert A. Ferlis. Measures of Effectiveness of Multimodal Urban Traffic Management (3 Vols.). Washington, D.C.; U.S. Department of Transportation, Federal Highway Administration, 1979.

Develops a set of goals and objectives for TSM strategies and tactics together with measures of effectiveness for determining the degree to which each objective is achieved. Case studies were used to develop data collection techniques necessary to evaluate and monitor the effectiveness of various TSM strategies. Also includes an operational guide for traffic engineers and public officials intended to help them develop and evaluate solutions to local traffic management problems.

Boyle, Daniel K. The Effect of Small-Scale Transit Improvements on Saving Energy. Preliminary Research Report 153. Albany: New York State Department of Transportation, 1979.

Examines the energy effects of small-scale transit improvements in New York State's eight metropolitan areas. Actions included in the TSM plans of the eight MPOs are analyzed for effects on ridership, mode shift, and energy savings, as well as energy costs of development, implementation, and operation.

Cambridge Systematics, Inc. Transportation Air Quality Analysis-Sketch Planning Methods. Washington, D.C.: U.S. Environmental Protection Agency, 1979.

A two-volume report describing sketch planning methods for transportation and air quality planning. Volume One describes the methods; Volume Two illustrates their use through case studies. Quick, first-cut analyses of changes in travel behavior and transportation system performance are made possible with these techniques. These quantitative methods are oriented to the analysis of auto restricted zones, high occupancy vehicle priority treatments, transit improvements, parking programs, carpool and vanpool incentives, and staggered work hours. Methods require use of worksheets, programmable calculators, and in some cases, computer analysis.

Dale, Charles W. Procedure for Estimating Highway User Costs, Fuel Consumption and Air Pollution. Washington, D.C.: U.S. Department of Transportation, Federal Highway Administration, March 1980.

Presents a set of manual techniques for quick estimation of changes and impacts due to signalization improvements, intersection improvements, and other TSM measures. Focuses particularly on post-implementation evaluation procedures for traffic related TSM actions.

Darling, Eugene, Jr. and Jeffrey D. Garlitz. Computer Modeling of Transportation-Generated Air Pollution. Washington, D.C.: U.S. Department of Transportation, Research and Special Programs Administration, 1978.

Information is furnished on two subjects: (1) the characteristics of currently operational air pollution dispersion models suitable for analyzing transportation-generated pollutants and (2) the availability of air quality data acquired in the vicinity of transportation systems.

DiRenzo, John and Richard B. Rubin. Air Quality Impacts of Transit Improvements, Preferential Lane, and Carpool/Vanpool Programs. Washington, D.C.: U.S. Environmental Protection Agency, 1978.

This report evaluates the use and cost-effectiveness of reserved lanes, improved transit, carpools, and vanpools as techniques for improving air quality.

As one of the documents required by Section 108 of the Clean Air Act, it is intended to help elected officials, local government administrators and transportation planners determine which transportation controls are considered to be reasonably available for their jurisdiction.

Gross, Janis, M. Forecasting Energy Impacts of TSM Actions: An Overview. Preliminary Research Report 156. Albany: New York State Department of Transportation, 1979.

Summarizes findings of a study which evaluated energy savings of TSM actions planned or taken in New York State for 1978-80. Both direct energy savings and energy costs of construction and maintenance were quantified for a number of TSM tactics.

JHK and Associates and Peat Marwick, Mitchell & Co. Recommended Measures of Effectiveness for TSM Tactics, Working Paper 7. Washington, D.C.: Federal Highway Administration, 1977.

Reviews various considerations involved in effectiveness measurement of TSM tactics and outlines techniques for evaluation.

Lunefeld, Harold. Evaluation of Traffic Operations, Safety, and Positive Guidance Projects. Washington, D.C.: Office of Traffic Operations, Federal Highway Administration, October 1980.

A detailed, technical manual for highway and traffic engineers to help them to develop measures of effectiveness for traffic problems and to use such measures in evaluating traffic improvements, such as signalization, geometric design, and other TOPICS-type projects.

Meyer, Michael D. Monitoring System Performance: A Foundation for TSM Planning. Prepared for the TRB TSM Conference, Arlington, Texas, November 1979. Cambridge: MIT, 1979.

Examines the role that monitoring has and should have in TSM planning, including measures of effectiveness, levels of monitoring, differences in monitoring effectiveness of tactical and strategic TSM measures, and appropriate actors in the monitoring and evaluation process.

Public Technology, Inc. The Urban Transportation Planning System: An Introduction for Management. Washington, D.C.: Government Printing Office, 1981.

The Urban Transportation Planning System (UTPS) is a sophisticated transportation simulation tool now widely used by regional planning agencies. This report is designed to show cities how UTPS can be used to solve their transportation planning problems, including TSM analyses, air quality, and energy conservation for transportation.

Public Technology, Inc. Traffic Performance Measurement. Washington, D.C.: Government Printing Office, 1978.

Provides information about how to measure and evaluate the performance of the various elements of an urban traffic system in terms of local goals and objectives. Discusses the impacts on broader urban concerns, such as energy conservation and air quality. Includes local and Federal program and contact list as well as an annotated bibliography.

Public Technology, Inc. Transit System Productivity. Washington, D.C.: Government Printing Office, 1978.

Focuses on the concept of and varying institutional perspectives of transit productivity, ways of increasing productivity through performance indicators, and areas for potential productivity improvement. Includes local and Federal program and contact list as well as an annotated bibliography.

Public Technology, Inc. Transportation Planning and Impact Forecasting Tools. Washington, D.C.: Government Printing Office, 1978.

Discusses some problems with the use of existing planning tools and focuses on the widely used planning package, the Urban Transportation Planning System (UTPS). Includes local and Federal program and contact list as well as an annotated bibliography.

R.H. Pratt Associates, Inc. A Study of Low Cost Alternatives to Increase the Effectiveness of Existing Transportation Facilities: Results of Survey and Analysis of Twenty-One Low Cost Techniques. Washington, D.C.: U.S. Department of Transportation, January 1973.

A classic study of TSM, before the term was coined. Evaluates 21 low cost techniques designed to increase the effective processing capacity of fixed capital transportation facilities. Considers effectiveness of techniques in meeting this objective, cost parameters, impacts on the disadvantaged, environmental and transportation safety factors, technical and institutional viability, and expected response from travelers.

Transportation Research Board. "Impacts of Air Quality Control Measures." Transportation Research Record 714. Washington, D.C.: National Academy of Sciences, 1979.

Contains a number of papers discussing the relationship between transportation and air quality and methods for evaluating impacts.

Wagner, Fred A. and Keith Gilbert. Transportation System Management: An Assessment of Impacts. Washington, D.C.: U.S. Department of Transportation, 1978.

Provides an assessment of the impact of areawide applications of various classes of TSM actions. Individual Transportation System Management actions are grouped into four classes, according to their impact on transportation supply and travel demand. For each of these classes, computations are performed to determine how a major multi-year program applying these actions would affect the area's vehicle miles traveled and vehicle hours traveled. The results will serve to help local areas to develop appropriate transportation measures for use in local TSM plans as required by DOT regulations and SIPS as mandated by the Environmental Protection Agency. The second portion of the document contains six working papers describing experience with and impacts of some of the major TSM actions. The appendix explains the development of the methodology that led to the findings in this report.

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